FORT CAMPBELL, KENTUCKY

TECHNICAL DESIGN GUIDE

Instructions for Use

This Document has been prepared jointly by the Fort Campbell Directorate of Public Works and the Louisville District Army Corps of Engineers. Contents of the document are controlled by Public Works. It is updated and housed on the Directorate of Contracting website under LINKS. The document contains mandatory criteria, policies, and procedures that apply to all design and construction at Fort Campbell.

To aid the reader, the document utilizes (blue) hyperlink text, which can be accessed by "clicking" the colored text. In addition, much of the document is formatted using construction-industry "CSI" standards and Unified Facilities Guide Specifications (UFGS).

Highlighted text is part of the most recent document update 5 Sep 2008.

FORT CAMPBELL, KENTUCKY

TECHNICAL DESIGN GUIDE

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Technical Design Guide
CHAPTER 1

General Information and Administrative Requirements

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1-1 Purpose

1-1.2 Prior to the development of this Technical Design Guide, the source for Ft. Campbell specific Engineering and design guidance was contained in the *"Fort Campbell Installation Design Guide (IDG)"* and *the "Louisville District Architect-Engineer Design Guide (AEDG) for Military Construction."* The ***"Fort Campbell, Kentucky, Technical Design Guide"*** has been developed to provide a single-source comprehensive resource for technical requirements regarding all MILCON and OMA program projects located on post. The technical guidance and criteria in this document is considered specific to Fort Campbell and it applies to all engineering and construction efforts completed by the Directorate of Public Works (DPW), The US Army Corps of Engineers (COE), and all Contract A-E designers.

1-1.2 .The ***"Fort Campbell, Kentucky, Technical Design Guide"*** is the result of ongoing joint efforts between Fort Campbell and Louisville District. The document is the property of the Fort Campbell, Directorate of Public Works. It is maintained by the Directorate of Public Works and is made available on the Directorate of Contracting website (http://www.campbell.army.mil/ima/sites/installation/contracting.asp) under LINKS. A joint DPW and COE committee oversees maintenance, evaluation, and revision of the technical contents. Specific guidance and criteria contained within are developed through specialized sub-committees with representatives from engineering, construction, and maintenance personnel from Ft. Campbell and Louisville COE. It is intended by the committee that the document continuously grows to accept additional information, accept changes in technology, and reflect changes in Army guidance, policies and visions.

1-1.3 The Fort Campbell DPW vision includes the need for consistent design and construction of environmentally sound, energy efficient, easily maintainable facilities. . This technical document is part of an ongoing commitment to bring that vision into reality at Ft. Campbell.

1-2 Document Format

1-2.1 The technical content of this document uses Construction Specifications Institute (CSI) format.

1-2.2 Fort Campbell Requirements are considered mandatory. Requirements shall be reflected on construction contract documents and support data.
1-2.3 Instructions to Designers provide technical directions and describe where Fort Campbell Requirements shall be stated in contract and supporting documents.

1-3 Application

1-3.1 Contents of this document shall apply to design and construction effort for all MCA funded and OMA funded projects completed by the DPW and/or the Louisville District COE. It applies to both in-house staff and to contracted designers.

1-3.2 This document shall be used in collaboration design and Urgan Design requirements described in companion document: ACSIM, **Installation Design Standards**, also available on the Internet.

1-4 Design Submittals

1-4.1 All MILCON funded project designs shall follow design and submittal procedures outlined in the Project Management Plan (PMP) together with the A-E Scope of Services, or the in-house Quality Control Plan/Contract.

1-4.2 All OMA funded project designs shall follow design and submittal procedures identified in the designer prepared "Scope Definition Document" and Scope of Services or Contract.

1-4.3 It is the responsibility of the Designers of Record to insure technical contents of this document are incorporated into design documents prior to submission for review.

1-5 Document Improvements and Deviations

1-5.1 The committee considers this to be a "Living Document." Recommended changes, additions and requests for deviation are invited from anyone who uses it. Recommended changes, additions, additional guidance topics and requests to deviate from the guidance are accepted at any time. Recommendations can be offered electronically or in paper form or by verbal request. To assist those reviewing

recommendations, a sample form containing the needed information is available in **Figure 1**. Completed forms shall be provided to the DPW or Louisville COE Committee Members identified below:

Sally P. Castleman
Phone (270) 798-7319
Email: sally.p.castleman@us.army.mil

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Recommended Document Change

Please Indicate the Type of Proposed Change:

____ Modification ____ New Topic

Please Indicate the Recommended Priority:

____ Routine ____ Urgent

Please Explain the Proposed Change:

Please identify any guidance, criteria, or reasons causing the proposed change:

Please Provide the Point of Contact who generated this proposal:

Name: _____

Phone: _____

Email: _____

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TECHNICAL DESIGN GUIDE
CHAPTER 2
General Requirements

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2.0 General Design Criteria

MILCON Projects

For new construction in the MILCON program, design effort will be completed in accordance with the approved Project Management Plan (PMP), design contract scope of services, and identified criteria. The ACSIM, Installation Design Standards, together with this document shall both apply to engineering and construction actions.

OMA Projects

For Operations and Maintenance projects, design effort will be completed in accordance with the DPW contract scope of services. Scope of design services shall be based upon the designer prepared project specific **Scope Definition Document** that is completed after a pre-design conference and site evaluation.

2.0.1 Deliverables

Hard-copy Drawings

Final construction contract drawings and as-built drawings submitted for official government records shall be digital and placed on 24" x 36" plastic film (Mylar) sheets. Sheet border shall be provided by DPW-EDB. A graphic scale shall be shown on each sheet of the drawings.

Electronic drawings submitted for review shall be reproduced on 8-1/2" x 11” or 11” x 17” paper using a laser printer.

Digital Drawings

CADD Drawings containing Geographic data (Site Plan, Survey and Mapping Plan, Storm Sewer Plan, Electrical Utilities Plan…) will use the Tennessee (TN) State Plane Coordinate System. The Datum used will be the North American Datum of 1983 (NAD83). The mapping units will be US feet. Vertical upland topographic surveys will use North American Vertical Datum (NAVD) 1988.

Digital geographic data will have accuracy within two feet unless otherwise stated in the Scope of Work.

Digital geographic data will be 99% free of topological errors including, but not limited to: the absence of dangling nodes, undershoots, overshoots, and snapped nodes for line segments (road centerlines, edge-of-curb, elevation contours…); the existence of features that have area square footage (building footprints, parking lots, sidewalks…) will have polygon representations in the CADD drawings.

All CADD drawings shall be done on Intergraph Microstation Release 5 or a compatible approved equal system.

The CADD Drawing file naming convention shall follow Chapter 2 of the "A/E/C CADD Standards” Document within the Spatial Data Standards Facilities/Infrastructure/Environment (SDS/FIE) model maintained by the CADD/GIS Technology Center (http://tsc.wes.army.mil).

Layer/Level assignments of feature data within the CADD drawings will follow ‘Appendix A: *Model File Level/Layer Assignment Tables*’ of the "A/E/C CADD Standards” Document within the Spatial Data Standards Facilities/Infrastructure/Environment (SDS/FIE) model maintained by the CADD/GIS Technology Center (http://tsc.wes.army.mil).

The "A/E/C CADD Standards” Document (26MB) are available at the following internet site: http://tsc.wes.army.mil/products/tssds-tsfms/tssds/projects/sds/
To request an “A/E/C CADD Standard” CD, go to http://tsc.wes.army.mil/comments/aecsds_comments/AECSDS-CommentForm.asp and fill out the CD request form.

The ‘CADD Drawing file naming convention’ is referenced in the *‘\Release 2_x Document\’* folder on of the "A/E/C CADD Standards” CD. It is an Adobe Acrobat PDF document named ‘volume1.pdf’. See Chapter 2 for ‘CADD Drawing Naming Convention’ standards.

The ‘Layer/Level assignments of feature data within CADD drawings’ is referenced in the *‘\Release 2_x Document\’* folder on the "A/E/C CADD Standards” CD. It is an Adobe Acrobat PDF document named ‘volume1.pdf’. See ‘Appendix A: *Model File Level/Layer Assignment Tables*’’ within the PDF document.

For MILCON projects, Drawings shall also be prepared in accordance with COE Standards available from the PE/A.

For OMA projects, Drawings shall also be prepared in CADD format using standard 24" X 36" sheets.

Drawings for all projects that are ready to Advertise (RTA) shall be in the approved electronic format.

Specifications-

For MILCON projects, specifications for projects that are RTA shall be included only in the approved electronic format.

For OMA projects, Construction specifications shall be prepared as agreed in the Scope Definition Document. Specifications for projects that are RTA shall be included only in the approved electronic format.

Design Analysis

For MILCON projects, design support documentation shall be provided. The Design Analysis shall be completed in the approved format. At the conclusion of the design effort, the documentation shall be provided in an approved electronic format.

2.0.2 Antiterrorist / Force Protection

All new construction projects including additions and alterations shall include antiterrorist / Force Protection (AT/FP) features in accordance with UFC 4-010-01, DOD Minimum Antiterrorism Standard for Buildings.

2.0.3 Fire Protection/Life Safety

Every project including MILCON and OMA shall be designed using only the following DOD directed criteria:

- **UFC 1-200-01, General Building Requirements** shall be used mandatory guidance concerning required model building codes for design and construction.
- Fire Protection requirements shall comply with **UFC 1-300-01, Fire Protection Engineering For Facilities.**
- Exiting requirements shall comply with the Life Safety Code, NFPA 101.
- No asbestos containing materials shall be used for construction.

2.0.4 Metric Design

Consideration of Metric dimensioning (SI) is required for all MILCON projects. Project specific guidance is available through the Louisville District project PE/A.
For OMA projects, metric dimensioning is used on a case-by-case basis: If the original project was developed in English (IP) units, follow-on OMA projects can also use English inch-pound (IP) units. If the original documents were developed in metric units, the OMA projects must also be executed in metric.

2.0.5 Surveying and Mapping Requirements

Fort Campbell has the following control point network and datum requirements for every MILCON project.

- Two new control monuments shall be established on site and tied to Tennessee State Plane Coordinate System NAD 83.
- The survey control points are GPS Class I and Class II Horizontal with additional elevation coming from an off-post USGS Class I bench mark to establish Second Order Class II vertical on all survey control points.
- Hardcopy books of existing points (including sketches) are maintained at both Fort Campbell (POC Scott Slade (270) 798-9724) and the Louisville District (POC Chris Heintz (502) 315-6408.
- For work contracted by Louisville District, the contractor is required to establish a permanent baseline at the project. In areas where existing concrete monuments are abundant, iron pins with caps are allowed. The contractor supplies CELRL-ED-M-SM (Survey and Mapping Section) with description sheets for the points they establish and the District forwards the information to Fort Campbell.

- Similarly, OMA work performed by Fort Campbell will have the survey control point data reported to the DPW POC for forwarding to the District.

2.0.6 Geotechnical Requirements

The following is a list of aggregate sources for concrete, asphalt, stone-base, sub-base, and DGA which met or exceeded the quality standards set forth in the technical sections of the COE specifications for Fort Campbell projects:

Coarse material sources for base course, bituminous paving, cast-in-place structural concrete, concrete pavements, and pre-cast architectural concrete.

- Hopkinsville Stone, Hopkinsville, KY, Ledges 11 to 17, about 85 feet.
- KY Stone Company, Canton, KY, Ledges 2 and 3, about 33 feet.
- Vulcan Materials, Gilbertsville, Kentucky. Ledges 4 and 26, about 393 feet.
- Martin-Marietta Aggregates, Smithland, Kentucky, Ledges 16 to 19, about 51 feet.
- Vulcan Materials, Clarksville, TN, Ledges 16 & 17, about 30 feet.
- Winn Materials, Clarksville, TN, Ledge 3, about 20 feet.

Natural fine aggregate sources for concrete, asphalt, stone-base, subbase and DGA are listed below.

- Delta Materials, Henderson, Kentucky.
- Ingram Materials, Paducah, Kentucky.
- Mayfield Aggregates, Mayfield, Kentucky.
- Delta Materials, Cairo, Illinois Manufactured fine aggregates for concrete:
- Hopkinsville Stone Company, Hopkinsville, Kentucky.

POC for further information at the Louisville District contact:

Mr. David Black (502) 315-6436
Mr. David Kiefer (502) 315-6445

2.0.7 Cost Engineering

Every project both MILCON and OMA requires a construction cost estimate. For MILCON projects the estimate shall be prepared using M-CACES software. Cost estimates for OMA projects shall be provided to the DPW at the time of submittal for bid issue. Official government cost estimates are not to be made public. They remain the property of the Government, and FOR OFFICIAL USE ONLY.

2.0.8 Engineering Considerations and Instructions for Field Personnel

This documentation is required for all MILCON projects, and is normally a part of the Design Analysis. It offers the designers an opportunity to provide a written document

providing important design facts to the construction field personnel. An example format of the **Engineering Instructions** is provided, which shall be revised and reflect project specific information.

2.0.9 Transfer and Acceptance

Completion of the Transfer and Acceptance of Military Real Property, DD Form 1354 is required for all projects. A draft copy of this information must be submitted with the Final Design submittal. This requirement applies to both MILCON and OMA program projects.

2.1 Special Ft. Campbell Criteria

2.1.1 Historic District

The "Clarksville Base" portion of Ft. Campbell contonment area is eligible for the National Register of Historic Places as a significant Cold War historic district. Designers are required to consult with the State Historic Preservation Office (SHPO) and the federal Advisory Council on Historic Preservation for any projects that are sited at the Clarksville Base. POC is DPW Environmental Division Cultural Resource Manager at 270-798-7437.

2.1.2 Environmental

The Environmental Division is under the guidance of the Directorate of Public Works at Fort Campbell. The **Environmental Division** Internet address will provide added information and points of contact.

Environmental Compliance is mandatory for all projects.

- **Designers shall NOT contact Kentucky or Tennessee regulators** regarding environmental issues. Contact the Ft. Campbell Environmental Div.

- A 40-hour "Environmental Quality Officer" course is available bi-monthly on post by Ft. Campbell's Environmental Division. Designers are encouraged to attend.

- Designs shall take into consideration wetlands and endangered species on the installation.
- Several environmental topics contained in this document include the following:

  APPENDIX A:
  Occupational Health Considerations
  Clean Air Act

Clean Water Act
Safe Drinking Water Act
TSCA (Lead Based Paint and Lead Containing Paint)
(Radon)
FIFRA (Pesticides)
Solid Waste Disposal/Diversion Practices
Hazardous Waste Disposal Practices
Emergency Planning and Community Right to Know
NESHAP National emission standards for hazardous air pollutants

APPENDIX B:
State Water and Sewer State Submittals

2.1.3 Underground and Aboveground Storage Tanks

Aboveground and underground petroleum product storage tanks shall not be permitted at new construction projects without design review and approval by the Directorate of Public Works , Environmental Division Petroleum Storage Tank Program Manager.

Underground Storage Tanks (USTs) shall not be installed without approval from the DPW Environmental Division. If permitted, USTs shall be double walled steel fiberglass coated with interstitial monitoring and automatic tank gauging. The monitoring system shall be compatible with the systems already in use and capable of being remotely monitored by the Environmental Division. No used oil USTs shall be installed.

Above Ground Storage Tanks (ASTs) shall not be installed without approval from the DPW Environmental Division. If permitted, ASTs shall follow requirements outlined in the Ft. Campbell: Standard Design Requirements For Aboveground Fuel Tanks prior to submission for permit requests.

Design for used petroleum products holding and storage shall not include tanks. Only 55-gallon drum containers shall be used that are placed on approved pavement materials properly designed for hazardous spill containment.

2.1.4 Solid Waste Disposal / Recycling Diversion Practices

In the interest of reducing waste, Fort Campbell is actively recycling and reducing waste in all on-post operations. Contractors are required to participate in on-post programs. They are encouraged to find ways of reducing waste. Recycling shall be practiced to the maximum extent possible. Refuse materials shall be separated in accordance with installation policies and practices.

It is the intent of the installation to divert at least 50% (by weight) of all construction, renovation, and demolition debris from the Woodlawn C/D landfill. Recyclable waste

materials shall not be landfilled on or off post. Recyclable materials shall be transported to designated locations for recycling or reuse.
Contractors must evaluate all diversion options and make good-faith effort to achieve the highest diversion rate within the project schedule and budget.

Contract specifications shall require at least a 50% diversion of construction and demolition (C & D) waste materials such as wood, plumbing fixtures, electrical materials (lights and panels), windows, doors, toilet partitions, HVAC equipment, and scrap metals be diverted from the landfill. Diversion can be accomplished by deconstructing the wood buildings and components per instructions below or by moving the structure off-post. Construction specifications shall require a C&D Waste Management Diversion Plan to be submitted and approved by DPW.

All material disposal and diversion shall be handled in accordance with Appendix A-7, Solid Waste Disposal/Diversion Practices. Salvageable materials shall be disposed of as per the contract specifications. If salvageable materials are transported off the installation, the contractor shall provide the project COR with the following information, type of material, method of disposal, and weights of material.

2.1.5 Erosion and Sedimentaion Control

Erosion and sedimentation control is required for activities that result from opening, operating, and closing all site excavation and excavation at present and planned borrow pits on the Fort Campbell Military Reservation.

The requirements contained in the Appendix I, **Erosion and sedimentation Control** shall apply at Fort Campbell, KY by its military units and all authorized subcontractors. It provides step-by-step procedures to help plan, design, and install soil and water Best Management Practices (BMP). It does not override any local, city, county, state, or federal rule, regulation, or law, including job safety and utility safety laws. Where there is a difference between this plan and any language contained in any contractual document, the contractual document must be followed.

The guidance provides criteria for the design, installation, and maintenance of water management and sediment control practices to abate nonpoint source (NPS) Pollution. Those responsible for design of these practices should evaluate the conditions existing on a particular site and determine if the minimum criteria contained in these standards are adequate or if more stringent criteria should be used.

Properly applied, this information will provide an efficient plan to operate the borrow pit site(s) while ensuring maximum safety and minimizing adverse impact to the environment. By following these guidelines, it is the intent of this management tool to furnish a uniform plan that will provide continuity throughout the life of the borrow pit.

2.1.5 Permits

Local permits are required for construction activities at Ft. Campbell. These permits must be Contractor completed and submitted prior to beginning any construction effort. Contract documents must identify and contain permits that will apply to the contract. . Local permits shall include demolition, digging, excavation, compaction, electrical, fuel tank installation, and environmental. Several of the specific permit forms that apply are located within sections this document along with information identifying appropriate installation drop-off locations and points of contact.

Digging and Excavation Permits
Borrow Permits

In addition, Specifications requirements shall include Contractor requirements for obtaining all utility and state (Kentucky or Tennessee) permits. These are related to utility services and various environmental topics.

2.1.6 Mold and Moisture Control:

Design features identified in **Appendix G** are critical to long term building environmental quality. They shall be incorporated into all projects.

2.1.7 Fort Campbell DPW Computer Software Capabilities:

Software capabilities may vary within the DPW. To assure that electronic files can be accessed, the following versions of software are commonly utilized in the DPW:

Microstation, version 8, 2004 (8.5)	Microsoft Office 2003

Digital files being transferred to Fort Campbell should be saved to allow accessibility with the above software. Files shall not be "write protected" or "view only".

2.1.8 Installation Internet Addresses

Ft. Campbell

The Directorate of Public Works

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GENERIC SCOPE DEFINITION DOCUMENT

The following 2 pages contain a generic example standardized "Scope Definition Document" which is required for each military O&M task order.

Items in black are part of the standard format.

Items in red are project task order specific, and should be changed for each customer request.

Items in blue are options to be considered.

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS

SCOPE DEFINITION DOCUMENT
For
PROJECT NAME

At
LOCATION

Date

1. BACKGROUND: Public Works Center, Detroit Arsenal defined a need for roof replacement on Buildings 229 & 231 at the Warren, MI facility (Site Map - see Enclosure 1), due to leaks and the age of the existing roofing material. There is also work slated to repair & replace air-handling units on these roofs under a separate contract prior to this replacement. Nick Ballard (ED-D-A) attend the meetings, surveyed the structures and obtained photographs and drawings for COE Louisville. This is a year-end funded design Project and must be finalized by mid-September 2000.

Information for this Scope of Work was acquired during a site visit to Detroit Arsenal on June 27, 2000 with the following personnel in attendance at meetings or the site. Kirk Dailey & Nick Ballard COE – Louisville; Jim Park (DPW Director), Bob Novak (Chief of Engineering Plans and Services) & Nabil Tominna (Project PE/A) of PWC Detroit Arsenal.

2. DESCRIPTION OF WORK: Each building is approximately 42,000 S.F.with 5400 S.F. of Penthouse roof and 36,600 S.F. of main roof with typical rooftop equipment. (Bldg. Photos - see Enclosure 2). All building equipment and problems were surveyed during the site visit and noted for review and plan preparation. (Field Notes - see Enclosure 3). PWC Detroit Arsenal provided 11 existing drawings pertinent to this roof project. (Reference Drawings - see Enclosure 4) They will also provide information as to equipment to be abandoned, capped off, removed and utility line rerouting. The customer has requested informal reviews when construction contract documents are approximately 50% complete, and a final review when 100% complete.

Initial discussions derived at the site visit and discussions indicated that the customer preferred replacement be a Modified Bitumen Roof. Existing built-up roofing is approximately 20 years old, and although in very good condition, will soon need replacement. No major environmental hazardous conditions exist. (Asbestos Reports – see Enclosure 5).

The customer also stated that he would like to receive contractor furnished an Operations and Maintenance Manual, including the manufacturers' cut-sheets showing recommended future roof penetration methods.

- Special Environmental Concerns or Requirements and Responses**:**
- Lead Based Paint Removal: None
- Asbestos Abatement: (4) Roof samples being taken contained no asbestos.
- Other: None
- Fire Protection or Life Safety Concerns or Requirements: None
- Special work sequencing or Optional items: None

1. SCOPE OF DELIVERABLES TO BE PROVIDED:
   Design: **[Simplified Design Method Plans and Specs]**
   Review: ?? sets ½ full size CAD prints & Specs – hard copy
   Contract: **(1) Electronic CD/Hard disc to DOC**
   Post Award: All final records, and (1) electronic version Microstation drawings & specs

4. TYPE OF CONSTRUCTION CONTRACT: Job Order Contractor (JOC)

5. DESIGN TEAM & DPW REVIEWERS:
   - COE Louisville: N. Ballard, J. Jaggers, G. Minter (QC) / M. Mirzaian (PE/A)
   - DPW: Engineering:
     Master Planning:
     Environmental
     Maintenance Shops:
     Safety:
     Fire Department:
     ITBC:
     End User:

6. DESIGN COST ESTIMATE: $15,000 (See Attachment 1)

7. DESIGN SCHEDULE: 10 July to 10-12 September 2000

8. CONSTRUCTION COST ESTIMATE: Base Bid: $480,000
   Option 1: $518,000

9. QUALITY EXPECTATIONS: Minimum QCP w/ one A/E reviewer. When signed by all parties, this document becomes the contract with the ED customer.
This package has been completed and assembled by the PE/A: Nicholas M. Ballard

This assembled complete package has been checked for completeness and compliance with the Engineering Division Quality Operating System.

Any change in any one of the items above will require a modification of this contract.

ED PE/A Name: Nicholas M. Ballard	Customer Name: Kirk P. Dailey
ED Unit Name: ED-D-A	Customer Office Symbol: PM – M
Signature:	Signature:
Date Signed: 11 August 2000	Date Accepted: 11 August 2000

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EXAMPLE
Engineering Considerations and Instructions for Field Personnel

B-1 General

B-1.1 Contractor's construction trailers on site must be wired per NEC, meet separation clearances, have electric meters but no water meters. COE is to coordinate with DPW Master Plans and utility personnel.

B-2 Civil

B-2.1 Notification of road closures during construction shall be given to the following agencies:

- Provost Marshall Office, Traffic Section (270) 798-6812.
- Directorate of Directorate of Public Works , Master Plans, (270) 798-2909.

B-3 Geotechnical

B-3.1 During stripping and rough grading, positive surface drainage should be maintained to prevent the accumulation of water. The exposed subgrade materials are likely to be soft in some locations. Also, if conditions are encountered which are different from those described in the plans, the geotechnical engineer should be notified. Once subgrades are established, concentrated loads from construction equipment could cause pumping of the subgrade and require re-compaction.

B-3.2 Foundation designs are based on the subsurface investigation program. To verify that the foundation designs are appropriate for the structures, inspection by Corps of Engineers of the footings and undercutting is very important. Linda Davis (502) 315-6437 or Steve Durrett should be notified of the contractor schedule for performing earthwork and foundations so that inspections of the materials can be performed.

B-4 Utilities / Landscaping

B-4.1 Care should be taken in placement of underground utilities so as not to cause interference with landscaping trees.

B-4.2 Railroad crossings for gas and water piping are to be included in the drawings. The portion of the AREA-03 (the reference from which the details are taken) dealing with railroad crossings is included with these instructions.

B-4.3 Where gas and water piping are shown to be valved and capped for future expansion, the valve should be a gate valve. These are installed to prevent the need to shut down a section of the main and interrupt service in order to connect a new service line.

B-4.4 Valves should been placed to isolate each building from the main service (water and gas), and to allow only for minimal main shut down when tying to existing main lines.

B-5 Architectural

B-5.1 Hold metal roofing pre-submittal meeting, with construction, supplier, and contractor to discuss standing seam metal roof system specifications.

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Fort Campbell Standard Design Requirements For Aboveground Fuel Tanks (ASTs)

Effective date: 1 January 1999

This S.O.P. has incorporated the National Electrical Code (NEC), National Fire Protection Association (NFPA Code), Underwriters Laboratories (UL), and Industry standards.

1.0 General:

1.1 All aboveground petroleum/fuel tanks, (ASTs) shall conform to all Federal, State, Local regulations and guidelines, and with these design requirements. This includes tanks for permanent placement as part of new construction, as replacement of existing storage systems, and tanks used for temporary storage by construction Contractors and military units.

1.2 All ASTs shall be double-walled type tanks. Means shall be provided to establish the integrity of the secondary containment.

1.3 When there is a discrepancy between any or all of these guidelines, these requirements will be the final authority over all others except NFPA.

1.4 The Directorate of Public Works , Environmental Division, Petroleum Storage Tank Manager is the Installation Local Authority Having Jurisdiction (AHJ) who must approve any design proposal and construction before any installation of an AST.

2.0 Definitions:

Fuel tank: is any vessel containing more than 60 U.S. gallons of Class I or Class II flammable liquids.

Emergency Vent: An opening, construction method, or device that will automatically relieve excessive internal pressure due to an exposure fire.

Normal Vent: as a minimum size, all vents shall be at least 1-¼ inches in inside diameter. It must have a bug proof, rain cap secured on top of the vent. The vent must be at least 3 feet higher than the highest point within a 10-foot radius of the ATS.
Anti-siphon valve: a device to prevent any siphoning due to damaged fuel lines, broken pumps, leaky or leaking fuel pumps. This device is not a check valve.

Overfill protection device: a device to serve as a catch basin to prevent any and all overfill spillage. Minimum size shall be 5 gallons.

Fuel Level Gauge: a device that is easily readable that automatically indicates the actual fuel level in the AST. A standard float type gauge is acceptable.

Temporary AST: a fuel tank that will be used for up to 90 calendar days. At which time, it then becomes a permanent installed tank.

Emergency shut-off valve: A device to immediately shut off the fuel supply in case of an emergency or a fire.

Portable Fuel Tank: Any closed vessel having a liquid capacity over 60 U.S. gallons, and less than 2,000 U.S. gallons, and not intended for fixed installation.

Day Tank: A fuel tank, located inside a structure, that provides fuel to a engine. The standard size of a day tank is 25 U.S. gallons, but may have the capacity of up to 100 U.S. gallons.

Secondary Containment Tank: A tank having an inner and an outer wall with an interstitial space between the walls and having means for monitoring the interstitial space for a leak.

Flammable Liquid: Any Liquid within the scope of this S.O.P. and subject to the requirements of this S.O.P. shall be known generally as either a flammable liquid or a combustible liquid and shall be defined and classified in accordance with this S.O.P.

Gasoline: Is a Class I B liquid that has a flash point below 73° F and a very high boiling point between 100° and 400° F. The Flash point of Gasoline is –40° to –50° F.

Diesel Fuel: Is a Class II Combustible Liquid, with a flash point of 125° F.

Combustible Liquid: A combustible liquid shall be defined as any liquid that has a closed-cup flash point at or above 100° F, as determined by the test procedures and apparatus set forth in 1-7-4, of NFPA 30.

3.0 Location of AST:

3.1 All proposed installations sites of ASTs must have written prior approval by the Local Authority Having Jurisdiction.

3.2 All permanently installed ASTs shall be of the concrete encased, double walled type. The concrete encased tanks shall be of at least 3,500-psig density and be at least 6 inches in thickness.

3.3 Clearance distances:

3.3.1 No AST shall be installed closer than 5-feet from any type of an electrical disconnect device.
3.3.2 All ASTs between the size of 60 U.S. gallons and 2,000 U.S. gallons shall be located no closer than 10-feet from any building, lean-to, or property line.
3.3.3 All ASTs shall have at the minimum of 5 ft of unobstructed clearance on all sides to facilitate refueling, maintenance and serviceability.
3.3.4 No AST shall be installed without having at least a 15-foot aerial clearance from overhead or underground electrical lines, which includes but limited to weather heads, transformers, and fuses.
3.3.5 The minimum distance between any two ASTs shall be 3-feet.
3.3.6 The minimum distance between an AST with Gasoline or Diesel fuel and a LP tank shall be 20-feet.

3.4 All ASTs shall rest on the ground or on foundations, made of concrete, masonry, piling, or steel. Tank foundations shall be designed to minimize the possibility of uneven settling of the tank and to minimize corrosion in any part of the tank resting on the foundation.

4.0 Aboveground Fuel Lines:

4.1 Below ground fuel, lines shall not be permitted for use with an AST.

4.2 Aboveground supply and return lines.

4.2.1 Fuel lines shall be suspended a minimum of 6 inches off the ground and be supported every 3-feet with some type of approved support.
4.2.2 All AST fuel lines shall be protected against corrosion.
4.2.3 All ASTs shall have some type of protective features that prohibit any collision from motor vehicles.
4.2.4 All above ground fuel lines shall be insulated, heat traced, and protected with a covering equal to vinyl.
4.2.5 The fuel lines shall be separated by a minimum distances of 6 inches.
4.2.6 All AST aboveground fuel lines shall be of black carbon type steel.
4.2.7 All AST aboveground supply fuel lines shall be ½-inch inside diameter, unless otherwise directed.
4.2.8 All AST aboveground supply fuel lines shall have a shut off valve located as close as possible to the AST.
4.2.9 All AST aboveground return fuel lines shall be ¾-inch inside diameter, unless otherwise directed by the Local Authority having Jurisdiction.
4.2.10 There shall be no traps or check valves in the return fuel line to the AST.
4.2.11 All pipe joints shall be of the threaded type, no welding of pipes or of the joints shall be permitted.

4.2.12 Joints shall be made liquid tight and shall be threaded, except that listed flexible connectors shall be permitted where installed with prior written approval of the Local Authority Having Jurisdiction.

4.2.13 All threaded joints shall be made up tight with a suitable thread sealant or lubricant. Joints in piping systems handling Class I liquids shall be welded when located in concealed spaces within buildings.

5.0 Normal Venting for aboveground Tanks:

5.1 Venting requirements shall be in accordance with current Unified Facilities Guide Specifications, Section 13202, Fuel Storage Systems requirements. Stage I vapor recovery is the process of recovering vapors when a storage tank is filled. Stage I vapor recovery is mandatory on all Army Facilities. Stage II vapor recovery is the process of recovering vapors during vehicle fueling operations. Stage II vapor recovery is optional and will be included if required by state and local clean air regulations.

5.2 Prevent the development of vacuum or pressure sufficient to exceed the design pressure due to filling or emptying and the atmospheric temperature changes.

5.3 If any tank has more than one fill or withdrawal connection and simultaneous filling or withdrawal can be made, the vent size shall be based on the maximum anticipated simultaneous flow.

5.4 The outlet of all vents and vent drains on tanks equipped with venting to permit pressures exceeding 2.5 psig shall be arranged to discharge in such a way as to prevent localized overheating of, or flame impingement on, and part of the tank, in the event vapors from such vents are ignited.

5.5 Where vent pipe outlets for tanks storing Class I liquids are adjacent to building or public ways, they shall be located so that the vapors are released at a safe pint outside of buildings and not less than 12 ft. above the adjacent ground level. In order to aid their dispersion vapors shall be discharged upward or horizontally away from closely adjacent walls. Vent outlets shall be located so eaves will not trap the flammable vapors or other obstructions and shall be at least 5 ft from building openings.

6.0 Emergency Venting for Fire Exposure for Aboveground Tanks.

6.1 Every aboveground tank shall have some form of construction or device that will relieve excessive internal pressure caused by exposure fires. This requirement shall also apply to each compartment of a compartmented tank, the interstitial space of a secondary containment type tank, and the enclosed space of tanks of closed top dike construction.

6.2 The outlet of all vents and vent drains on tanks, equipped with emergency venting to permit pressures exceeding 2.5 psig shall be arranged to discharge in such a way as to prevent localized overheating of or flame impingement on any part of the tank, in the event vapors from such vents are ignited.

7.0 Miscellaneous Requirements:

7.1 All ASTs permanently installed shall have a device(s) for fuel leak detection, fuel level, and all other monitoring requirements.

7.2 All ASTs shall be marked in accordance with N.F.P.A. 704.

7.3 All ASTs shall be grounded, and wired in accordance with NEC 70.

7.4 All ASTs shall have some type of spill containment that will hold 100% of the AST capacity.

7.5 All ASTs that have filling and emptying connections for any Class I or Class II, flammable liquids shall be closed and liquid tight when not in use and shall be properly identified.

7.6 All ASTs fill caps shall have an AHJ approved means of locking when not being refueled.

7.7 All ASTs shall have some device of fire fighting equipment in the immediate area. (Contact Fort Campbell Fire Prevention Section for further details).

7.8 Means shall be provided for determining the level of liquid in the tank. This means shall be accessible to the delivery operator.

7.9 Precautions shall be taken to prevent the ignition of flammable vapors. Sources of ignition include, but are not limited to:

a. Open Flames
b. Lightning
c. Hot surfaces
d. Radiant heat
e. Smoking
f. Cutting and welding
g. Spontaneous ignition
h. Frictional heat or sparks
i. Static electricity
j. Electrical sparks
k. Stray currents
l. Ovens, furnaces, and heating equipment.

End

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Division 00800 – General Provisions

Section

00800 Special Contract Requirements

SECTION 00800
Special Contract Requirements

Ft. Campbell Requirements

Ft. Campbell Specification Section 00800, Special Contract Requirements, shall apply to all MILCON projects.

Contents shall also be applied to all OMA projects issued by the Ft. Campbell Directorate of Contracting (DOC) or the COE.

Instructions to Designers

1. Modify the project specifications paragraphs as necessary to include all applicable portions of the Ft. Campbell 00800 version: **Section 00800, Special Contract Requirements**.

2. For electronic copies of the document, contact the PE/A for MILCON and OMA projects by the COE. A-E's directly serving the installation should contact the PM.

Ft. Campbell Version (Partial) Specification

Section 00800: Special Contract Requirements

20. WARRANTY OF CONSTRUCTION (MAR 1984) ALTERNATE 1 (APR 1984) FAR 52.246-21I.

20.1 General Requirements.

20.1.1 In addition to any other warranties in this contract, the Contractor warrants, except as provided in paragraph 20.1.10 of this clause, that work performed under this contract conforms to the contract requirements and is free of any defect in equipment, material, or design furnished, or workmanship performed by the Contractor or any subcontractor or supplier at any tier.

20.1.1.1 Warranty Payment.

Warranty work is a subsidiary portion of the contract work, and has a value to the Government approximating 1% of the contract award amount. The Contractor will assign a value of that amount in the breakdown for progress payments mentioned in the Contract Clause: Payments Under Fixed-Price Construction Contracts. If the Contractor fails to respond to warranty items as provided in paragraph 20.5, the Government may elect to acquire warranty repairs through other sources and, if so, shall backcharge the Contractor for the cost of such repairs. Such backcharges shall be accomplished under the Changes Clauses of the contract through a credit modification(s).

20.1.1.2 Since the warranty period will extend beyond the construction completion date, this contract shall remain open until the warranty period expires.

20.1.2 This warranty shall continue for a period of 1 year from the date of final acceptance of the work. If the Government takes possession of any part of the work before final acceptance, this warranty shall continue for a period of 1 year from the date the Government takes possession.

(a) As a part of the one year warranty inspection, the Contracting Officer will conduct an infrared roof survey on any project involving a membrane roofing system. This survey will be conducted in accordance with ASTM C1153-90, "Standard Practice for the Location of Wet Insulation in Roofing Systems Using Infrared Imaging". In accordance with paragraph 20.1.3 and 20.1.4, the Contractor shall be required to replace all damaged materials and to locate and repair sources of moisture penetration, at no additional cost to the Government.

20.1.3 The Contractor shall remedy at the Contractor's expense any failure to conform, or any defect. In addition, the Contractor

shall remedy at the Contractor's expense any damage to Government-owned or controlled real or personal property, when that damage is the result of--

(a) The Contractor's failure to conform to contract requirements; or

(b) Any defect of equipment, material, workmanship, or design furnishes.

20.1.4 The Contractor shall restore any work damaged in fulfilling the terms and conditions of this clause. The Contractor's warranty with respect to work repaired or replaced will run for 1 year from the date of repair or replacement.

20.1.5 The Contracting Officer shall notify the Contractor, in writing, (see para. 20.2.3 and 20.5) within a reasonable time after the discovery of any failure, defect, or damage.

20.1.6 If the Contractor fails to remedy any failure, defect, or damage within a reasonable time after receipt of notice, (see para. 20.5) the Government shall have the right to replace, repair, or otherwise remedy the failure, defect, or damage at the Contractor's expense.

20.1.7 With respect to all warranties, express or implied, from subcontractors, manufacturers, or suppliers for work performed and materials furnished under this contract, the Contractor shall--

(a) Obtain all warranties that would be given in normal commercial practice;

(b) Require all warranties to be executed, in writing, for the benefit of the Government, if directed by the Contracting Officer; and

(c) Provide names, addresses, and telephone numbers of all subcontractors, equipment suppliers, or manufacturers with specific designation of their area of responsibilities if they are to be contacted directly on warranty corrections; and

(d) Enforce all warranties for the benefit of the Government, if directed by the Contracting Officer.

20.1.8 In the event the Contractor's warranty under paragraph 20.1.2 of this clause has expired, the Government may bring suit at its expense to enforce a subcontractor's, manufacturer's, or supplier's warranty.

20.1.9 Unless a defect is caused by the negligence of the Contractor or subcontractor or supplier at any tier, the Contractor shall not be liable for the repair of any defects of material or design furnished by the Government nor for the repair of any damage

that results from any defect in Government-furnished material or design.

20.1.10 This warranty shall not limit the Government's rights under the Inspection and Acceptance clause of this contract with respect to latent defects, gross mistakes, or fraud.

20.1.11 Defects in design or manufacture of equipment specified by the Government on a "brand name and model" basis, shall not be included in this warranty. In this event, the Contractor shall require any subcontractors, manufacturers, or suppliers thereof to execute their warranties, in writing, directly to the Government.

20.2 Performance Bond.

20.2.1 The Contractor's Performance Bond will remain effective throughout the construction warranty period and warranty extensions.

20.2.2

(a) In the event the Contractor or his designated representative(s) fails to commence and diligently pursue any work required under this clause, and in a manner pursuant to the requirements thereof, the Contracting Officer shall have the work performed by others, and after completion of the work, will charge the remaining warranty funds established by paragraph 20.1.1.1 of any or all expenses incurred by the Government while performing the work, including, but not limited to administrative expenses.

(b) In the event sufficient funds are not available to cover the warranty work performed by the Government at the Contractor’s expense, the Contracting officer shall have the right to recoup expenses from the bonding company.

20.2.3 Following oral or written notification of required warranty repair work, the Contractor will respond as dictated by para. 20.5. Written verification will follow oral instructions. Failure of the Contractor to respond will be cause for the Contracting Officer to proceed against the Contractor as outlined in the paragraph 20.2.2 above.

20.3 Pre-Warranty Conference.

Prior to contract completion and at a time designated by the Contracting Officer, the Contractor shall meet with the Contracting Officer to develop a mutual understanding with respect to the requirements of this clause. Communication procedures for Contractor notification of warranty defects, priorities with respect to the type of defect, reasonable time required for Contractor response, and other details deemed necessary by the Contracting Officer for the execution of the construction warranty shall be established/reviewed at this meeting. In connection with these requirements and at the time of the

Contractor's quality control completion inspection, the Contractor will furnish the name, telephone number and address of a licensed and bonded company which is authorized to initiate and pursue warranty work action on behalf of the Contractor. This point of contact will be located within the local service area of the warrantied construction, will be continuously available, and will be responsive to Government inquiry on warranty work action and status. This requirement does not relieve the Contractor of any of his responsibilities in connection with other portions of this provision.

20.4 Equipment Warranty Identification Tags.

20.4.1 The Contractor shall provide warranty identification tags on all Contractor and Government furnished equipment which he has installed.

(a) The tags shall be similar in format and size to the exhibits provided by this specification, they shall be suitable for interior and exterior locations, resistant to solvents, abrasion, and to fading caused by sunlight, precipitation, etc. These tags shall have a permanent pressure-sensitive adhesive back, and they shall be installed in a position that is easily (or most easily) noticeable. Contractor furnished equipment that has differing warranties on its components will have each component tagged.

(b) Sample tags shall be submitted for Government review and approval. These tags shall be filled out representative of how the Contractor will complete all other tags.

(c) Tags for Warrantied Equipment: The tag for this equipment shall be similar to the following. Exact format and size will be as approved.

EQUIPMENT WARRANTY
CONTRACTOR FURNISHED EQUIPMENT

MFG MODEL NO.

SERIAL NO.

CONTRACT NO.

CONTRACTOR NAME

CONTRACTOR WARRANTY EXPIRES

MFG WARRANTY(IES) EXPIRE

EQUIPMENT WARRANTY
GOVERNMENT FURNISHED EQUIPMENT

MFG MODEL NO.

SERIAL NO.

CONTRACT NO.

DATE EQUIP PLACED IN SERVICE

MFG WARRANTY(IES) EXPIRE

(d) If the manufacturer's name (MFG), model number and serial number are on the manufacturer's equipment data plate and this data plate is easily found and fully legible, this information need not be duplicated on the equipment warranty tag. The Contractor warranty expires (warranty expiration date) and the final manufacturer's warranty expiration date will be determined as specified by para. 20.1.

20.4.2 Execution. The Contractor will complete the required information on each tag and install these tags on the equipment by the time of and as a condition of final acceptance of the equipment.

20.4.3 Payment. The work outlined above is a subsidiary portion of the contract work, and has a value to the Government approximating 5% of the value of the Contractor furnished equipment. The Contractor will assign a value of that amount in the breakdown for progress payments mentioned in the Contract Clause: PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS.

20.4.4 Equipment Warranty Tag Replacement. As stated in para. 20.1.4, the Contractor's warranty with respect to work repaired or replaced shall run for one year from the date of repair or replacement. Such activity shall include an updated warranty identification tag on the repaired or replaced equipment. The tag shall be furnished and installed by the Contractor, and shall be identical to the original tag, except that the Contractor's warranty expiration date will be one year from the date of acceptance of the repair or replacement.

20.5 Contractor's Response to Warranty Service Requirements.

20.5.1 Following oral or written notification by the Contracting Officer or an authorized representative of the installation designated in writing by the Contracting Officer, the Contractor shall respond to warranty service requirements in accordance with the "Warranty Service Priority List" and the three categories of priorities listed below. If the Contractor does not perform the warranty within the timeframe

specified, the Government will perform the work and backcharge the warranty payment item established under paragraph 20.1.1.1.

First Priority Code 1 Perform on site inspection to evaluate situation, and determine course of action within 4 hours, initiate work within 6 hours and work continuously to completion or relief.

Second Priority Code 2 Perform on site inspection to evaluate situation and determine course of action within 8 hours, initiate work within 24 hours and work continuously to completion or relief.

Third Priority Code 3 All other work to be initiated within 3 work days and work continuously to completion or relief.

The "Warranty Service Priority List" is as follows:

Code 1 Air Conditioning Systems
a. Recreational support.
b. Air conditioning leak in part of building, if causing damage.
c. Not cooling unit

Code 3 Doors
a. Overhead doors not operational.
b. Interior/Exterior personnel doors or hardware not functioning properly.

Code 1 Electrical
a. Power failure (entire area or any building operational after 1600 hours).
b. Security lights.
c. Smoke Detectors.

Code 2 Electrical
a. Power failure (no power to a room or part of building).
b. Receptacle and lights (in a room or part of building).

Code 3 Electrical
a. Street Lights.

Code 1 Gas
a. Leaks and breaks.
b. No gas to family housing unit or cantonment area.

Code 1 Heat
a. Area power failure affecting heat.
b. Heater in unit not working.

Code 1 Hot Water heater Failure

Code 2 Kitchen Equipment
a. Dishwasher.
b. All other equipment hampering preparation of a meal.

Code 3 Plumbing
a. Leaky faucets.

Code 2 Plumbing
a. Flush valves.
b. Fixture drain, supply line commode, or any water pipe leaking.
c. Commode leaking at base.

Code 3 Interior
a. Floors
b. Paint chipping or peeling
c. Casework

Code 1 Roof Leaks
Temporary repairs will be made where major damage to property is occurring.

Code 2 Roof Leaks
Where major damage to property is not occurring, check for location of leak during rain and complete repairs on a Code 2 basis.

Code 2 Water (Exterior)
No water to facility.

Code 2 Water, Hot
No hot water in portion of building listed

Code 3 All other work not listed above.

20.5.2 Should parts be required to complete the work and the parts are not immediately available the Contractor shall have a maximum of 12 hours after arrival at the job site to provide the Contracting Officer or an authorized representative of the installation designated in writing by the Contracting Officer, with firm written proposals for emergency alternatives and temporary repairs for Government participation with the Contractor to provide emergency relief until the required parts are available on site for the Contractor to perform permanent warranty repair. The Contractors proposals shall include a firm date and time that the required parts shall be available on site to complete the permanent warranty repair. The Contracting Officer or an authorized representative of the installation designated in writing by the Contracting Officer, will evaluate the proposed alternatives

and negotiate the alternative considered to be in the best interest of the Government to reduce the impact of the emergency condition. Alternatives considered by the Contracting Officer or an authorized representative of the installation designated in writing by the Contracting Officer will include the alternative for the Contractor to "Do Nothing" while waiting until the required parts are available to perform permanent warranty repair. Negotiating a proposal which will require Government participation and the expenditure of Government funds shall constitute a separate procurement action by the using service.

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TECHNICAL DESIGN GUIDE
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Division 01000

Section

01356	Stormwater Polution Protection
01560	Environmental Protection
01572 - 01670	Construction and Demolition Waste Removal/Diversion Recycle of Recoverable Materials

SECTION 01356
Stormwater Polution Protection

Ft. Campbell Requirements:

Ft. Campbell special requirements apply Section 01356 for all COE and DPW prepared projects.

Instructions to Designers:

Project plans and specifications shall include guidance and requirements contained in **Erosion and Sedimentation Control**:

Additional required guidance is found in **Chapter 2.**

For electronic copies of the document, contact the PE/A for MILCON and OMA projects by the COE. A-E's directly serving the installation should contact the PM.

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SECTION 01560
Environmental Protection

Ft. Campbell Requirements:

Ft. Campbell specification Section 1560, Environment Protection shall be used instead of UFGS 01355 for all COE and DPW prepared projects.

Instructions to Designers:

Project specifications shall include the Ft. Campbell Specification:
Section 01560, Environment Protection.

Additional required guidance is found in **Appendix A.**

For electronic copies of the document, contact the PE/A for MILCON and OMA projects by the COE. A-E's directly serving the installation should contact the PM.

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Ft. Campbell version:
Section 01560, Environment Protection.

SECTION C-01560

ENVIRONMENT PROTECTION
4/03

PART 1 GENERAL

1.1 SUMMARY (Not Applicable)

1.2 SUBMITTALS

The following shall be submitted in accordance with Section C-01300 SUBMITTAL PROCEDURES:

1.2.1 SD-8, Statements

Work Plans; GA.

1.2.1.1 Environment Protection

Prior to commencement of work at the site, the Contractor will submit within 10 calendar days after Notice to Proceed, his written detailed proposal for implementing the requirements for environmental pollution control specified herein. The contractor will then meet the representatives of the Contracting Officer upon their completion of review of his proposal as needed for compliance with the environmental pollution control program.

1.2.1.2 Preconstruction Survey

Prior to start of any onsite construction activities, the Contractor and the Contracting Officer shall make a joint condition survey, after which the Contractor shall prepare a brief report indicating on a layout plan the condition of trees, shrubs, and grassed areas immediately adjacent to the site of the work and adjacent to his assigned storage area and access routes(s) as applicable. This report will be signed by both the Contracting Officer and Contractor upon mutual agreement as to its accuracy and completeness.

1.2.1.3 Waste Disposal Scheme

As part of his proposed implementation under Paragraph 3.2, and prior to onsite construction, the Contractor shall submit a description of his scheme for disposing of waste materials resulting from the work under this contract. If any waste material is dumped in unauthorized areas, the Contractor shall remove the material and restore the area to the condition of the adjacent undisturbed areas. Where directed, contaminated ground shall be excavated, disposed of as approved, and replaced with suitable fill material, all at the expense of the Contractor.

PART 2 POLLUTION PREVENTION PLANS

2.1 ENVIRONMENTAL PROTECTION REQUIREMENTS

Provide and maintain, during the life of the contract, environmental protection as defined. Plan for and provide environmental protective measures to control pollution that develops during normal construction practice. Plan for and provide environmental protective measures required to correct conditions that develop during the construction of permanent or temporary environmental features associated with the project. Comply with all Federal, State, and local regulations.

2.1.1 Environmental Protection Plan

The contractor will develop a site specific Environmental Protection Plan which will address in detail the following:

a. Hazardous materials (HM) to be brought onto the post

Any hazardous materials planned or used on the post by the contractor will be managed with the same intent and purpose as the Hazardous Materials Management Program (HMMP) maintained by the DPW Environmental Division Pollution Prevention Branch. Ft. Campbell’s HMMP was established to maintain effective and regulatory compliant management of hazardous materials used on the post. The HMMP provides establishment of source reduction methods, recycling and reuse opportunities, modifications of processes and procedures, shelf life management, authorized HM use list, full visibility of all HM at any given time, the least toxic and least amount of HM acquired, stored, or used, and proper handling, storage, and disposal of all HM. A hazardous material as per 29 CFR 1910.1200 will be included. A hazardous material as per 29 CFR 1910.1200 is any material which is a physical or health hazard. The

Contractor shall complete the **FTCKY HAZMAT INVENTORY FORM** , which appears as an appendix to this section. The inventory form requires a list (including quantities) of HM to be brought to the post and copies of the corresponding material safety sheets (MSDS). The completed form shall be submitted to the Contracting Office representative and to Fort Campbell Environmental Division - Pollution Prevention Branch. In the event the usage of additional Hazardous Materials are found necessary during the project, they will be included into the MSDS package of the Environmental Protection Plan. At project completion, any hazardous material brought onto the post shall be removed from the site by the Contractor. Ft. Campbell is required by Executive Order 12856, "Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements", to comply with the requirements of the Emergency Planning and Community Right-to-Know Act (EPCRA). EPCRA requires Ft. Campbell to identify the amounts of chemicals present on, or released from its facilities, understand the potential problems that hazardous materials pose to the surrounding communities and environment, and provide information to the public and local emergency planning organizations. To comply with EPCRA requiremnts, Ft. Campbell must track and be accountable for hazardous materials (HM) used throughout the post. As required by the Emergency Planning and Community Right - to - Know Act (EPCRA), the Contractor will account for the quantity of HM brought to the post, the quantity used or expended during the job, and the leftover quantity which (1) may have additional useful life as HM and shall be removed by the Contractor, or (2) may be hazardous waste, which shall then be removed as specified herein. This information will be provided to the Environmental Division Pollution Prevention Branch on a calendar year basis or project basis if less than a single calendar year, and must be submitted by the end of January following the year reported.

b. Hazardous waste (HW) generated

The Environmental Protection Plan must list, quantify explain how any HW generated during the project will be disposed. Disposal of hazardous waste generated by the contractor shall be disposed off site according to applicable regulations at the contractor's expense. A report must be submitted annually of the generation of hazardous waste on post and must be provided to the

Contracting Officer representative and to Environmental Division - Pollution Prevention Branch.

c. Storage of hazardous waste

In accordance with post regulations and 40 CFR 262, hazardous waste shall be stored near the point of generation up to a total quantity of (one quart) 1 L of acutely hazardous waste or (55 gallons) 200 L of hazardous waste (Satellite Accumulation Point). Any volume exceeding these quantities shall be moved to a HW permitted area within 3 days. Locations of hazardous waste storage areas must be approved by DPW-ED-PP. Containers must be labeled in accordance with 40 CFR 262 and must contain the words Hazardous Waste and other words which identify the contents of the container. Prior to shipment of hazardous waste on site or off, the waste must be placed into good condition Department of Transportation (DOT) specification containers for hazardous waste (49 CFR 172.101). Containers must be labeled with required labels for HW and for DOT shipping. The area selected for the storage of hazardous wastes must minimize the threat to human health or the environment in the event of a release.

d. Minimization of hazardous waste

In accordance with post regulations, the Contractor should substitute materials as necessary to reduce the generation of HW and include a statement to that effect in the Environmental Plan.

e. Environmental conditions likely to be encountered during this project

Contact the Contracting officer for conditions in the area of the project which may be subject to special environmental procedures. Include this information in the Preconstruction Survey. Describe in the Environmental Plan any permits required prior to working the area, and contingency plans in case an unexpected environmental condition is discovered.

f. Any Hazardous Waste removal or disposal must be manifested through Environmental Division’s Pollution Prevention Branch, Hazardous Waste Program Manager and must be signed and numbered. Permitting plans for any transportation and disposal, excavation, or construction of

hazardous waste that will require an environmental permit from an issuing agency

The Contractor is responsible for generating the permits and delivering the completed documents to the Contracting Officer. The Contracting Officer will review the permits and the Contractor shall file the documents with the appropriate agency and complete disposal with the approval of the Contracting Officer. The Contracting Officer shall advise Environmental Plan of any Hazardous Waste generated and shall send contractor to Environmental Pollution Protection Branch. Correspondence with the State concerning the environmental permits and completed permits shall be delivered to the Contracting Officer.

g. Radon mitigation design and testing

All residential and non-residential construction performed at Fort Campbell must have passive radon mitigation features implemented into the design. The contractor will install preliminary features as per drawings. The contractor will hire an independent testing company to perform radon monitoring prior to inhabitation of the units. The testing firm must be EPA accredited and approved to perform work in the State of Tennessee (Kentucky). A list of accredited testing firms in the state of TN (KY) can be obtained through the state Radon Program Coordinator (615) 532-0733. In the event radon concentrations greater than 4 pCi/L (pico curies per liter of air) are revealed consult Fort Campbell DPW through the Contracting Officer’s representative for guidance pertaining to retesting. If upon further testing, elevated (unacceptable)levels are present, additional mitigation features will be installed followed by more testing. The buildings will not be inhabited until levels of less than 4 pCi/L have been achieved.

Extend the pipe of the passive radon mitigation system through the roof and leave it open (do not Cap).

Place electrical outlets near (e.g. within 6 feet) of the radon vent pipe riser in the attic.

The riser should be located in an area of the attic with at least 3-4 feet of clearance to allow for easy access to install and maintain the fan.

If at all possible, the aggregate bed under the slab should not be compacted in order to provide the maximum subslab vacuum coverage.

With respect to the number of risers, suggest an interval of 1 for every 3-5000 SF of slab.

2.1.1.1 Environmental Protection Plan Format

The Environmental Protection Plan shall follow the following format:

1. Hazardous materials to be brought onto the post
2. MSDS package
3. Employee training documentation
4. Hazardous materials/waste storage plan
5. Hazardous waste to be generated
6. Pre-construction survey results
7. Permitting requirements identified
8. Waste Disposal Plan
9. Site Specific Spill Contingency Plan

2.1.1.2 Environmental Plan Review

Fourteen days after the environmental protection meeting, submit to the Contracting Officer the proposed environmental plan for further discussion, review, and approval.

2.1.1.3 Commencement of the Work

As directed by the Contracting Officer, following approval.

2.1.2 Storm Water Pollution Prevention Plan

The following Pollution Prevention Plan is incorporated into the contract documents as a portion of the construction activities to be undertaken by the Contractor. The plan as outlined below contains the minimum requirements for the work under this contract.

POLLUTION PREVENTION PLAN FOR
(PROJECT)

The purpose of this plan is to detail the controls that will be utilized for this construction in order to control sediment in the storm water runoff from the construction site drainage area.

Project Location: Fort Campbell Army Base
Fort Campbell, Kentucky
(PROJECT)
(LOCATION)
Latitude - 36 38'10" North
Longitude - 87 27' 40" East
(Values Approximate for Latitude - Longitude)

Constructed by: U.S. Army Corps of Engineers
Louisville District
P.O. Box 59
Louisville, KY 40201-0059

Description of Site and Construction Activity: This construction is **(INSERT DESCRIPTION)**.

The soil disturbing activity will consist of clearing and grubbing and demolition for the installation of the erosion and sediment control features, grade work, excavation for utilities, and parking lots. The sediment and erosion controls being utilized include straw bale dam, basket curb inlet, stone outlet sediment trap, fabric drop inlet protection, gravel donut inlet protection, construction entrance/exit, silt fence, and silt fence rock overflow, and temporary seeding and mulching. Clearing and grubbing must be held to a minimum necessary for grading and equipment operation.

Temporary seeding and mulching shall be deemed necessary if no construction activity occurs in the disturbed areas for more than fourteen (14) days. Construction must be sequenced to minimize the exposure time of cleared surface areas. Grading activities must be avoided during periods of highly erosive rainfall. Slopes of 2H:1V will be protected using and erosion control blanket. Other slopes that may be seeded and mulched may experience washout problems and require the use of an erosion control blanket. Contractor is to refer to manufacturer’s recommendations for the type of erosion control blanket to be used on particular slopes.

Runoff Coefficient: The present runoff coefficient for the site is approximately 0.6 to 0.75. The development of the site will not significantly increase this coefficient. Developed coefficient is approximately **(INSERT COEFFICIENT).**

Receiving Waters: The water for the disturbed areas will pass through erosion control then into the storm system. The storm system for the majority of the site empties into **(LOCATION)**.

Erosion and Sediment Controls:

STABILIZATION PRACTICES	STRUCTURAL PRACTICES	
Permanent Seeding	Straw Bale Dam	Gravel Donut Inlet
Mulching	Basket Curb Inlet	Protection
	Stone Outlet Sediment	Temporary Construction
	Trap	Entrance/Exit
	Fabric Drop Inlet	Silt Fence
	Protection	Silt Fence Rock Overflow

2.1.2.2 Contracting Officer shall provide Environmental Plan for review to Environmental Division, Pollution Protection Branch.

2.2 ANTICIPATED SEQUENCE OF ACTIVITY:

Place erosion control measures in locations in close proximity to those shown on the drawings. Additional erosion control measures may be required to comply with the NPDES permit once demolition and construction begins.

Surface water flowing toward the construction area will be diverted around the construction area to reduce its erosion potential. Silt fence, sediment traps or straw bale check dams shall be properly constructed to detain runoff and trap sediment.

Construct new site amenities including utilities, buildings, parking areas, and sidewalks after completing the necessary demolition.

Landscape and grade remaining areas according to the drawings.

Upon completion, remove any temporary measures not necessary for future phases of the project after stabilization of the area. Any sediment removed from these measures shall be disposed of at a time and location designated by the Contracting Officer. Any other areas disturbed during the removal of the sediment control structures shall be seeded and mulched within 24 hours.
NOTE: The Contractor controls the actual sequence, however, the sediment control measures must be established prior to initiation of work in any area. Contractors for Phased projects will be

required to coordinate this work and interface Pollution Prevention Plans to ensure compliance with the intent of the Pollution Control Plans and to maintain continuous pollution prevention. Construction should be staged or phased for this project. Areas of one phase should be stabilized before other phases are initiated. Stabilization shall be accomplished by temporarily or permanently protecting the disturbed soil surface from rain fall impacts and runoff.

2.3 DEMONSTRATION OF COMPLIANCE WITH FEDERAL, STATE AND LOCAL REGULATIONS.

All activities constructed under this contract will be performed in accordance with Federal, State and Local regulations. The construction contractor's specifications require compliance with all applicable regulations.

2.4 POLLUTION PREVENTION PLAN AND NOTICE OF INTENT

The Contractor will implement the Pollution Prevention Plan (PPP) as shown on the plans and directed in these specifications. This plan must be implemented in accordance with the NPDES permit. A Notice of Intent (NOI) will be prepared by the U.S. Army Corps of Engineers and submitted to the state of Tennessee (KENTUCKY) fourteen (14) days prior to the notice to proceed being issued. The NOI Contractor Consent form for Tennessee (KENTUCKY) must be signed by the Contractor. A blank **Contractor's Signature Form** is attached at the end of this section. The Contractor shall maintain a copy of the PPP in their construction trailer. Any changes made to the plan must be documented and approved by the Contracting Officer.

2.5 INVENTORY FOR POLLUTION PREVENTION PLAN

The materials or substances listed below are expected to be present onsite during construction:

These are examples of materials that could be Hazardous Materials and an inventory must be kept using Ft. Campbell's Hazardous Material Form attached. This list is not comprehensive but for illustration only. The Contractor must maintain and update a Hazardous Material list and inventory forms.

Concrete	Fertilizer	Detergents	Paints (Enamel and Latex)
Cleaning Solvents	Wood	Sealants	Metal Rebar/Structural Steel
Concrete Additives	Tar	Asphalt	Petroleum Based Products

2.6 SPILL PREVENTION

The following are the material management practices to reduce the risk of spills or other accidental exposure of materials and substances to storm water runoff.

2.6.1 Good Housekeeping

a. An effort will be made to store only enough product required to perform the task. Storage shall meet Federal, State and Local regulations to include 150 % containment of bulk storage over 19 liters.

b. All materials stored onsite will be stored in a neat and orderly manner in their appropriate containers and properly labeled. When possible, material should be stored under a roof or in an enclosed area. If this is not possible, material will be covered with a tarpaulin or suitable replacement to prevent direct contact between storm water and the materials. All runoff from the storage area will be routed through a control structure.

c. Products will be kept in their original containers with the original manufacturer’s label.

d. Substances will not be mixed with one another unless recommended by the manufacturer.

e. Whenever possible, all of the product will be used up before disposing of container.

f. Manufacture’s recommendations for proper use and disposal will be dictated by Federal, State and Local regulations. Manufacturer’s recommendations may be followed if as stringent or more than Federal, State and Local.

g. The contractor will conduct daily inspections to ensure proper use and disposal of materials onsite.

2.6.2 Hazardous Products

These practices are used to reduce the risks associated with hazardous materials and must be incorporated into the Pollution Prevention Plan:

a. Products will be kept in their original containers unless they are not resealable.

b. Original labels and material safety data will be retained they contain important product information.

c. All containers will have the Diamond label affixed per the National Fire Prevention Associations Publication 704.

d. Disposal of surplus product will be performed as recommended by the manufacturer or as required by State and Local regulations.

2.7 SPILL PREVENTION PRACTICES

In addition to good housekeeping and material management practices discussed in the previous sections of this plan, a Site Specific Spill Contingency Plan must be prepared by the Contractor and submitted to Fort Campbell Environmental Division. The SSSCP must be developed as outlined in the Fort Campbell Environmental Handbook. Guidance and instructions for preparation of the **SITE SPECIFIC SPILL CONTINGENCY PLAN** (SSSCP) are included at the end of this section. In addition to the requirements of the SSSCP, the following practices must be followed by the Contractor for spill prevention and clean up:

a. Materials and equipment necessary for cleanup will be kept in the material storage area. There will be enough equipment to supply at least three (3) men. Equipment and materials will include but not be limited to; brooms, dust pans, mops, rags, gloves, goggles, absorbing compound, and plastic and metal trash containers specifically for this purpose.

b. Manufacturer’s recommended methods for spill cleanup will be clearly posted and site personnel will be made aware of the procedures and the location of information and cleanup supplies.

c. All spills will be cleaned up immediately after discovery. Disposal of the waste from the spill shall be at the Contractor’s expense and shall be coordinated with the Pollution Prevention Branch before removal or disposal.

d. The spill area will be kept well ventilated and personnel will wear appropriate protective clothing to prevent injury from contact with a hazardous substance.

e. All spills of toxic or hazardous materials will be reported to the Ft. Campbell Fire Department and DPW Environmental through the Contracting Officers Representative who will report to the appropriate State or Local government agency if necessary.

f. Once a spill has occurred, the spill prevention plan will be adjusted to include measures to prevent this type of spill from recurring with a discussion of the appropriate cleanup for that type of spill. Also, a description of the spill, what cleaned it, and the cleanup measures will be included.

g. The prime Contractor will be responsible for the day-to-day site operations, including spill prevention and will designate an employee, by name, to be the primary cleanup coordinator. Each subcontractor bringing more than 75 liters or 68 kilograms of a spillable substance shall also designate a cleanup coordinator. The cleanup coordinators will designate three (3) additional site personnel for spill prevention and cleanup.

h. Everyone will be trained in spill prevention and cleanup and shall know the primary cleanup coordinator and any additional site personnel to contact. Fort Campbell's Environmental Handbook (excerpt included below) will be the basis for spill prevention training.

(TAKEN FROM)

FORT CAMPBELL ENVIRONMENTAL HANDBOOK
Guidance and Instruction
SPILL PLANNING AND RESPONSE

Spill response equipment is a critical component of an effective response to an unexpected release of hazardous materials. Making an inventory of potential spots for emergency releases and having appropriate and sufficient spill response equipment to deal with those potential releases is required for each unit. Attachment 1 provides spill response materials minimum requirements.

SPILL PLANNING AND RESPONSE TRAINING REQUIREMENTS:

1) All personnel involved with the management and handling of oil and hazardous materials must be periodically trained in spill

prevention and response. The training will be similar to the Hazardous Communication Program - Worker Right to Know and will include the following key features:

a) Health effects of exposure to oil or hazardous materials;

b) Applicable first aid procedures to be used following exposure;

c) Personal Protective Equipment requirements and procedures for using equipment;

d) Evacuation procedures;

e) Spill material combustibility and potential for flash-back along vapor trails;

f) Fire fighting procedures and special hazards of combustible products;

g) Reactivity of spill material with common materials including water;

h) Use and maintenance of all alarms and monitoring equipment associated with spill prevention or response;

I) Initial Notification procedures;

j) Site specific contingency plans;

k) Location of posted Site Specific Spill Contingency Plan;

l) Immediate spill response actions including location of pump controls and valves to stop spill flow; location and use of fire extinguishers, absorbents, neutralizing agents and other immediate spill response procedures;

m) Visual inspections requirements of the particular areas; and

n) Purpose and requirements of good housekeeping.

2) Spill response training exercises will be conducted once per year for personnel working at oil and hazardous material sites. Personnel entering one of these positions will be trained within two weeks after starting work and after any significant changes to the spill plan or training program. Records of the type,

extent, and frequency of each individual's training will be maintained until closure of the applicable area or until three years after the date the individual last worked in the area. . Refresher training shall be given with the Toolbox Safety Meetings and documented on the Quality Control Reports. Training shall cover what to do, and who to contact in case of a spill and what emergency action must be taken if any.

SPILL RESPONSE IS HANDLED BY FOUR DISTINCT OPERATIONS:

a) SPILL REPORTING

The first action to be taken in the event of a spill is to report the spill. If you observe a release of a hazardous material, report it to your supervisor and the Fire Department as required below. If the spill is in a Training Area, then the spill will be reported to Range Control, who will then notify the Fire Department. The Fire Department will notify DPW Environmental Division and if required, Installation Safety, Emergency Medical, and Preventative Medicine. The DPW Environmental Division does all reporting to State/Federal Agencies.

The Fire Department (or Range Control) must be promptly notified of any of the following spills:

(1) Any uncontrolled quantity of a hazardous substance, or if assistance is needed by Fire Department or Environmental Division, or as instructed by the MSDS or supervisor's discretion.

(2) Oil and other petroleum products with quantity exceeding 10 gallons or area of spill greater than two feet in any direction or any amount that has spilled into a stream or body of water.

Environmental Division review has determined the material(s) listed requires special reporting at the quantity shown: (To be supplied by environmental staff during plan review.)

b. STOP OR CONTAIN THE SPILL

Assess the situation before attempting to contain any hazardous material spilled and proceed only if it is safe to do so. You must have knowledge of the spilled substance and don any required personal protective equipment. If necessary, make the spill scene off limits to any unauthorized personnel. If situation warrants, evacuate the area.

c. CLEAN UP THE SPILL

Under no circumstances should untrained and/or ill-equipped persons attempt to perform cleanup. In some instances, spill cleanup may require respiratory protection and other personal protective equipment. If it is within the capability of the unit that caused the spill, then that unit is responsible for its cleanup. Environmental Division will make the decision to obtain assistance and coordinate with other units as required. If you handle/work with the hazardous material as part of your job, you are to be trained and qualified to participate in the clean up of the spill. **All contractors must have an OSHA 1910.120 qualified spill response contractor available to respond to spills in 4 to 6 hours that require heavy equipment to remove contaminated soils/absorbents. Spill that cannot be removed because of response delays may need to be covered with heavy plastic and or secured to prevent further spread of contamination.**

d. DISPOSE OF SPILLED HAZARDOUS MATERIAL.

All spilled material and other contaminated material (soil, gravel, absorbents, etc.) must be properly disposed. It is the responsibility of the contractor that created the spill to properly package, dispose of the waste, and ensure the site is properly cleaned at no cost to the government. Some spill incidents may require cleanup, disposal, soil testing and a site closure report by an approved licensed environmental contractor approved by Fort Campbell. Environmental Division will determine the required cleanup and disposal method.

2.8 PRODUCT SPECIFIC PRACTICES

The following product specific practices will be followed on-site:

a. Petroleum Products - All vehicles will be periodically inspected for leaks and shall receive regular preventative maintenance to reduce the chance of leaks occurring. Petroleum products will be stored in tightly sealed containers which are clearly labeled. Bulk storage areas will be equipped with secondary containment appropriate for risk of loss from the primary container (s). Storage shall meet Federal, State and Local regulations. Secondary containment shall hold 150 % of the bulk amount stored over 19 liters. The Contractor will

maintain a specific spill contingency and countermeasures plan for use in a bulk storage area.

b. Fertilizer - Fertilizers used will be applied only in the minimum amounts recommended by the manufacturer. Once applied, fertilizer will be worked into the soil to limit exposure to storm water. The contents of any partially used bags of fertilizer will be transferred to a sealable container to avoid spills.

c. Paints, Solvents, and Sealants - All containers will be tightly sealed and kept in the storage area when not in use. Any excesses of these materials will not be discharged into the storm sewer system, but will be properly disposed of according to manufacturer’s instructions or State and Local regulations.

d. Concrete Trucks - Concrete trucks will be allowed to wash out, discharge surplus concrete and drum wash water only in a designated area. All wash water from the concrete trucks must be retained on-site and treated according to Federal, State and Local regulations. Upon completion of the job, all discharges of surplus concrete and any soil contaminated by the concrete wash water will be removed from the site and taken to an approved disposal area. Water with the potential of entering sink holes or storm sewers will not be allowed to be discharged.

2.9 INSTALLATION/CONSTRUCTION

2.9.1 Inlet Protection

2.9.1.1 Fabric Drop Inlet Protection

a. Construct a dike on the downslope side of the inlet to prevent runoff from bypassing. Dike should be 150 mm higher than inlet protection.

b. Cut fabric from a single roll to avoid joints.

c. Construct the fence as shown on in the drawings.

d. Space the support posts evenly against the inlet perimeter a maximum of one (1) m apart, and drive them about 0.5 m into the ground.

2.9.1.2 Gravel Donut Inlet Protection

a. Construct a dike on the downslope side of the inlet to prevent runoff from bypassing. Dike should be 150 mm higher than inlet protection.

b. Construct as shown in the drawings.

2.9.1.3 Basket Curb Inlet

a. Install immediately after a new inlet is placed or on existing inlets, before any land disturbing activity.

b. If necessary, adapt basket dimensions to fit inlet box dimensions, see drawings.

c. Remove the grate and place basket in the inlet.

d. Cut and install a piece of filter fabric large enough to line the inside of the basket and extending a minimum of 150 mm beyond the frame.

e. Replace the inlet grate, which also serves to anchor the fabric.

2.9.2 Silt Fence and Silt Fence Rock Overflow

a. Construct as shown on the drawings.

b. Staked and entrenched straw bales must be installed along the base of all fills and cuts and on the downhill sides of stockpiled soil.

2.9.3 Straw Bale Dam

a. Construct as shown on the drawings.

b. Staked and entrenched straw bales must be installed along the base of all fills and cuts and on the downhill sides of the stockpiled soil.

2.9.4 Seeding

a. Test soil to determine its nutrient level or apply a 12-12-12 fertilizer at a rate of 75 to 110 kilograms per hectare.

b. Work fertilizer into the soil 50 mm - 100 mm deep with a disk or rake operated across the slope.

c. Select a seed mixture and application rate that best suits the soil type and climate. Also, consult the county soil, water conservation office for assistance.

d. Apply seed uniformly with a drill or cultipacker seeder, or by broadcasting, and cover to recommended depth.

e. If drilling or broadcasting, firm the seedbed with a roller or cultipacker.

f. Mulch seeded area to increase seeding success.

2.9.5 Mulching

a. Apply at the recommended rate based on the material being used.
b. Spread uniformly with no more than 25% of the ground surface visible.
c. If straw or hay is used, it must be anchored immediately.

2.10 INSPECTION AND MAINTENANCE

All measures that are being utilized will be inspected at least once each week and after each storm event. An inspection report shall be written after each inspection and submitted to the Contracting Office representative within 24 hours. Once a problem is found or sediment has reached the clean-out elevation, corrective action shall commence within 24 hours. Inspections shall continue until the controls are removed or the vegetative cover is firmly established.

PART 3 EXECUTION

3.1 GENERAL

The Contractor shall perform all work in such manner as to minimize the pollution of air, water, or land, and shall, within reasonable limits, control noise and the disposal of solid waste materials, as well as other pollutants. Information contained in the following specifications should also be referenced:

Section 02050	Demolition
Section 02080	Removal and Disposal of Asbestos Containing Materials
Section 02090	Demolition or Buildings with Lead Containing Paint and Disposal of Lead-Based Paint

3.2 IMPLEMENTATION

Within 10 calendar days after Notice to Proceed and prior to commencement of the work at the site, the Contractor shall meet the representatives of the Contracting Officer to review and alter his proposal as needed for compliance with the environmental pollution control program.

3.3 PROTECTION OF LAND AREAS

Except for any work on storage areas and access routes specifically assigned for the use of the Contractor under this contract, the land areas outside the limits of permanent work performed under this contract shall, in accordance with CONTRACT CLAUSE: PROTECTION OF EXISTING VEGETATION, STRUCTURE, UTILITIES AND IMPROVEMENTS, be preserved in their present condition. Contractor shall confine his construction activities to areas defined for work on the plans or specifically assigned for his use. In accordance with CONTRACT CLAUSE: OPERATIONS AND STORAGE AREAS, storage and related areas and access routes required temporarily by the Contractor in the performance of the work will be assigned by the Contracting Officer. No other areas on Government premises shall be used by the Contractor without written consent of the Contracting Officer.

3.4 PROTECTION OF TREES AND SHRUBS

CONTRACT CLAUSE: PROTECTION OF EXISTING VEGETATION, STRUCTURES, UTILITIES AND IMPROVEMENTS, is hereby supplemented as follows: The Contractor shall not deface, injure or destroy trees or shrubs, nor remove or cut them without special authority. No ropes, cables, or guys shall be fastened to or attached to any existing nearby trees for anchorage.

3.4.1 Tree Protective Structures

Where, in the opinion of the Contracting Officer, trees may possibly be defaced, bruised, injured or otherwise damaged by the Contractor's equipment or by his other operations, he may direct the Contractor to provide temporary protection of such trees by placing boards, plans, or poles around them.

3.4.2 Restoration of Damaged Trees

Any tree scarred or damaged by the Contractor's equipment or operations shall be restored as nearly as possible to its original condition at the Contractor's expense. All scars made on

trees not designated on the plane to be removed by construction operations shall be coated as soon as possible with an approved tree wound dressing. Trees that are to remain, either within or outside established clearing limits, that are damaged by the Contractor so as to be beyond saving in the opinion of the Contracting Officer, shall be immediately removed, if so directed, and replaced with a nursery-grown tree of the same species and size.

3.5 PROTECTION OF WATER RESOURCES

The Contractor shall control the disposal of fuels, oils, bitumen, calcium chloride, acids, or harmful materials, both on and off the Government premises, and shall comply with applicable Federal, State, County and Municipal laws concerning pollution of rivers and streams while performing work under this contract. The contractor should note that the entire cantonment area is within the delineated Well Head Protection Area for Fort Campbell. This means any release in this area has the potential, due to the installations geological features to impact their drinking water source. For this reason special measures need to be taken to prevent chemicals, fuels, oils, greases, bituminous materials, herbicides and insecticides from entering public waters or potentially migrating via sinkholes or other karst related geologic features to drinking water sources. Special measures will include the generation of a site-specific Spill Prevention Control and Countermeasures Plan. Water used in onsite material processing, concrete curing, foundation and concrete cleanup, and other waste waters shall not be allowed to reenter a stream if an increase in the turbidity of the stream could result therefrom.

3.6 BURNING

Air pollution restrictions applicable to this project are as follows. Materials shall not be burned on the Government premises. If the Contractor elects to dispose of waste materials off the Government premises, by burning, he shall make his own arrangements for such burning area and shall, as specified in CONTRACT CLAUSE: PERMITS AND RESPONSIBILITIES, conform to all local regulations.

3.7 DUST CONTROL

The Contractor shall maintain all excavations, stockpiles, access roads, waste areas, and all other work areas free from excess dust to such reasonable degree as to avoid causing a hazard or nuisance to the Using Service or to others. Approved temporary

methods consisting of sprinkling, chemical treatment, or similar methods will be permitted to control dust. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs.

3.8 EROSION CONTROL

Surface drainage from cuts and fills within the construction limits, whether or not completed, and from borrow and waste disposal areas, shall be graded to control erosion within acceptable limits. Temporary control measures shall be provided and maintained until permanent drainage facilities are completed and operative. The area of bare soil exposed at any one time by construction operations should be held to a minimum.

3.9 CORRECTIVE ACTION

The Contractor shall, upon receipt of a notice in writing of any noncompliance with the foregoing provisions, take immediate 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 a claim for extension of time or for excess costs of damages by the Contractor unless it was later determined that the Contractor was in compliance.

3.10 POST-CONSTRUCTION CLEANUP OR OBLITERATION

In accordance with CONTRACT CLAUSE: CLEANING UP, the Contractor shall, unless other wise instructed in writing by the Contracting Officer, obliterate all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. The disturbed areas shall be graded and filled and the entire area seeded.

3.11 PAYMENT

No separate payment or direct payment will be made for the cost of the work covered under this section, and such work will be considered as a subsidiary obligation of the Contractor.

-- END OF SECTION --

Return to designer instructions

FTCKY HAZMAT INVENTORY FORM

Date: ____/____/____ *Ft. Campbell Environmental Division/Pollution Prevention Branch/ 798-3105* Page ____ of ____

Unit (Bde, Bn, Co.): _____ Bldg #: _____ State:_____ POC Name: _____ Phone #: _____

Bldg Description: _____ HazMat Storage Location:_____
(ie. motor pool, aviation hangar, supply room, etc.) *(i.e. flammable wall locker, supply closet, etc.)*

NSN (If unknown, attach MSDS)	**Manufacturer**	**Material Name**	**Material Use**	**Expire Date**	**Disposal Procedure**	**Containers On Hand**	**Weight or Volume Per Container**	**Amount Used Per Month (Approximate)**
Example: *6810-00-281-2785*	*CSD Inc.*	*MEK*	*Degreaser*	*12-99*	*Hazardous Waste Disposal*	*1 Can*	*1 Gal.*	*1Gal.*

Updated 3/25/98

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Construction Activity Water Permitting Requirements
Contractor's Signature Form

State of Tennessee
Department of Environment and Conservation
Rule 1200-4-10.05
Division of Water Pollution Control
NPDS General Permit TNR 100000

To be completed by developer:
NOI Submission Date:_____

Project Name:_____

Project Location:_____
County

I have agreed to perform construction-related professional services, described as:
_____
that will likely impact the nature of storm water runoff from the named construction activity. Erosion control services involve primarily:

____ Prepare erosion control plan
____ Inspection of controls
____ Install, maintain erosion and sediment controls
____ Other

I understand the terms and conditions of Rule 1200-4-10.05 and that I, and my company, as the case may be, are responsible for the legally liable for complying with this Rule and the applicable State and Federal Laws. I understand that State or EPA or private actions may be taken against me if the terms and conditions of the Rule are not met.

Printed Name:_____ Title:_____

Signature:_____ Date:_____

Company Name:_____

Address:_____

City:_____ State:_____ Phone No._____

Field Person in charge:_____ Phone No._____

Owner/Developer: I certify that the above has been retained to perform the described construction related services noted above and as outlined in the referenced NOI.

Signature:_____ Date:_____

-- End of form --

Back to Paragraph 2.4

August 17, 1998

FORT CAMPBELL CONTRACTOR SITE SPECIFIC SPILL CONTINGENCY PLAN

NAME: _____

CONTRACT NUMBER: _____

GENERAL DISCRIPTION OF WORK: _____

_____

_____

1. RESPONSIBLE PERSONS

A. PRIMARY PERSON
Name: _____ TITLE:_____
Work Phone: _____ Home Phone: _____

B. ALTERNATE PERSON
Name: _____ TITLE:_____
Work Phone: _____ Home Phone: _____

C. SECOND ALTERNATE PERSON
Name: _____ TITLE:_____
Work Phone: _____ Home Phone: _____

2. SPECIAL PRECAUTIONARY MEASURES FOR BUILDING(S) AND ASSOCIATED AREAS

If more than one building, Specify hazardous materials for those buildings.
Building (S) # _____

A. Avoid contacts with spilled substances.
B. Refer to Material Safety Data Sheets (MSDS) for particular hazards and precautionary measures for special handling and spill procedures. Flammable materials will be extinguished as to local fire regulations and the material safety data sheets. If needed, list any materials that need special handling, PPE or special precautionary measures.

_____
_____
_____
_____
_____
_____
_____

3. EMERGENCY SPILL EQUIPMENT ON HAND

(For example, sweeping compound and absorbent material, brooms and plastic dust pans, emergency spill kits, non- sparking shovels, other items as needed and required)

BUILDING#: _____ BUILDING#: _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

4. HAZARDOUS MATERIAL AND QUANTITY NORMALLY ON HAND

A. ***Attach a listing of Hazardous Materials on hand, using the FTCKY HAZMAT Inventory Form.***

B. Material Safety Data Sheets are readily available and located at (the specific location is required).

Bldg. #:_____

Bldg. #:_____

5. SPILL RESPONSE AND NOTIFICATION PROCEDURES

A. REPORT THE SPILL.

The first action in the event of a spill is to report the spill. If you observe a release of a hazardous material, report it to your supervisor and the Fire Department as required below. If the spill is in a Training Area, then the spill will be reported to Range Control, who will then notify the Fire Department. The Fire Department will notify Environmental Division and, if required, Installation Safety, Emergency Medical, and Preventative Medicine. The Environmental Division does all reporting to State/Federal Agencies.

The Fire Department (or Range Control) must be promptly notified of any of the following spills:

- Any uncontrolled quantity of a hazardous substance, or if assistance is needed by Fire Department or Environmental Division, or as instructed by the MSDS or supervisor's discretion:
- Oil and other petroleum products with quantity exceeding 10 gallons or area of spill greater than two feet in any direction or any amount that is spilled into a stream or body of water.
- Environmental Division review has determined the material(s) listed requires special reporting at the quantity shown: (To be supplied by environmental staff during plan review.)

Name: _____ Quantity _____
Name: _____ Quantity _____
Name: _____ Quantity _____

Signature of Environmental Division staff: _____

SUPERVISOR (to notify in case of spill)

NAME: _____ TITLE:_____
WORK PHONE: _____ HOME PHONE: _____

FIRE DEPARTMENT: phone 911
RANGE CONTROL: phone (270) 798-3001 or on radio frequency FM 49.95
ENVIRONMENTAL phone (270) 798-3105

1. If required by your **ORGANIZATION**, additional people to be notified within your chain of command: If not required, fill in N/A.

ALTERNATE PERSON

NAME: _____ RANK:_____
WORK PHONE: _____ HOME PHONE: _____

ALTERNATE PERSON

NAME: _____ RANK:_____
WORK PHONE: _____ HOME PHONE: _____

The spill report must include the following information:

- Name/Phone/Unit of individual reporting the spill; _____
- Spill (Building Location of Number, etc.); _____
- Name of spilled material; _____
- Amount spilled; _____
- Rate currently spilling; _____
- Extent of spill, including drainage features; _____
- Injuries, if any; _____
- Time spill occurred; _____
- Any additional information. _____

B. STOP OR CONTAIN THE SPILL.

Assess the situation before attempting to contain any hazardous material spilled and proceed only if it is safe to do so. You must have knowledge of the spilled substance and don any required personal protective equipment. If necessary, make the spill scene off limits to any unauthorized personnel. If situation warrants, evacuate the area.

C. CLEAN UP THE SPILL.

Under no circumstances should untrained and/or ill-equipped persons attempt to perform cleanup. In some instances, spill cleanup may require respiratory protection and other personal protective equipment. If it is within the capability of the unit that caused the spill, then that unit is responsible for its cleanup. Environmental Division will make the decision to obtain assistance and coordinate with other units as required.
If you handle/work with the hazardous material as part of your job, you are to be trained and qualified to participate in the clean up of the spill.

D. DISPOSE OF SPILLED HAZARDOUS MATERIAL.

All spilled material and other contaminated material (soil, gravel, absorbents, etc.) must be properly disposed. It is the responsibility of the unit that created the spill to properly package and dispose of the waste. Environmental Division will determine the required disposal method.

Responsible Person Signature and Date

_____

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SECTION 01572 - 01670
Construction and Demolition Waste Removal/Diversion Recycle of Recovered Materials

Ft. Campbell Requirements:

Requirements in this section and Appendix A-7. **Solid Waste Disposal/Diversion Practices** shall apply to all construction and demolition activities at Fort Campbell. Contract specifications shall require at least a 50% diversion of demolished building materials such as wood, plumbing fixtures, electrical materials (lights and panels), windows, doors, toilet partitions, HVAC equipment, and scrap metals be diverted from the landfill. See Chapter 2, Paragraph 2.1.4 (Click here). Diversion can be accomplished by deconstructing the wood buildings and components per instructions below or by moving the structure off-post.

Demolition materials shall not be salvaged by the contractor and shall not be removed from the installation. Non salvageable demolition materials shall not to be transported off the installation.

Notify the DPW Environmental Division if unknown waste is discovered during site investigations. Waste could be explosive, hazardous or toxic waste.

Dumpster service for new construction and for demolition is not provided by the installation. The contractor shall arrange for dumpster service at the Contractor's own expense.

In general, utilities are not to be abandoned in place; all abandoned utilities are to be removed. There are circumstances where this requirement does not apply. Abandonment of utilities and removal shall be a topic of discussion at design conferences.

Instructions to Designers:

1 Modify UFGS 01572 - 01670 paragraphs to include the building demolition/diversion requirements above and modify contract specifications.

2 Construction specifications shall require a Building Materials Diversion Plan to be submitted and approved by DPW.

3 When a project requires removal/disposal of environmentally hazardous waste generated at Fort Campbell, the DPW Environmental Division must be involved in the permitting process. Modify project drawings and specifications paragraphs to include each of the above features as they apply to the project. Additional guidance on Environmental Requirements and Hazardous Waste Disposal Practices is contained in **Appendix A**, and project specifications shall be modified to indicate these requirements.

4 For mercury containing light bulb disposal, insert the **Mercury Light Bulb** paragraph.

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CHAPTER 3
Technical Requirements and Instructions
Division 02000

Section	
02080	Removal and Disposal of Asbestos Containing Materials
02090	Demolition or Buildings with Lead-Based Paint, Removal and Disposal of Lead-Based Paint
02220	Demolition
02226	Removal and Salvage of Historic Building Materials
02315 - 02316	Excavation, Filling and backfilling
02364	Termiticide Treatment Measures for Subterranean Termite Control
02510	Water Distribution System
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02753-02754	Concrete Pavements
02770	Concrete Sidewalks and Curbs and Gutters
02930	Exterior Planting

SECTION 02080
Removal and Disposal of Asbestos Containing Materials

Ft. Campbell Requirements:

Removal and disposal of asbestos containing materials shall be conducted in accordance with Ft. Campbell specification section 02080, Removal and Disposal of Asbestos Containing Materials, which shall be included in all projects containing or possibly containing Asbestos products.

Friable and non-friable asbestos containing materials are to be removed from buildings before demolition. Abatement contractors are to notify the TSCA program in writing at least two days prior to beginning asbestos removal. The point of contact for this notification is Russ Godsave at (270) 798-9637.

Contractors must abide with the asbestos regulations in order for the asbestos to be accepted at the Woodlawn Landfill. These procedures include proper notification, manifesting, documentation, vehicle marking, unloading and PPE.

Many contractors depend on refuse contractors to transport the asbestos waste, and their personnel accompanying the asbestos do not normally have asbestos knowledge or training. Therefore, those delivering the materials to the landfill must have proof of medical surveillance and proper PPE.

Instruction to Designers:

1. Asbestos studies have been completed for numerous existing buildings and facilities at Fort Campbell. Designers shall investigate and review the data as required to insure proper identification and notification of asbestos presence at planned OMA and MILCON projects. These studies are available for inspection at the DPW Maintenance Division. POC is Audie Hardin at 270-956-1801.

2. All projects containing or possibly containing Asbestos products shall include **Ft. Campbell specification section 02080, Removal and Disposal of Asbestos Containing Materials**
3. Additional Environmental guidance applies. See **Appendix A**.

4. For electronic copies of the document, contact the PE/A for MILCON and OMA projects by the COE. A-E's directly serving the installation should contact the PM

Ft. Campbell Specification

Section 02080, Removal and Disposal of Asbestos Containing Materials

SECTION 02080

REMOVAL AND DISPOSAL OF ASBESTOS CONTAINING MATERIALS

11/97

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) PUBLICATIONS:

ANSI Z9.2-79	Fundamentals Governing the Design and Operation of Local Exhaust Systems

CODE OF FEDERAL REGULATIONS (CFR) PUBLICATIONS:

40 CFR 61, Subpart A	General Provisions
40 CFR 61, Subpart M	National Emission Standard for Asbestos
40 CFR 241	Guidelines for the Land Disposal of Solid Wastes
40 CFR 257	Criteria for Classification of Solid Waste Disposal Facilities and Practices
29 CFR 1926.1101	OSHA Construction Industry Asbestos Standard
29 CFR 1910.120	OSHA Hazardous Waste Emergency Response Standard
29 CFR 1910 subpart I	OSHA Personal Protective Equipment Standard

NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH

Method 7400	Manual of Analytical Methods, 3rd Ed.,Vol. 1, Physical and Chemical Analysis Method (P&CAM)Fibers
Method 7402	Asbestos Fibers

UNDERWRITERS LABORATORIES, INC. (UL) PUBLICATIONS

UL 586 1986 High Efficiency Particulate, Air Filter

1.2 DESCRIPTION OF WORK

The work covered by this section includes the handling of friable and nonfriable asbestos containing materials (ACMs) which may be encountered during removal and demolition operations and the incidental procedures and equipment required to protect workers and occupants of the building or area, or both, from contact with airborne asbestos fibers. The work also includes the disposal of the removed asbestos-containing materials. Perform work in accordance with 29 CFR 1926.1101; 40 CFR 61, Subpart A; 40 CFR 61, Subpart M; and the requirements specified herein.

Please refer to pages B20-B38 of the Detail drawings, Volume 1 of 7 for specific locations and quantities of asbestos containing materials.

Please see drawing TU 1.0 for locations of underground chilled water lines, steam lines and condensate lines which are insulated with asbestos containing materials. A total of 6002 linear feet (1850m) are assumed to be present. The breakdown of the piping is as follows:

100 mm (4") chilled water supply - 425 m (1361 ft)
100 mm (4") chilled water return - 425 m (1361 ft)
150 mm (6") steam - 350 m (1148 ft)
125 mm (5") steam - 150 m (492 ft)
80 mm (3") condensate - 250 m (820 ft)
50 mm (2") condensate - 250 m (820 ft)

In addition two cooling towers located at buildings 6775 and 6781 are composed of transite panels and have interiors that contain a honey combed fill material which contains asbestos. An estimated total of 160 square feet of asbestos containing materials are present in each of the two units.

1.2.1 Asbestos Survey

An asbestos Survey was conducted in the contract work area(s) to identify the presence of asbestos containing materials as described in 1.2 above. The data collected is contained in the

Asbestos and Lead-Based Paint Survey Report for the Third Brigade Barracks, Fort Campbell, Kentucky , prepared by Gobbel Hays Partners, which is on file at the Fort Campbell PW, Environmental Division. Contact must be made through the Contracting officer.

1.2.2 Unidentified ACM

If suspect ACM not covered by the drawings or the specifications is encountered, the contractor will stop work and immediately notify the contracting officer. Upon direction from the contracting officer, the contractor may be required to conduct sampling and testing of these suspect materials in accordance with the Industrial Hygienist's recommended procedures.

1.3 DEFINITIONS

1.3.1 Aggressive method

Removal or disturbance of building material by sanding, abrading, grinding or other method that breaks, crumbles, or disintegrates intact Asbestos Containing Material (ACM).

1.3.2 Amended Water

Water containing a wetting agent or surfactant.

1.3.3 Area Monitoring

Sampling of asbestos fiber concentrations inside and out of the regulated area, which is representative of the airborne concentrations of asbestos fibers which may reach the breathing zone.

1.3.4 Asbestos

Includes chrysotile, amosite, crocidolite, tremolite , anthophyllite, actinolite, and any of these minerals that have been chemically treated and/or altered. For purposes of this standard, "asbestos" includes PACM, as defined below.

1.3.5 Asbestos Abatement Contractor

A business entity certified, licensed, or accredited by the state in which a response action involving asbestos-containing

building material that is friable, or expected to become friable during the response action.

1.3.6 Asbestos Containing Material (ACM)

Any material containing more than one percent asbestos

1.3.7 Asbestos Fibers

Asbestos fibers having a length-to-diameter ratio of at least 3 to 1 and a length of 5 micrometers or longer as counted in the NIOSH Method 7400 or Method 7402 procedure using either phase contrast light microscopy (PCM) or transmission electronic microscopy (TEM).

1.3.8 Asbestos Permissible Exposure Limit (PEL)

Legally enforceable level of asbestos fibers in air set by the Occupational Safety and Health Association (OSHA), as an eight (8) hour time weighted average (TWA) of asbestos fibers not to exceed 0.1 fibers per cubic centimeter of air as set forth in 29 CFR 1926 1101

1.3.9 Authorized Person

Any person authorized and required by work duties to be present in regulated areas.

1.3.10 Breathing Zone

A hemisphere forward of the shoulders with a radius of approximately 6 inches to 9 inches.

1.3.11 Category I Nonfriable ACM

Category I Nonfriable ACM includes asbestos-containing packing, gaskets, resilient floor covering, and asphalt roofing products.

1.3.12 Category II Nonfriable ACM

Category II Nonfriable ACM includes any asbestos-containing material not included in Category I that, when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure.

1.3.13 Certified Asbestos Supervisor

One certified by the State in which work is to be performed and has passed an examination covering "Supervision of Asbestos Abatement Projects" or similar title training. This training must be the equivalent in curriculum, training, method and length to the EPA Model Accreditation Program (MAP) asbestos abatement workers training 40 CFR part 763 subpart E, Appendix C.

1.3.14 Certified Asbestos Worker

One certified by the National Asbestos Council and holds current cards illustrating the board number.

1.3.15 Certified Licensed Contractor

A Contractor who has been trained at an EPA approved course and certified/accredited by the state for which the work is to be performed in.

1.3.16 Certified Industrial Hygienist (CIH)

One certified in the comprehensive practice of industrial hygiene by the American Board of Industrial Hygiene.

1.3.17 Class I Asbestos Work

Activities involving the removal of Thermal System Insulation (TSI) and surfacing ACM and PACM.

1.3.18 Class II Asbestos Work

Activities involving the removal of ACM which is not thermal system insulation or surfacing material. This includes, but it not limited to, the removal of asbestos-containing wallboard, floor tile, sheeting, roofing, siding shingles, and construction mastics.

1.3.19 Class III Asbestos Work

Repair and maintenance operations, where "ACM, including thermal system insulation and surfacing material, is likely to be disturbed.

1.3.20 Clean Room

An uncontaminated, transitional room having facilities for storage of employees' street clothing and uncontaminated materials and equipment.

1.3.21 Competent Person

In addition to the definition in 29 CFR 1926.32(f), one who is capable of identifying existing asbestos hazards in the workplace and selecting the appropriate control strategy for asbestos exposure and has the authority to take prompt corrective measures to eliminate them, as specified in 29 CFR 1926.32 (f); in addition, for Class I and Class II work, one who is specially trained in a training course which meets the criteria of EPA's Model Accreditation Plan (40 CFR 763) for project designer or supervisor, or its equivalent and, for Class II who is trained in an operations and maintenance (O&M) course developed by EPA (40 CFR 763 . 92 (a)(2)).

1.3.21 Critical Barrier

One or more layers of plastic sealed over all openings into a work area or any other similarly placed physical barrier sufficient to prevent airborne asbestos in work area from migrating to an adjacent area.

1.3.23 Decontamination Area

An enclosed area adjacent and connected to the regulated area and consisting of an equipment room, shower area, and clean room which is used for the decontamination of workers, materials and equipment contaminated with asbestos.

1.3.24 Demolition

The wrecking or taking out of any load-supporting structural member and any related razing, removing, or stripping of asbestos products.

1.3.25 Disturbances

Contact which releases fibers from ACM or PACM or debris containing ACM or PACM. This term includes activities that disrupt the matrix of ACM or PACM, render ACM or PACM friable, or generate visible debris. Disturbance includes cutting away small amounts of ACM and PACM, no greater than the amount which can be contained in one standard sized glove bag or waste bag in

order to access a building component. In no event will the amount of ACM or PACM so disturbed exceed that which can be contained in one glove bag or waste bag which will not exceed 60 inches in length and width.

1.3.26 Employee Exposure

That exposure to airborne asbestos fibers that would occur if the employee were not using respiratory protective equipment.

1.3.27 Encapsulant

A liquid material which can be applied to ACM which controls the possible release of asbestos fibers from the material either by creating a membrane over the surface (bridging encapsulant) or by penetrating into the material and binding its components together (penetrating encapsulant).

1.3.28 Encapsulate

The process where by an encapsulant is applied to ACM to control the release of asbestos fibers into the air.

1.3.29 Equipment Room (Change Room)

A contaminated room located within the decontamination area that is supplied with impermeable bags or containers for the disposal of contaminated protective clothing and equipment.

1.3.30 Excursion Limit

The contractor will ensure that no employee is exposed to an airborne concentration of asbestos in excess 1.0 fibers per cubic centimeter of air (1.0 f/cc) as averaged over a sampling period of 30 minutes.

1.3.31 Fiber

A particulate form of asbestos, 5 micrometers or longer, with a length-to-diameter ratio of at least 3 to 1.

1.3.32 Friable Asbestos Material

Material that contains more than one percent asbestos by weight which can be crumbled, pulverized, or reduced to powder by hand pressure when dry.

1.3.33 Glovebag Technique

A method with limited applications for removing small sections of asbestos-containing material from HVAC ducts, short piping runs, valves, joints, elbows, and other nonplanar surfaces in a noncontained regulated area. The glovebag is constructed and installed in such a manner that it surrounds the object or material to be removed and contains all asbestos fibers released during the removal process. All workers who are permitted to use the glovebag technique must be highly trained, experienced and skilled in this method. Glovebag techniques must be performed in accordance with 29 CFR 1926.1101 which require at least two persons perform class I removals. Glovebags may not be moved along a piece of pipe.

1.3.34 Glovebag

An impervious plastic bag-like enclosure affixed around an asbestos-containing material, with glove-like appendages through which material and tools may be handled. Glovebags will be made of 6 mil thick plastic and will be seamless at the bottom. Glovebags are for single use and must be smoke tested for leaks prior to usage.

1.3.35 HEPA Filter Equipment

High-efficiency particulate air (HEPA) filtered vacuuming equipment with a UL 586 filter system capable of collecting and retaining at least 99.97 percent of all mono-dispersed particles of 0. 3 micrometer diameter or larger.

1.3.36 Homogeneous Area

An area of surfacing material or thermal system insulation that is uniform in color and texture.

1.3.37 Intact

ACM which has not been crumbled, pulverized, or otherwise deteriorated so that it is no longer likely to be bound with its matrix.

1.3.38 Negative Initial Exposure Assessment

A demonstration based by the contractor , which complies with the criteria in paragraph (f)(2)(iii) of 29 CFR 1926.1101, that employee exposures during an operation are expected to be consistently below the PELs.

1.3.39 Nonfriable Asbestos Material

Material that contains asbestos in which the fibers have been locked in by a bonding agent, coating, binder, or other material so that the asbestos is well bound and may not release fibers in excess of the action level during any appropriate use, handling, storage, transportation, or processing. Nonfriable asbestos containing material must be removed prior to demolition/renovation. Nonfriable asbestos containing materials are to be disposed as special waste at a state permitted subtitle D landfill apprroved to accept asbestos..

1.3.40 Presumed Asbestos Containing Material (PACM)

Thermal system insulation and surfacing material found in buildings constructed no later than 1980.

1.3.41 Personal Monitoring

Sampling of airborne asbestos fiber concentrations within the breathing zone of an employee.

1.3.42 Prior Experience

Experience required of the contractor, his employees, and his Industrial Hygienist on asbestos projects of similar nature and scope to insure capability of performing the asbestos removal in a satisfactory manner. Similarities will be in areas related to material composition, project size, number of employees and the engineering work practice and personal protection controls required.

1.3.43 Regulated Areas

Areas established to demarcate where Class I, II and III asbestos work is conducted, and any adjoining area where debris and waste from such asbestos work may accumulate; and a work area within which airborne concentrations of asbestos, exceed or there is a reasonable possibility they may exceed the permissible exposure limit.

1.3.43.1 Enclosed Regulated Area

A regulated area which has been isolated by physical boundaries and maintained under negative pressure to prevent the spread of asbestos dust, fibers, or debris. A local HEPA filtered exhaust system is required.

1.3.44 Regulated Asbestos-Containing Material (RACM) for abatement at Fort Campbell will include the following:

(a) Friable asbestos containing material

(b) All category I nonfriable ACM

(c) All category II nonfriable ACM

1.3.45 Thermal System Insulation (TSI)

ACM applied to pipes, fittings, boilers, breeching, tanks, ducts or other structural components to prevent heat loss or gain.

1.3.46 Thermal System Insulation ACM

Thermal system insulation which contains more than 1 percent asbestos.

1.3.47 Time Weighted Average (TWA)

The TWA is an individuals 8-hour time weighted average of airborne concentration of fibers per cubic centimeter of air.

1.4 SUBMITTALS

The following will be submitted in accordance with Section 01300 SUBMITTALS to and approved by the contracting officer prior to commencing work involving asbestos materials:

1.4.1 SD-01, Data

1.4.1.1 Local Exhaust Equipment;

1.4.1.2 HEPA Vacuum Equipment;

1.4.1.3 Respirators; including fit test records

1.4.1.4 Pressure Differential Monitor;

1.4.1.5 Hazardous Communication Plan (if hazardous materials will be brought onto site)

1.4.1.6 Training Data

Submit signed and dated certificates for each employee that has received training for the appropriate task(s) assigned and the required amount of hours for the proper handling of materials that contain asbestos, that the employee understands the health implications and risks involved, including the illnesses possible from exposure to airborne asbestos fibers; understands the use and limitations of the respiratory equipment to be used; understands the results of monitoring of airborne quantities of asbestos as related to health and respiratory equipment; and understands engineering and other hazard control techniques and procedures.

1.4.2 SD-08 Statements

1.4.2.1 Testing Laboratory;

Submit the name, address, and telephone number of the testing laboratory selected to perform the monitoring, testing, and reporting of airborne concentrations of asbestos fibers. The laboratory will be approved by the American Industrial Hygiene Association (AIHA) to participate in the AAR program. Submit proof that persons reading the samples have been judged proficient by successful participation within the last year in the National Institute for Occupational Safety and Health (NIOSH) Proficiency Analytical Testing (PAT) Program or proof that the individuals reading the air samples are current participants in the Asbestos Analysts Registry (AAR). If bulk sample analysis is necessary the testing laboratory will have to submit their certification of National Laboratory Accreditation Program (NVLAP) participation.

1.4.2.2 Industrial Hygienist;

Submit the name, address, and telephone number of the Industrial Hygienist selected to prepare the asbestos plan, direct monitoring and perform training, and a certification that the Industrial Hygienist is certified by the American Board of Industrial Hygiene, including certification number, and date, and their previous experience in asbestos removal activities. For the purposes of this specification the terms industrial hygienist, Certified Industrial Hygienist and CIH are synonymous. The industrial hygienist will be contracted by the abatement firm performing the work. In additon to being a CIH, the individual must be accredited in the discipline he is performing. The Industrial Hygienist must be an accredited building inspector if he is to collect samples or an accredited designer if he is to perform asbestos design specifications.

1.4.2.3 Prior Experience;

As evidence that the asbestos removal effort will be accomplished by trained and competent personnel totally familiar with safe and legal asbestos working practices, the contractor will furnish for Government approval (for himself or for his selected asbestos removal subcontractor) written documentation of successfully completed asbestos abatement projects of similar nature and scope. A short summary of three (3) asbestos abatement projects performed will include:

a. The name, address, and telephone number of the contact person(someone specifically familiar with the contractor's work). If available, include copies of letters of reference from previous users of the contractors service.

b. A short description of the type of removal (e.g. pipe lagging, sprayed girders and/or ceilings, transite siding, etc.), its extent (square feet, linear feet), and days to complete (scheduled and actual).

c. Documentation of any licenses or certifications as an asbestos abatement Contractor in the jurisdiction covered. If none, a negative response is required.

d. The contractor will certify that the firm and its employees are familiar with regulations of the Occupational Safety and Health Administration (OSHA) and the U.S.

Environmental Protection Agency (EPA)cited in the project specification and related to asbestos abatement.

e. The contractor will further document that no RACM will be stripped, removed , or otherwise be handled or disturbed unless at least one on-site representative, such as a foreman, management level, or other authorized representative trained in the provisions of this regulation and the means of complying with them, is present. Annually the trained on-site individual will receive refresher training in the provisions of this regulation. The required training will include as a minimum: applicability; notifications; material identification; control procedures for removals including, at least, wetting, local exhaust ventilation, negative pressure enclosures, glove-bag procedures, and High Efficiency Particulate Air (HEPA) filters; waste disposal work practices; reporting and record keeping; and asbestos hazards and worker protection. Evidence that the required training has been completed will be posted and made available for inspection by the NESHAP administering agency at the demolition or renovation site.

f. A notarized statement, signed by an officer of the asbestos abatement company, containing the following information: (If none, a negative reply is required.)

(1) A record of any citations issued by Federal, State or local: regulatory agencies relating to asbestos abatement activity. Include projects, dates and resolutions.

(2) A list of penalties incurred through noncompliance with asbestos abatement project specifications including liquidated damages, overruns in scheduled time limitations and resolutions

(3) Situations in which an asbestos related contract has been terminated including projects, dates and reasons for terminations.

(4) A listing of any asbestos-related legal proceedings/claims which the contractor (or employees Scheduled to participated in this project) has participated or is currently involved. Include descriptions of role, issue and resolution to date.

1.4.2.4 Asbestos Plan;

Submit a detailed Plan of the work procedures to be used in the removal and disposal of materials containing asbestos. Include in the Plan an explanation of Initial Exposure Assessment. The Plan will be prepared, signed, and sealed, including certification number and date, by the contractor s Certified Industrial Hygienist. Such Plan will include a sketch showing the location, size, and details of regulated areas, location and details of the decontamination area, layout of decontamination area, and locations of local exhaust equipment. The Plan will also include interface of trades involved in the construction, sequencing of asbestos-related work, disposal plan, type of wetting agent to be used, air monitoring, respirators, protective equipment, pressure differential monitoring device, and a detailed description of the method employed in order to control ambient air conditions within the regulated area. All milestones and schedules will be included within this Plan. The Plan will be approved by the contracting officer prior to the start of any asbestos work. Prior to beginning work, the contractor will meet with the contracting officer to discuss in detail the Asbestos Plan, including work procedures and safety precautions.

1.4.2.5 Notification Requirements;

a. Initial Notification

At least 10 working days before asbestos stripping or removal work or any other activity begins such as site preparation that would break up, dislodge or similarly disturb asbestos containing materials.

The contractor will:

(1) Provide the U.S. Environmental Protection Agency (EPA) Regional NESHAP administering agency with the required notice of intention to demolish or renovate. If work is performed in Tennessee, notification shall be in accordance with State of Tennessee regulation Ch 1200-3-11 and Code of Federal Regulations 40 CFR 61, Subpart M. The contractor will send notification forms to:

Department of Environment and Conservation-Division of Air Pollution Control
9th Floor, L&C Annex
401 Church Street
Nashville, Tennessee 37243-1531.

If the work is performed in Kentucky, the NESHAP notification forms are to be sent to the:

Kentucky Division for Air Quality
Asbestos Branch, Paducah Region
4500 Clarks River Road
Paducah, Kentucky 42003

Forms are located at the end of this section. Work will not commence on any dates other than those stated in the notification without re-notification of all parties. Delivery of the notice by U.S. Postal Service, commercial delivery service, or hand delivery is acceptable. The contractor will also provide the Contracting Office representative copies of all notifications and re-notifications.

(2) Update notice, as necessary, including when the amount of asbestos affected changes by at least 20 percent.

(3) The contractor will submit to the Contracting Administrator (CA) a copy of the NESHAP notification on the same day it is sent to the administrating agency (state). The CA will, in-turn, forward a copy of the NESHAP notification to the Directorate of Public Works/Environmental Division/Compliance Branch, Building 2182, 13 ½ Street, IMSE-CAM-PWE, Fort Campbell, KY 42223-5130. The contractor will provide the Contracting Officer Representative (COR) and Environmental Division notification 48 hours prior to the start of removal or disturbance of Asbestos Containing Material (ACM). If the contractor was not required by the state to submit a NESHAP notification, the contractor shall submit to the Contracting Officer Representative (COR) 48 hour electronic notification of intent to start removal of asbestor containing material. Such notification shall include the following:

- Building number
- Anticipated start and end dates
- Description of material being disturbed or abated
- Quantity of material being disturbed or abated including units (SF, LF, CY)
- Description of approximate location of work (eg latrines, NW corner of building, 2nd floor, etc.)

The COR will in turn forward a copy of the notification to the DPW Environmental Division

b. Re-notification

For asbestos stripping or removal work in a demolition or renovation operation that will begin on a date other than the

one contained in the original notice, notice of the new start date must be provided to the NESHAP-administering agency as follows:

(1) When the asbestos stripping or removal operation or demolition operation covered by this paragraph will begin after the date contained in the notice,

(a) Notify the NESHAP administering agency of the new start date by telephone as soon as possible before the original start date, and

(b) Provide the NESHAP administering agency with a written notice of the new start date as soon as possible before, and no later than, the original start date. Delivery of the updated notice by the U.S. Postal Service commercial delivery service, or hand delivery is acceptable.

(2) When the asbestos stripping and removal operation or demolition operation covered by this paragraph will begin earlier than the original start date, provide the NESHP administering agency with a written notice of the new start date at least 10 working days before asbestos stripping or removal work begins.

(3) In no event will an operation covered by this paragraph begin on a date other than the date contained in the written notice of the new start date.

c. Notification Information

The following will be included in the notice:

(1) An indication of whether the notice is the original or a revised notification.

(2) Name, address, and telephone number of both the facility owner and operator and the asbestos removal contractor.

(3) Type of operation: demolition or renovation.

(4) Address including specific building number and description of the facility or affected part of the facility including the size (square meters/square feet and number of floors), age, and prior use of the facility.

(5) Procedure, including analytical methods, employed to detect the presence of RACM and Category I and Category II nonfriable ACM.

(6) Estimate of the approximate amount of RACM to be removed from the facility in terms of length of pipe in linear meters (linear feet), surface area in square meters (square feet) on other facility components, or volume in cubic meters (cubic feet).

(7) Location of the facility being demolished or renovated.

(8) Scheduled start and completion dates of demolition or renovation.

(9) Description of planned demolition or renovation work to be performed and method(s) to be employed, including demolition or renovation techniques to be used and description of affected facility components.

(10) Description of work practices and engineering controls to be used to comply with the requirements of this subpart, including asbestos removal and waste-handling emission control procedures.

(11) Name and location of the waste disposal site where the asbestos-containing material will be deposited.

(12) A certification that at least one person trained as required by paragraph (e) of 1.4.2.3 of this section will supervise the stripping and removal described by this notification.

(13) Description of procedures to be followed in the event that unexpected ACMs are encountered.

(14) Name, address, and telephone number of the waste transporter.

d. Demolition

Refer to Appendix A-10 for demolition NESHAP requirements.

1.4.3 SD-09, Reports

1.4.3.1 Monitoring Results;

Fiber counting will be completed and results reviewed by the Certified Industrial Hygienist within 16 hours. The CIH will notify the contractor and the contracting officer immediately of any exposures to fibers in excess of the acceptable limits. Submit monitoring results to the contracting officer within 3 working days, signed by the testing laboratory, the employee performing air monitoring and the CIH.

1.4.3.2 Local Exhaust System;

Local exhaust systems must be installed and operated in accordance with ANSI Z9.2-79. The local HEPA filtered exhaust system will be operated continuously, 24 hours a day, to maintain the enclosure under negative pressure until the enclosure of the regulated area is removed. Pressure differential recordings for each workday will be reviewed by the Industrial Hygienist and submitted to the contracting officer within 24 hours from the end of each workday. The contractor will notify the contracting officer immediately of any variance in the pressure differential which could cause exposure of adjacent unsealed areas to asbestos fiber concentrations.

1.4.3.3 Job Progress Report;

During abatement activities, the Industrial Hygienist will submit a weekly job progress report to the contracting officer detailing abatement activities. Include review of progress with respect to Asbestos Plan, milestones and schedules, major problems and actions taken, injury reports, equipment breakdowns and a compilation of the weeks bulk material and air sampling results conducted by the contractor's Industrial Hygienist or air sampling professional. Submission of individual monitoring results will be as dictated by SD-09, Reports. The progress report will be signed by the contractor, asbestos abatement subcontractor and the Industrial Hygienist.

1.4.3.4 Within 48 hours after removal of asbestos containing material (ACM), the contractor will provide the Contract Administrator (CA) a copy of the asbestos survey drawings that annotates in blue or red ink the ACM(s) that have been removed as a result of the project. A copy of the building asbestos survey drawings may be obtained at the DPW Environmental Division. The CA will in-turn forward a copy of the survey annotation to the Directorate of Public Works / Environmental

Division / Compliance Branch, Building 2182, 13 ½ Street, IMSE-CAM-PWE, Fort Campbell, Kentucky 42223-5130.

1.4.4 SD-13, Certificates

1.4.4.1 Local exhaust and HEPA vacuum filters;

Local exhaust and HEPA vacuum filters need to be maintained as per manufacturers specifications. Asbestos prefilters need to be replaced daily and HEPA filters changed based upon daily readings of the manometer as described in section 2.7 of this specification.

1.4.4.2 Respirators;

Respiratory protection will be provided by the contractor according to 29 CFR 19261101.and the requirements specified in section 2.2 of this specification. The contractor will have developed and implemented a respiratory protection program meeting all the requirements of 29 CFR 1910.134 OSHA s Respiratory Protection Standard.

1.4.5 SD-18, Records

1.4.5.1 Landfill Delivery Records;

Submit written evidence that the contractor plans to use the **Woodlawn** Landfill for disposal and will follow all approved procedures for asbestos disposal issued by the EPA, state and local regulatory agencies. Submit copies of all waste shipment records and resulting correspondence. An asbestos waste shipment record appears **at the end of this specification**.

1.5 TITLE TO MATERIALS

Materials resulting from demolition work, except as specified otherwise, will become the responsibility of the contractor and will be disposed of as specified herein.

1.6 PROTECTION OF EXISTING WORK TO REMAIN

Perform demolition work without damage or contamination of adjacent work. Where such work is damaged or contaminated,

restore work to the original condition at no additional cost to the government.

1.7 SEQUENCE OF WORK

No other work shall be performed in the asbestos regulated area prior to completion and certification of the asbestos abatement work.

1.8 PERMISSIBLE EXPOSURE LIMITS (PELS)

a.Time-weighted average limit (TWA). Ensure that no employee is exposed to an airborne concentration of asbestos in excess of 0.1 fiber per cubic centimeter of air as an eight (8) hour time-weighted average (TWA).

b. Excursion limit. Ensure that no employee is exposed to an airborne concentration of asbestos in excess of 1.0 fiber per cubic centimeter of air (1.0 f/cc) as averaged over a sampling period of thirty (30) minutes.

1.9 MEDICAL SURVEILLANCE 29 CFR 1926.1101(m)

1.9.1 Medical examinations

Submit evidence of a medical surveillance program for all employees who for a combined total of 30 or more days per year are engaged in Class I, II and III work or are exposed at or above the permissible exposure limit or excursion limit, and for employees who wear negative pressure respirators. The content of the examination shall be consistent with 29 CFR 1926.1101 (m). This examination is not required if adequate records show the employee has been examined as required by 29 CFR 1926.1101 (m) within the past year. The same medical examination shall be given on an annual basis to employees engaged in an occupation involving asbestos fibers and within 30 calendars days before or after the termination of employment in such occupation.

1.9.2 Medical Records

Maintain complete and accurate records as required by 29 CFR 1926.1101(n) employees' medical examinations for a period of at least 40 years after termination of employment and make records of the required medical examinations available for inspection and copying to: The Assistant Secretary of Labor for Occupational Safety and Health, The Director of the National

Institute for Occupational Safety and Health (NIOSH), authorized representatives of either, and an employee's physician upon the request of the employee or former employee.

l.l0 TRAINING

All workers must receive training specific to the tasks performed on the project. In addition, each employee must have received an equivalent level of training within 3 months prior to assignment to asbestos work or shall be instructed for a minimum of 8 hours by the CIH with regard to the methods of recognizing asbestos; the health effects associated with asbestos; the relationship between smoking and asbestos in producing lung cancer; its purposes, proper use, fitting instructions, and limitations of respirators; the nature of operations that could result in exposure to asbestos, the importance of necessary protective controls to minimize exposure and any necessary instructions in the use of these controls and procedures; the appropriate work practices for performing the asbestos removal job; medical surveillance program requirements; and a review of 29 CFR 1926.1101 safety and health precautions and the use and requirements for protective clothing and equipment including respirators. Fully cover engineering and other hazard control techniques and procedures. Maintain complete and accurate records of training for each employee. Records shall be maintained for one year beyond the last date of employment.

Employees who perform Class I or Class II removals will have received the EPA worker 4-day course. Supervisors will have received the EPA 5-day Competent person training.

1.12 PERMITS

Obtain necessary permits in conjunction with this project for the abatement, demolition, transportation and disposal of asbestos containing materials, and provide timely notification of such actions as may be required by Federal, State, regional, and local authorities. Refer, also, to SD-18, Records (Landfill Delivery Records) for additional requirements.

1.13 SAFETY AND HEALTH COMPLIANCE

In addition to detailed requirements of this specifications, comply with laws, ordinances, rules, and regulations of Federal, State, regional, and local authorities regarding handling,

storing, transporting, and disposing of asbestos waste materials. Comply with the applicable requirements of the current issue of 29 CFR 1926.1101 and 40 CFR 61, Subpart A and 40 CFR 61, Subpart M. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting work. Where specification requirements and referenced documents vary, the most stringent requirements will apply.

PART 2 PRODUCTS

2.1 EQUIPMENT AND MATERIAL USED IN REMOVAL OPERATIONS

Furnish the contracting officer with two complete sets of personal protective equipment, as required herein, for each entry into and inspection of the regulated area.

2.2 RESPIRATORS

The contractor will provide respirators , and ensure they are used in the following circumstances. Respiratory protection is required on all asbestos abatement jobs.

a. During all class I removal jobs.

b. During all class II work where the ACM is not removed in a substantially intact state.

c. During all Class II and III work which is not performed using wet methods, provided, however that respirators need not be worn during removal of sloped roofs when a negative exposure assessment has been made and the ACM is removed in an intact state.

d. During all Class II and III asbestos jobs where the contractor does not produce a “negative exposure assessment.”

e. During all Class III jobs where TSI or surfacing ACM or PACM is to be disturbed.

f. During all Class IV work performed in regulated areas where employees performing other work are required to wear respirators.

g. During all work where employees are exposed above the PEL or the excursion limit.

h. During emergencies.

Select respirators approved by the Mine Safety and Health Administration (MSHA) and the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services, for use in atmospheres containing asbestos fibers according to the table below. During the performance of work when removal or demolition of asbestos materials is not underway and after the TWA and ceiling limits have been established, the contractor shall provide respirators as required in 29 CFR 1926.1101(h). The contractor shall establish a respirator program as required by ANSI Z88.2-80 and 29 CFR l910.134.

RESPIRATORY PROTECTION FOR ASBESTOS FIBERS

Airborne concentration of asbestos or condition of use	Required respirator
Not in excess of 1 f/cc (l0XPEL), or otherwise as required independent other than a disposable, equipped of exposure	Half-mask air purifying respirator with high efficiency filters.
Not in excess of 5 f/cc (50XPEL).	Fullface piece air-purifying respirator equipped with high efficiency filters.
Not in excess of 10 f/cc (100XPEL).	Any powered air-purifying respirator equipped with high efficiency filters or any supplied air respirator operated in continuous flow mode.
Not in excess of 100 f/cc (100XPEL)	Fullface piece supplied - air

	respirator operated in pressure demand mode.
Greater than 100 f/cc (1,000XPEL), or unknown concentration.	Fullface piece supplied air respirator operated in pressure demand mode, equipped with an auxiliary positive pressure self contained breathing apparatus.

*Airborne concentrations are based upon the 8 hour TWA - PEL

*A high efficiency filter means a filter that is at least 99.97 percent efficient against mono-dispersed particles of 0.3 micrometers in diameter or larger.

*Air purifying respirators must be equipped with high-efficiency particulate air (HEPA) filters. The HEPA filters are not reusable.

In addition to the above selection criteria the contractor will provide tight fitting powered air purifying respirators equipped with high efficiency filters or a full face piece supplied air respirator operated in the pressure demand mode equipped with HEPA egress cartridges or an auxiliary positive pressure self contained breathing apparatus for all employees within the regulated area where Class I work is being performed for which a negative exposure assessment has not been produced and the exposure assessment indicates the level will not exceed 1 f/cc as an 8- hour time weighted average. A full face piece supplied air respirator operated in the pressure demand mode equipped with an auxiliary positive pressure self-contained breathing apparatus shall be provided under such conditions, if the exposure assessment indicates exposure levels above 1.0 f/cc as an 8-hour time weighted average.

2.3 SPECIAL CLOTHING

2.3.1 Protective Clothing

Protective clothing shall be coveralls or similar whole-body clothing, head coverings, gloves, and foot coverings.

2.3.2 Work Clothing

Provide boot covers and cloth work clothes to be worn under the protective coveralls.

2.4 HYGIENE FACILITIES

A decontamination area shall consist of an equipment room, shower area, and clean room in series. The equipment room shall be supplied with impermeable, labeled bags and containers for the containment and disposal of contaminated protective equipment. Shower facilities shall be provided which comply with 29 CFR l910.14(d)(3). The clean change room shall be equipped with a locker or appropriate storage container for each employee's use.

2.5 EYE PROTECTION

Provide goggles for personnel engaged in asbestos operations when the use of a full face respirator is not required.
Eye protection will be provided as per 29 CFR 1910.133 OSHA’s Eye and Face Protection Standard.

2.6 WARNING SIGNS AND LABELS

2.6.1 Warning Signs

Warning signs must be of sufficient size to be clearly legible and display the following information:

DANGER

ASBESTOS

CANCER AND LUNG DISEASE HAZARD

AUTHORIZED PERSONNEL ONLY

RESPIRATORS AND PROTECTIVE CLOTHING ARE REQUIRED IN THIS AREA

2.6.2 Warning Labels

Labels must be of sufficient size to be clearly legible, printed in large, bold letters on a contrasting background, and displaying the following legend:

DANGER

CONTAINS ASBESTOS FIBERS

AVOID CREATING DUST

CANCER AND LUNG DISEASE HAZARD

2.7 LOCAL EXHAUST SYSTEM

Provide a local exhaust system in the enclosed regulated areas. Filters on vacuums and exhaust equipment will be UL 586-labeled HEPA filters. Local exhaust equipment shall be sufficient to maintain a minimum pressure differential of minus 0.02 inches of water column relative to adjacent, unsealed areas. The local exhaust system must be equipped with a manometer-type negative pressure differential monitor with minor scale division of 0.02 inches of water and accuracy within plus or minus 10 percent. The manometer must be calibrated daily as recommended by the manufacturer. Provide manually recorded manometer readings of the pressure differential between the enclosed regulated area and adjacent unsealed areas at the beginning of each workday and every 2 working hours thereafter. The local exhaust system will be operated continuously, 24 hours per day, until the regulated area enclosure is removed. Replace filters as required to maintain the efficiency of the system. The building heating, ventilating, and air-conditioning (HVAC) system will not be used as the local exhaust system for the enclosed regulated area.

2.8 TOOLS AND MISCELLANEOUS EQUIPMENT

2.8.1 Airless Sprayer

An airless sprayer, suitable for application of sealing material, will be used.

2.8.2 Scaffolding

Scaffolding, as required to accomplish the specified work, shall meet all applicable safety regulations.

2.8.3 Transportation Equipment

Transportation equipment, as required, will be suitable for loading, temporary storage, transporting, and unloading of contaminated waste without exposure to persons or property.

2.8.4 Vacuum Equipment

All vacuum equipment utilized in the work area will utilize HEPA filtration systems.

2.8.5 Water Sprayer

The water sprayer will be an airless or other low pressure sprayer for amended water application.

2.8.6 Other Tools and Equipment

The contractor shall provide other suitable tools for the stripping, removal, encapsulation and disposal activities including but not limited to: knives, stiff nylon brushes, sponges, rounded edge shovels, brooms, and carts.

2.9 MATERIALS

2.9.1 Lockdown Sealant

The sealing agent will be penetrating sealants and will meet the following criteria:

a. They will withstand most impact or abrasion and protect the surface.

b. Sealants selected for use by the contractor will be one of those demonstrating probable effective performance under the tests conducted by an independent testing laboratory and are approved by the contracting officer.

c. They will have high flame retardant characteristics, and a low toxic fume and smoke emission rating.

d. They will not be noxious or toxic to application workers, or subsequent workers in the area.

e. They will have some permeability to water vapor to prevent condensation accumulation, and resist solution by common cleaning agents. They will be water insoluble when cured.

f. They will be acceptable weathering and aging characteristics.

g. They will be acceptable by architectural standards.

h. They will be compatible with all insulating material likely to be applied to the stripped surfaces.

I. They will be demonstrably capable of adhering to the surfaces of the substrate.

j. They must contain a light blue or red paint tint. (Food coloring is not acceptable.)

PART 3 EXECUTION

3.1 GENERAL

3.1.1 Respirator Program.

Submit evidence of a respirator program as required by ANSI Z88.2 and 29 CFR 1910.134.

3.1.2 Protective Clothing

Provide and require the use of protective clothing for any employee exposed to airborne concentrations of asbestos that exceed the TWA and/or excursion limit, or for which a required negative exposure assessment is not produced, and for any employee performing Class I and II operations (other than roofing felts and mastics) which involve the removal of over 25 linear or 10 square feet of TSI or surfacing ACM and PACM.

3.1.3 Hygiene Facilities

For employees performing Class I work involving over 25 linear or 10 square feet of TSI or surfacing ACM and PACM, establish a decontamination area that consists of an equipment room, shower area, and clean room in series. Ensure that employees enter and exit the regulated area through the decontamination area. Where it is demonstrated that it is not feasible to locate the shower between the equipment room and the clean room, or where work is performed outdoors, ensure that employees remove asbestos contamination from their work suits in the equipment room using a HEPA vacuum before proceeding to a shower.

3.1.4 Warning Signs and Labels

Provide warning signs at approaches to regulated areas containing airborne asbestos fibers. Locate signs at such a distance that personnel may read the sign and take the necessary protective steps required before entering the area. Provide labels and affix to asbestos materials, scrap, waste, debris, and other products contaminated with asbestos.

3.1.5 Accessibility of Work Areas

The Government will rearrange areas to the extent of providing a reasonable, direct, and an unobstructed path to the work sites. During asbestos removal, the Contractor will confine his equipment and employee pattern to these designated areas. Where the building is still occupied during the removal operations, interference with the functional operation of the building occupants outside these areas will not be permitted. Where conflicts arise due to Contractor's operations, the decision of the Contracting officer or his authorized representative will be final.

3.1.6 Preparation for Removal

3.1.6.1 Movable Furnishings

Movable furnishings, equipment and fixtures in the work area will be pre-cleaned and removed from the area of work by the Government before asbestos work begins.

3.1.6.2 Pre-Cleaning

All wall and floor surface areas, other than those from which asbestos is to be removed, and all non-movable furnishings, equipment, and fixtures remaining in the work area will be pre-cleaned with a HEPA filter equipped vacuuming device or wet cleaning methods prior to sealing with plastic sheeting. Do not use any methods which would raise dust such as dry sweeping or vacuuming with equipment not equipped with HEPA filters. After pre-cleaning, enclose fixed objects in 6-mil polyethylene sheeting, label, and seal securely with tape, objects which must remain in the work area and that require special ventilation or enclosure requirements will be suitably protected as approved by the contracting officer. Items in the work area which may require access by user during abatement will be designated

during the pre-abatement walkthrough and enclosures constructed with access flaps sealed with waterproof tape.

3.1.7 Regulated Areas

All Class I, II, and III asbestos work will be conducted within regulated areas. The regulated area will be demarcated in any manner that minimizes the number of persons within the area and protects persons outside the area from exposure to airborne concentrations of asbestos. Where critical barriers or negative pressure enclosures are used, demarcate the regulated area. Signs will be provided and displayed pursuant to 29 CFR 1026.1101(k)(6). Access to regulated areas will be limited to authorized persons. All persons entering a regulated area where employees are required to wear respirators, will be supplied with a respirator. All asbestos work performed within regulated areas will be supervised by a competent person.

3.1.7.1 Enclosed (Critical Barrier) Regulated Area Requirements

Seal openings in areas where the release of airborne asbestos fibers is expected. Establish a regulated area with the use of curtains, portable partitions, or other enclosures in order to prevent the escape of asbestos fibers from the contaminated area. The established regulated area will be provided with protective covering of walls and ceilings with a continuous membrane of two layers of minimum 6-mil plastic sheeting sealed with tape to prevent water or other damage and two layers of 6-mil plastic sheeting over floors extending a minimum of 24 inches up walls. All penetrations of the floor, walls, and ceiling will be sealed with 6-mil polyethylene plastic and duct tape. Seal joints using spray adhesive and duct tape. Openings will be allowed in enclosures of regulated areas for the supply and exhaust of air for the local exhaust system.

3.2 ASBESTOS ABATEMENT PROCEDURES

3.2.1 Initial Exposure Assessment

Ensure that a "competent person" conducts an exposure assessment immediatel Before or at the initiation of the operation to ascertain expected exposure during that operation or workplace. The assessment must be completed in ti to comply with requirements which are triggered by exposure data or the lac of a "negative exposure assessment," and to provide information necessary t assure that all control systems planned are appropriate for that operation

will work properly.

An Initial Exposure Assessment will be conducted in accordance with 29 CFR 1926.1101

For Class I asbestos work, until exposure monitoring is conducted, and is documented that employees on the job will not be exposed in excess of the PELs, or otherwise makes a negative exposure assessment, it is presumed that employees are exposed in excess of the TWA and excursion limit. A negative exposure assessment can only be obtained by demonstrating requirements contained in 29 CFR 1926.1101.

3.2.2 Monitoring Requirements

Perform exposure monitoring as required to determine accurately the airborne concentrations of asbestos to which employees are exposed. Determinations of employee exposure will be made from breathing zone air samples that are representative of the 8-hour TWA and 30-minute short-term exposures of each employee. Representative 8-hour TWA employee exposure will be determined on the basis of one or more samples representing full-shift exposure for employees in each work area. Representative 30-minute short-term employee exposures will be determined on the basis of one or more samples representing 30-minute exposures associated with operations that are most likely to produce exposures above the excursion limit for employees in each work area.

3.2.2.1 Monitoring Prior to Asbestos Work

Provide area monitoring and establish the reference TWA l day prior to the masking and sealing operations for each asbestos removal site. The reference TWA is determined by taking at least three general area air samples in each asbestos regulated area.

3.2.2.2 Periodic monitoring

Conduct daily monitoring that is representative of the exposure of each employee who is assigned to work within a regulated area who is performing Class I or II work unless a negative exposure assessment for the entire operation has been made. Conduct periodic monitoring of all work where exposures are expected to exceed a PEL at intervals sufficient to document the validity of the exposure prediction. When all employees required to be

monitored daily are equipped with supplied-air respirators operated in the positive-pressure mode, daily monitoring is not required. However employees performing Class I work using a control method which is not listed in Class I Requirements paragraph, will continue to be monitored daily even if they are equipped with supplied-air respirators.

3.2.2.3 Monitoring Adjacent Areas Prior to Asbestos Work

Provide area monitoring and establish the reference TWA inside the building outside the enclosed regulated area l day prior to beginning asbestos work.

3.2.2.4 Termination of Monitoring

If the periodic monitoring reveals that employee exposures, as indicated by statistically reliable measurement, are below the PEL and excursion limit, monitoring may be discontinued for those employees whose exposures are represented by such monitoring. Institute additional monitoring whenever there has been a change in process, control equipment, personnel or work practices that may result in new or additional exposures above the PEL and/or excursion limit.

3.2.3 Respiratory Protection

Respirators will be provided and used according to the requirements of 29 CFR 1926.1101 and section 2.2 of this specification.

3.2.4 Controls and Work Practices

The following controls and work practices will be used in all classes of work regardless of levels of exposure:

a. Vacuum cleaners equipped with HEPA filters to collect all debris and dust containing ACM or PACM;

b. Wet methods, or wetting agents, to control employee exposures during asbestos handling, mixing, removal, cutting, application, and cleanup, except where demonstrated that the use of wet methods are infeasible;

c. Prompt clean-up and disposal of wastes and debris contaminated with asbestos in leak-tight container;

d. Local exhaust ventilation equipped with HEPA filter dust collection systems;

e. Enclosure or isolation of processes producing asbestos dust;

f. Ventilation of the regulated area to move contaminated air away from the breathing zone and toward a filtration or a collection device equipped with a HEPA filter.

The following work practices and controls will not be used for work related to asbestos or the work which disturbs ACM or PACM, regardless of measured levels of asbestos exposure or results of the initial exposure assessments:

a. High-speed abrasive disc saws that are not equipped with point of cut ventilator or enclosures with HEPA filters exhaust air;

b. Compressed air used to remove asbestos, or ACM, unless the compressed air is used in conjunction with an enclosed ventilation system designed to capture the dust cloud created by the compressed air;

c. Dry sweeping, shoveling or other dry clean-up and debris containing ACM and PACM;

d. Employee rotation as a means of reducing employee exposure to asbestos.

3.2.5 Class I Abatement Requirements

In addition to all provisions required in control and work methods above, the following controls and work practices will be used for all Class I work.

a. Installation and operation of the control systems, will be supervised by a competent person.

b. Work involving the removal of more than 25 linear or 10 square feet of thermal system insulation or surfacing material; for all other Class I jobs, where a negative exposure assessment, or where employees are working in areas adjacent to the regulated area, while the Class I work is being performed, use one of the following methods to ensure that airborne asbestos does not migrate from the regulated areas:

(1) Critical barriers will be placed over all openings to the regulated area;

(2) Use another barrier or isolation method which prevents the migration of airborne asbestos from the regulated area, as verified by perimeter area surveillance during each work shift at each boundary of the regulated area, showing no visible asbestos dust; and perimeter area monitoring showing that clearance levels contained in 40 CFR Part 763, Subpart 3, or that perimeter area levels are no more than background levels representing the same area before the asbestos work began.

c. HVAC systems will be isolated in the regulated area by sealing with a double layer of 6 mil plastic or the equivalent;

d. Impermeable dropcloths will be placed on surfaces beneath all removal activity;

e. All objects within the regulated area will be cleaned out and covered with impermeable dropcloths or plastic sheeting which is secured by duct tape or an equivalent.

f. Where a negative exposure assessment cannot be produced, or where exposure monitoring shows that a PEL is exceeded, ventilate the regulated area to move contaminated air away from the breathing zone of employees toward a HEPA filtration or collection device.

3.2.5.1.1 Vinyl and Asphalt Flooring Materials

For removing vinyl and asphalt flooring materials which contain ACM in buildings constructed no later than 1980:

a. Flooring or its backing will not be sanded.

b. Vacuums equipped with HEPA filter, disposable dust bag, and metal floor tool (no brush) will be used to clean floors.

c. Resilient sheeting will be removed by cutting with wetting of the snippoint and wetting during delamination. Rip-up of resilient sheet floor material is prohibited.

d. All scraping of residual adhesive and/or backing will be performed using wet methods.

e. Dry sweeping is prohibited.

f. Mechanical chipping is prohibited unless performed in a negative pressure enclosure which meets the requirement of this section.

g. Tiles will be removed intact, unless it is demonstrated that intact removal is not possible.

h. When tiles are heated and can be removed intact, wetting may be omitted.

I. Resilient flooring material including associated mastic and backing will be assumed to be asbestos-containing materials unless an industrial hygienist determines them to be non asbestos containing materials using recognized analytical techniques.

J. Splash guards consisting of 6 mil polyethylene sheeting will be utilized when chemical strippers are used . Splash guards will extend along the wall from the floor to a height of 4 feet.

3.2.5.1.2 Any other Removal of ACM

a. The material will be thoroughly wetted with amended water prior and during its removal.

b. The material will be removed in an intact state unless the employer demonstrates that intact removal is not possible.

c. Cutting, abrading, or breaking the material will be prohibited unless the employer can demonstrate that methods less likely to result in asbestos fiber release are not feasible.

d. ACM removed will be immediately bagged or wrapped, or kept wetted until transferred to a closed receptacle, no later than the end of the work shift.

3.2.5.3 Asbestos Contaminated Soil

Any area of contaminated soil is to be removed of by the following procedures:

a. Before the soil removal commences, mark the wall in the area(s) at the existing ground elevation.

b. Using small shovels, all loose soil will be removed to a minimum depth of 3 inches.

c. Verification of the depth will be made by measurement from the excavation floor to the bottom of the original ground elevation mark or the wall.

3.3 COLLECTION

3.3.1 Nonfriable Non-Regulated Asbestos Containing Material (Non-RACM)

The non-friable ACM found in this project will be handled as RACM and will require special collection action as detailed in Para. 3.3.2.

The notification requirements of Para. 1.4.2 also are applicable to Non-RACM.

3.3.2 Regulated Asbestos Containing Material (RACM)

All asbestos containing materials for this project will be treated as RACM due to the nature of the materials present. Asbestos containing material will be removed in manageable sections and maintained in a wet condition. Material should be containerized upon removal and before being moved to any new location.

Maintain surfaces of the regulated area free of accumulations of asbestos fibers. Restrict the spread of dust and debris; keep waste from being distributed over the general area. Do not dry sweep or blow down the space with compressed air.

Collect asbestos waste, scrap, debris, bags, containers, equipment, and asbestos-contaminated clothing which may produce airborne concentrations of asbestos fibers; place in sealed impermeable bags imprinted with a caution label (Para. 2.6.2) and label with the name of the contractor and the location at which the waste was generated. The sealed bags will then be placed in a second sealed impermeable bag also imprinted with the warning label. Bags will be placed in asbestos roll off boxes for shipment to the landfill.

3.3.2.1 Removing Material Intact

Asbestos containing materials should be removed intact whenever possible (removal of pipe and pipe insulation by wrapping, sealing the insulation and cutting the uninsulated ends of the pipe). Asbestos containing materials will not be dropped or thrown to the ground. Materials between 15 and 50 feet above the ground may be containerized at elevated levels or placed into inclined chutes or scaffolding for subsequent collection and containerization. Asbestos materials in open containers will be kept wet at all times.

3.3.2.2 Containers

Containers (drums or 6-mil polyethylene bags) will be sealed when full. Wet material will be heavy and double bagging of waste material is required. Bags, if used, will not be overfilled. They should be securely sealed to prevent accidental opening and leakage by tying the tops of the bags in an overhand knot or by taping in goose neck fashion. Do not seal bags with wire or cord. Bags may be placed in drums for staging and transportation to the landfill. Bags will be decontaminated on exterior surfaces by wet cleaning before being placed in clean drums and sealed with locking ring tops. Where unusual circumstances prohibit use of plastic disposal bags or drums, the contractor will submit, in the asbestos plan, an alternate proposal for removal, containerizing, and disposal of the asbestos containing materials.

3.3.2.3 Sharp Edged Components

Asbestos containing or contaminated waste with sharp edged components (e.g. nails, screws, metal lath, tin sheeting) that could otherwise tear polyethylene bags will be placed into drums for disposal.

3.3.2.4 Asbestos Contaminated Soil

Any removed soil will be placed in 6-mil plastic bags, sealed and then placed in approved containers such as fiber waste drums for disposal. Do not overfill plastic bags.

3.3.2.5 Wastewater

a. Pre-filtering. Any water produced by the decontamination of either equipment or persons will be (1)

collected, (2) filtered through a system capable of trapping particles 5 microns and larger, specifically designed to remove asbestos fibers, and (3) filtrate disposed into a local sanitary sewer system.

b. Filter System. The filtration system will contain a series of several filters with progressively smaller pore sizes to avoid rapid clogging of the system by large particles. Disposable filters will be treated as asbestos waste.

3.4 DISPOSAL OF ACM

3.4.1 All Asbestos Containing Materials

3.4.1.1. Prior to delivery of asbestos containing materials at the Woodlawn Landfill the contractor will provide Fort Campbell, DPW Roads and Grounds at least 24 hours notice of when ACM is to be disposed.

3.4.2. Once drums, bags and otherwise containerized asbestos containing materials have been removed from the work area, they will be loaded into an enclosed truck for transportation to the Woodlawn landfill. Asbestos waste will not be allowed to be placed in trucks with non-asbestos waste. All bags utilized will be of 6-mil polyethylene and must be double lined.

3.4.3. All containers will be labelled according to the requirements of 29 CFR 1910.1200 OSHA Hazardous Communication Standard and will contain the following:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD

3.4.4. The enclosed cargo area of the truck will be free of debris and lined with 6-mil polyethylene sheeting to prevent contamination from leaking or spilled containers. Floor sheeting will be installed first and extend up the sidewalls. Wall sheeting will be overlapped and taped into place so that no materials may escape to the environment.

3.4.5. Drums will be placed on level surfaces in the cargo area and packed tightly together to prevent shifting and tipping. Do not throw containers into the cargo area.

3.4.6. Personnel loading asbestos containing waste will be protected by disposable clothing including head, body and foot protection and at a minimum, half-face piece, air purifying, dual cartridge respirators equipped with high efficiency particulate air (HEPA) filters.

3.4.7. Large steel dumpsters (roll-off boxes) may be used for asbestos waste disposal. These should be lined with polyethylene and should have doors, tops or covers that can be closed to prevent vandalism or other disturbance of the containerized asbestos debris and wind dispersion of asbestos fibers. Uncontainerized asbestos materials will not be placed in these type dumpsters, nor will they be used for non-asbestos waste. Bags will be placed, not thrown, into these containers to avoid splitting.

3.4.8. Disposal of waste asbestos material at Woodlawn Landfill. Contact Fort Campbell-DPW, Environmental Division through the Contracting Officers representative.

3.4.9. For temporary storage, store sealed impermeable bags in asbestos waste drums. If temporary storage is within regulated areas and under negative pressure drums are not required. An area for interim storage of asbestos waste-containing drums will be assigned by the contracting officer or by an authorized representative. This area must be secure. No ACM wastes, except those properly labeled and properly containerized and physically located in the assigned holding area will be allowed to remain at the site overnight.

3.4.10. Procedures for hauling and disposing will comply with 40 CFR 61 Subpart M, 40 CFR 241, 40 CFR 257, and State, regional and local standards. Vehicles used to transport asbestos containing waste material must be clearly marked. The markings must:

(i) Be displayed in such a manner and location that a person can easily read the legend.

(ii) Conform to the requirements for 51 cm x 36 cm (20 in. x 14 in.) upright format signs specified in 29 CFR 1910.145(d)(4) and this paragraph; and

(iii) Display the following legend in the lower panel with letter sizes and styles of a visibility at least equal to those specified in this paragraph.

Legend

DANGER
ASBESTOS DUST HAZARD
CANCER AND LUNG DISEASE HAZARD
Authorized Personnel only

Notation
2.5 cm (1 inch) Sans Serif, Gothic or Block
2.5 cm (1 inch) Sans Serif, Gothic or Block
1.9 cm (3/4 inch) Sans Serif, Gothic or Block
14 Point Gothic

Spacing between any two lines must be at least equal to the height of the upper of the two lines.

3.4.11. Upon reaching the landfill, trucks are to approach the dump location as closely as possible for unloading of the asbestos containing waste.

3.4.12. Bags, drums and components will be inspected as they are off loaded at the disposal site. Material in damaged containers will be repacked in empty drums or bags as necessary. Uncontaminated drums may be recycled.

3.4.13. Waste containers will be placed on the ground at the disposal site, not pushed or thrown out of trucks since the weight of wet material could rupture containers.

3.4.14. Personnel off-loading containers at the disposal site will wear protective equipment consisting of disposable head, body and foot protection and, at a minimum, half-face piece, air-purifying, dual cartridge respirators equipped with high efficiency particulate air (HEPA) filters. Following the removal of all containerized waste, the truck cargo area will be decontaminated to meet the no visible residue criteria. Polyethylene sheeting will be removed and discarded along with contaminated cleaning materials and protective clothing, in bags or drums at the disposal site. If landfill personnel have not been provided with personal protective equipment for the compaction operation by the landfill operator, the contractor will supply protective clothing and respiratory protection for the duration of this operation.

3.4.15. Shipment Records

a. Maintain waste shipment records, using copies of the **form located at the end of this section** and include the following information:

(i) The name, address, and telephone number of the waste generator.

(ii) The name and address of the local, State, or EPA Regional office responsible for administering the asbestos NESHAP program.

(iii) The approximate quantity in cubic meters (cubic feet).

(iv) The name and telephone number of the disposal site operator.

(v) The name and physical site location of the disposal site.

(vi) The date transported.

(vii) The name, address, and telephone number of the transporter(s).

(viii) A certification that the contents of this consignment are fully and accurately described by proper shipping name and are classified, packed, marked, labeled, and are in all respects in proper condition for transport by highway according to applicable international and government regulations.

b. Provide a copy of the waste shipment record, described above to the disposal site owners or operators at the same time as the asbestos-containing waste material is delivered to the disposal site.

c. For waste shipments where a copy of the waste shipment record, signed by the owner or operator of the designated disposal site, is not received by the contractor within 35 days of the date the waste was transported, contact the owner or operator of the designated disposal site to determine the status of the waste shipment. The contractor will report in writing to the NESHAP administering agency if a copy of the waste shipment record, signed by the owner or operator of the designated waste

disposal site, is not received by the contractor within 45 days of the date the waste was transported. Include in the report the following information:

(i) A copy of the waste shipment record for which a confirmation of delivery was not received, and

(ii) A cover letter explaining the efforts taken to locate the asbestos waste shipment and the results of those efforts.

d. Retain a copy of all waste shipment records, including a copy of the waste shipment record signed by the owner or operator of the designated waste disposal site, for at least 2 years.

e. Provide to the contracting officer within 3 working days following delivery of asbestos containing waste material copies of all waste shipment records. Also within 3 working days of initiation, provide to the contracting officer copies of any correspondence with the NESHAP administering agency.

Furnish upon request, and make available for inspection by the NESHAP administering agency, all records under this section.

3.4.16 Wastewater

It is the contractor's responsibility to comply with any local wastewater systems' regulations or policy regarding the disposal of wastewater from asbestos abatement activities.

3.5 CLEANUP AND FINAL CLEARANCE

3.5.1 Cleanup

Clean all surfaces in the work area and other contaminated areas with water and/or HEPA vacuum equipment. After cleaning the work area, allow 24 hours for settlement of dust and wet clean or clean with HEPA vacuum equipment all surfaces in the work area. When asbestos removal, disposal, and cleanup are complete, the contractor will certify, in writing, that the area is free of any asbestos material or debris.

3.5.2 Visual Inspection After Cleanup

Prior to the performance of final air monitoring, the contractor and the contracting officer or his representative will perform a

visual inspection for asbestos dust/residue. If residue is found, additional wipedown/vacuuming will be performed to the satisfaction of the contracting officer. If recleaning is required, monitor the airborne fiber concentration after recleaning.

3.5.3 Monitoring After Final Cleanup

After the removal site has passed the visual inspection, provide area monitoring of fibers (at least 5 samples per removal site) under aggressive conditions. Collect and analyze the samples to establish airborne asbestos fiber concentration within the area after final cleanup but before removal of the enclosure of the regulated area. The fiber counts from the samples will be less than 0.01 fibers (longer than 5 micrometers) per cubic centimeter of air or not be greater than the levels referenced as background before the work was initiated, whichever is less. Should any of the final sampling indicate a higher value, the contractor will take appropriate actions to reclean the area and will repeat the monitoring.

3.5.4 Sampling

Sampling under aggressive conditions will include the following procedures:

a. Before starting the sampling pumps, direct the exhaust from forced air equipment (such as a l horsepower leaf blower) against all walls, ceiling, floors, ledges and other surfaces in the room. This should take at least 5 minutes per 1000 sq. ft. of floor.

b. Place a 20-inch fan in the center of the room. (Use one fan per 10,000 cubic feet of room space.) Place the fan on low speed and point it toward the ceiling.

c. Start the sampling pumps and sample for the required time.

d. Turn off the pump and then the fan(s) when sampling is complete.

3.5.5 Air Clearance Failure

Should clearance sampling results fail to meet the final cleanup requirements, the contractor will take appropriate action at no

additional cost to the Government, to reclean, resample, and analyze data until final cleanup requirements are met.

3.5.6 Site Inspection

While performing asbestos removal work, the contractor will be subject to onsite inspection by the contracting officer who may be assisted by safety or health personnel. If the work is in violation of specification requirements, the contracting officer will issue a stop work order to be in effect immediately and until the violation is resolved. Standby time and expenses required to resolve the violation will be at the contractor's expense.

3.5.7 Sealing Permanent Exposed Surfaces (RACM)

After the asbestos material has been removed and HEPA vacuumed to the greatest extent possible, all permanent asbestos exposed interior surfaces will be coated with an approved lockdown sealant to permanently bind any remaining fibers in place. Sealant will be applied by airless sprayers and in accordance with the sealant manufacturers recommendations.

3.5.8 Sealant Tint

The sealant will have an adequate tint to easily distinguish between sections sealed and sections not sealed.

3.5.9 Reestablishment of the Work Area

Reestablishment of the work area will occur only after the completion of the following to the contracting officers satisfaction: performance of clean-up procedures and the successful achievement/ documentation of clearance air monitoring values.

3.5.10 Visual Inspection

The contractor and contracting officer will visually inspect the work area for any remaining visible residue. Evidence of asbestos materials will necessitate additional cleaning requirements.

3.5.11 Clearance of Work Area

Following satisfactory clearance of the work area, remaining barriers may be removed and disposed of as asbestos contaminated waste.

3.5.12 Remaining Building Demolition Procedures

Contractor may proceed with remaining building demolition procedures as described in SECTION 02050: DEMOLITION.

End of Section

Return to Designer Instructions

Department of Environment
and Conservation
Division of Air Pollution Control

9th Floor, L & C Annex
401 Church Street
Nashville, TN 37243-1531
(615) 532-0554

ASBESTOS WASTE SHIPMENT RECORD

GENERATOR

1. Work site name and mailing address | Owner's name | Owner's telephone no. ( )
2. Operator's name and address | Operator's telephone no. ( )
3. Waste disposal site (WDS) name, mailing address, physical site location and disposal facility permit number | WDS phone no. ( ) | Permit no.
4. Name and address of responsible agency
5. Description of materials | 6. Containers No. Type | 7. Total quantity m^3 yd^3
8. Special handling instructions and additional information
9. OPERATOR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and government regulations.

Print/type name & title | Signature | Month Day Year

TRANSPORTER

10. Transporter 1 (acknowledgement of receipt of materials)

Print/type name & title | Signature | Month Day Year

Address | ( ) Telephone No.

11. Transporter 2 (acknowledgement of receipt of materials)

Print/type name & title | Signature | Month Day Year

Address | ( ) Telephone No.

DISPOSAL SITE

12. Discrepancy indication space
13. Waste disposal site
Owner or operator: Certification of receipt of asbestos materials covered by this manifest except as noted in item 12.

Print/type name & title | Signature | Month Day Year

CN-1054 (Instructions on Reverse)

INSTRUCTIONS

Waste Generator Section (Items 1-9)

1. Enter the name of the facility at which asbestos waste is generated and the address where the facility is located. In the appropriate spaces, also enter the name of the owner of the facility and the owner's phone number.

2. If a demolition or renovation, enter the name and address of the company and authorized agent responsible for performing the asbestos removal. In the appropriate spaces, also enter the phone number of the operator.

3. Enter the name, address, and physical site location of the waste disposal site (WDS) that will be receiving the asbestos materials. In the appropriate spaces, also enter the phone number of the WDS. Enter "on-site" if the waste will be disposed of on the generator's property.

4. Provide the name and address of the local, State, or EPA Regional office responsible for administering the asbestos NESHAP program.

5. Indicate the types of asbestos waste materials generated. If from a demolition or renovation, indicate the amount of asbestos that is
   - Friable asbestos material
   - Nonfriable asbestos material

6. Enter the number of containers used to transport the asbestos materials listed in item 5. Also enter one of the following container codes used in transporting each type of asbestos material (specify any other type of container used if not listed below):
   DM - Metal drums, barrels
   DP - Plastic drums, barrels
   BA - 6 mil plastic bags or wrapping

7. Enter the quantities of each type of asbestos material removed in units of cubic meters (cubic yards).

8. Use this space to indicate special transportation, treatment, storage or disposal or Bill of Lading information. If an alternate waste disposal site is designated, note it here. Emergency response telephone numbers or similar information may be included here.

9. The authorized agent of the waste generator must read and then sign and date this certification. The date is the date of receipt by transporter.

NOTE: The waste generator must retain a copy of this form.

Transporter Section (Items 10 & 11)

10. & 11. Enter name, address, and telephone number of each transporter used, if applicable. Print or type the full name and title of person accepting responsibility and acknowledging receipt of materials as listed on this waste shipment record for transport. Enter date of receipt and signature.

NOTE: The transporter must retain a copy of this form.

Disposal Site Section (Items 12 &13)

12. The authorized representative of the WDS must note in this space any discrepancy between waste described on this manifest and waste actually received as well as any improperly enclosed or contained waste. Any rejected materials should be listed and destination of those materials provided. A site that converts asbestos-containing waste material to nonasbestos material is considered a WDS.

13. The signature (by hand) of the authorized WDS agent indicates acceptance and agreement with statements on this manifest except as noted in item 12. The date is the date of signature and receipt of shipment.

NOTE: The WDS must retain a completed copy of this form. The WDS must also send a completed copy to the operator listed in item 2.

Back to Shipment Records Paragraph 1.4.5.1
Back to Shipment Records Paragraph 15

DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF AIR POLLUTION CONTROL

NOTIFICATION OF ASBESTOS DEMOLITION OR RENOVATION

Operator Project #	Postmark	Date Received	Notification #

I. Type of Notification (O-Orig., R-Revised, C-Cancelled)

II. Facility Information (Identify Owner, Removal Contractor, Operator)

Owner Name:
Address:
City: State: Zip:
Contact: Telephone: ( )

Removal Contractor:
Address:
City: State: Zip:
Contact: Telephone: ( )

Other Operator (If Different From Owner):
Address:
City: State: Zip:
Contact: Telephone: ( )

III. Type of Operation (D-Demo., O-Ordered Demo., R-Renov., E-Emer. Renov.)

IV. Is Asbestos Present? (Yes/No)

V. Facility Description (Include Building Name, Number and Floor or Room Number)

Building Name:
Address:
City: State: Zip:
Site Location:
Building Site Total Sq. Ft.: # of Floors: Age in Years:
Present Use: Prior Use:

VI. Procedure and Analytical Method Used to Detect the Presence of Asbestos Material

VII. Approximate Amount of Asbestos in Work Area Including

1. Regulated ACM to be Removed 2. Category I ACM Not Removed 3. Category II ACM Not Removed	RACM To Be Removed	Nonfriable Asbestos Material				Units of Measurement
		Not To Be Removed		To Be Removed		
		Cat I	Cat II	Cat I	Cat II	
Pipes						LnFT Ln m
Surface Area						SqFt Sq m
Vol. RACM Off Facility Components						CuFT Cu m

VIII. Scheduled Dates for Asbestos Removal Start: Complete:
Scheduled Dates of Preparation Start: Complete:
Days of Week: (circle) ALL Sun Mon Tue Wed Thu Fri Sat Hours of Day:

IX. Scheduled Dates for Demo./Renovation Start: Complete:

X. Description of Planned Demolition or Renovation Work, Method(s) to be Used:

XI. Description of Work Practices and Engineering Controls to be used to Prevent Emissions of Asbestos at the Demolition and Renovation Site:

CN-1055 -1- RDA 1298

XII. Waste Transporter #1		
Name:		
Address:		
City:	State:	Zip:
Contact Person:	Telephone: ( )	
Waste Transporter #2		
Name:		
Address:		
City:	State:	Zip:
Contact Person:	Telephone: ( )	
XIII. Waste Disposal Site		
Name:		
Location:		
City:	State:	Zip:
Telephone:		
XIV. If Demolition Ordered by a Government Agency, Please Identify Below:		
Name:	Title:	
Authority:		
Date of Order (mm/dd/yy):	Date Ordered to Begin (mm/dd/yy)	
XV. For Emergency Renovations		
Date and Hour of Emergency (mm/dd/yy):		
Description of the Sudden, Unexpected Event:		
Explanation of How the Event Caused Unsafe Conditions or Would Cause Equipment Damage or an Unreasonable Financial Burden:		
XVI. Description of Procedures to be Followed in the Event Asbestos is Found or Previously Nonfriable Asbestos Material Becomes Crumbled, Pulverized, or Reduced to Powder.		
XVII. I Certify That an Individual Trained in the Provisions of this Regulation (40 CFR Part 61, Subpart M) Will be On-Site During the Demolition or Renovation and Evidence That Required Training has Been Accomplished by This Person Will be Available for Inspection During Normal Business Hours. (REQUIRED AFTER NOVEMBER 20, 1991)		
(Signature of Owner/Operator)		(Date)
XVIII. I Certify That the Above Information Is Correct.		
(Signature of Owner/Operator)		(Date)

Submit Completed Form by U.S. Postal Service / Commercial Delivery Service or Hand Deliver to:

Department of Environment and Conservation
Division of Air Pollution Control
9th Floor, L & C Annex
401 Church Street
Nashville, TN 37243-1531
(615) 532-0554

Back to Notification Requirements Paragraph 1.4.2.5

WOODLAWN LANDFILL ASBESTOS POLICY

MEMORANDUM OF UNDERSTANDING

WOODLAWN ROAD LANDFILL
FORT CAMPBELL, KENTUCKY

ASBESTOS POLICY

Woodlawn Landfill is operated under a permit issued by the Division of Solid Waste Management, Department of Conservation, State of Tennessee and in accordance with Federal, State and Local Regulations. A special waste permit was issued by the State of Tennessee for the landfill to accept Asbestos Containing Waste, but only with certain stipulations.

Haulers bringing asbestos waste to the landfill must comply with the Federal, State and Local Regulations and with state permit requirements. The following is a list of some of those requirements:

1. Any vehicle hauling asbestos containing waste must be marked with signs in accordance with APC rule 1200-3-11-.02(2)(k)4 providing warning that the vehicle contains asbestos. Improperly marked vehicles will not be accepted at the landfill.

2. Any vehicle hauling asbestos containing waste must be enclosed or in a covered 39-14-303 carrier as described in Tennessee Code Annotated. Vehicles not meeting this requirement will not be accepted at the landfill.

3. The vehicle driver and any passengers must have fit tested respirators to be present or within 100 meters during unloading operations at the landfill. Facial hair that would interfere with a proper air seal around the respirator is not allowed on personnel wearing respirators unless the respirator has been specifically approved for that purpose. Failure to comply with the requirement will bar that individual from future entry into the landfill. A copy of the fit test certificate will be presented to the landfill operator when requested.

4. Asbestos waste will be placed in the area designated by the landfill personnel. The materials will be carefully unloaded to prevent spillage or puncture of the containers. Improper handling of the asbestos waste will prohibit that person from future asbestos operations at the landfill.

5. Asbestos waste will be accepted at the landfill only after receiving a 24 hour notice. A time will be designated for receiving the asbestos waste. Shipments arriving at the landfill more than thirty minutes from that time may be refused entry.

6. The shipper must furnish a copy of the NESHAP 10 day notice and an asbestos waste manifest to the landfill personnel before being accepted. Improperly completed information will be grounds to reject the acceptance of the asbestos waste.

I have read and understand the above requirements. I understand that failure to observe that regulations and requirements will cause me not to be allowed to deliver and dispose of asbestos containing waste at the Woodlawn Road Landfill.

Signature: _____

Employer: _____

Date: _____

Approved respirator fit test date: _____

[Back to Shipment Records Paragraph 1.4.5.1]

[Back to Instructions to Designers]

SECTION 02090
Demolition or Buildings with Lead-Based Paint, Removal and Disposal of Lead – Based Paint

Ft. Campbell Requirements:

Removal and disposal of lead-based paint materials shall be conducted in accordance with Ft. Campbell specification section 02090, Demolition or Buildings with Lead-Based Paint, Removal and Disposal of Lead–Based Paint, which shall be included in all projects containing or possibly containing lead-based products.

Lead-based paint materials shall be removed before demolition of buildings.

Instruction to Designers:

1. All projects containing or possibly containing lead products shall include Ft. Campbell specification section **02090, Removal and Disposal of Lead-Based Materials.**

2. Additional Environmental guidance applies. See **Appendix A**.

02090 Removal and Disposal of Lead- Based Materials

SECTION 02090

Removal and Disposal of Lead Based Painted Materials

10/97

PART 1 GENERAL

1.1 Intent

The intention of this specification is to summarize the requirements of the contractor to protect his workers in accordance with the OSHA Lead Construction Standard detailed in 29 CFR 1926.62. This standard is intended to reduce the occupational health hazard of lead exposure and must be applied to all occupational exposures to lead in construction work in any amount. The intent of this specification is also to summarize requirements for segregation and disposal of lead containing waste resulting from the demolition.

The contractor is required by 29 CFR 1926.62 to perform an exposure assessment to determine if any employee may be exposed to lead at or above the action level of 30 ug/m^3 as an 8-hour TWA. As per the standard the contractor must perform initial air monitoring or present objective data, demonstrating that under any conditions or activity involving lead at or above the action level does not exist. During initial air monitoring activities, or until a negative exposure assessment has been achieved all employees must wear the appropriate respiratory protection when performing certain listed high exposure •trigger tasks as defined by the standard.

This document only summarizes requirements of the OSHA standard for convenience purposes and is not all-inclusive. All requirements of 29 CFR 1926.62 are to be strictly followed along with all other applicable Federal, State and local regulations.

1.2 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z9.2 - 1979 Fundamentals Governing the Design and Operation of Local Exhaust Systems

ANSI Z88.2 - 1980 Respiratory Protection

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.134 - Respiratory Protection
29 CFR 1910.1025 - Lead Standard for General Industry
29 CFR 1910.1200 - Hazard Communication
29 CFR 1926.55 - Gases, Vapors, Fumes, Dusts, and Mists
29 CFR 1926.57 - Ventilation
29 CFR 1926.62 - Lead Standard for General Industry
40 CFR 260 - Hazardous Waste Management Systems: General
40 CFR 261 - Identification and Listing of Hazardous Waste
40 CFR 262 - Generators of Hazardous Waste
40 CFR 263 - Transporters of Hazardous Waste
40 CFR 264 - Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265 - Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 268 - Land Disposal Restrictions
49 CFR 172 - Hazardous Materials Tables and Hazardous Materials Communications Regulations
49 CFR 178 - Shipping Container Specification

UNDERWRITERS LABORATORIES INC. (UL)

UL 586 - 1990 High-Efficiency, Particulate, Air Filter Units

1.3 DEFINITIONS

1.3.1 Action Level

Employee exposure, without regard to use of respirators, to an airborne concentration of lead of 30 micrograms per cubic meter (•g/m^3) of air averaged over an 8-hour period. As used in this section, "30 micrograms per cubic meter of air" refers to the action level.

1.3.2 Area Monitoring

Sampling of lead concentrations within the lead control area and inside the physical boundaries which is representative of the airborne lead concentrations which may reach the breathing zone of personnel potentially exposed to lead.

1.3.3 Physical Boundary

Area physically roped or partitioned off around a lead control area to limit unauthorized entry of personnel. As used in this section, "inside boundary" will mean the same as "inside lead control area."

1.3.4 Certified Industrial Hygienist (CIH)

As used in this section, refers to an Industrial Hygienist employed by the Contractor and is certified by the American Board of Industrial Hygiene in comprehensive practice.

1.3.5 Change Rooms and Shower Facilities

Rooms within the designated physical boundary around the lead control area equipped with separate storage facilities for clean protective work clothing and equipment and for street clothes which prevent cross-contamination.

1.3.6 Decontamination Room

Room for removal of contaminated personal protective equipment (PPE).

1.3.7 Eight-Hour Time Weighted Average (TWA)

Airborne concentration of lead averaged over an 8-hour workday to which an employee is exposed.

1.3.8 High Efficiency Particulate Air (HEPA) Filter Equipment

HEPA filtered vacuuming equipment with a UL 586 filter system capable of collecting and retaining lead-contaminated paint dust.

A high efficiency particulate filter means 99.97 percent efficient against 0.3 micron size particles.

1.3.9 Lead

Metallic lead, inorganic lead compounds, and organic lead soaps. Excluded from this definition are other organic lead compounds.

1.3.10 Lead Control Area

An area isolated by physical boundaries to prevent unauthorized entry of personnel. It may consist of an enclosed area or structure with full containment to prevent the spread of lead dust, paint chips, or debris of lead-containing paint removal/demolition operations or in those cases, when an enclosed lead control area is not practical, restriction of access into the area may be accomplished by roping off the area or by providing some other form of physical boundary constraint.

1.3.11 Lead Permissible Exposure Limit (PEL)

Fifty micrograms per cubic meter of air as an 8-hour time weighted average as determined by 29 CFR 1910.1025. If an employee is exposed for more than 8 hours in a work day, the PEL shall be determined by the following formula:

PEL (micrograms/cubic meter of air) = 400/No. hrs worked per day

1.3.12 Personal Monitoring

Sampling of lead concentrations within the breathing zone of an employee to determine the 8-hour time weighted average concentration in accordance with 29 CFR 1926.62. Samples shall be representative of the employee's work tasks. Breathing zone shall be considered an area within a hemisphere, forward of the shoulders, with a radius of 6 to 9 inches and the center at the nose or mouth of an employee.

1.4 QUALITY ASSURANCE

1.4.1 Medical Examinations

Before exposure to lead-contaminated dust, provide workers with a comprehensive medical examination as required by 29 CFR 1926.62 and 29 CFR 1910.1200. The examination will not be required if adequate records show that employees have been examined as required by 29 CFR 1926.62 within the last year.

1.4.1.1 Medical Records

Maintain complete and accurate medical records of employees for a period of at least 40 years or for the duration of employment plus 20 years, whichever is longer.

1.4.2 CIH or Their Designated Representative Responsibilities:

a. Certify training.
b. Review and approve lead-containing paint demolition plan for conformance to the applicable referenced standards.
c. Inspect the demolition work for conformance with the approved plan.
d. Direct monitoring.
e. Ensure work is performed in strict accordance with specifications at all times.
f. Ensure hazardous exposure to personnel and to the environment are adequately controlled at all times.

1.4.3 Training

Train each employee performing paint demolition, disposal, and air sampling operations prior to the time of initial job assignment, in accordance with 29 CFR 1926.62.

1.4.3.1 Training Certification

Submit certificates signed and dated by the CIH and by each employee stating that the employee has received training.

1.4.4 Respiratory Protection Program

a. Furnish each employee required to wear a negative pressure respirator or other appropriate type with a respirator fit test at the time of initial fitting and at least every 6 months thereafter as required by 29 CFR 1926.62.

b. Establish and implement a respiratory protection program as required by ANSI Z88.2, 29 CFR 1910.134, 29 CFR 1910.1025, CFR 1926.62, and 29 CFR 1926.55.

1.4.5 Hazard Communication Program

Establish and implement a Hazard Communication Program as required by 29 CFR 1910.1200.

1.4.6 NOT USED

1.4.7 Safety and Health Compliance

In addition to the detailed requirements of this specification, comply with laws, ordinances, rules, and regulations of federal, state, and local authorities regarding removing, handling, storing, transporting, and disposing of lead waste materials. Comply with the applicable requirements of the current issue of 29 CFR 1926.62.

1.4.8 Pre-Construction Conference

Along with the CIH, meet with the Contracting Officer to discuss in detail the lead-containing paint demolition work plan, including work procedures and precautions for the work plan.

1.5 SUBMITTALS

Submit the following in accordance with Section C-01300, "Submittals." The testing laboratory qualifications and lead-containing demolition plan shall be approved by the government. All other submittals will be for informational purposes only.

1.5.1 Manufacturer's Catalog Data

a. Vacuum filters
b. Respirators

1.5.2 NOT USED

1.5.3 Statements

a. Qualifications of CIH
b. Exposure assessment documentation
c. Testing laboratory qualifications
d. Lead-containing paint demolition plan
e. Rental equipment notification
f. CIH approval of work plan (signature, date, and certification number)
g. Respiratory protection program
h. Hazard communication program

1.5.3.1 CIH Qualifications

Submit name, address, and telephone number of the CIH selected to perform responsibilities in paragraph entitled "CIH Responsibilities." Provide previous experience of the CIH. Submit proper documentation that the Industrial Hygienist is certified by the American Board of Industrial Hygiene in comprehensive practice, including certification number and date of certification/recertification.

1.5.3.2 Testing Laboratory

The contractor will provide documentation which includes the name, address and telephone number of the laboratories to be providing services. In addition, the documentation will indicate that each laboratory is an EPA National Lead Laboratory accreditation Program (NLLAP) accredited laboratory that each is rated proficient in the NIOSH/ EPA Environmental Lead Proficiency Analytical Testing Program (ELPAT) and will document the date of current accreditation. Certification will include accreditation for heavy metal analyses, list of experience relevant to analyses of lead in air, and a Quality Assurance and Quality Control Program.

1.5.3.3 Written Compliance Plan

In accordance with 29 CFR 1926.62 (e)(2)(I), the contractor shall submit a detailed job-specific plan of the work procedures to be used in the demolition of the buildings. The written compliance plan should include but is not limited to:

a. Details of the planned exposure assessment or a discussion of the objective data utilized from a previous project.

b. A description of equipment and materials, controls, crew size, job responsibilities, and operations and maintenance procedures for each activity in which lead is emitted.

c. A description of specific control methods (e.g., abatement process selection, wet methods). For engineering controls, include supporting engineering plans and studies used to select methods.

d. Technology considered in meeting the PEL.

e. Air monitoring data documenting sources of lead emissions.

f. A detailed implementation schedule for the compliance plan, including the schedule for inspections by a competent person.

g. A description of the lead work practice program that will be used to control worker exposures. (This includes the use of protective work clothing and equipment, hygiene facilities and practices, and housekeeping practices.

h. A description of arrangements made among contractors on multi-contractor work sites to inform affected employees (including bystanders) of potential lead exposures, and to clarify responsibilities with regard to control of those exposures.

1.5.4 Air Monitoring

Submit monitoring results to the Contracting Officer within 3 working days, signed by the testing laboratory employee performing the air monitoring, the employee that analyzed the sample, and the CIH.

1.5.5 NOT USED

1.5.6 SD-18, Records

a. Certification of medical examinations
b. Employee Training certification

1.5.7 Within 48 hours prior to beginning lead-based paint (LBP) disturbance (excluding building demolitions), the contractor will submit to the Contracting Officer Representative (COR) and Environmental Division / Compliance Branch written notification which shall include: Such notification shall include the following:

- Building number
- Anticipated start and end dates
- Description of surface being disturbed or abated
- Quantity of surface being disturbed or abated including units (e.g. SF, LF, number of components, etc.)
- Description of approximate location of work (e.g. latrines, NW corner of building, 2nd floor, etc.)
- Type of removal activity (e.g. surface preparation, stripping, etc.)

If needed, a copy of the LBP survey may be obtained at the DPW Environmental Division. Within 48 hours of being received, the COR will in-turn forward a copy of the survey annotation to the Fort Campbell / Directorate of Public Works / Environmental Division / Compliance Branch / TSCA Program Manager, IMSE-CAM-PWE, Building 2182, 13 ½ Street, Fort Campbell, Kentucky 42223-5130. Within 48 hours after LBP removal, the contractor will provide the CA a written description of the surfaces that were abated and the type of removal action (surface preparation, stripping of paint from the surface, component removal). The CA will forward a copy of the survey annotation to the DPW Environmental Division.

1.6 REMOVAL

1.6.1 Title to Materials

Lead containing materials resulting from demolition work, except those classified as hazardous waste, will become the property of the Contractor and will be disposed in accordance with section 3.5 of this specification.

1.7 EQUIPMENT

The contractor shall furnish the Contracting Officer with one complete set of personal protective equipment daily, as required by the CIH, for entry into and inspection of the demolition work within the lead controlled area. Required personal protective equipment may include, but is not limited to fitted respirators and whole body covering including appropriate foot, head, and hand protection. PPE shall be provided by the contractor and will remain the property of the contractor.

1.7.1 Respirators

Respirators will comply with the requirements of 29 CFR 1910.134. Furnish appropriate respirators approved by the NIOSH, Department

of Health and Human Services, for use in atmospheres containing lead dust.

1.7.2 Special Protective Clothing

Special protective clothing will be worn as per the Lead Protection Plan (sec 1.5.3.3) and in accordance with OSHA 29 CFR 1910 .132. Reduction of levels of protective clothing can only be performed after approval from the CIH.

1.7.2.1 Furnished Clothing

Protective clothing shall be provided in a clean and dry condition at least weekly, and daily to employees whose exposure levels without regard to use of a respirator are over 200 •g/m^3 of lead as an 8-hour TWA. The contractor shall provide for the cleaning, laundering, and disposal of protective clothing and equipment as needed.

1.7.2.2 Protective Clothing Handling

The contractor shall assure that contaminated protective clothing which is to be cleaned, laundered, or disposed of, is placed in a closed container in the change area which prevents dispersion of lead outside the container.

The container shall be labeled as follows:
"CAUTION: Clothing contaminated with lead. Do not remove dust by blowing or shaking. Dispose of lead contaminated wash water in accordance with applicable local, state, or federal regulations."

1.7.3 Rental Equipment Notification

If rental equipment is to be used during lead-containing paint handling, removal, or demolition, notify the rental agency in writing concerning the intended use of the equipment. Furnish a copy of the written notification to the Contracting Officer.

1.7.4 Vacuum Filters

UL 586 labeled HEPA filter must be used.

PART 2 NOT USED

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Notification

Notify the Contracting Officer 20 days prior to the start of any demolition work where elements with lead containing coatings or paint are present.

3.1.2 NOT USED

3.1.3 Protection of Existing Work to Remain

Perform demolition work without damage or contamination of adjacent areas. Where existing work is damaged or contaminated, restore work to its original condition or better.

3.1.4 Boundary Requirements

Establish a lead control area to prevent the spread of lead dust, paint chips, or debris of lead-containing paint and restrict access to the area. Provide physical boundaries around the lead control area by roping off the area or providing curtains, portable partitions or other enclosures to ensure that airborne concentrations of lead will not reach 30 micrograms per cubic meter of air outside of the lead control area.

3.1.5 NOT USED

3.1.6 NOT USED

3.1.7 Change Room and Shower Facilities

Item 3.1.7 will only be required in case of a positive exposure assessment according to Section 3.1.11 of this specification. Provide clean change rooms and shower facilities (if feasible), within the physical boundary around the designated lead control area in accordance with requirements of 29 CFR 1926.62.

3.1.8 Mechanical Ventilation System

Item 3.1.8 will only be required in case of a positive initial determination according to Section 3.1.11 of this specification. If exposure is in excess of the PEL, the following control devices may be implemented:

a. Use adequate ventilation to control personnel exposure to lead in accordance with 29 CFR 1926.57.

b. To the extent feasible, use fixed local exhaust ventilation connected to HEPA filters or other collection systems, approved by the certified industrial hygienist. Local exhaust ventilation systems shall be designed, constructed, installed, and maintained in accordance with ANSI Z9.2.

c. If air from exhaust ventilation is recirculated into the workplace, the system shall have a high efficiency filter with reliable back-up filter and controls to

monitor the concentration of lead in the return air and to bypass the recirculation system automatically if it fails. Air may be recirculated only where exhaust to the outside is not feasible.

3.1.9 Personnel Protection

Item 3.1.9 will only be required in case of a positive initial determination according to Section 3.1.11 of this specification. Personnel shall wear and use protective clothing and equipment as specified herein. Eating, smoking, or drinking is not permitted in the lead control area. No one will be permitted in the lead control area unless they have been given appropriate training and protective equipment.

3.1.10 Warning Signs

Item 3.1.10 will only be required in case of a positive initial determination, according to Section 3.1.11 of this specification. Provide warning signs at approaches to lead control areas, if the exposure will be above the PEL. Locate signs at such a distance that personnel may read the sign and take the necessary precautions before entering the area. Signs shall comply with the requirements of 29 CFR 1926.62.

3.1.11 Exposure Assessment

The contractor shall comply with all provisions of 29 CFR 1926.62 (d). Until the contractor performs an employee exposure assessment, the contractor shall implement appropriate protective measures in accordance with 29 CFR 1926.62. See **table-1**, which lists applicable paragraphs of the standard that must be addressed during the exposure assessment. It also lists requirements for when exposures are above the action level, the permissible exposure level and at any level.

The personal protective clothing and controls shall be used as long as employee exposure is greater than the PEL. The CIH will be responsible for determining the exposure level and appropriate personal protective equipment.

3.1.12 Exposure Assessment Requirements

Until an exposure assessment has been performed, the contractor shall provide the employees with the interim protection outlined in 29 CFR 1926.62.
The personal protective clothing, controls, and hygiene facilities shall be used as long as employee exposure is greater than the PEL.

3.1.13 Additional Exposure Assessment

After the initial exposure assessment, additional assessments shall be conducted whenever there has been a change of equipment, process, control, personnel, or a new task has been initiated.

3.2 WORK PROCEDURES

The contractor shall perform demolition in accordance to the demolition plan(sec 02050), and the written compliance plan (sec 1.5.3.3). Use procedures and equipment required to limit occupational and environmental exposure to lead when lead-containing paint material is removed in accordance with 29 CFR 1926.62. Dispose of paint chips, demolition debris, and associated waste in compliance with federal, state, and local requirements.

3.2.1 Personnel Exiting Procedures

Whenever personnel exit the lead-controlled area, they shall perform the following procedures and shall not leave the work place wearing any clothing or equipment worn during the work day:

a. Vacuum themselves off using the HEPA vacuum.
b. Remove protective clothing in the decontamination room, and place them in an approved container.
c. Shower(if required by CIH).
d. Change to clean clothes prior to leaving the physical boundary designated around the lead-contaminated job site.

3.2.2 Monitoring

Monitoring of airborne concentrations of lead shall be in accordance with 29 CFR 1926.62 and as specified herein. Air monitoring, testing, and reporting shall be performed by a CIH or an Industrial Hygiene (IH) Technician who is under the direction of the CIH.

a. The CIH or the IH Technician under the direction of the CIH shall be on the job site directing the monitoring, and inspecting the work to ensure that the requirements of the Contract have been satisfied during the entire demolition operation.

b. Take personal air monitoring samples on employees who are anticipated to have the greatest risk of exposure as determined by the CIH. In addition, take air monitoring samples on at least 25 percent of the work crew or a minimum of two employees, whichever is greater, during each work shift.
c. Submit results of air monitoring samples, signed by the CIH, within 72 hours after the air samples are taken. Notify the Contracting Officer within 2 hours of exposure to lead at or in excess of the action level of 30 micrograms per cubic meter of air outside of the

lead control area. Contractor must notify each employee in writing of the results which represent the employees exposure as per 29 CFR 1926.62.

3.2.2.1 Monitoring During Paint Disturbance

Perform personal and area monitoring during demolition activities as required by 29 CFR 1926.62. Sufficient area monitoring shall be conducted at the physical boundary to ensure unprotected personnel are not exposed above 30 micrograms per cubic meter of air at all times. If the outside boundary lead levels are at or exceed 30 micrograms per cubic meter of air, work shall be stopped and the CIH shall immediately correct the condition(s) causing the increased levels and notify the Contracting Officer immediately. The CIH shall review the sampling data collected on that day to determine if condition(s) requires any further change in work methods. Work shall resume when approval is given by the CIH. The Contractor shall control the lead level outside of the work boundary to less than 30 micrograms per cubic meter of air at all times. At least one sample on each shift shall be taken on the downwind side of the lead control area. If adjacent areas are contaminated, clean and visually inspect contaminated areas. The CIH shall certify that the area has been cleaned of lead contamination.

3.3 NOT USED

3.4 NOT USED

3.5 CLEANUP AND DISPOSAL

3.5.1 Cleanup

Maintain surfaces of the lead control area free of accumulations of paint chips and dust. Restrict the spread of dust and debris; keep waste from being distributed over the work area. Do not dry sweep or use compressed air to clean up the area.

3.5.2 Certification

The CIH shall certify the following in writing: air monitoring results are less than 30 micrograms per cubic meter inside and outside the lead control area, the respiratory protection for the employees was adequate, the work procedures were performed in accordance with 29 CFR 1926.62, and that there were no visible accumulations of lead-contaminated paint and dust at the worksite. Do not remove the lead control area or roped-off boundary and warning signs prior to the Contracting Officer's receipt of the CIH's certification. Reclean areas showing dust or residual paint chips.

3.5.3 Testing of Lead-Containing Paint Debris

Waste Products shall be separated into the following categories:

a. Old woodwork, walls, roofing, plaster, windows, doors, concrete block debris, (all the debris associated with the demolition of the building).

b. Rags, sponges, mops, HEPA filters, air monitoring cartridges, scrapers, and other materials used for testing, and cleanup

c. Disposable work clothes and respirator filters

The waste produced by demolition (only aforementioned point a) has been determined to be non hazardous waste; therefore, testing is not required and may be disposed at the Woodlawn Landfill. The Contractor must evaluate, in accordance with 40 CFR 261 for hazardous waste, the waste described on points b. and c. to determine if they are hazardous. For initial pricing purposes, it will be assumed that the items described in b. and c. above are non-hazardous, lead containing waste. If the Toxic Characteristic Leaching Procedure (TCLP) as required by 40 CFR 261 reveals that any items in b. or c. above as hazardous, an appropriate price adjustment will be negotiated in accordance with the Changes Clause.

Prior to initiation of the work and subsequent to final demolition and cleanup of the work site, soil testing will be performed to determine if the demolition project has contaminated the surface soils with lead. Remediation of contaminated soil resulting from the demolition is the sole responsibility of the contractor.

3.5.4 Disposal of Lead Contaminated Hazardous Waste

a. Collect lead-contaminated hazardous waste, scrap, debris, bags, containers, equipment, and lead-contaminated clothing which may produce airborne concentrations of lead particles. Label the containers in accordance with 49 CFR 172. Dispose of lead-contaminated waste material at an EPA permitted hazardous waste treatment, storage, or disposal facility off Government property **after first coordinating with and having HW manifest signed by P2 Branch**.

b. Store waste materials in U.S. Department of Transportation (49 CFR 178) approved 55-gallon drums. Properly label each drum to identify the type of waste (49 CFR 172) and the date the drum was filled. The Contracting Officer or an authorized representative will assign an area for interim storage of waste-containing drums. Do not store hazardous waste drums

in interim storage longer than 90 calendar days from the date affixed to each drum.

c. Handle, store, transport, and dispose lead or lead-contaminated waste in accordance with 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, and 40 CFR 265. Comply with land disposal restriction notification requirements as required by 40 CFR 268.

3.5.4.1 Disposal Documentation

Submit written evidence that the hazardous waste treatment, storage, or disposal facility (TSD) is approved for lead disposal by the EPA and state or local regulatory agencies. Submit one copy of the completed manifest, signed and dated by the initial transporter in accordance with 40 CFR 262. **Manifest must be signed by the HW manager as well as transporter before leaving the installation.**

3.5.5 Disposal of Lead Contaminated Non-Hazardous Waste

Any portion of the segregated waste products which does not test as hazardous by the testing requirements stated above, may be disposed at the Woodlawn Landfill.

3.5.6 Payment for Hazardous Waste Disposal

Payment for disposal of hazardous waste will not be made until a signed copy of the manifest from the treatment or disposal facility certifying the amount of lead-containing materials delivered is returned and a copy is furnished to the Government.

Table 1: **Lead Contamination Levels**

OSHA Instruction CPL 2-2.58
DEC 13 1993
Office of Health Compliance Assistance

APPENDIX C
APPLICABLE PARAGRAPHS OF 1926.62

For Specific Air Lead Levels					During Assessment of Trigger Tasks
Regardless of Level	≥ AL		> PEL	> 4 X PEL	
	1 - 30 Days	> 30 Days			
1926.62(d) - Exposure Assessment and Interim Protection 1926.62(h) - Housekeeping 1926.62(l)(5) - Handwashing Facilities 1926.62(l)(1)(i) - Hazcom Training (and/or 1926.21 - Safety Training and Education)	1926.62(d)(4) - Monitoring Representative of Exposure for Each Exposed Employee 1926.62(j)(1)(i) - Initial Medical Surveillance 1926.62(j)(2)(ii) - Follow-up Blood Sampling 1926.62(k) - Temporary Removal Due to Elevated Blood Lead 1926.62(l)(1)(ii)-(iv) - Information and Training	1926.62(j)(1)(ii) - Medical Surveillance Program 1926.62(j)(3) - Medical Exams and Consultation (if required)	1926.62(e) - Engineering and Work Practice Controls 1926.62(f) - Respiratory Protection 1926.62(g) - Protective Clothing and Equipment 1926.62(i) - Hygiene Facilities and Practices 1926.62(m) - Signs	1926.62(g)(2) - Clean Protective Clothing Daily	1926.62(f) - Appropriate Respiratory Protection 1926.62(g) - Protective Clothing and Equipment 1926.62(i)(2) - Change Areas 1926.62(i)(5) - Handwashing Facilities 1926.62(j)(1)(i) - Biological Monitoring 1926.62(l)(1)(i) - Hazcom Training 1926.62(l)(2)(iii) - Respirator Training 1926.21 - Safety Training and Education

Table 1

---End of Section---

[Back to Paragraph 3.1.11]

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SECTION 02220
Demolition

Ft. Campbell Requirements:

Requirements in this section and Appendix A-7. **Solid Waste Disposal/Diversion Practices** shall apply to all construction and demolition activities at Fort Campbell. Contract specifications shall require at least a 50% diversion (by weight) of demolished building materials such as wood, plumbing fixtures, electrical materials (lights and panels), windows, doors, toilet partitions, HVAC equipment, and scrap metals be diverted from the landfill (See Chapter 2, para 2.1.4 (Click here)). Diversion can be accomplished by deconstructing the wood buildings and components per instructions below or by moving the structure off-post.

Requirements in this section and Appendix A-10. **National emission standards for hazardous air pollutants (NESHAP)** regulatory requirements for demolition apply .

Demolition materials shall not be salvaged by the contractor and shall not be removed from the installation. Non-salvageable demolition materials shall not to be transported off the installation.

Notify the DPW Environmental Division if unknown waste is discovered during site investigations. Waste could be explosive, hazardous or toxic waste.

Dumpster service for new construction and for demolition is not provided by the installation. The contractor shall arrange for dumpster service at the Contractor's own expense.

In general, utilities are not to be abandoned in place; all abandoned utilities are to be removed. There are circumstances where this requirement does not apply. Abandonment of utilities and removal shall be a topic of discussion at design conferences.

Instructions to Designers:

1 Modify UFGS 02220 paragraphs to include the building demolition/diversion requirements above and modify contract specifications.

2 Construction specifications shall be modified to require a Building Materials Diversion Plan to be submitted and approved by DPW.

3 When a project requires removal/disposal of environmentally hazardous waste generated at Fort Campbell, the DPW Environmental Division must be involved in the permitting process. Modify project drawings and specifications paragraphs to

include each of the above features as they apply to the project. Additional guidance on Environmental Requirements and Hazardous Waste Disposal Practices is contained in **Appendix A**, and project specifications shall be modified to indicate these requirements.

4 National emission standards for hazardous air pollutants (NESHAP) regulatory requirements for demolition apply for asbestos abatement and most people understand that. However, in addition **NESHAP** notification is also required even if the operation involves removal of "non-regulated" ACM only in any amount, OR even if the operation involves no asbestos removal whatsoever. See this EPA site for specific items covered. When NESHAP items are encountered, project demolition specifications shall be modified to include the requrirements identified in Appendix A.

5 For mercury containing light bulb disposal, insert the **Mercury Light Bulb** paragraph.

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The following Mercury Containing Bulbs paragraph shall be included in Spec Section 02220, Demolition in all projects:

"3.4.? Mercury Containing Light Bulbs: Mercury containing light bulbs such as mercury vapor, metal halide, high pressure sodium, and fluorescent light bulbs, or any other mercury-containing light bulbs shall be considered and handled as hazardous waste for recycle.. The contractor shall collect these old/used bulbs or tubes and very carefully deliver them to the DPW-PPOC yard before the time of demolition of old buildings or a section of a building. For disposal and recycling of these bulbs, have the Contracting Officer's representative contact the DPW-PPOC yard hazardous waste supervisor before delivery to the yard so that packaging requirements for transport of the bulbs can be determined."

Return to Designer Instructions

SECTION 02226
Removal and Salvage of Historic Building Materials

Ft. Campbell Requirements:

Historic District:

The "Clarksville Base" portion of Ft. Campbell contonment area is eligible for the National Register of Historic Places as a significant Cold War historic district. Designers are required to consult with the State Historic Preservation Office (SHPO) and the federal Advisory Council on Historic Preservation for any projects that are sited at the Clarksville Base. POC is DPW Environmental Division Cultural Resource Manager at 270-798-7437.

Instructions to Designers:

1. Complete the requirements as they apply to specific projects.

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SECTION 02315 - 02316
Excavation, Filling and backfilling

Ft. Campbell Requirements:

Ft. Campbell requires contractors to obtain a permit for **digging and excavation**. For MILCON projects the contractor shall coordinate all excavation activities with the construction Project Engineer. For OMA projects the contractor shall notify DPW of scheduled excavation activities and request marking of utilities at least 3 days prior to the start of excavation work. DPW Utilities Branch will mark underground utilities in the vicinity of the excavation no earlier than three days prior to the work being started.

Existing utility lines are not to be abandoned in place. Remove abandoned lines.

DPW will mark gas/water/sewer/electric/steam/chill water/storm/fuel lines/drain utilities before digging begins. South Central Bell and ITBC will mark phone lines and cable TV. If contractor cuts utility lines after being marked or does not get them marked he should be responsible for making immediate repairs (to be coordinated with the appropriate Government maintenance entity or be billed for repairs if the Government makes the repairs.

If contractor cuts utility lines after being marked or does not get them marked, he is responsible for making **immediate** repairs (to be coordinated with the appropriate Government maintenance entity) or be billed for repairs if the Government makes the repairs. Repairs shall be made to the satisfaction of the appropriate government entity.

Ft. Campbell will allow a 4-8 hour utility outage if the utility is not a critical customer need and is properly coordinated and public notification is made to impacted customers. Outages shall be limited to not more than 3-4 to a customer for the contract duration. For a major outage, Ft. Campbell would advertise for at least 2 weeks prior to outage occurrence.

Avoid locating new utility lines under pavement where possible. When underground utilities are sleeved under roadways, sleeves shall be extended a minimum of 10 feet beyond the roadway on both sides to protect lines from penetration by new road signs, poles, etc.

Instructions to Designers:

1. Meet with DPW utility people to get exact locations of utilities. Fort Campbell has a great deal of underground utility lines (both active and abandoned) that do not show up on Base utility maps. Therefore, any utilities to be installed underground must be coordinated with DPW as soon as possible during the design process. OMA projects shall include in the contract emergency phone numbers for each utility impacted.

2. Specifications Demolition section paragraphs shall incorporate the permit and demolition requirements at all construction projects.

3. Include any **digging/excavation permits** being considered.

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SECTION 02364
Termiticide Treatment Measures for Subterranean Termite Control

Ft. Campbell Requirements:

Termite treatment measures shall be provided on ALL new construction projects.

Environmental quality shall be maintained in delivery, storage, application, and protection of chemicals in accordance with Ft. Campbell policies and procedures.

Instructions to Designers:

1. Point of Contact is Joe Whitfill at 270-798-9850.

2. See **Appendix A** for environmental requirements.

3. Specifications section UFGS 02364, paragraphs shall be included at all new construction (and additions) projects.

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SECTION 02510
Water Distribution System

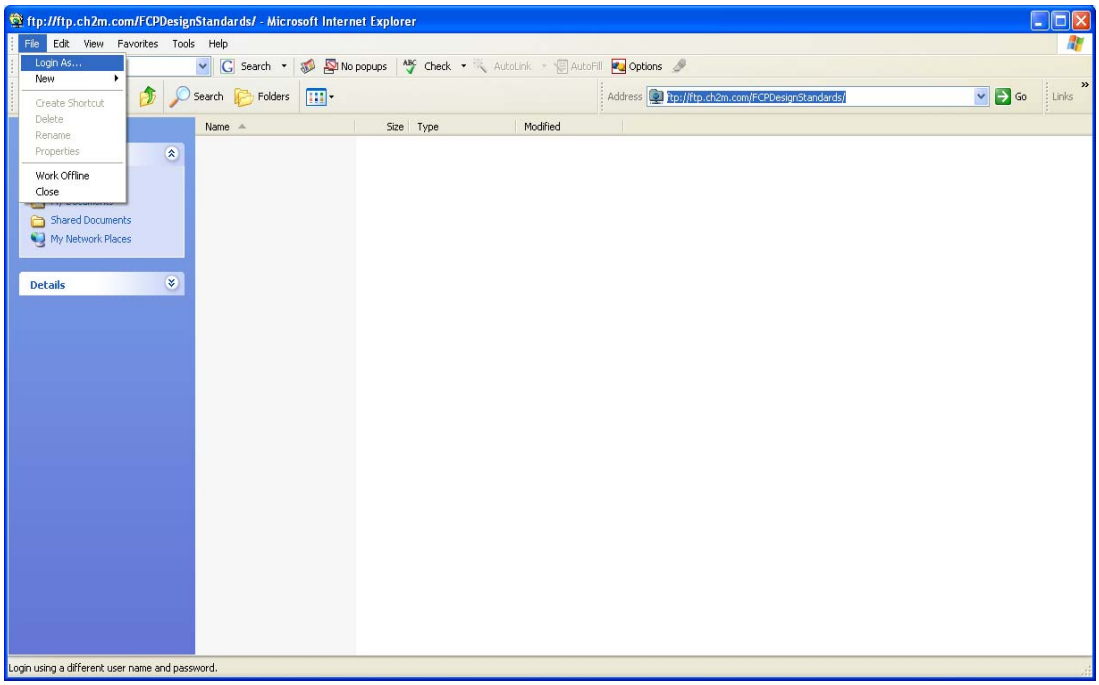
Ft. Campbell Requirements:

The Fort Campbell water distribution was privatized in 2003. The owner of the system is now CH2MHill. All additions/alterations to the system must be done in accordance with the CH2MHill Design Manual. CH2M HILL's "Fort Campbell Water and Wastewater Design and Construction Standards" which is available on the Web. **You will need Adobe Acrobat Reader to open the standards as a .PDF file.**

It is recommended you use an FTP program available from your system administrator or as shareware from many sites on the web such as Smart FTP or CuteFTP. (Typing "FTP" in Google will find dozens.)
URL: ftp://ftp.ch2m.com/fcpdesignstandards
Username: fortcampbell
Password: fcpftp
Filename: FCP W+WW Design Guide and Const Standards Rev3 Feb07.pdf

Alternately, you can use Microsoft Internet Explorer as your FTP program. However, results are often slow & inconsistent. Directions below:

1. Enter the following in the Internet Explorer address bar:
   ftp.ch2m.com/fcpdesignstandards
2. Hit return. An error message may appear. Just ignore it.
3. Under the "View" pull-down menu, go to "Open FTP site in windows explorer". An FTP window will open on your computer.
4. Go to the File→Login As…as shown below:



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SECTION 02531 - 02532
Sanitary Sewers

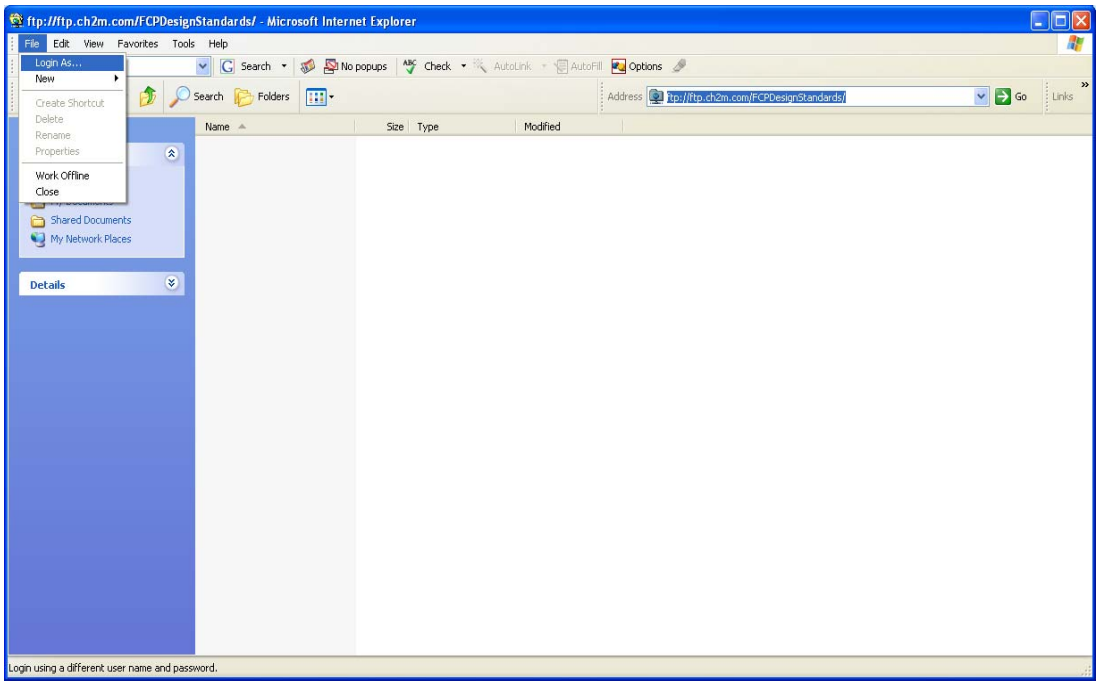
Ft. Campbell Requirements:

The Fort Campbell wastewater collection and treatment system was privatized in 2003. The owner of the system is now CH2MHill. All additions/alterations to the system must be done in accordance with the CH2MHill Design Manual. CH2M HILL's "Fort Campbell Water and Wastewater Design and Construction Standards" which is available on the Web. **You will need Adobe Acrobat Reader to open the standards as a .PDF file.**

It is recommended you use an FTP program available from your system administrator or as shareware from many sites on the web such as Smart FTP or CuteFTP. (Typing "FTP" in Google will find dozens.)
URL: ftp://ftp.ch2m.com/fcpdesignstandards
Username: fortcampbell
Password: fcpftp
Filename: FCP W+WW Design Guide and Const Standards Rev3 Feb07.pdf

Alternately, you can use Microsoft Internet Explorer as your FTP program. However, results are often slow & inconsistent. Directions below:

1. Enter the following in the Internet Explorer address bar:
   ftp.ch2m.com/fcpdesignstandards
2. Hit return. An error message may appear. Just ignore it.
3. Under the "View" pull-down menu, go to "Open FTP site in windows explorer". An FTP window will open on your computer.
4. Go to the File→Login As…as shown below:



SECTION 02552
Pre-Engineered Underground Heat Distribution System

Ft. Campbell Requirements:

Include spec provisions to maintain utilities when executing new work. Think about constructability and coordination of demo with installation of new. Goal is not to leave an occupant or customer without service (gas, water, heat, sewer, etc.).

At design meetings, discuss what outages will be needed and for how long. Generally, Ft. Campbell will allow a 4-8 hour utility outage if the utility is not a critical customer need and is properly coordinated and public notification is made to impacted customers. Outages shall be limited to not more than 3-4 to a customer for the contract duration.

At design meetings, discuss notification schedule for outages. For a major outage, Ft. Campbell would advertise for at least 2 weeks prior to outage occurrence.

All utility lines installed underground shall be marked with magnetic tape.

Fort Campbell has a great deal of underground utility lines (both active and abandoned) that do not show up on Base utility maps. Therefore, any utilities to be installed underground must be coordinated with DPW as soon as possible during the design process.

Utility lines are not to be abandoned in place. Remove abandoned lines.

Trenching through roadways shall be avoided to the maximum extent possible. Whenever possible utilities shall be pressure-pumped below roadways.

Ft. Campbell requires permit for digging. For MILCON projects the contractor shall coordinate all excavation activities with the construction Project Engineer. For OMA projects the contractor shall notify DPW of scheduled excavation activities and request marking of utilities at least 3 days prior to the start of excavation work. DPW Utilities Branch will mark underground utilities in the vicinity of the excavation no earlier than three days prior to the work being started.

DPW will mark gas/water/sewer/electric/steam/chill water/storm/fuel lines/drain utilities before digging begins. South Central Bell and ITBC will mark phone lines and cable TV. If contractor cuts utility lines after being marked or does not get them marked he should be responsible for making immediate repairs (to be coordinated with the appropriate Government maintenance entity or be billed for repairs if the Government makes the repairs.

Include in contract requirements stating that the contractor is responsible for **IMMEDIATE** repair of existing project site utility lines broken during construction. Repairs shall be made to the satisfaction of the appropriate government entity.

OMA projects shall include in the contract phone numbers for each utility that contractor is to use in case of an emergency.

Instructions to Designers:

1. Point of Contact is Larry Martin at 270-956-1801.

4. Include Discussions of any digging /excavation being considered at the design Meeting.

5. At the design meeting, obtain a current list of points of contact for utilities.

6. Design, contract drawings, and specifications section UFGS 02770 paragraphs shall include each of the above features as they apply to the project.

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SECTION 02556
Gas Distribution System

Ft. Campbell Requirements:

Design:

Fort Campbell has a great deal of underground utility lines (both active and abandoned) that do not show up on Base utility maps. Therefore, any utilities to be installed underground must be coordinated with DPW as soon as possible during the design process.

Verify capacity of existing infrastructure, and whether it will is sized sufficiently to handle new construction.

At design meetings, discuss what outages will be needed and for how long. Generally, Ft. Campbell will allow a 4-8 hour utility outage if the utility is not a critical customer need and is properly coordinated and public notification is made to impacted customers. Outages shall be limited to not more than 3-4 to a customer for the contract duration. For a major outage, Ft. Campbell would advertise for at least 2 weeks prior to outage occurrence.

Include provisions to maintain utilities when executing new work. Think about constructability and coordination of demo with installation of new. Goal is not to leave an occupant or customer without service (gas, water, heat, sewer, etc.).

Provide individual meters on gas, water, and electric service lines for all buildings. Meters shall be capable of receiving a device, which will allow remote monitoring in the future. For most buildings, use residential type gas meter. 3/16" orifice, output range of 5-1/2 to 8-1/2 inches of water column, normally set at 8" W.C.

Additional requirements are found in **Appendix A** and **Appendix F.**

Design Criteria:

- Use only 1 regulator to drop pressure from 28lb to 8" W.C. then install the meter.
- Use of plastic piping for gas line mains of up to 6" may be used. Gas lines of 8" and greater shall be steel. If steel piping is used provide insulated flange at building. Cathodic protection shall be provided for steel piping.
- **New requirements with public gas utility company:**
  - Install gas piping to operate at 60 psig. Request you make changeorders to on-going work to the maximum extent possible. This is the system operating pressure. If the decision is for the Gov't to retain ownership, we will also move to this system pressure.
  - Pressure testing new piping at 1.5 (120 psig) times maximum rating of the new pipe.
  - Gas systems must be pressure tested at original construction and documented (records are required to be kept for the life of the system.

Construction:

Trenching through roadways shall be avoided to the maximum extent possible. Whenever possible utilities shall be pressure-pumped below roadways.

All utility lines installed underground shall be marked with magnetic tape.

Utility lines are not to be abandoned in place. Remove abandoned lines.

Require use of Kerotest for underground gas lines. Retain and forward ALL PAPERWORK associated with new gas piping and testing to (Utilities Branch of DPW) directly!

Ft. Campbell requires permit for digging. For MILCON projects the contractor shall coordinate all excavation activities with the construction Project Engineer. For OMA projects the contractor shall notify DPW of scheduled excavation activities and request marking of utilities at least 3 days prior to the start of excavation work. DPW Utilities Branch will mark underground utilities in the vicinity of the excavation no earlier than three days prior to the work being started.

Include in contract requirements stating that the contractor is responsible for **IMMEDIATE** repair of existing project site utility lines broken during construction. Repairs shall be made to the satisfaction of the appropriate government entity.

OMA projects shall include in the contract phone numbers for each utility that contractor is to use in case of an emergency.

Instructions to Designers:

1. Point of Contact at DPW is Audie Hardin at 270-956-1801.

2. Research locations and sizes of proposed utilities during design phase, then meet with DPW utility people to investigate exact location of utilities.

3. Include any **digging/excavation permits**.

4. At the design meeting, obtain a current list of points of contact for utilities.

5. Design, contract drawings, and specifications section UFGS 02770 paragraphs shall include each of the above features as they apply to the project.

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SECTION 02630
Storm Drainage System

Ft. Campbell Requirements:

Verify capacity of existing infrastructure, and whether it will is sized sufficiently to handle new construction.

Drainage of downspouts into storm sewer is encouraged in order to prevent erosion.

Include provisions to maintain utilities when executing new work. Think about constructability and coordination of demo with installation of new. Goal is not to leave an occupant or customer without service (gas, water, heat, sewer, etc.).

Avoid use of odd pipe sizes (i.e. 3").

Trenching through roadways shall be avoided to the maximum extent possible. Whenever possible utilities shall be pressure-pumped below roadways.

All utility lines installed underground shall be marked with magnetic tape.

Include in contract requirements stating that the contractor is responsible for **IMMEDIATE** repair of existing project site utility lines broken during construction. Repairs shall be made to the satisfaction of the appropriate government entity.

OMA projects shall include in the contract phone numbers for each utility that contractor is to use in case of an emergency.

Additional Requirements are found in **Appendix A, Clean Water.**

Instructions to Designers:

1. Point of Contact is Larry Martin at 270-956-1801.

2. Include any **digging/excavation permits**.

3. At the design meeting, obtain a current list of points of contact for utilities.

4. Design, contract drawings, and specifications section UFGS 02630 paragraphs shall include each of the above features as they apply to the project.

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SECTION 02744-02745
Bituminous Roadways

Ft. Campbell Requirements:

Corps of Engineers Guide Specifications shall be used and modified to reference “KDOT” for Asphalt pavement through out the installation except for Airfield pavements.

All new facilities should include waste handling equipment, concrete pads and screens as necessary. The designer should have some idea of the volume of waste to be generated by the final permanent facility. If the facility will generate recyclable materials, capacity for recyclable bins should be included.

Instructions to Designers:

1. Design, contract drawings, and specifications paragraphs shall include each of the above features as they apply to the project.
2. Include any **digging/excavation permits**.

SECTION 02753 - 02754
Concrete Pavements

Ft. Campbell Requirements:

Fort Campbell has experienced unsatisfactory life and performance in exterior concrete pavements due to alkali-silica reaction (ASR). ASR causes excessive expansion of concrete, leading to degraded load capacity, surface spalling, and eventual premature pavement failure. Secondary damage includes displacing adjoining vertical construction applying threatening lateral loads on adjacent embedded and pavement features.

Concrete for exterior pavements and hardstand areas shall specify and require only low alkali Portland Cement with Class F fly ash as the pozzolanic cement replacement and Ground Granulated Blast-Furnace (GGBF) Slag in combination for the concrete mix design test proportioning. Specific concrete mixture proportions have been developed for concrete pavement in an attempt to mitigate concrete expansion problems currently being experienced at the base.

Instructions to Designers:

1. Design, contract drawings, and specifications paragraphs shall include each of the above features as they apply to the project.

2. Fort Campbell prefers that military vehicle and equipment parking/hardstand areas be concrete vice asphalt.

3. For new construction projects having concrete pavement for parking hardstand areas, roadways, airfield runways and aprons, one of the following Louisville District COE, Engineering Division technical elements -- ED-T, ED-TC and/or ED-TG -- shall be consulted. These elements will provide specific design instructions and review all site related concrete specifications.

4. Include any **digging/excavation permits**.

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SECTION 02770
Concrete Sidewalks and Curbs and Gutters

Ft. Campbell Requirements:

Use of curbs and gutters is encouraged especially at road corners and radius. Use of parking blocks is not encouraged as this inhibits snow removal.

Handicapped curb ramps must meet ADA requirements.

Concrete for exterior pavements and hardstand areas shall use Class F fly ash as the pozzolanic cement replacement. Specific concrete mixture proportions have also been developed for these features in an attempt to mitigate concrete expansion problems currently being experienced at the base.

All new facilities shall include waste handling equipment, concrete pads and screens as necessary. The designer should have some idea of the volume of waste to be generated by the final permanent facility. If the facility will generate recyclable materials, capacity for recyclable bins should be included

Instructions to Designers:

3. Design, contract drawings, and specifications shall include each of the above features as they apply to the project.

    1. For MILCON projects, COE in-house units ED-TC and ED-TS shall be consulted for review of all site related concrete specifications.
    2. Include any **digging/excavation permits**.

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SECTION 02930
Exterior Planting

Ft. Campbell Requirements:

Installation grounds keeping is limited. Maintenance free design around facilities and plant areas is required.

Ensure that the landscaping provided does not interfere with overhead power lines when it reaches maturity.

Fort Campbell maintains lists of suitable plant materials for use at the installation. These lists are subdivided into plant sizes. The following Ft. Campbell Landscape Plant Lists are in Appendix E.

Native Evergreens/Conifers
Native Deciduous
Introduced Evergreens

Introduced Deciduous

Instructions to Designers:

1. Design, contract drawings, and specifications shall include only approved and listed plant materials.

2. Point of Contact for Landscaping is Linda Alderdice at 270-798-2616

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TECHNICAL DESIGN GUIDE
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Division 03000

Section

03300 Cast-In-Place Structural Concrete
03307 Concrete for Minor Structures
03330 Cast-In-Place Architectural Concrete

SECTION 03300
Cast-In-Place Structural Concrete

Ft. Campbell Requirements:

Concrete used in masonry bond beams should be 9/11 slump and contain plastiziser.

Concrete shall use Class F fly ash as the pozzolanic cement replacement.

To accommodate environmental Radon protection, all specification items identified as "vapor barrier" shall be modified to read "vapor/radon barrier"

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SECTION 03307
Concrete For Minor Structures

Ft. Campbell Requirements:

Concrete used in masonry bond beams should be 9/11 slump and contain plastiziser.

Concrete shall use Class F fly ash as the pozzolanic cement replacement.

To accommodate environmental Radon protection, all specification items identified as "vapor barrier" shall be modified to read "vapor/radon barrier".

SECTION 03330
Cast-In-Place Architectural Concrete

Ft. Campbell Requirements:

Concrete shall use Class F fly ash as the pozzolanic cement replacement.

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TECHNICAL DESIGN GUIDE
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Section

04200 Masonry

SECTION 04200
Masonry

Ft. Campbell Requirements:

All exterior split faced units shall be fabricated with integral water repellant and shall be integrally colored during manufacture. Water repellant primer and stain shall also be applied to all exterior split faced CMU after completion of exterior work and split face is not subject to damage by construction activities.

Block filler shall be used on all exposed CMU.

Modify specifications section 04200, Masonry, to incorporate the following paragraphs, specifically including all items highlighted in red:

See Appendix D: Exterior Finishes.

2.4.2.1 Architectural Units

Units shall have patterned face shell. Face shell pattern shall be [fluted] [vertical scored] [split ribbed] [_____]. All exterior architectural units shall be fabricated with integral water repellant and shall be integrally colored during manufacture. Water repellant primer and stain shall also be applied to all exterior architectural CMU walls after completion

of exterior work and when the masonry is not subject to damage by construction activities.
~~Units shall be integrally colored during manufacture.~~ Color shall be [_____]. Patterned face shell shall be properly aligned in the completed wall.

2.10 MORTAR

Mortar shall be Type [S] [N] in accordance with the proportion specification of ASTM C 270 except Type S cement-lime mortar proportions shall be 1 part cement, 1/2 part lime and 4-1/2 parts aggregate; Type N cement-lime mortar proportions shall be 1 part cement, 1 part lime and 6 parts aggregate; when masonry cement ASTM C 91 is used the maximum air content shall be limited to 12 percent and performance equal to cement-lime mortar shall be verified. Verification of masonry cement performance shall be based on ASTM C 780 and ASTM C 1072. Mortar for prefaced concrete masonry unit wainscots shall contain aggregates with 100 percent passing the 2.36 mm No. 8 sieve and 95 percent passing the 1.18 mm No. 16 sieve. Pointing mortar in showers and kitchens shall contain ammonium stearate, or aluminum tri-stearate, or calcium stearate in an amount equal to 3 percent by weight of cement used. Cement shall have a low alkali content and be of one brand. Aggregates shall be from one source. **Efflorescence testing of mortar shall be in accordance with ASTM C 67. Any component causing efflorescence shall be rejected.**

2.11 GROUT

Grout shall conform to ASTM C 476. Cement used in grout shall have a low alkali content. Grout slump shall be between 200 and 250 mm. 8 and 10 inches. Grout shall be used subject to the limitations of Table III. Proportions shall not be changed and materials with different physical or chemical characteristics shall not be used in grout for the work unless additional evidence is furnished that the grout meets the specified requirements. **Efflorescence testing of mortar shall be in accordance with ASTM C 67. Any component causing efflorescence shall be rejected.**

3.26.3 Efflorescence Test

Brick**, split faced and scored CMU** which will be exposed to weathering shall be tested for efflorescence. Tests shall be scheduled far enough in advance of starting masonry work to

permit retesting if necessary. Sampling and testing shall conform to the applicable provisions of ASTM C 67. Units meeting the definition of "effloresced" will be subject to rejection.

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TECHNICAL DESIGN GUIDE
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Section

05500 **Metals**

SECTION 05500
Metals

Ft. Campbell Requirements:

Avoid painted handrailings and guardrails. Use unpainted galvanized (exterior), stainless steel or aluminum railings (interior).

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Technical Requirements and Instructions
Division 06000

Section

06200 Finish Carpentry
06650 Solid Polymer (solid Surfacing) Fabrications

SECTION 06200
Finish Carpentry

Ft. Campbell Requirements:

Use finished or painted wood trim instead of plastic for chair rails, and other decorative locations.

DPW is using wood veneer casework instead of plastic laminate on O&M projects. Hollow metal interior doors shall be used in barracks buildings.

SECTION 06650
Solid Polymer Fabrications

Ft. Campbell Requirements:

Prefer using solid surfacing on counter tops and possibly on windowsills for more scratch and stain resistance.

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Division 07000

Section

07200 Roofing, General
07240 Exterior Insulation and Finish System
07311 Roofing, Strip Shingles
07412 Non-Structural Metal Roofing
07416 Structural Standing seam Metal Roofing (SSSMR)
07510 Built-Up Roofing
07530 Elastomeric Roofing (EPDM)
07551 Modified Bitumen Roofing

SECTION 07000
Roofing General

All new and/or roof replacement projects will incorporate the installation of a permanent fall protection system which meets the requirements of ASHA Guideline 1926:502 (d) (16) (ii-iii-iv). This system shall be similar or equal to a Super Anchor system as manufactured by Super Anchor Safety, 8522 216th Street SE, Woodinville, WA 98072-8009 (Phone 425-488-8868).

SECTION 07311
Roofing, Strip Shingles

Ft. Campbell Requirements:

Shingles shall be of simple seal-down 3-tap design. Use only light colors, and maximum life quality. Minimum slope for shingles shall conform to manufacturer recommendations.

Flat built-up roofs are not to be utilized in new roof system designs. Minimum low slope for roofs shall be ½ inch per foot.

Modified bitumen is the preferred membrane on low slope roof conditions for recover, replacement, and new installations.

The roof specification shall require the contractor to test new roofing systems by flooding roofs with interior gutters and to fire hose-spray exterior gutter roofs to insure water tightness.

SECTION 07412
Non-Structural Metal Roofing

Ft. Campbell Requirements:

Metal roofing shall be vertical seam with UL class 90 uplift approval.

Color shall conform to Ft. Campbell approved standard schemes. See Appendix D

The roof specification shall require the contractor to test new roofing systems by flooding roofs with interior gutters and to fire hose-spray exterior gutter roofs to insure water tightness.

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SECTION 07416
Structural Standing Seam Metal Roof System

Ft. Campbell Requirements:

Metal roofing shall be vertical seam with ASTM E 1592 uplift approval.

Color shall conform to Ft. Campbell approved standard schemes. See Appendix D

The roof specification shall require the contractor to test new roofing systems by flooding roofs with interior gutters and to fire hose-spray exterior gutter roofs to insure water tightness.

SECTION 07510
Built-up Roofing

Ft. Campbell Requirements:

Flat no-slope built-up roof systems are to be utilized in new facility designs by approved exception only.

Minimum low slope for new roofs shall be ½ inch per foot.

Modified bitumen is the preferred membrane on low slope roof conditions for recover, replacement, and new installations.

The roof specification shall require the contractor to test new roofing systems by flooding roofs with interior gutters and to fire hose-spray exterior gutter roofs to insure water tightness.

SECTION 07530
Elastomeric Roofing (EPDM)

Ft. Campbell Requirements:

Flat no-slope built-up roof systems are to be utilized in new facility designs by approved exception only.

Minimum low slope for new roofs shall be ½ inch per foot.

Modified bitumen is the preferred membrane on low slope roof conditions for recover, replacement, and new installations.

The roof specification shall require the contractor to test new roofing systems by flooding roofs with interior gutters and to fire hose-spray exterior gutter roofs to insure water tightness.

SECTION 07551
Modified Bitumen Roofing

Ft. Campbell Requirements:

Flat no-slope built-up roof systems are to be utilized in new facility designs by approved exception only.

Minimum low slope for new roofs shall be ½ inch per foot.

Modified bitumen is the preferred membrane on low slope roof conditions for recover, replacement, and new installations.

The roof specification shall require the contractor to test new roofing systems by flooding roofs with interior gutters and to fire hose-spray exterior gutter roofs to insure water tightness.

TECHNICAL DESIGN GUIDE
CHAPTER 3
Technical Requirements and Instructions
Division 08000

Section

08330 - 08331	**Overhead Coiling/Rolling Doors**
08360	**Overhead Sectional doors**
08700	**Hardware**

CHAPTER 3
Division 08000
Technical Requirements and Instructions

SECTION 08330 - 08331
Overhead Coiling/Rolling Doors

Ft. Campbell Requirements:

Door manufacturer representative shall conduct a final inspection of the door installation(s) and certify the installation is complete and correct, and meets all requirements for the full warranty.

Instructions to Designers:

1. Modify UFGS 08331 paragraphs to include the on-site visit and verification requirement.

3. Modify the UFGS 08331 paragraphs to include a certification of inspection by the door manufacturer representative.

SECTION 08360
Overhead Sectional Doors

Ft. Campbell Requirements:

Door manufacturer representative shall conduct a final inspection of the door installation(s) and certify the installation is complete and correct, and meets all requirements for the full warranty.

Instructions to Designers:

1. Modify UFGS 08360 paragraphs to include the on-site visit and verification requirement.

2. Modify the UFGS 08360 paragraphs to include a certification of inspection by the door manufacturer representative.

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SECTION 08700
Hardware

Ft. Campbell Requirements:

Fort Campbell utilizes an "*I/C - 7 pin Insta-Key"* integrated master keying system. Interchangeable cores provided shall be compatible with the existing "*I/C - 7 pin Insta-Key*" system. The *I/C - 7 pin Insta-Key* lock system is the standard lock system for Troop housing. Combination locks used in secured areas shall be Mass Hamilton X09 type. The "*I/C - 7 pin Insta-Key*" system is *also* encouraged for all other building types. Biting list is to be added to keying schedule. Four blank keys are to be provided with each change key.

Electric locks shall be stand alone Best BASIS “G” system with encoders and kiosh as required (See Attachment at end of this section for ording data). All key over-rides - see Insta-Key above..

Prefer knobs instead of levers.

Panic device hardware shall be touch pad type.

Install kickplates on doors in heavy use areas.

Concealed door closers shall not be avoided without prior DPW approval.

Require door stops at all interior and exterior locations.

Use and specify Hasp and Pad locks on exterior doors to mechanical/ electrical rooms.

Electrical Pad-mounted Transformer locks shall be included in the contract.

Furniture locks are repaired/replaced on case by case basis by the Ft. Campbell Lockmaster. No standardization of furniture locks is possible.

Instructions to Designers:

1. Modify specifications paragraphs to include each of the above features as they apply to the project.

2. The Installation POC regarding keys is Mr. Ayers (270) 798-3581.

STANLEY
Security Systems

May 6, 2007
Fort Campbell
Attn: Bob Ayers
16th & Bastogne
4245
Fort Campbell, KY

Pete Graham
Sales — Louisville, KY
Stanley Security Solutions, Inc
Best Access Systems
11947 Cumberland Rd.
Fishers, IN 46037
Cell 5024397115 Fax 502 326

pgraham@stanleyworks.com
www.bestaccess.com
127-000994IL

Ref: Basis G Electronic Locksets

Bob,

The following is the list of part numbers for the battery operated electronic Jocksets for the barrack doors. All locks are designed for standard 1-3/4” thick doors.

The locks can use the government issued I.D. card. These locks will use track 3 of the magnetic stripe.

Barrack Doors - These are the (3) types of magnetic stripe card readers with lever handle trim.

Cylindrical — 93KG7DVI5MS-S3-626

Mortise - 45HG7DV

Exit Device — EXG7EV1 5MS-626-HAND-MANUF.-TYPE

Example: EXG7EV1 5MS-626-RHR-PH2-RM
Specify one each of the following Manuf. and Type in part number above for exit device trim:

MANUF.- Precision — PHI or PH2
Von Duprin 99 — VD9
Sargent 8000 — SA8 — only available for rim device
TYPE-Rim -RM
Mortise - MO
Vertical Rod VR

The manufacturers the devices through bolt to are Precision 1000 or 2000 series, Von Duprin 99 series or Sargent 8000 series. These will work with either rim, mortise, surface or concealed vertical rod devices. The exit device trim will work with either the night latch or classroom function devices.

Attachment Page 1/2

The programming equipment for the locksets and for encoding your 1.0. cards, you will need the following parts:

Basis G - BAS-SWS-G - for server - Programming Software

- BAS-SWC-G — for each additional user location — Programming Software
- BASD-CAB - Programming Cable, connects to lockset
- VPD-T15 - Driver Bit, for battery compartment
- VPD-CLN - Magnetic stripe reader cleaning cards (bx 50)
- BASD-MSE- Magnetic stripe card encoder and software
- HP-PDA - PDA programming device
- HP-PDA-CAB- PDA programming cable - connects to BASD-CAB.
- VPD-BB - Replacement battery pack for Basis G lock.

The Kiosk Station allows for a user to obtain a temporary card after hours until a new permanent ID card is re-issued.

BASD - ID Express Station — Kiosk

BASD - IDEXPRESS-SWS - Kiosk Software

VPA-PVC - Magnetic stripe cards, non-encoded (bx 500)

Once you have the software set up you can add any amount of locks to the system. Locks do not have to be re-programmed to handle lost cards or room changes.

* For high traffic exterior and common doors you will want to hardwire the access control devices such as panic bars, locksets, electric strikes, etc. and use the Basis ET605 System to integrate the Basis G database.

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Division 09000

Section

09000 Finishes, General
09900 Painting, General

SECTION 09000
Finishes, General

Ft. Campbell Requirements:

Exterior and interior finish colors shall conform to Appendix D.

SECTION 09200
Exterior Insulation and Finish System

Ft. Campbell Requirements:

Exterior Insulating Finish Systems (EIFS): EIFS may be used as an exterior finish material only in limited applications. Building envelope finishes shall be predominantly brick, split-face block or metal panels (in industrial or otherwise approved land use areas). Unless otherwise approved, EIFS applications shall not exceed 20% of the total exterior building surface, and shall not be applied at grade or in other locations where the material is subject to damage from lawn mowing activities or is easily accessible to vandalism.

SECTION 09400
Metal Panel Siding

Ft. Campbell Requirements:

Metal panel siding may be used in industrial land use areas. Use of metal panel siding in other land use areas must be approved.

SECTION 09900
Paint, General

Ft. Campbell Requirements:

Use of semi-gloss, eggshell, and other enamelized paint finishes shall be maximized. Use of flat paints shall be minimized.

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TECHNICAL DESIGN GUIDE
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Division 10000

Section

10160 Toilet Partitions
10430 Exterior Signage
10440 Interior Signage

10800 Toilet Accessories

SECTION 10160
Toilet Partitions

Ft. Campbell Requirements:

Use of solid phenolic partitions is encouraged.

SECTION 10430
Exterior Signage

Ft. Campbell Requirements:

Exterior signage is classified into three major categories:

- Facility Identification Signage
- Directional and Street Signage
- Regulatory Signage

All Sign sizes and styles and locations shall be in accordance with TM-5-807-10.

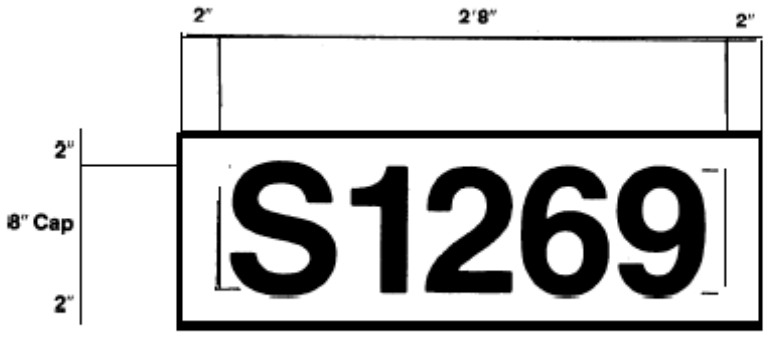
Identification signage shall be metal post and panel type and will be included in the construction contract. Graphics and lettering will not be included in the construction contract, but will be furnished and installed by the Fort Campbell Sign Shop.

Signs applied to the facilities such as building number signage shall be shall be standard grade .080 aluminum. Other data for the sign is as follows:

(1) *Colors.* White reflective letters and numbers on premium 2 mil vinyl mahogany brown background.
(2) Dimensions. lft-0in. H x 3ft-0in. W.
(3) Number. Upper case helvetica medium, 8-inch capital letter height. Copy—centered. Average line length-5 characters per line (See Attachment 1 below).

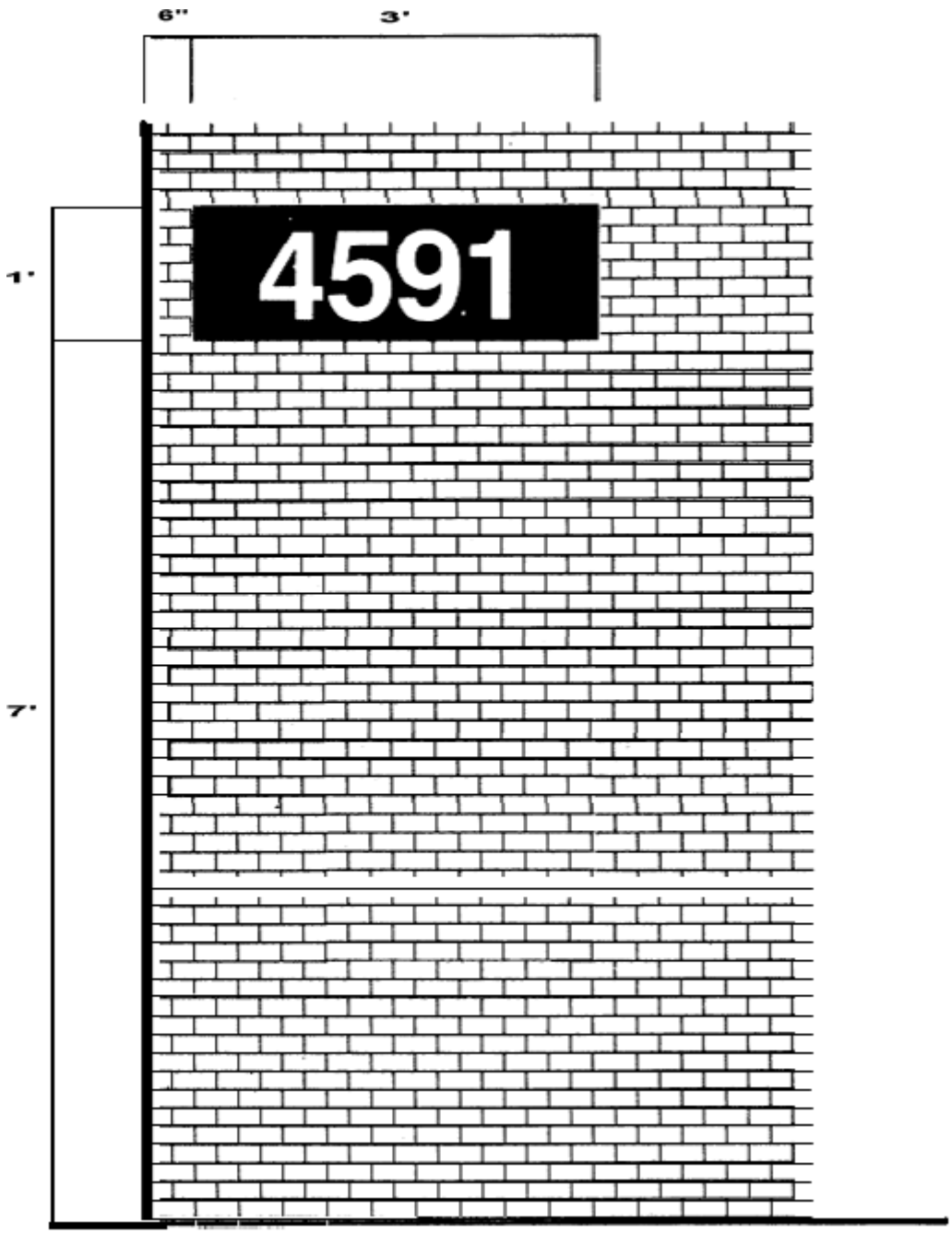
Building number signs are required at four corners of each facility. Signs should be located on the sides of the building where rapid identification is possible (See Attachment 2 below). Signs are wall-mounted. Numbers must appear in accordance with AR 420-70.

Signs identifying locations of each “Mechanical Room” is required.



Sign grid 2, 1'0" H x 3'0" W sign panel

Attachment 1



Attachment 2

Projects that include new roads, shall also include street signage in the construction contract.

Instructions to Designers:

1. Incorporate the above Fort Campbell requirements into the project specifications.

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SECTION 10440
Interior Signage

Ft. Campbell Requirements:

If "addressable" fire alarm system is not used for a building, provide a building map identifying fire alarm zones and mount on wall next to fire alarm system panel.

Interior Designer shall (re)number building spaces for "wayfinding" and provide the information to signage subcontractor on construction drawings.

When interior signage is renumbered from the construction drawing room numbering sequence to accommodate “wayfinding”, provide original construction drawing room number in metal slot mounted above door of each room for fire and maintenance purposes when construction drawings typically would be referenced. This confusing problem can be overcome by having “wayfinding” numbering from the beginning of design.

SECTION 10800
Toilet Accessories

Ft. Campbell Requirements:

Accessories shall not have keyed locking devices.

Toilet tissue dispensers shall be a simple design similar to Bobrick Washroom Equipment, Inc. number B-685 and B-686 series accessories.

Trash receptacles provided in restrooms shall have lids.

Sanitary napkin and tampon dispensers shall not be provided.

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Section

11400 Food Service Equipment

SECTION 11400
Food Service Equipment

Ft. Campbell Requirements:

Kitchen facilities that use deep fat frying equipment should have equipment for extracting and storing the used cooking oil.

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Section

13100	Lightning Protection System
13120 - 13121	Metal Buildings
13202 – 13216	Petroleum/Fuel Storage Tanks
13280	Asbestos Abatement
13281	Lead Hazard Control Activities
13721	Small Intrusion Detection System
13801	Energy Monitoring and Control System (EMCS)
13850 – 13851	Fire Detection and Alarm Systems
13900	Fire Protection systems

SECTION 13100
Lightning Protection

Ft. Campbell Requirements:

Lightning Protection Systems and Snow Guards

1. Facilities Requiring Lightning Protection Systems

1.1 Priority level 1. Must have lighting protection.

a) Any facility involved with children, example schools or child development structures

b) Communications facilities

c) Facilities which houses large amounts of computer processing equipment

d) Faculties which are in isolated areas away from other large structures or wooded areas.

1.2 Priority level 2. These structures are to be evaluated on an as-needed basis with the recommendations from Ft. Campbell's fire marshal and DPW.

a) Barracks

b) Maintenance facilities

c) Family Housing

d) Administration buildings

2. Lightning Protection System Installation Methods

2.1 Lightning protection equipment manufacturer’s mechanical clamps/supports for air terminal base and roof conductor installation shall be the preferred method for all our projects.The use off adhesives in lieu of mechanical clamps/supports is an acceptable method for lightning protection equipment installation provided the following are met:

a) Roof design/construction does not allow or makes it physically impossible for the mechanical clamps to be utilized.

b) A variance from the original contract requirements is submitted by the Contractor indicating the type of adhesive and the reason for such variance. Corps must approve.

c) The proposed adhesive is listed as an approved compound by both the lightning system and roofing manufacturer.

d) All prep-work and application requirements are carefully followed in accordance with adhesive and roofing manufacturer instructions.

2.2 The use of the S-5 clamps (Cube) is an acceptable method for lightning protection equipment support provided the following are met:

a) 1.2 a) above is met.

b) A variance from the original contract requirements is submitted by the Contractor, with installation details, and the reason for such variance. Corps must approve.

c) The cube is used only as a means for support of the lightning protection equipment and does not compromise the “Lightning Protection System” requirements listed under NFPA 70, NFPA 780, UL 96, and UL 96A.

d) The cube does not void roofing manufacturer’s warranty.

3.0 Snow Guards

Regardless of the manner or configuration of the mounting of a lightning protection system and equipment, the components are not intended to withstand the forces exerted by masses of ice and snow shifting on the roof. In those instances where lightning protection systems will be exposed to such forces, we recommend the installation of snow guards or snow guard systems.

Instructions to Designers:

1. For metal roofing systems, modify UFGS 13100 paragraphs to include the building lightning protection requirements above.

2. Construction contract drawings shall include the requirements lightning protection features identified above for projects having metal roof systems.

SECTION 13120 - 13121
Metal Buildings

Ft. Campbell Requirements:

For new construction, pre-engineered metal structural frames/buildings shall not be structurally tied to masonry. If tied, frame deflection must be limited to L/600, which increases steel frame cost to the point which it exceeds the cost of a designed structure. This fact has been verified by metal building manufacturers, and precludes perceived advantages of pre-engineered structural systems.

See Appendix D for colors.

See: TI 809-30, Metal Building Systems

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SECTION 13202 - 13216
Petroleum/Fuel Storage Tanks

Ft. Campbell Requirements:

New tank installations and replacements shall comply with Section 2.1.3, **Underground and Aboveground Storage Tanks.**

Construction permits are necessary for all petroleum/fuel storage systems. Permits require Environmental Division design review and approval.

Instructions to Designers:

1. Contact the Directorate of Public Works , Environmental Division, Authority Having Jurisdiction for storage tanks prior to starting and submitting design proposals.

2. Modify project specifications to include requirements identified above.

SECTION 13280
Asbestos Abatement

Ft. Campbell Requirements:

Asbestos Abatement shall be accomplished in accordance with Fort Campbell requirements identified in specification section 02080: **Removal and Disposal of Asbestos Containing Materials.**

Section 02080 requirements should be combined and incorporated into the UFGS 13280 section, or the Section 02080 may be renumbered. Requirements of both sections should be coordinated.

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SECTION 13281
Lead Hazard Control Activities

Ft. Campbell Requirements:

Lead Abatement shall be accomplished in accordance with Fort Campbell requirements identified in specification section 02090: **Removal and Disposal of Lead Containing Materials**

Section 02090 requirements should be combined and incorporated into the UFGS 13281 section, or the Section 02090 may be renumbered. Requirements of both sections should be coordinated.

SECTION 13721
Small Intrusion Detection System

Ft. Campbell Requirements:

No electric equipment shall be installed within or on any Fort Campbell building, structure, or premises, nor shall any alteration or addition be made in any such existing equipment without first securing an Electrical Permit (FC Form 4183) from the Fort Campbell Electrical Inspector in accordance with CAM Reg 420-4.

In addition to a phone jack inside the arms vault, place an additional phone jack outside the arms vault. The phone line in the arms vault shall be a single line only (no multiple lines on the same phone).

Instructions to Designers:

1. Installation of ICIDS Equipment in secure communications rooms shall be in accordance with instructions found in **Section 16700+: Telecommunications Systems.**

2. Installation of ICIDS Equipment in Arms Room shall be in accordance with the following instructions and **Floor Plan Sketch**:

- Modify project specifications to insure Contractor will provide all materials (excluding the RADC, Keypad, LED indicator lamp, and sensors)
- Modify specifications to insure Contractor will schedule a meeting with the Alarm Administrator prior to commencement of work (270) 798-3990/1225/7587 Note: Type & placement of sensors will be noted at meeting.

1. Mount the Remote Area Data Collector (RADC) to the same side as the interior door opens, approximately two feet to the left or right of the door and five feet up from the floor. (Physical Security office will provide the RADC.)

2. Mount a four square box to the left or right of door as in step one approximately one foot from the doorframe and five feet up from the floor. Half inch EMT must be run from the four square box to the bottom of the RADC can. This is for the mounting the Keypad. (Physical Security will provide and install the keypad.)

3. A foursquare must be mounted to the ceiling (center) of the Arms Room or rear wall facing the door depending on the type of motion sensor to be used. Half inch EMT must be run from the foursquare to the RADC can (top). Note: Placement of sensors will be noted at time of meeting. (Physical Security will provide and install sensors)

4. Drill a half inch hole approximately eighteen inches above and centered on the arms room door to outside for mounting of the LED indicator lamp. (Physical Security will provide and install the LED.) Mount a foursquare box over the drilled hole and run half inch EMT from box to the RADC can (top).

5. Dedicated 120 VAC power must be run to the RADC can through ½" or ¾" EMT.

6. A dedicated phone line must also be run to the RADC can. This wire can be run using the conduit from either sensor.

7. A four conductor 22 AWG wire must be run from motion sensor to the RADC.

8. A two conductor 22 AWG wire must be run from foursquare above arms room door to the RADC. This is for the Balanced Magnetic Switch (BMS) for the door. (Physical Security will provide and install the BMS.)

9. A two conductor 22 AWG wire must be run from the foursquare above door to the foursquare for the keypad installation. This is for the LED indicator to be mounted on the outside of the arms room.

10. A two conductor 22 AWG wire must be run from the foursquare, for the keypad, to the RADC.

11. A two conductor shielded 24 AWG wire must be run from the foursquare for the keypad to the RADC.

NOTE: Leave approximately four feet of wire at both ends.

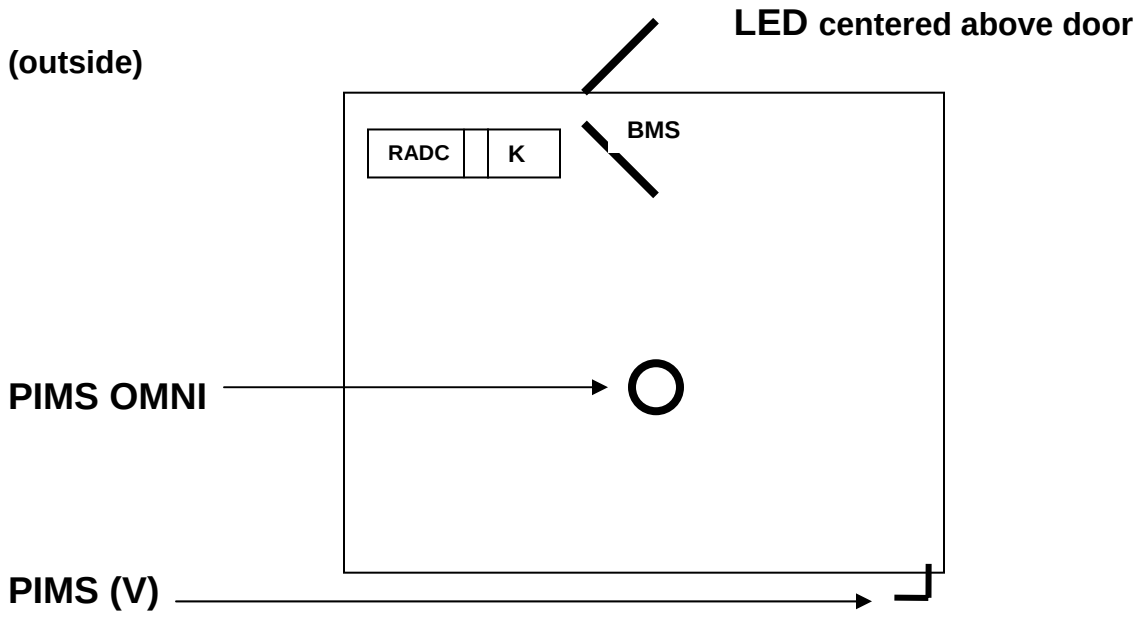
Conductors

11.1 Signal wiring: Type of wire to be used (another manufacturer's wire, of equal quality, can be substituted).

West Penn 220 = 2 conductor 22 AWG
West Penn 240 = 4 conductor 22 AWG
West Penn 2401 = 2 conductor, 24 AWG, shielded

11.2 Power wiring: Black, Red, Green- 12 AWG, stranded, to RADC.

Installation Floor Plan Sketch
ICIDS Equipment Typical Arms Room



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SECTION 13801
Energy Monitoring and Control System (EMCS)

Ft. Campbell Requirements:

Refer to Division 16000 for electrical work.

Connect all new building controls to the EMCS unless directed otherwise.

Refer to Section 15951 for connection requirements.

SECTION 13850 - 13851
Fire Detection and Alarm Systems

Ft. Campbell Requirements:

General:

No electric equipment shall be installed within or on any Fort Campbell building, structure, or premises, nor shall any alteration or addition be made in any such existing equipment without first securing an Electrical Permit (FC Form 4183) from the Fort Campbell Electrical Inspector in accordance with Fort Campbell Directorate of Public Works Standing Operating Procedure (SOP) 308, except as provided within said SOP. Copies of SOP and permits shall be obtained at DPW, Operations and Maintenance Division, Building 867, 16th Street, Fort Campbell, Kentucky.

All building designs which have a fire alarm system shall have an exterior strobe light alarm device mounted on the street side of the building's exterior. The strobe is to act as a visual indicator to responding fire crew. Response time is decreased since the crew does not need to find the actual building number.

If using flow switch, use only electric bell; do not specify motor gong; Be sure sprinkler alarm specification and alarm specification agree.

No tower is to be designed with out jockey pumps.

Ft. Campbell's fire truck ladder is 85 feet long.

Utilize looped and grid systems.

Fire Alarm Systems:

The Fire Alarm Control Panel shall be fully compatible with the existing King-Fisher Industrial Radio Alarm Control System (IRACS) presently in use at Fort Campbell. The fire alarm AM transmitter shall be Government furnished, contractor installed.

An addressable system is fine in almost any building, there are several circumstances where an addressable system is not really necessary and ends up costing more to install and maintain than it is really worth. Therefore, addressable systems shall be installed in all barracks and hangar type buildings. Non-addressable systems will be used in maintenance facilities as well as dining facilities. Non-addressable systems shall also be designed/installed in admin buildings, which are smaller or equal to 15,000 SF with 40-50 rooms. Any admin buildings which exceed these parameters shall receive an addressable system.
Panel boxes within a building should be keyed alike. (12/21/00)

Panel boxes should be keyed alike.

Fire detection and alarm systems shall be able to be programmed from the control panel and shall not require a peripheral device (such as a laptop computer) to program them.

Do not design remote fire alarm annunciators into the fire detection and alarm system.

Fire alarm control panels shall be installed only in electrical rooms with access from the outside of the building.

Ensure that smoke detector locations shown on drawings comply with the appropriate NFPA requirements. Contractors typically simply scale locations off drawings without verifying whether the locations actually comply with NFPA location / spacing criteria.

Do not install smoke detectors in vehicle maintenance areas due to false alarm problems. Automatic fire detectors in these areas shall be heat detectors.

Ensure that sleeping room smoke detectors in barracks comply with the requirements of Military Handbook 1008C (10 June 1997), i.e., local alarm only, 120 V, powered from the building's power system. Do not put all detectors on the same circuit. This will cause all detectors downstream of an open circuit to be disabled.

Contractor shall provide a set of fire alarm schematic diagrams and O&M manuals in the electrical or mechanical room (wherever the control panel is located). Each zone shall be identified at fire alarm control panel.

Identify fire alarm zones by means of a diagram posted at the building entrance.

Provide a minimum of 2 days of training for the fire detection and alarm system.

Building designs which have a fire alarm system shall have an exterior strobe light alarm device mounted on the outside of the building on the street side. The strobe acts as a visual indication to the responding firemen. It decreases response time because the firemen don't have to waste time hunting for building numbers.

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SECTION 13900
Fire Protection Systems

Ft. Campbell Requirements:

Special Requirements for Backflow preventers in sprinkler systems:

Do not use a strainer with the backflow preventer.

Provide a means to perform a full flow test of the backflow preventer. NFPA allows. Do not allow removal of the clappers from check valve and fire department connection for this purpose, however this is a nuisance. Provide a test valve for this purpose. Tee into the sprinkler system downstream of the backflow preventer. Route the discharge water outdoors.

Refer to Section 15400 for general backflow preventer requirements.

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TECHNICAL DESIGN GUIDE
CHAPTER 3
Technical Requirements and Instructions
Division 15000

Section

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15550	Water and Steam Heating
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15990	Testing, Adjusting, and Balancing HVAC Systems
15995	Commissioning HVAC Systems

SECTION 15000
General

Ft. Campbell Requirements:

Building service areas (mechanical rooms, electric/telephone rooms, cooling towers, grease traps, etc.) shall be easily accessible by maintenance personnel directly from the exterior, and shall include vehicle accessibility (i.e., pavement for utility trucks, etc.).

Make valves, balancing equipment, switches, etc., easily accessible for adjusting and maintenance. Ensure adequate clearances are maintained to pull tubes, filters, etc. on a

heat exchangers, boilers, HVAC coils, etc. Provide adequate space and clearances for maintenance of the equipment. The use of butterfly valves is not acceptable.

Make sure unions are located so that they can be turned with a wrench.

Do not install equipment on metal or sloping roof systems.

For each piece of equipment ask yourself how the maintenance technician will access the equipment for service, repair, and removal and replacement of heavy parts such as motors.

If a VAV system is used, the designer must carefully consider the mounting location of each VAV box. The VAV boxes must be easily accessible from a step ladder. They should be located so that moving furniture is not necessary. VAV boxes must not be located high above a suspended ceiling; this makes access nearly impossible. Designers must show the mounting height and insure access to all sides of the VAV boxes.

The use of copper-finn tube boilers is not acceptable.

Fort Campbell's preferred manufacturers are shown on the following table:

Item	**Preferred Manufacturer**	**Model/Remarks**
Plumbing Systems		
Circulating Pump	Taco	Bronze 10-15 gpm with Acqua stat on projects having copper runs over 60 feet
Commodes – flush type	Kohler	1.6 gallons with 3.5 gal Sloan flush valve manually operated
Commodes – tank type	Mansfield	135 bowl with 160 tank bottom flush
Faucet - lavatory	Delta	Single handle – or as specified
Faucet - shower	Simmons	Model 2000 Temp Troll
Urinals	Kohler	Sloan flush valve manually operated. Waterless urinals are not acceptable
Water Boiler	Hesco	With storage tanks, where appropriate
Water Cooler – Floor Mount	Sunrock	As specified
Water Cooler – Wall Hung	Sunrock	As specified
Water Heaters	None Specified	Residential – Gas desired. Instant water heaters are not acceptable
		General Notes
		Do not use institutional shower heads
		Provide cleanouts on main runs
		Install 18" clear maintenance chase when six fixtures or more are connected back-to-back
		Type K copper on recirculation systems

Mechanical Systems	
Air Compressors	Quincy
Air Conditioners	Trane
Chillers	Trane
Furnaces	Trane/Carrier
Electrical Systems	
Building Controls	Johnson or Honeywell
Utility Monitoring & Controls	Tridium

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SECTION 15080
Insulation

Ft. Campbell Requirements:

Do not use all service jacket (ASJ) in humid or unconditioned spaces. The adhesive on this product does not hold in high humidity conditions.

Do not use fiberglass outdoors or anywhere insulation may get wet.

Provide metal or PVC covering over piping or equipment insulation in spaces that are not air conditioned (cooled); mechanical rooms and storage rooms are examples.

SECTION 15100
Hydronic Piping

Ft. Campbell Requirements:

Provide a location for injecting chemical inhibitors into the system.

Provide a location for pulling water samples.

Provide strainers to remove solids from system.

Avoid using glycol systems. If a glycol system must be used, provide a means to flush the system and show it on the drawings.

Avoid the use of Dual Temperature piping systems.

Install expansion tank valves and unions so the tank can be isolated from the system for maintenance. Valves are to be mechanically tied down so they cannot be inadvertently closed. Provide a drain line and valve connected to the piping between the isolation valve and the expansion tank for draining the expansion tank in order to check the air pre-charge.

Show the required air pre-charge pressure on the drawings.

Install valves and unions to isolate individual equipment. Install valves to isolate individual buildings on central systems servicing several buildings..

Size balance valves to have about 1 psi pressure drop wide open so that they will not operate nearly closed to achieve the necessary flow restriction in the system.

Specify gate valves or ball valves in lieu of butterfly valves.

Avoid valves that function as a combination check, balance, and isolation valve all in one. These triple duty type valves compromise each function. Provide separate valves. Remove triple duty type valves from the specifications.

Detail and specify vents at all trapped high points in the piping.

Detail and specify drains at all trapped low points in the piping.

Use dial type thermometers installed in thermowells.

Provide spare thermowells at each temperature sensor.

Use oil filled dial type pressure gauges.

Where domestic water is used for system make-up, use a reduced pressure backflow preventer in the make-up line.

Use separate backflow preventers on the make-up lines to the chilled water and the hot water systems. Otherwise cross flow between the systems can occur (even if check valves are used).

SECTION 15190
Gas Piping

Ft. Campbell Requirements:

Gas lines shall not be used for electrical grounding.

Refer to **Appendix F** Utility Procedures for outside service lines.

SECTION 15400
Plumbing, General Use

Ft. Campbell Requirements:

Water lines and gas lines shall not be used for electrical grounding.

Water Supply:

- Testing – Conduct sterilization/flushing of new water lines. Perform bacteriological testing of new water lines. See **Ft. Campbell Water Distribution System**.

Fixtures:

- Use of Delta and American Standard fixtures. Discuss with plumbing shop at Pre-design Meeting to obtain fixtures preferences.
- Faucet fixtures shall be metal and not plastic.

Drains:

- Be sure equipment drains are sized properly.
- No HVAC drain lines to oil/water separators.

Waste:

- Cast iron pipe is preferred under building slabs for waste lines due to its service life and durability. PVC will be considered by Fort Campbell for approval if adequate design information is provided by designer as to its strength and service life.

Grease Traps:

- Provide access (i.e. a way for a pumper truck to drive right up to the trap) for maintenance and periodic pump out.

Backflow Preventers:

Locate in a visible location with full access to the device for component removal and service no more than than 4 feet above the floor.

Devices must be installed far enough away from walls and other equipment to allow service and repair (nominally 1 foot clearance on either side and 3 feet of clearance top and bottom) such that testing or repair can be performed without interference from adjacent equipment or building structure.

Reduced Pressure Backflow Preventor (RPBP) and Double Check Backflow Preventor (DCBP) devices should be equipped with test cocks.

Testable RPBP and DCBP devices should be equipped with strainers except in fire suppression systems.

All backflow devices must be installed horizontally unless the device is specifically designed for vertical installation.

RPBP relief valves must be vented to a drain of sufficient capacity to handle the full discharge flow of the relief valve.

Large RPBP devices (3”D or greater are best vented to the outside unless a large floor drain with sufficient capacity is available.

Preferred devices include: Watts Regulator Inc., Zurn-Wilkins Inc., or Ames Corporation

RPBP devices must not be installed underground where they are susceptible to flooding. If an outdoor location is required,install the backflow preventer in an insulated box with a heat plate for freeze protection.

Point of Contact for backflow prevention is Gary Sewell in Utilities Management Branch at 270-798-5640.

ALL personnel involved with "backflow devices" shall be Tennessee/Kentucky certified in backflow devices. Contractors shall be required to qualify as a licensed Tennessee/Kentucky "Master Plumbers" Contractor. DPW personnel installing, maintaining, or inspecting will also need to obtain and maintain the Tennessee certification (Master Plumber is optional). Tennessee offers training at no cost at it's training center in Murfreesboro several times a year. Initial training is 4 days, renewal training is 2 days.

Atmospheric Vacuum Breaker Devices (AVB) should be installed with no valves downstream. A minimum of 6 inches must be provided above all downstream piping and flood level rim of receptor (hose bib, sink faucet, etc.).

Consider parallel devices where shutdown for inspection and maintenance is not feasible.

Devices shall have individual serial numbers. Numbers are needed to track a device to ensure it is not relocated or another type of device is installed. This is verified on the annual inspections/testing.

The following are backflow applications and recommended devices:

Building Feed	RPBP	High Hazard
Building Bypass	RPBP	High Hazard
Boiler Make up water	RPBP	High Hazard
Chiller Make up Water	RPBP	High Hazard
Wash Water Systems	RPBP	High Hazard
Dynamometers	RPBP	High Hazard
Film Developers	RPBP	High Hazard
Fire Systems w/ chemicals	RPBP	High Hazard
Water Conditioners	RPBP	High Hazard
Chemical Feed Tanks	RPBP	High Hazard
Pump Seal Flush	RPBP	High Hazard
Sewage Plant Connections	RPBP	High Hazard
Compressor Cooling Water	RPBP	High Hazard
Building Feed	DCBP	Intermediate Hazard
Building Bypass	DCBP	Intermediate Hazard
Garbage Disposal	DCBP	Intermediate Hazard
Irrigation Systems	DCBP or PVB	Intermediate Hazard
Ice Machines	DCBP	Intermediate Hazard

Steam Cookers	DCBP	Intermediate Hazard
Drink Machines	DCBP	Intermediate Hazard
Dental Utility Boxes	DCBP	Intermediate Hazard
Mop Sink	AVB	Intermediate Hazard
Hose Bibs	AVB	Intermediate & Low Haz.
Laboratory Sinks	AVB	Intermediate Hazard
Dishwashers	AVB	Intermediate & Low Haz.
Kitchen Wash Sink	AVB	Intermediate Hazard

Abbreviation:	Type of Device:
RPBP	Reduced Pressure Backflow Preventor
DCBP	Double Check Backflow Preventor
PVB	Pressure Vacuum Breaker
AVB	Atmospheric Vacuum Breaker

SECTION 15550
Water and Steam Heating

Ft. Campbell Requirements:

Environmental Air Quality requirements apply. See Appendix A, **Environmental Topics**.

Install fire tube boilers in lieu of sectional boilers.

Install emergency boiler shutoff (push button) switches just inside mechanical room door.

In converters, use stainless steel converter tubes instead of copper.

Include manufacturer approved devices installed for testing samples of water and steam in the system (both in the mechanical room and at the ends of the system).

For Steam regulators, use Leslie regulator.

At the steam entrance into a building, install a double-block-and-bleed valve arrangement for positive isolation and venting of the steam during maintenance of the downstream system components.

For oil containing equipment, design a containment curb under the equipment.

Do not install equipment in pits.

Locate laminated copies of as-built drawings and control schematics in mechanical rooms.

SECTION 15620
Chillers

Ft. Campbell Requirements:

Locate equipment to minimize piping runs.

Do not install roof-top equipment on metal or sloping roof systems.

Where direct expansion units are employed, use only manufacturer standard sized package units.

Install only manufacturer standard sized package chillers.

On outdoor package chillers, provide a circulating pump and bypass to allow flow through the chiller during the heating season (trying to keep from draining the system).

Design for the chiller to have control of the pumps for chiller freeze protection.

Install strainers upstream of chiller barrels and condenser barrels.

Install a single pressure guage on the chiller barrel piped to read the inlet and outlet pressure.

Install a single pressure guage on the condenser barrel piped to read the inlet and outlet pressure.

Refer to Section 15951 Direct Digital Control for DDC for the points required to be monitored and controls from the Energy Monitoring and Control System. Specify that the chiller have the capability to communicate this data.

SECTION 15700
Air-Conditioning System (Unitary Type)

Ft. Campbell Requirements:

Do not install roof-top equipment on metal or sloping roof systems.

Locate equipment to minimize piping runs.

Use only manufacturer standard sized package.

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SECTION 15702
Computer Room Units

Ft. Campbell Requirements:

Provide soft water for make-up.

Provide automatic blowdown for humidifiers.

Oversized computer room units are common. Determining the cooling load by summing all the nameplate amp ratings of all the computer equipment will surely result in an oversized unit and cause inefficient operation. Space humidity may not be a problem only because the computer room unit has reheat capability. The unit adds enough heat to make up for the excess in airflow. Size computer room units to accommodate the actual heat release from the computer equipment; airflows will be decreased, the supply temperatures will be lower for a longer period of time, and the reheat will operate far less frequently. Always consider multiple computer room units to split the cooling load; if one unit fails, the other can keep the space at a reasonable temperature.

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SECTION 15895
Air supply, Distribution, Ventilation, and Exhaust System

Ft. Campbell Requirements:

Solvent cleaning in Arms Rooms - adequate ventilation a concern. Ventilate arms vaults at a rate of 0.1 CFM / Sq.Ft. minimum at all times. Provide separate manually operated ventilation at the rate of 0.5 CFM / Sq.Ft. during solvent cleaning.

Provide balancing dampers in all branch ducts feeding diffusers. Do not use volume dampers at diffusers for balancing because the noise created by a throttled damper at the diffuser is not attenuated.

Avoid over estimating cooling loads and cooling air flow to spaces. Doing so causes high space humidity, especially at part load cooling conditions. Refer to the appendix titled Mold and Humidity for air system considerations with regard to achieving good space humidity conditions.

Size cooling coils handling outdoor air for the design dry bulb temperature day, or the design humidity day which ever gives the greater coil capacity.

Provide dial type thermometers at air handlers to indicate the temperature of the supply air, return air, outdoor air, and mixed air.

Provide pressure gauges at air handlers to measure the supply duct pressure, the filter differential pressure, and the fan differential pressure.

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SECTION 15940
Vehicle Tailpipe Exhaust

Ft. Campbell Requirements:

The designer must verify the type of vehicles being serviced. Large diesel engine driven vehicles can require an exhaust volume much higher than the typical 400 to 600 CFM vehicle exhaust system can handle.

Before sizing the exhaust system components, determine the engine displacement, the engine speed while being run on the exhaust system, whether or not the engine is turbocharged, and whether the engine is operated loaded or unloaded at high idle speed.

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SECTION 15951
Direct Digital Controls (DDC)

Ft. Campbell Requirements:

General Requirements:

Provide system control schematic diagrams for each system indicating all required sensors, actuators.

Indicate the valve coefficient, Cv for each control valve.

Locate Freeze stats downstream of the heating coil and be sure manufacturer approved mounting is specified.

Electric actuators are to be oil immersed gear actuated or Belimo type. Do not use electro-hydraulic actuators.

Provide actuator position feedback to the DDC for monitoring the position of all valves and dampers.

Be sure conduit enters the control panel from the bottom only.

Specify that all wiring leaving the panel must be landed on a terminal strip separate from the control devices.

Provide control panel with hasp and pad lock in lieu of the panel lock. Pad lock shall be keyed same as the room door.

Do not use a personal computer (PC) as a router to convert from one protocol to another. PCs should be used as the interface to the system, not as a required component in the network.

Show the location of the control panels on the drawings.

Provide laminated control diagrams in the control panel.

EMCS Requirements on Bid Projects:

Include the following provisions in the specification, However do not include the notes to the designer in the specifications:

1.x Connection to the Energy Management and Control System (EMCS)

1.x.1 The Direct Digital Controls (DDC) system shall be connected to the existing Fort Campbell EMCS central workstations in buildings 865 and 3904. The existing EMCS is an Andover Continuum DDC system.

1.x.2 The connection shall provide monitoring and control of the building control system from the existing EMCS central workstations.

1.x.3 The connection to the EMCS shall provide the ability to do the following from the existing central workstations: monitor inputs, control outputs, revise equipment schedules, override schedules, set up trends, and receive alarms.

1.x.4 The connection shall use the existing post Ethernet network as the data transmission media.

1.x.5 The connection communication protocol shall be in strict conformance to the Building Automation and Control Network (BACnet®) Standard 135 published by the American Society of Heating Refrigerating and Air Conditioning Engineers (ASHRAE).

1.x.6 Additional hardware shall not be installed at building 865 or 3904.

1.x.7 Additional software shall not be installed on the existing EMCS workstations.

1.x.8 The contractor shall be responsible to complete the connection and system integration of the building controls to the existing EMCS including all required programming of the existing EMCS workstations. The point of contact for work on the existing EMCS (Andover Controls) workstation is Patrick Hamsley, Radco, phone 502 267-9636.

1.x.9 The control inputs and outputs, the schedules, and the alarms to be transmitted shall be as shown on the drawings.

> ***Note to the Designer: On the drawings, in addition to the system control schematics, and sequences of operation, provide a table showing for each system indicating the inputs, outputs, trends, schedules and alarms to be available at the EMCS. Refer to the section below titled EMCS Points for the minimum required points to be made available at the EMCS.***

1.x.10 A personal computer (PC) type workstation shall be provided at the building if specified or shown on the drawings for use as a local interface to the building controls.

1.x.11 A personal computer (PC) shall not be used as the building interface to the EMCS, nor shall a PC be be used to convert protocol used by the building controllers to BACnet protocol.

1.x.12 Notify the Contracting Officer 4 weeks in advance of the building connection to the post Ethernet and coordinate with the Directorate of Public Works (PWC) point of contact for Information Technology (IT) issues. The DPW contact is Tim Foe, phone 270-798-6716. DPW will provide IP addresses, install anti-virus software on any building workstations, and coordinate with Fort Campbell Information Technology Business Center (ITBC) concerning the connection to the post Ethernet.

> ***Note to the Designer: On the drawings, show the limit of work by the contractor for the EMCS connection. Generally, the Government (ITBC) will make the physical wiring connection using Category 5 cables between the new building controller and the Ethernet switch in the communications room. The contractor would then provide an empty conduit from the building controller cabinet to the communication closet or as directed by the Government (ITBC). Show two cables from the Ethernet switch in the Communications room to the building controller cabinet. One cable is for data communication to and from the EMCS, the other is for a communication port in the controller cabinet for connection of the portable service tool (laptop).***

EMCS Requirements on Design / Build Projects:
Include the following words in the Request for Proposal (RFP) in the section dealing with building controls. However do not include the notes to the RFP author in the RFP:

The HVAC control system shall be a direct digital control (DDC) system meeting the requirements of and installed in accordance with [Unified Facility Guide Specification UFGS-15951 Direct Digital Controls][Specification Section 15951 Direct Digital Controls]. The equipment shall be limited to the options contained within the specification.

The DDC system shall be connected to the existing Fort Campbell Energy Monitoring and Control System (EMCS) central workstations in buildings 865 and 3904.

The existing EMCS is an Andover Continuum DDC system.

The connection shall provide monitoring and control of the building controls from the existing central workstations.

The connection shall provide the ability to do the following from the existing central workstations: monitor and control inputs and outputs, revise equipment schedules, override schedules, view trend data collected and stored at the building controllers, set up trends at the workstation, and receive alarms from the building controllers.

The connection shall use the existing post Ethernet network as the data transmission media.

The connection communication protocol shall be in strict conformance to the Building Automation and Control Network (BACnet) Standard 135 published by the American Society of Heating Refrigerating and Air Conditioning Engineers (ASHRAE).

Additional hardware shall not be installed at building 865 or 3904.

Additional software shall not be installed on the existing EMCS workstations.

The contractor shall be responsible to complete the connection and system integration of the building controls to the existing EMCS including all required programming of the building controls and the existing EMCS workstations.

The point of contact for work on the existing EMCS (Andover Controls) workstation is Patrick Hamsley, Radco, phone 502-267-9636.

The control inputs and outputs, the schedules, and the alarms to be transmitted shall be as indicated in this scope of work.

Note to the RFP author: Include a list or table showing typical inputs, outputs, schedules, and alarms to be transmitted to the EMCS, and trends to be maintained by the building controls and available to the EMCS. Include the position of all damper and valve actuators as an input available at the EMCS. Refer to the section below titled EMCS Points for the minimum required points to be made available at the EMCS.

[A desktop personal computer (PC) type workstation shall be provided at the building for use as a local interface to the building controls.]

Note to the RFP author: Include the above requirement if the building occupants want a local interface to the controls. This will rarely be the case.

A personal computer (PC) shall not be used to interface the building controls to the EMCS network, nor shall it be used to convert protocol used by the building controllers to BACnet protocol.

Note to the RFP author: A PC is considered to be an unreliable means of providing router functions and can not be located in the mechanical room because of the dust, humidity, and temperature.

A portable workstation / tester (lap top type computer) shall be provided with controls set up and diagnostic software installed. This device shall serve as a tool for the maintenance staff to access and modify the controls configuration.

Notify the Contracting Officer 4 weeks in advance of the building connection to the post Ethernet and coordinate with the Directorate of Public Works (PWC) point of contact for Information Technology. The DPW contact is Tim Foe, phone 270-798-6716. DPW will provide IP addresses, install anti-virus software on [any building workstations and on] the portable workstation / tester service tool and coordinate with Fort Campbell Information Technology Business Center (ITBC) concerning the connection to the post Ethernet and opening the communication port.

Note to the RFP author: Delete the bracketed words if a PC for local interface to the controls is not provided.

The Government (ITBC) will make the physical connection between the new building controller and the Ethernet switch in the communications room. The contractor shall provide an empty conduit from the building controller cabinet to the communication closet.

Note to the RFP author: Contact ITBC to confirm that they will perform the work described or modify the above provisions in accordance with discussions with ITBC.

EMCS Requirements on All Projects - EMCS Points:
Inputs and outputs (points) to be connected to the Energy Monitoring and Control System are given below. The designer or author of the RFP should be sure that the procurement documents require that these points are available at the EMCS as a minimum.

Abbreviations that may be used in this section are as follows:

AI – analog input
AO – analog output
CSR – current sensing relay
DI – digital input
DO – digital output
dP – differential pressure
EMCS - Energy Monitoring and Control System
HVAC - Heating Ventilating and Air Conditioning
KW - Kilowatt
LAN – local area network
MZ – Multizone
SZ – Single Zone
VAV – Variable Air Volume

Ethernet Hub and Communication Cable

Verify that there will be an Ethernet hub within the building. This serves as the connection to the EMCS. A communication line will need to be extended to the mechanical room for connection of the gateway or router. If discussion with Fort Campbell ITBC is required, call Phil Butler at (270) 798-9654. This information will be included on the building plans.

Points

New instrumentation and controls such as sensors, control relays, and status indication will be connected to the EMCS. The following is a recommended summary of the minimum EMCS points to connect. Some of the listed equipment may not be used on this project. Some equipment may be missing. However, this list should give a feel for the types of points to connect. Note that some of the points such as damper or valve actuator position may not be needed by the building controls. Such points would be monitoring points.

Air Handler Units - Single Zone, VAV, and Multizone

Digital Outputs:

Start / Stop signal

Vent Delay signal. This is used to disable the outdoor air damper during morning warm up (or cool down) before the building occupants arrive. It is not required if the local controls are taking care of this function.

Analog Outputs: None

Digital Inputs:

Fan on / off status via dP switch is the preferred method. CSR is second preference.

Differential pressure switch across filters.

Economizer status.

Freezestat status.

Duct Smoke detector status.

Analog Inputs:

Supply air temperature.

Hot deck temperature for MZ units.

Cold deck temperature for MZ units.

Return air temperature.

Mixed air temperature. Add the sensor if it is not part of the normal controls.

Damper positions.

Valve positions.

Space temperature.

Space humidity where sensors are installed for humidity control.

OA temperature sensors will not be added or connected. OA temperature is currently monitored by the EMCS at a central location.

Alarms:

AHU fan failure to start

AHU fan failure to stop

Return Temperature High

Return Temperature Low

Space Temperature High

Space Temperature Low

Mixed Air Temperature Low

Freezestat Trip

Smoke condition

Trend: Data is stored at the building controller

Space temperature

Space humidity

Supply Air Temperature

VAV Boxes (applies to normal pressure independent VAV boxes)

Digital Outputs: None

Analog Outputs:

Space temperature setpoint adjustment.

Digital Inputs:

Fan Status, if the box is fan powered.

Analog Inputs:

Space Temperature

Air Flow through the primary air damper

Damper position

Valve position

Alarms: None

Trend: None

Hot Water Boiler

Digital Outputs:

Control Relay to disable the boiler.

Analog Outputs: None.

Digital Inputs:

Boiler (burner) status will be included.

Analog Inputs:

Hot water supply temperature to the building.

Hot water return temperature from the building.

Alarms:

Boiler trouble alarm from ignition controls

Hot leaving temperature high

Hot leaving temperature low

Trend: Data is stored at the building controller

Hot water supply temperature

Hot water return temperature

Steam to Hot Water Converter

Digital Outputs:

Control Relay to disable the steam valve.

Analog Outputs: None.

Digital Inputs: None.

Analog Inputs:

Converter entering water temperature.

Converter leaving water temperature.

Alarms:

Hot leaving temperature high

Hot leaving temperature low

Trend: Data is stored at the building controller

Hot water supply temperature

Hot water return temperature

Chillers

Digital Outputs:

Enable / Disable Signal.

Analog Outputs:

Chilled water setpoint adjustment.

Digital Inputs:

On / Off Status.

Chiller failure alarm: This is to indicate when there is a local chiller alarm. The specific condition causing the alarm need not be transmitted. The goal is to know when the chiller is in need of service.

Analog Inputs:

Chilled water supply temperature from the chiller to the building.

Chilled water return temperature from the building to the chiller.

Condenser water inlet temperature.

Condenser water outlet temperature.

Alarms:

Chiller failure signal from chiller packaged controls

Failure to stop after Disable command

Trend: Data is stored at the building controller

Chilled water supply temperature

Chilled water return temperature

Condensing Units

Digital Outputs:

Enable / Disable Signal. The signal serves to override the local automatic controls to force the condensing unit to stop.

Analog Outputs: None.

Digital Inputs:

On / Off Status via a CSR or interface to the on-board controls.

Analog Inputs: None.

Alarms:

Failure to stop after Disable command

Trend: None

Pumps

Digital Outputs:

Enable / Disable signal to override the local motor controls and force the pump to stop even if the motor starter is in the HAND position.

Analog Outputs: None.

Digital Inputs:

Pump on / off status; by a dP switch or by CSR.

Analog Inputs: None.

Alarms:

Failure to start.

Failure to stop.

Trend: None

Occupied Space

Digital Outputs: None

Analog Outputs: None.

Digital Inputs: None.

Analog Inputs:

Space temperature. Use VAV box sensors where possible. Use space sensors included for the control of air handlers where possible. In this case the space temperature may be shown as a point associated with the air handler. Additional space sensors may be added if necessary.

Alarms:

Space temperature high

Space temperature low

Trend: Data is stored at the building controller

Space temperature

Computer Room Units (such as Liebert units)

Digital Outputs: None.

Analog Outputs: None.

Digital Inputs: None.

Analog Inputs: None.

Alarms:

Trouble or failure signal from the packaged controls.

Trend: None

Make-up Air Units

As a rule, there is no EMCS control of the process exhaust equipment such as kitchen hoods. Likewise there will be no EMCS control of the associated make up air equipment serving kitchen hoods. However, where space sensors in the areas served by the make up air units are connected to the DDC, these will be included and connected to the EMCS.

Digital Outputs: None

Analog Outputs: None.

Digital Inputs:

On / Off Status.

Analog Inputs:

Space Temperature where this sensor is interfaced to the DDC.

Trend: None

Infrared Gas Heaters

Digital Outputs: None.

Analog Outputs: None.

Digital Inputs: None

Analog Inputs:

Space Temperature.

Alarms: None

Trend: None

SECTION 15990
Testing, Adjusting, and Balancing (TAB) HVAC Systems

Ft. Campbell Requirements:

Require the TAB technician to measure, balance, and report the building pressure relative to atmosphere.

Where VAV systems are employed, require measurement of the building pressure at full air flow and at minimum air flow.

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SECTION 15995
Commissioning of HVAC Systems

Ft. Campbell Requirements:

All projects, MILCON and OMA and other funding sources, shall be executed using commissioning procedures and processes per the COE specification.

Any special tools, computers, software, etc., required for operations and maintenance of the new equipment that will assist maintenance personnel maintain the facility shall be turned over to the contracting officer.

Specify training for DPW personnel**.** Training shall be given by factory authorized personnel.

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TECHNICAL DESIGN GUIDE
CHAPTER 3
Technical Requirements and Instructions
Division 16000

Section

16000 Electrical Work, General
16264 - 5 Standby Electric Generator Sets
16370 Electrical Distribution System, Aerial
16375 Electrical Distribution System, Underground
16415 Electrical Work, Interior
16528 Exterior Lighting Including Security
16700 + Communications Systems and Premises Distribution System

Section 16000
Electrical Work, General

No electric equipment shall be installed within or on any Fort Campbell building, structure, or premises, nor shall any alteration or addition be made in any existing equipment without first securing an Electrical Permit from the Fort Campbell Electrical Inspector in accordance with CAM Regulation 420-4 (Quality Assurance "Electrical" Inspection Standards). An Electrical Contractor Registration Form must be completed. This form will be attached to the back of your copy of the CAM Regulation. Your Contractor's license will then need to be validated against the Fort Campbell Review Board list of State Electrical Licenses valid on Fort Campbell KY before you can obtain a permit. To review CAM Regulation 420-4 click here. Permits shall be obtained at DPW, Utilities Maintenance Building 868, Bastogne & 16th Street, Fort Campbell, Kentucky.

SECTION 16264 - 5
Standby Generator Sets

Ft. Campbell Requirements:

General Requirements:

- All Emergency Standby Generator sets shall employ Diesel Engines using DF 2 fuel and the engine speed shall be 1800 RPMs with manufacturer recommended over-speed protections. No LP, Natural Gas or Gasoline prime movers shall be approved for any reason.
- All Emergency Standby Generator sets shall be sized to the service of the main breaker/fuse.
- All Emergency Standby Generator sets shall service the entire facility; no partial coverage of a facility shall be permitted.
- Engines shall be radiator and fan cooled, and shall not be naturally aspirated.
- All emergency/standby generator sets shall conform to NFPA 110 either Level 1 or Level 2 Standards and installation quality.
- All emergency/standby generator sets shall be 1 step load increase to 100% of Service Load.
- Each generator shall start and assume 100% load within 10 seconds.
- Specifications requirements shall include obtaining all local and state (Kentucky or Tennessee) permits prior to beginning construction. Local permits shall include demolition, digging, excavation, compaction, electrical, fuel tank installation, and environmental. All submittals, site locations, load analysis and designs shall be approved by the Local Authority Having Jurisdiction to include but not limited to the Generator Mechanic for Directorate of Public Works .

Site Requirements:

A. Location:

- The Generator Set shall be located a minimum of 10 feet from any building or structure.
- The Generator Set shall be located a minimum of 30 feet from any overhead power lines or transformer banks unless otherwise directed.
- The Generator Set shall have a minimum of 5 feet clearance on all sides to facilitate maintenance**.**
- The Generator Set shall be a minimum of 5 feet from any type of vehicular traffic to include but not limited to streets, parking lots, alleys, or access roads and activities including mowing equipment.
- The Generator Set exhaust stack shall be a minimum of 10 feet from any building or structure to include any protrusions such as an overhangs, eaves,

landscaping, etc., and it shall point away from any air conditioning or other air intake systems.

- The Generator Set shall have adequate access and ample room to be refueled using a standard refueling truck.
- Exterior located Generator Sets shall be placed on monolithically pour concrete foundation with stem walls. IAW CFR 40, section 112, a secondarily contained, monolithically poured pad shall be sized to hold 110% capacity of the fuel to be stored. The pad shall be slope to allow drainage thru a 4-inch PVC valve located in the corner of the lowest point of the pad, to include a 5-inch minimum thickness broom finish concrete rectangular pad. The pad shall extend a minimum 4-feet beyond the generator set in all directions. The concrete pad area shall be expanded as required to include associated electrical switch enclosures. Provisions for stub-up of electrical conduits shall be integral to design a construction of concrete base pad construction.
- See additional requirements for DAY TANKS.

B. Protection**:**

- The Generator Set shall have collision bollards placed around the generator pad. Each bollard shall be 6-inch diameter std. weight steel pipe 8 feet long.
- The bollard shall be installed in a 24-inch hole, 4 feet deep, and filled with concrete to include filling the bollard. The bollard shall then be painted caution yellow when finished.
- Bollards shall be placed 5 feet from the pad to prevent any vehicular damage to the generator set. One bollard will be placed at each corner of the generator base pad at a distance of 5 feet. The distance between any two bollards shall not exceed 6 feet. An average size generator set uses 10 bollards. The Local Authority having Jurisdiction will determine the location of each bollard when exceptions are necessary.
- See additional requirements for DAY TANKS.

Generator Set Requirements:

- All emergency/standby generators shall be mounted on spring isolators and flexible connections rated for seismic Zone C.
- The generator main circuit breaker: shall be set mounted and wired, UL listed, molded case thermal magnetic type. Each breaker shall be Shunt-Trip and wired to the engine fault conditions. Field circuit breakers shall not be acceptable for generator over current protections.

(Continued)

Day Tank Requirements:

- Sub-base (in skid/belly) fuel tanks will not be acceptable unless specifically specified and or approved by the Local Authority Having Jurisdiction to include but not limited to the Generator Mechanic for Directorate of Public Works .

- All day tanks shall be capable of holding manufacturer recommended tank size for 2-hour 100% continuous load run. For smaller installations not less than 25-gallon day tank fuel storage capacity will be specified.
- All main/day tanks shall be above ground double walled permanently mounted to the floor or exterior concrete pad or they shall be concrete encased vaulted (equal to or greater than CONVAULT Type).
- When the day tank is located outdoors, it shall have an Outdoor Weather Protective Housing installed. (If Required)
- Emergency Standby Generator Sets installed inside of a structure shall have a day tank installed as part of the package.
- Each above ground fuel tank shall be at the minimum distance of 10 feet from any structure, overhang, property line, parking lot, or roadway.
- Each above ground fuel tank shall have 6-inch standard weight steel pipe concrete filled bollards placed around it to prevent accidental collision or impact from vehicles and or mowers. These bollards shall be primed and painted to prevent corrosion. The color shall be yellow.
- All fuel lines, (supply and return), shall be of black steel, non-wielded (threaded) construction. The fuel lines shall not rest on grade. They shall be mounted at the minimum height of at least 6 inches above grade. The fuel lines shall be separated at the minimum distance of 6 inches. The supply fuel line shall be ½ ID, and the return fuel line shall be ¾ ID unless larger is manufacturer recommended. All fuel lines will have a vinyl or metal protective covering.
- All fuel lines will be insulated and have heat trace installed to prevent gelling of the fuel.
- Each day tank shall include a spin on canister type fuel filter to prevent contamination of the fuel supply.
- Each main fuel tank shall be equipped with an Anti-siphon valve.
- Each tank shall have a manual ball type shut off valve installed as close as possible to the Anti-siphon valve. No check valves shall be used in either the supply or the return fuel lines.
- Operation:
    - Each day tank shall use 120 VAC, 60 Hz electrical power. Each day tank shall have a supply pump capable of delivering fuel at the rated capacity of 2-gpm rate. It shall have a second pump capable of returning excess due to an overflow condition to the AST at the rated delivery of 3-gpm. Automatic operation. At 50% of fuel, the supply pump will energize and pump fuel from the AST back into the day tank. At 90% fuel level, the supply pump will de-energize.
    - Manual operation. The day tank shall be equipped with a manual operation switch to allow the operator to manually energize the supply pump.
    - Electronic 120 VAC fuel shutoff solenoid valve shall be installed down stream of the supply fuel pump. It shall be connected as to energize open when the supply pump is energized, and de-energized with the supply pump is de-energized.

- Over-flow activation float switch, shall be automatically activated if the fuel level in the day tank exceeds 95% fuel level. The return fuel shall then be pumped back into the AST.

- Controls and Functions:
  - The day tank control panel shall have the following minimum indications:
    Fuel Level
    Fuel Pump Status

Automatic Transfer Switch (ATS):

- Each ATS shall be of the standard type unless otherwise specified to be an Isolation Bypass type ATS. Equipment shall be a standard product of a manufacturer regularly engaged in manufacturing the products whose applications are similar to the required design and rating of ATS equipment. Equipment shall be capable of being serviced by a manufacturer authorized and trained organization that is reasonably convenient to the site.
  - Each ATS shall have a fusible disconnect or circuit breaker upstream of the ATS or unless otherwise specifically stated that the ATS shall be a Service Entrance Rated ATS.
  - Each ATS shall have an automatic exerciser installed to be able to program the generator set and the ATS to exercise once a week with or with out a load.

Instructions to Designers:

1. All project generator set guide specifications shall be revised to include the following mark-up: **Specification 16264-5, Design Specification for Emergency Standby Generators.**

2. Include all above listed features and specific equipment requirments into project design and contract document drawings and specifications as they apply.

3. The Local Authority having Jurisdiction shall approve all designs, drawings and specifications before bid issue of such projects. This is to insure that once the Generator systems has been inspected and accepted by the appropriate people, it will meet all codes, regulations, and SOPs of Fort Campbell and the state of Kentucky or Tennessee. Once it has been accepted, it becomes Real Property, and P.W.B.C. will be responsible to maintain it. As of this time, Nick Overstake, P.W.B.C. Electric shop is the Local Authority having Jurisdiction on all Generators, Deluge Pumps, and above ground Fuel Systems on Fort Campbell. He can be reached at 270-956-2853 or on his cell phone 931-216-6682.

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Note To Designer: Contents of this DRAFT specification shall be reviewed and incorporated into the project specifications.
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SECTION 16264-5

DIESEL-GENERATOR SET, STATIONARY 15-300 KW, STANDBY APPLICATIONS
06/03

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.11	(1987; R 1993) Instrument Transformers for Revenue Metering, 10 kV BIL through 350 kV BIL (0.6 kV NSV through 69 kV NSV)
ANSI C39.1	(1981; R 1992) Requirements for Electrical Analog Indicating Instruments

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53/A 53M	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 106	(1999el) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 135	(1997c) Electric-Resistance-Welded Steel Pipe
ASTM A 181/A 181M	(2000) Carbon Steel Forgings for General-Purpose Piping
ASTM A 234/A 234M	(2000) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM B 395	(1995) U-Bend Seamless Copper and Copper Alloy Heat Exchanger and Condenser Tubes

ASTM B 395M	(1995) U-Bend Seamless Copper and Copper Alloy Heat Exchanger and Condenser Tubes (Metric)
ASTM D 975	(1998b) Diesel Fuel Oils

ASME INTERNATIONAL (ASME)

ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.5	(1996; B16.5a) Pipe Flanges and Flanged Fittings NPS 1/2 thru NPS 24
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B31.1	(1998) Power Piping
ASME BPVC SEC VIII D1	(1998) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage
ASME BPVC SEC IX	(1998) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS5	(1994; CS5a-1995) Cross-Linked Polyethylene Insulated Shielded Power Cables Rated 5 Through 46 kV
AEIC CS6	(1996) Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 5 Through 69 kV

ELECTRICAL GENERATING SYSTEMS ASSOCIATION (EGSA)

EGSA 101P	(1995a) Engine Driven Generator Sets

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code

IEEE Std 1	(1986; R 1992) General Principles for Temperature Limits in the Rating of Electric Equipment and for the Evaluation of Electrical Insulation
IEEE Std 48	(1998) Standard Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 kV through 765 kV
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)
IEEE Std 100	(1997) IEEE Standard Dictionary of Electrical and Electronics Terms
IEEE Std 120	(1989) Electrical Measurements in Power Circuits
IEEE Std 404	(1993) Cable Joints for Use with Extruded Dielectric Cable Rated 5000 V Through 138 000 V and Cable Joints for Use with Laminated Dielectric Cable Rated 2500 V Through 500 000 V
IEEE Std 519	(1992) Harmonic Control in Electrical Power Systems

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1	(1993) Molded Case Circuit Breakers and Molded Case Switches

NEMA ICS 2	(1993) Industrial Controls and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC
NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures
NEMA WC 7	(1988; Rev 3 1996) Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 8	(1988; Rev 3 1996) Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA MG 1	(1998) Motors and Generators
NEMA PB 1	(1995) Panelboards
NEMA SG 3	(1995) Power Switching Equipment

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30	(1996; Errata TIA 96-2) Flammable and Combustible Liquids Code
NFPA 37	(1998) Installation and Use of Stationary Combustion Engines and Gas Turbines
NFPA 70	(1999) National Electrical Code

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE ARP 892	(1965; R 1994) D-C Starter-Generator, Engine
SAE J 537	(1996) Storage Batteries

UNDERWRITERS LABORATORIES (UL)

UL 489	(1996; Rev thru Dec 1998) Molded-Case Circuit Breakers, Molded-Case

	Switches, and Circuit-Breaker Enclosures
UL 891	(1994; Rev thru Jan 1995) Dead-Front Switchboards
UL 1236	(1994; Rev thru Mar 1999) Battery Chargers for Charging Engine-Starter Batteries

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Layout; G
Drawings; G

a. Base-mounted equipment, complete with base and attachments including anchor bolt template and recommended clearances for maintenance and operation.

b. Starting system.

c. Fuel system.

d. Cooling system.

e. Exhaust system.

f. Electric wiring of relays, breakers, programmable controllers, and switches including single line and wiring diagrams.

g. Lubrication system, including piping, pumps, strainers, filters, heat exchangers for lube oil and turbocharger cooling, electric heater, controls and wiring.

h. Location, type, and description of vibration isolation devices.

i. The safety system, including wiring schematics.

j. One-line schematic and wiring diagrams of the generator, exciter, regulator, governor, and all instrumentation.

k. Panel layouts.

l. Mounting and support for each panel and major piece of electrical equipment.

m. Engine-generator set rigging points and lifting instructions.

Acceptance; G

Drawings, which accurately depict the as-built configuration of the installation, upon acceptance of the diesel-generator, set installation. Layout drawings shall be revised to reflect the as-built conditions and submitted with the as-built drawings.

SD-03 Product Data

Performance Tests; G

Calculations of the engine and generator output power capability, including efficiency and parasitic load data.

Sound Limitations; G

Sound power level data for the packaged unit operating at 100% load in a free field environment. The data should demonstrate compliance with the sound limitation requirements of this specification.

Generator; G

Each generator KW rating and short circuit capacity (both symmetric and asymmetric).

Day Tank; G

Calculations for the capacity of each day tank, including allowances for recirculated fuel, usable tank capacity, and duration of fuel supply.

Power Factor; G

Generator capability curve showing generator kVA output (kW vs. kvar) for both leading and lagging power factors ranging from 0 to 1.0.

Heat Rejected to Engine-Generator Space; G

Manufacturers data to quantify heat rejected to the space with the engine generator set at rated capacity.

Time-Delay on Alarms; G

The magnitude of monitored values, which define alarm or action, set points, and the tolerance (plus and/or minus) at which the device activates the alarm or action.

Cooling System; G

a. The maximum and minimum allowable inlet temperatures of the coolant fluid.

b. The maximum allowable temperature rise in the coolant fluid.

c. The minimum allowable inlet fuel temperature.

Manufacturer's Catalog; G

Manufacturer's standard catalog data describing and depicting each engine-generator set and all ancillary equipment in sufficient detail to demonstrate specification compliance.

Vibration Isolation; G

Vibration isolation system performance data for the range of frequencies generated by the engine-generator set during operation from no load to full load and the maximum vibration transmitted to the floor. Description of seismic zone C or equivalent qualification of the

engine-generator mounting, base, and vibration isolation.

Instructions; G

Instructions including: the manufacturer's pre-start checklist and precautions; startup procedures for test mode, manual-start mode, and automatic-start mode, (as applicable); running checks, procedures, and precautions; and shutdown procedures, checks, and precautions. Instructions shall include procedures for interrelated equipment (such as heat recovery systems, co-generation, load-shedding, and automatic transfer switches). Instructions shall be weatherproof, laminated in plastic, framed, and posted where directed. Posted data shall include wiring and control diagrams showing the key mechanical and electrical control elements, and a diagrammatic layout of the system.

Experience; G

Statement and locations showing that each component manufacturer has a minimum of 3 years experience in the manufacture, assembly and sale of components used with stationary diesel-engine generator sets for commercial and industrial use of similar generator set size, location and function as that identified in the construction documents.

Field Engineer;

A letter listing the qualifications, schools, formal training, and experience of the field engineer.

Site Welding;

A letter listing the welder qualifying procedures for each welder, complete with supporting data such as test procedures used, what was tested to, and a list of the names of all welders and their qualifications symbols.

General Installation; G

A complete copy of the manufacturer's installation procedures. A detailed description of the manufacturer's recommended break-in procedure.

Site Visit;

A site visit letter stating the date the site was visited and listing discrepancies found.

SD-06 Test Reports

Onsite Inspection and Tests; G,

a. A letter giving notice of the proposed dates of all onsite inspections and tests at least 14 days prior to beginning tests.

b. A detailed description of the Contractor's proposed procedures for onsite tests including the test including the test plan and a listing of equipment necessary to perform the tests. Submission shall be at least 7 days prior to beginning tests.

c. Six copies of the onsite test data described below in 216 x 279 mm (8-1/2 x 11 inch) 3-ring binders with a separate section for each test. Sections shall be separated by dividers with tabs. Data plots shall be full size 216 x 279 mm (8-1/2 x 11 inches) minimum), showing all grid lines, with full resolution.

(1) A description of the procedures for onsite tests.

(2) A list of equipment used, with calibration certifications.

(3) A copy of measurements taken, with required plots and graphs.

(4) The date of testing.

(5) The parameters verified.

(6) The condition specified for the parameter.

(7) The test results, signed and dated.

(8) A description of all adjustments made.

SD-07 Certificates

Vibration Isolation; G

Torsional analysis including prototype testing or calculations, which certify and demonstrate that no damaging or dangerous torsional vibrations will occur when the prime mover is connected to the generator, at synchronous speeds, plus/minus 10%.

Prototype Tests;

Manufacturer's standard certification that prototype tests were performed for the generator model proposed.

Reliability and Durability; G

Documentation, which cites engines and generators in similar service to demonstrate compliance with the requirements of this specification. Certification does not exclude annual technological improvements made by a manufacturer in the basic standard model set on which experience was obtained, provided parts interchangeability has not been substantially affected and the current standard model meets all the performance requirements of this specification. For each different set, 2 like sets shall have performed satisfactorily in a stationary power application, independent and separate from the physical location of the manufacturer's and assembler's facilities, for a minimum of 2 consecutive years without any failure to start, including periodic exercise. The certification shall state that for the set proposed to meet this specification, there were no failures resulting in downtime for repairs in excess of 72 hours or any failure due to overheating during 2 consecutive years of service. Like sets are of the same model, speed, bore, stroke, number and configuration of cylinders, an output powers rating. Like generators are of the same model, speed, pitch, cooling, exciter, voltage regulator and output power rating. A list shall be provided with the name of the installations, completion dates, and name and telephone number of a point of contact.

Emissions; G

A certification from the engine manufacturer stating that the engine exhaust emissions meet federal, state, and local regulations and restrictions specified. At a minimum, this certification shall include emission factors for criteria pollutants including nitrogen

oxides, carbon monoxide, particulate matter, sulfur dioxide, non-methane hydrocarbon, and for hazardous air pollutants (HAPs).

Sound limitations; G

A certification from the manufacturer stating that the sound emissions meet the specification.

Flywheel Balance; G

Manufacturer's certification that the flywheel has been statically and dynamically balanced and is capable of being rotated at 125% of rated speed without vibration or damage.

Materials and Equipment; G

A letter stating that where materials or equipment are specified to comply with requirements of UL, or other standards, written proof of such compliance has been obtained. The label or listing of the specified agency, or a written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency are acceptable as proof.

Factory Inspection and Tests; G

A certification that each engine generator set passed the factory tests and inspections and a list of the test and inspections.

Inspections; G

A letter certifying that all facilities are complete and functional, that each system is fully functional, and that each item of equipment is complete, free from damage, adjusted, and ready for beneficial use.

Cooling System; G

Certification that the engine-generator set and cooling system function properly in the ambient temperatures specified.

1.3 SYSTEM DESCRIPTION

Each engine-generator set shall be provided and installed complete and totally functional, with all necessary ancillary equipment to include air filtration; starting system; generator controls, protection, and isolation; instrumentation; lubrication; fuel system; cooling system; and engine exhaust system. Each engine generator set shall satisfy the requirements specified in the Engine Generator Parameter Schedule.

1.3.1 Engine-Generator Parameter Schedule

ENGINE GENERATOR PARAMETER SCHEDULE

Service Load [kW]	[_____] [kVA]
Power Factor	**.08**
Motor Starting kVA (maximum)	[_____] kVA
Maximum Speed	**1800 rpm**
Engine-Generator Application	**stand-alone**
Engine Cooling Type **glycol**	**water/ethylene**
Heat Exchanger Type	fin-tube
Governor Type	**Isochronous**
Frequency Bandwidth (steady state]	± **0.4**%
Voltage Regulation (No load to full load)	± 2% (max.)
Voltage Bandwidth (steady state)	± **0.5**
Frequency	**60** Hz
Voltage	[_____] volts

Phases [3 Phase,	[3 Phase, Wye] Delta] [1 Phase]
Minimum Generator Subtransient Reactance	**12%** percent
Nonlinear Loads	[_____] kVA
Max Step Load Increase Service	100% of Load at 0.8 PF
Max Step Load Decrease Service Load at (without shutdown)	100 % of **0.8** PF
Max Time to Start and be Ready to Assume Load	**10** seconds
Max Summer Outdoor Temp (Ambient)	49 degrees C
Min Winter Outdoor Temp (Ambient)	-30 degrees C
Installation Elevation level	150M above sea

1.3.2 Output Capacity

Each generator set shall provide power equal to the sum of service load plus the machine's efficiency loss and associated ancillary equipment loads. Rated output capacity shall also consider engine and/or generator over-sizing required to meet requirements in paragraph Engine-Generator Parameter Schedule.

1.3.3 Power Rating

Standby ratings shall be in accordance with EGSA 101P.

1.4 GENERAL REQUIREMENTS

1.4.1 Engine-Generator Set

Each set shall consist of one engine, one generator, and one exciter, mounted, assembled, and aligned on one base; and all other necessary ancillary equipment, which may be mounted

separately. Sets shall be assembled and attached to the base prior to shipping. Set components shall be environmentally suitable for the locations shown and shall be the manufacturer's standard product offered in catalogs for commercial or industrial use. A generator strip heater shall be provided for moisture control when the generator is not operating.

1.4.2 Nameplates

Each major component of this specification shall have the manufacturer's name, type or style, model or serial number, and rating number on a plate secured to the equipment. As a minimum, nameplates shall be provided for: Engines; Relays; Generators; Day tanks; Transformers (CT & PT); Regulators; Pumps and pump motors; Governors; Generator Breaker; Economizers; Heat exchangers (other than base-mounted).

Engines	Relays
Generators	Day tanks
Transformers (CT & PT)	Regulators
Pumps and pump motors	Governors
Generator Breaker	Economizers
Heat exchangers (other than base-mounted)	

Where the following equipment is provided as a standard component by the diesel-engine generator set manufacturer, the nameplate information may be provided in the maintenance manual in lieu of nameplates.

Battery charger	Heaters
Exhaust mufflers	Exciters
Switchgear	Silencers
Battery	

1.4.3 Personnel Safety Device

Exposed moving parts, parts that produce high operating temperatures, parts which may be electrically energized, and parts that may be a hazard to operating personnel during normal operation shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. The safety devices

shall be installed so that proper operation of the equipment is not impaired.

1.4.4 Verification of Dimensions

Before performing work, the premises shall be visited and details of the work verified. The Contracting Officer shall be advised in writing of any discrepancies before performing any work.

1.4.5 Conformance to Codes and Standards

Where equipment is specified to conform to requirements of any code or standard such as UL, the design, fabrication and installation shall conform to the code.

1.4.6 Site Welding

Structural members shall be welded in accordance with Section 05090 WELDING, STRUCTURAL. For all other welding, procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by a previously qualified employer may be accepted as permitted by ASME B31.1. Welder qualification tests shall be performed for each welder whose qualifications are not in compliance with the referenced standards. The Contracting Officer shall be notified 24 hours in advance of qualification tests. The qualification tests shall be performed at the work site if practical. The welder or welding operator shall apply the assigned personal symbol near each weld made as a permanent record

1.4.7 Engine Generator Set Enclosure

The engine generator set enclosure shall be corrosion resistant and fully weather resistant. The enclosure shall contain all set components and provide ventilation to permit operation at rated load under secured conditions. Doors shall be provided for access to all controls and equipment requiring periodic maintenance or adjustment. Removable panels shall be provided for access to components requiring periodic replacement. The enclosure shall be capable of being removed without disassembly of the engine-generator set or removal of components other than exhaust system. The enclosure shall reduce the noise of the generator set to within the limits specified in the paragraph SOUND LIMITATIONS.

1.4.8 Vibration Isolation

The maximum engine-generator set vibration in the horizontal, vertical and axial directions shall be limited to 0.15 mm (6 mils) peak-peak RMS with an overall velocity limit of 24 mm/seconds 0.95 inches/seconds RMS, for all speeds through 110% of rated speed. The engine-generator set shall be provided with vibration-isolation in accordance with the manufacturer's standard recommendation. Where the vibration-isolation system does not secure the base to the structure floor or unit foundation, seismic restraints shall be provided in accordance with the seismic parameters specified.

1.4.9 Experience

Each component manufacturer shall have a minimum of 3 years experience in the manufacture, assembly and sale of components used with stationary diesel engine-generator sets for commercial and industrial use. The engine-generator set manufacture/assembler shall have a minimum of 3 years experience in the manufacture, assembly and sale of stationary diesel engine-generator sets for commercial and industrial use.

1.4.10 Field Engineer

The engine-generator set manufacturer or assembler shall furnish a qualified field engineer to supervise the complete installation of the engine-generator set, assist in the performance of the onsite tests, and instruct personnel as to the operational and maintenance features of the equipment. The field engineer shall have attended the engine-generator manufacturer's training courses on installation and operation and maintenance for engine generator sets.

1.4.11 Seismic Requirements

Seismic requirements shall be in accordance with Sections 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT, 15070 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT and 16070 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT [as shown on the drawings]. All emergency/standby generators shall be mounted on spring isolators rated for seismic zone “C”.

1.5 STORAGE AND INSTALLATION

The Contractor shall properly protect material and equipment in accordance with the manufacturers recommended storage

procedures, before, during, and after installation. Stored items shall be protected from the weather and contamination. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

1.6 OPERATION AND MAINTENANCE MANUALS

The operation and maintenance manuals shall be submitted and approved prior to commencing onsite tests.

1.6.1 Operation Manual

Three copies of the manufacturers standard maintenance manual. (All available manuals)

a. Procedures for each routine maintenance item. Procedures for troubleshooting. Factory-service, takedown overhaul, and repair service manuals, with parts lists.

b. The manufacturer's recommended maintenance schedule.

c. A component list, which includes the manufacturer's name, address, type or style, model or serial number, rating, and catalog number for the major components, listed in paragraph GENERAL REQUIREMENTS.

d. A list of spare parts for each piece of equipment and a complete list of materials and supplies needed for operation.

e. One hard copy of each manual and 2 complete copies of CD’s shall be permitted instead of 3 hard copies.

1.6.1 Deleted

1.6.2 Maintenance Manual

Three copies of the [manufacturers standard maintenance manual] [maintenance manual containing the information described below in 216 x 279 mm (8-1/2 x 11 inch) three-ring binders shall be provided. Each section shall be separated by a heavy plastic divider with tabs. Drawings shall be folded, with the title block visible, and placed in plastic pockets with reinforced holes].

a. Procedures for each routine maintenance item. Procedures for troubleshooting. Factory-service, overhaul, and repair service manuals, with parts lists.

b. The manufacturer's recommended maintenance schedule.

c. A component list, which includes the manufacturer’s name, address, type or style, model or serial number, rating, and catalog number for the major components, listed in paragraph GENERAL REQUIREMENTS.

d. A list of spare parts for each piece of equipment and a complete list of materials and supplies needed for operation.

1.7 SPECIAL TOOLS AND FILTERS

Two sets of special tools and two sets of filters required for maintenance shall be provided. Special tools are those that only the manufacturer provides, for special purposes, or to reach otherwise inaccessible parts this also includes, software, hardware, cables and connectors and laptop computer if required for re-programming of any component. One handset shall be provided for each electronic governor when required to indicate and/or change governor response settings. Two complete sets of filters shall be supplied in a suitable storage box. These filters shall be in addition to filters replaced after testing.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall be as specified.

2.1.1 Circuit Breakers, Low Voltage

NEMA AB 1, UL 489, and NEMA SG 3.

2.1.2 Filter Elements (Fuel-oil, Lubricating-oil, and Combustion-air)

Manufacturer's standard.

2.1.3 Instrument Transformers

ANSI C12.11.

2.1.4 Pipe (Sleeves, Fuel/Lube-oil, Compressed-Air, Coolant and Exhaust)

ASTM A 53/A 53M, ASTM A 106 or ASTM A 135, steel pipe. Pipe smaller than 50 mm (2 inches) shall be Schedule 80. Pipe 50 mm (2 inches) and larger shall be Schedule 40.

2.1.5 Pipe Flanges and Fittings

a. Pipe Flanges and Flanged Fittings: ASTM A 181/A 181M, Class 60, or ASME B16.5, Grade 1, Class 150.

b. Pipe Welding Fittings: ASTM A 234/A 234M, Grade WPB or WPC, Class 150, or ASME B16.11, 1360.7 kg. (3000 lb.)

c. Threaded Fittings: ASME B16.3, Class 150.

d. Valves: MSS SP-80, Class 150.

e. Gaskets: Manufacturers Standard.

2.1.6 Pipe Hangers

MSS SP-58 and MSS SP-69.

2.1.7 Electrical Enclosures

2.1.7.1 General

NEMA ICS 6.

2.1.7.2 Panel-boards

NEMA PB 1.

2.1.8 Electric Motors

Electric motors shall conform to the requirements of NEMA MG 1. Motors shall have sealed ball bearings, a maximum speed of 1800 rpm and integral automatic or manual reset thermal overload protectors. Motors used indoors shall have drip proof frames; those used outside shall be totally enclosed. AC motors larger than 373 W (1/2 Hp) (1/2 Hp) shall be of the squirrel cage induction type for standard voltage of **460** volts, 60 Hz three phase power. AC motors 373 W (1/2 Hp) (1/2 Hp) or smaller, shall be for standard voltage **115** volts, 60 Hz single-phase power.

2.1.9 Motor Controllers

Motor controllers and starters shall conform to the requirements of NFPA 70 and NEMA ICS 2.

2.2 ENGINE

Each engine shall operate on No. 2-D diesel conforming to ASTM D 975, shall be designed for stationary applications and shall be complete with ancillaries. The engine shall be a standard production model described in the manufacturer's catalog. The engine shall, supercharged or turbocharged. The engine shall be four-stroke-cycle and compression-ignition type. The engine shall be vertical inline, V-, or opposed-piston type, with a solid cast block or individually cast cylinders. The engine shall have a minimum of two cylinders. Opposed-piston type engines shall have no less than four cylinders. Each block shall have a coolant drain port. Each engine shall be equipped with an over-speed sensor.

2.3 FUEL SYSTEM

The fuel system for each engine generator set shall conform to the requirements of NFPA 30 and NFPA 37 and contain the following elements.

2.3.1 Pumps

2.3.1.1 Main Pump

Each engine shall be provided with an engine driven pump. The pump shall supply fuel at a minimum rate sufficient to provide the amount of fuel required to meet the performance indicated within the parameter schedule. The fuel flow rate shall be based on meeting the load requirements and all necessary re-circulation.

2.3.1.2 Auxiliary Fuel Pump

Auxiliary fuel pumps shall be provided to maintain the required engine fuel pressure, either required by the installation or indicated on the drawings. The auxiliary pump shall be driven by a dc electric motor powered by the starting/station batteries. The auxiliary pump shall be automatically actuated by a pressure-detecting device.

2.3.2 Filter

A minimum of one full flow fuel filter shall be provided for each engine. The filter shall be readily accessible and capable

of being changed without disconnecting the piping or disturbing other components. The filter shall have inlet and outlet connections plainly marked.

2.3.3 Relief/Bypass Valve

A relief/bypass valve shall be provided to regulate pressure in the fuel supply line, return excess fuel to a return line, and prevent the build-up of excessive pressure in the fuel system.

2.3.4 Day Tank

Each engine shall be provided with a separate self-supporting day tank if required. Each day tank shall be provided with connections for fuel supply line, fuel return line, fuel overflow line, local fuel fill port, gauge, vent line, drain line, and float switch assembly for control. A fuel return line cooler shall be provided as recommended by the manufacturer and assembler. The temperature of the fuel returning to the day tank shall be below the flash point of the fuel. A temperature-sensing device shall be installed in the fuel supply line.

2.3.4.1 Capacity

Each tank shall have capacity to supply fuel to the engine for an uninterrupted 2-hour period at 100% rated load without being refilled or 25 gallons, which ever is recommended or specified.

2.3.4.2 Local Fuel Fill
Each local fuel fill port on the day tank shall be provided with a screw-on cap.

2.3.4.3 Fuel Level Controls

a. Each tank shall have a float-switch assembly to perform the following functions:

(1) Activate the "Low Fuel Level" alarm at 70% of the rated tank capacity.

(2) Activate the "Overfill Fuel Level" alarm at 95% of the rated tank capacity.

2.3.4.4 Arrangement
Gravity flow tanks and any tank that allows a fuel level above the fuel injectors shall be provided with an internal or

external factory installed valve located as near as possible to the shell of the tank. The valve shall close when the engine is not operating.

2.3.5.1 Capacity, Standby

Each day tank shall have capacity to supply fuel to the engine for an uninterrupted 2-hour period at 100% rated load without being refilled, plus any fuel, which may be returned to the main fuel storage tank. The calculation of the capacity of each day tank shall incorporate the requirement to stop the supply of fuel into the day tank at 90% of the ultimate volume of the tank.

2.3.5.2 Drain Line

Each day tank drain line shall be accessible and equipped with a shutoff valve. Self-supporting day tanks shall be arranged to allow drainage into a 305 mm (12 inch) tall bucket.

2.3.5.3 Local Fuel Fill

Each local fuel fill port on the day tank shall be provided with a screw-on cap.

2.3.5.4 Fuel Level Controls

a. Each day tank shall have a float-switch-assembly to perform the following functions:

(1) Activate the "Overfill Fuel Level" alarm at 95% of the rated tank volume.

(2) Activate the "Low Fuel Level" alarm at 70% of the rated tank Capacity.

2.3.5.5 Arrangement

Day tanks may allow gravity flow into the engine. Gravity flow tanks shall be provided with an internal or external valve located as near as possible to the shell of the tank. The valve shall close when the engine is not operating. Day tanks shall be provided with any necessary pumps to supply fuel to the engine as recommended by the generator set manufacturer. The fuel supply line from the day tank to the manufacturer's standard engine connection shall be threaded pipe.

2.3.6 Fuel Supply System

The fuel supply from the main storage of fuel to the day tank shall be as specified in Section 13202 FUEL STORAGE SYSTEMS.

2.4 LUBRICATION

Each engine shall have a separate lube-oil system conforming to NFPA 30 and NFPA 37. Each system shall be pressurized by engine-driven oil pumps. Each system shall be furnished with a relief valve for oil pressure regulation (for closed systems) and a dipstick for oil level indications. The crankcase shall be vented in accordance with the manufacturer's recommendation except that it shall not be vented to the engine exhaust system. Crankcase breathers, if provided on engines installed in buildings or enclosures, shall be piped to vent to the outside. The system shall be readily accessible for service such as draining, refilling, etc. Each system shall permit addition of oil and have oil-level indication with the set operating. The system shall utilize an oil cooler as recommended by the engine manufacturer.

2.4.1 Filter

One full-flow filter shall be provided for each pump. The filter shall be readily accessible and capable of being changed without disconnecting the piping or disturbing other components. The filter shall have inlet and outlet connections plainly marked.

2.4.2 Lube-Oil Sensors

Each engine shall be equipped with lube-oil pressure sensors. Pressure sensors shall be located downstream of the filters and provide signals for required indication and alarms.

2.5 COOLING SYSTEM

Each engine cooling system shall operate automatically while the engine is running. Each cooling system shall be sized for the maximum summer outdoor design temperature and site elevation. Water-cooled system coolant shall use a combination of water and ethylene-glycol sufficient for freeze protection at the minimum winter outdoor temperature specified. The maximum temperature rise of the coolant across the engine shall be no more than that recommended and submitted in accordance with paragraph SUBMITTALS.

2.5.1 Coolant Pumps

Coolant pumps shall be the centrifugal type. Each engine shall have an engine-driven primary pump. Secondary pumps shall be electric motor driven and have automatic controllers.

2.5.2 Deleted

2.5.2.1 Fin-Tube-Type Heat Exchanger (Radiator)

Heat exchanger may be factory coated with corrosive resistant film providing that corrosion measures are taken to restore the heat rejection capability of the radiator to the initial design requirement via over-sizing, or other compensating methods. Internal surfaces shall be compatible with liquid fluid coolant used. Materials and coolant are subject to approval by the Contracting Officer. Heat exchangers shall be pressure type incorporating a pressure valve, vacuum valve and a cap. Caps shall be designed for pressure relief prior to removal. Each heat exchanger and the entire cooling system shall be capable of withstanding a minimum pressure of 48-kPa gauge (7 psi). (7 psi.) Each heat exchanger shall be protected with a strong grille or screen guard. Each heat exchanger shall have at least two tapped holes. One tapped hole in the heat exchanger shall be equipped with a drain cock, the rest shall be plugged.

2.5.3 Expansion Tank

The cooling system shall include an air expansion tank tank, which will accommodate the expanded water of the system generated within the normal operating temperature range, limiting the pressure increase at all components in the system to the maximum allowable pressure at those components. The tank shall be suitable for an operating temperature of 121 degrees C (250 degrees F) and a working pressure of 0.86 MPa (125 psi). (125 psi.) The tank shall be constructed of welded steel, tested and stamped in accordance with ASME BPVC SEC VIII D1 for the stated working pressure. A bladder type tank shall not be used. Steel legs or bases for vertical installation shall support the tank.

2.5.5 Temperature Sensors

Each engine shall be equipped with coolant temperature sensors. Temperature sensors shall provide signals for pre-high and high indication and alarms.

2.6 SOUND LIMITATIONS

The noise generated by the diesel generator set operating at 100 percent load shall not exceed the following sound pressure levels in any of the indicated frequencies when measured in a free field at a radial distance of 7 meters (22.9 feet) at 45 degrees apart in all directions.

Frequency Band (Hz)	Maximum Acceptable Pressure Level (Decibels)
31	[_81___]
63	[_77___]
125	[_71___]
250	[_64___]
500	[_58___]
1,000	[_55___]
2,000	[_54___]
4,000	[_54___]
8,000	[_56___]

2.7 AIR INTAKE EQUIPMENT

Filters and silencers shall be provided in locations that are convenient for servicing. The silencer shall be of the high-frequency filter type, located in the air intake system as recommended by the engine manufacturer. Silencer shall be capable of reducing the noise level at the air intake to a point below the maximum acceptable levels specified in paragraph SOUND LIMITATIONS. A combined filter-silencer unit meeting requirements for the separate filter and silencer items may be provided. Expansion elements in air-intake lines shall be rubber.

2.8 EXHAUST SYSTEM

The system shall be separate and complete for each engine. Piping shall be supported so as to minimize vibration. Where a V-type engine is provided, a V-type connector with necessary flexible sections and hardware shall connect the engine exhaust outlets.

2.8.1 Flexible Sections and Expansion Joints

A flexible section at each engine and an expansion joint at each muffler shall be provided. Flexible sections and expansion joints shall have flanged connections. Flexible

sections shall be made of convoluted seamless tube without joints or packing. Expansion joints shall be the bellows type. Expansion and flexible elements shall be stainless steel suitable for diesel-engine exhaust gas at the maximum exhaust temperature that is specified by the engine manufacturer. Expansion and flexible elements shall be capable of absorbing vibration from the engine and compensation for thermal expansion and contraction.

2.8.2 Exhaust Muffler

A chamber type exhaust muffler shall be provided. The muffler shall be constructed of welded steel and designed for [outside] [inside] [vertical] [horizontal] mounting. Eyebolts, lugs, flanges, or other items shall be provided as necessary for support in the location and position indicated. Pressure drop through the muffler shall not exceed the recommendations of the engine manufacturer. Outside mufflers shall be zinc coated or painted with high temperature 204 degrees C (400 degrees F) resisting paint. The muffler and exhaust piping together shall reduce the noise level to less than the maximum acceptable level listed for sound limitations in paragraph SOUND LIMITATIONS. The muffler shall have a drain valve, nipple, and cap at the low-point of the muffler.

2.8.3 Exhaust Piping

Exhaust muffler shall be provided for each engine, size and type as recommended by the generator set manufacturer. A chamber type exhaust muffler shall be provided. The muffler shall be constructed of welded steel and designed for outside horizontal mounting. Eyebolts, lugs, flanges, or other items shall be provided as necessary for support in the location and position indicated. Pressure drop through the muffler shall not exceed the recommendations of the engine manufacturer. Outside mufflers shall be zinc coated or painted with high temperature, 204o C resisting paint. The muffler and exhaust piping together shall reduce the noise level to less than the maximum acceptable level listed for sound limitations. The muffler shall have a drain valve, nipple, and cap at the low-point of the muffler.

A flexible section at each engine and an expansion joint at each muffler shall be provided. Flexible sections and expansion joints shall have flanged connections. Flexible sections shall be made of convoluted seamless tube without joints or packing. Expansion joints shall be the bellows type.

Expansion and flexible elements shall be stainless steel suitable for diesel engine exhaust gas at the maximum exhaust temperature that is specified by the engine manufacturer. Expansion and flexible elements shall be capable of absorbing vibration form the engine and compensation for thermal expansion and contraction.
Exhaust Piping: Horizontal sections of exhaust piping shall be sloped downward away from the engine to a condensate trap and drain valve. Changes in direction shall be long-radius. Exhaust piping shall be provide with a hinged gravity operated, self-closing rain cover.

2.9 EMISSIONS

The finished installation shall comply with Federal, state, and local regulations and restrictions regarding the limits of emissions.

2.10 STARTING SYSTEM

The starting system for standby engine generator sets used in emergency applications shall be in accordance with NFPA 99 and NFPA 110 and as follows

2.10.1 Controls

An engine control switch shall be provided with functions including: run/start (manual), off/reset, and automatic mode. Start-stop logic shall be provided for adjustable cycle cranking and cool down operation. The logic shall be arranged for manual starting and fully automatic starting in accordance with paragraph AUTOMATIC ENGINE-GENERATOR SET SYSTEM OPERATION. Electrical starting systems shall be provided with an adjustable cranking limit device to limit cranking periods from 1 second up to the maximum duration.

2.10.2 Capacity

The starting system shall be of sufficient capacity, at the maximum outdoor summer temperature specified to crank the engine without damage or overheating. The system shall be capable of providing a minimum of three cranking periods with 15-second intervals between cranks. Each cranking period shall have a maximum duration of 15 seconds.

2.10.3 Functional Requirements

Starting system shall be manufacturers recommended dc system utilizing a negative circuit ground. Starting motors shall be in accordance with SAE ARP 892.

2.10.4 Battery

A starting battery system shall be provided and shall include the battery, battery rack, inter-cell connectors, and spacers. The battery shall be in accordance with SAE J 537. Critical system components (rack, protection, etc.) shall be sized to withstand the seismic acceleration forces specified. The battery shall be lead-acid non-maintenance type, with sufficient capacity, at the minimum outdoor winter temperature specified to provide the specified cranking periods. Valve-regulated lead-acid batteries are not acceptable.

2.10.5 Battery Charger

A 10-amp voltage regulated battery charger shall be provided for each engine generator set. Charger may be mounted in an automatic transfer switch if desired. Chargers shall not be mounted on the generator set. Charger shall be equipped with float, taper and equalize charge settings. Operations monitors shall provide visual output along with individual from C contacts rated at 4-amps, 120 VAC, 30 VDC from remote indication of:

Loss of AC power - RED Light

Low battery voltage - RED Light

High battery voltage - RED Light

Power ON - GREEN Light (no relay contact)

2.10.6 Starting Aids

The manufacturer shall provide one or more of the following methods to assist engine starting.

2.10.6.1 Deleted

2.10.6.2 Jacket-Coolant Heaters
A thermostatically controlled electric heater shall be mounted in the engine coolant jacketing to automatically maintain the coolant within plus or minus 3 degrees of the control temperature. The heater shall operate independently of engine

operation so that starting times are minimized. The control temperature shall be the temperature recommended by the engine manufacturer to meet the starting time specified.

2.11 GOVERNOR

Each engine shall be provided with a governor, which maintains the frequency within a bandwidth of the rated frequency, over a steady-state load range of zero to 100% of rated output capacity. The governor shall be configured for safe manual adjustment of the speed/frequency during operation of the engine generator set, without special tools, from 90 to 110 % of the rated speed/frequency, over a steady state load range of zero to 100% of rated capacity. Isochronous governors shall maintain the midpoint of the frequency bandwidth at the same value for steady-state loads over the range of zero to 100% of rated output capacity

2.12 GENERATOR

Each generator shall be of the synchronous type, one or two bearing, conforming to NEMA MG 1, equipped with winding terminal housings in accordance with NEMA MG 1, equipped with an amortisseur winding, and directly connected to the engine. Insulation shall be Class H standby rating at a minimum of 130 ^{o} C temperature rise. Generator design shall protect against mechanical, electrical and thermal damage due to vibration, 25 percent over-speeds, or voltages and temperatures at a rated output capacity of 100 percent. Generator ancillary equipment shall meet the short circuit requirements of NEMA MG 1. Frames shall be the drip-proof type.

2.12.1 Current Balance

At 100 percent rated load, and load impedance equal for each of the three phases, the permissible current difference between any two phases shall not exceed 2 percent of the largest current on either of the two phases.

2.12.2 Voltage Balance

At any balanced load between 75 and 100 percent of rated load, the difference in line-to-neutral voltage among the three phases shall not exceed 1 percent of the average line-to-neutral voltage. For a single-phase load condition, consisting of 25 percent load at unity power factor placed between any phase and neutral with no load on the other two phases, the

maximum simultaneous difference in line-to-neutral voltage between the phases shall not exceed 3 percent of rated line to neutral voltage. The single-phase load requirement shall be valid utilizing normal exciter and regulator control. The interpretation of the 25 percent load for single-phase load conditions means 25 percent of rated current at rated phase voltage and unity power factor.

2.12.3 Waveform

The deviation factor of the line-to-line voltage at zero load and at balanced full rated load at 0.8 power factor shall not exceed 10%. The RMS of all harmonics shall be less than 5.0% and that of any one harmonic less than 3.0% at full rated load. Each engine-generator shall be designed and configured to meet the total harmonic distortion limits of IEEE Std 519.

2.13 EXCITER

The generator exciter shall be of the brushless type. Semiconductor rectifiers shall have a minimum safety factor of 300% for peak inverse voltage and forward current ratings for all operating conditions, including 110% generator output at 40 degrees C (104 degrees F) ambient. The exciter and regulator in combination shall maintain generator-output voltage within the limits specified.

2.14 VOLTAGE REGULATOR

Each generator shall be provided with a solid-state voltage regulator, separate from the exciter. The regulator shall maintain the voltage within a bandwidth of the rated voltage, over a steady-state load range of zero to 100% of rated output capacity. Regulator shall be configured for safe manual adjustment of the engine generator voltage output without special tools, during operation from 90 to 110% of the rated voltage over the steady state load range of zero to 100% of rated output capacity. Regulation drift shall not exceed plus or minus 0.5% for an ambient temperature change of 20 degrees C. (36 degrees F.)

2.14.1 Steady State Performance (Regulation or Voltage Droop).

The voltage regulator shall have a maximum droop of 2% of rated voltage over a load range from 0 to 100% of rated output

capacity and automatically maintain the generator output voltage within the specified operational bandwidth.

2.15 GENERATOR PROTECTION

Short circuit and overload protection for the generator shall be provided. The generator circuit breaker (IEEE Device 52) ratings shall be consistent with the generator rated voltage and frequency, with continuous, short circuit and interrupting current ratings to match the generator capacity. The manufacturer shall determine the short circuit current interrupting rating of the breaker. The breaker shall be engine generator base mounted by the engine-generator set manufacturer. UL listed molded case thermal magnetic type rated at [____] amps, [____] pole, and [____] volts. Each breaker shall be provided with shunt trip and wired to the engine fault conditions. Field circuit breakers shall not be acceptable for generator over-current protection. Surge protection shall be provided for each phase of the generator, to be mounted at the generator terminals.

2.15.1 Panel-boards

Panel-boards shall be metal-enclosed, general purpose, [3-phase, 4-wire], [1-phase, 3-wire], [600][_____] volt rated, with neutral bus and continuous ground bus, conforming to NEMA PB 1 and UL 891. Neutral bus and ground bus capacity shall be [as shown][full capacity]. Enclosure designs, construction, materials and coatings shall be [as indicated][suitable for the application and environment]. Bus continuous current rating shall be [at least equal to the generator rating and correspond to UL listed current ratings specified for panelboards and switchboards][as indicated]. Current withstand rating (short circuit rating) shall match the generator capacity. Buses shall be copper.

2.15.2 Devices

Switches, circuit breakers, switchgear, fuses, relays, and other protective devices shall be as specified in Section 16475 COORDINATED POWER SYSTEM PROTECTION.

2.16 SAFETY SYSTEM

Devices, wiring, remote panels, local panels, etc., shall be provided and installed as a complete system to automatically activate the appropriate signals and initiate the appropriate actions. The safety system shall be provided with a self-test

method to verify its operability. Alarm signals shall have manual acknowledgement and reset devices. The alarm signal systems shall reactivate for new signals after acknowledgment is given to any signal. The systems shall be configured so that loss of any monitoring device shall be dealt with as an alarm on that system element.

2.16.1 Audible Signal

The audible alarm signal shall sound at a frequency of 70 Hz at a volume of 75 dB at 3.1 m (10 feet). The sound shall be continuously activated upon alarm and silenced upon acknowledgment. Signal devices shall be located as shown.

2.16.2 Visual Signal - Signal

The visual alarm signal shall be a panel light. The light shall be normally off, activated to be blinking upon alarm. The light shall change to continuously light upon acknowledgement. If automatic shutdown occurs, the display shall maintain activated status to indicate the cause of failure and shall not be reset until cause of alarm has been cleared and/or restored to normal condition. Shutdown alarms shall be red; all other alarms shall be amber.

2.16.3 Alarms and Action Logic

2.16.3.1 Shutdown

Simultaneous activation of the audible signal, activation of the visual signal, stopping the engine, and opening the generator main circuit breakers shall be accomplished.

2.16.3.2 Problem

Activation of the visual signal shall be accomplished.

2.16.4 Local Alarm Panel

Device/Condition/ Manufacturers Function	Action/Location/ Function	No. of Offering
Low Coolant Level	SD/CP VA	3
Overvoltage Protection Shutdown	SD/CP VA O	3
Underfrequency	SD/CP VA	1

Undervoltage	SD/CP VA	1
Magnetic Pickup Failure	SD/CP VA	1
Overcurrent	SD/CP VA	1
Short Circuit	SD/CP VA	1
Auxiliary Fault Alarm	CP VA	1
Audible Alarm	CP AA	1
Overcurrent	CP VA	1
Oil Pressure Sender Fault	CP VA	1
Weak Battery	CP VA	1

A local alarm panel shall be provided with the following shutdown and alarm functions [as indicated] [in accordance with NFPA [99] [110 level [1] [2]] and including the listed Corps of Engineers requirements, mounted either on or adjacent to the engine generator set.

Device/ Condition/ Function	What/Where/Size	NFPA 99	NFPA 110 Level 1	NFPA 110 Level 2	Corps of Engrs Required
Shutdowns W/Alarms					
High engine temperature	Automatic/ jacket water/ cylinder	SD/CP VA	SD/CP VA	SD/CP VA	SD VA
Low lube-oil pressure	Automatic/ pressure/ level	SD/CP VA	SD/CP VA	SD/CP VA	SD VA
Overspeed shutdown $ alarm	(110% (± 2%) of rated speed	SD/CP VA	SD/CP VA	SD/CP VA	SD VA
Overcrank failure to start	Automatic/ Failure to to start	SD/CP VA	SD/CP VA	SD/CP VA	
Air shutdown damper (200-600kW)	When used		SD/CP VA	SD/CP VA	
Day tank overfill limit indication & transfer pump shutdown (95% volume)	Automatic/Day Tank/Level				SD/OPA (Pump)
Red emergency	Manual Switch		SD/CP VA	SD/CP VA	SD VA

stop switch					
Failure to crank	Corps of Engrs. Required				
[Day tank] [Integral Main Fuel Tank] low fuel limit Device/ Condition/ indication (70% volume remaining)	Corps of Engrs. Required				
Alarms					
Low lube-oil pressure	Pressure/ level	CP VA	CP VA	CP VAO	CP VA
Low fuel level	Main tank, 3 hours remaining	VA/AA	CP VA	CP VAO	
High fuel level	Integral Main Fuel Storage Tank 95% Volume				CP VA
Low coolant	Jacket water	CP/VA	CP VA	CP VA	
Pre-high temperature	Jacket water/ cylinder	CP VA	CP VA	CP VAO	CP VA
Pre-low lube-oil pressure		CP VA			CP VA
High battery voltage			CP VA	CP VAO	
Low battery voltage			CP VA	CP VAO	
Battery charger AC failure	AC supply not available		CP VA	CP VAO	
Control switch not in AUTO			CP VA	CP VAO	
Low starting air pressure			CP VA	CP VAO	
Low starting hydraulic			CP VA	CP VAO	

pressure

SD - Shut Down
CP - On Control Panel
VA - Visual Alarm
AA - Audible Alarm
O - Optional]

2.16.5 Time-Delay on Alarms

For startup of the engine-generator set, time-delay devices shall be installed bypassing the low lubricating oil pressure alarm during cranking, and the coolant-fluid outlet temperature alarm. The lube-oil time-delay device shall return its alarm to normal status after the engine starts. The coolant time-delay device shall return its alarm to normal status 5 minutes after the engine starts.

2.16.6 Remote Alarm Panel

A remote alarm panel shall be provided as indicated. A remote alarm panel shall be provided in accordance with NFPA 99, NFPA 110 and as follows:

Device/Condition/ Function	What/Where/Size	NFPA 99	NFPA 110 Level 1	NFPA 110 Level 2
Remote annunciator panel	Battery powered		Alarms	
Loads on genset		VA		
Battery charger malfunction		VA		
Low lube-oil	Pressure/level	VA/AA	AA	AAO
Low Temperature	Jacket water	VA/AA	AA	AAO
High Temperature	Jacket water/ cylinder	VA/AA	AA	AAO
Low fuel level	Main tank, 3 hr remaining	VA/AA	AA	AAO
Overcrank	Failure to start	VA/AA	AA	AAO
Overspeed		VA/AA	AA	AAO
Pre-high temperature	Jacket water/ cylinder		AA	
Control switch not in			AA	

AUTO				
Common alarm contacts for local & remote common alarm			X	X
Audible alarm silencing switch			X	O
Air shutdown damper	When used		AA	AAO
Common fault alarm			AA	

X - Required
SD - Shut Down
CP - On Control Panel
VA - Visual Alarm
AA - Audible Alarm
O - Optional]

2.17 ENGINE GENERATOR SET CONTROLS AND INSTRUMENTATION

Devices, wiring, remote panels, local panels, etc., shall be provided and installed as a complete system to automatically activate the appropriate signals and initiate the appropriate actions.

2.17.1 Controls

A local control panel shall be provided with controls [as indicated] [in accordance with NFPA 110 level [1] [2]] [and as follows] mounted on the engine generator set. A remote control panel shall be provided [with devices as indicated] [fully redundant to the local control panel] as required.

Device/Condition/ Function	Corps Requirement	NFPA 110 Level 1	NFPA 110 Level 2	MFG Offering
Controls				
Switch: run/start - off/set - auto	CP			CP/STD
Emergency stop switch & alarm	CP			CP/STD
Lamp test/indicator test	CP	CP VA	CP VA	CP/STD
Common alarm contacts/ fault relay		X	X	CP/O
Panel lighting	CP			CP/STD
Audible alarm & silencing/reset switch	CP			
Voltage adjust for voltage	CP			CP/STD

Regulator				
Pyrometer display w/selector switch	CP			
Remote emergency stop switch		CP VA	CP VA	
Remote fuel shutoff switch				
Remote lube-oil shutoff switch				

2.17.2 Engine Generator Set Metering and Status Indication

A local panel shall be provided with devices [as indicated] [in accordance with NFPA 110 level [1] [2]] [and as follows] mounted to the engine generator set as indicated. A remote control panel shall be provided [with devices as indicated] [fully redundant to the local control panel] as required.

Device/Condition/Corps Requirement Function		NFPA 110 Level 1	NFPA 110 Level 2	MFG Offering	
Genset Status & Metering					
Genset supplying load		CP VA	CP VAO	CP VAO	
System ready					CP/STD
Engine oil pressure	CP				CP/STD
Engine coolant temperature	CP				CP/STD
Engine RPM (Tachometer)	CP				CP/STD
Engine run hours	CP				CP/STD
Pyrometer display w/selector switch	CP				
AC volts (generator), 3-phase	CP				CP/STD
AC amps (generator), 3-phase	CP				CP/STD
Generator frequency	CP				CP/STD
Phase selector switches (amps & volts)	CP				CP/STD
Watts/kW					CP/VA-O
Voltage Regulator Adjustment	CP				

CP - On Control Panel
VA - Visual Alarm
AA - Audible Alarm

O - Optional
STD - Manufacturers Standard Offering

2.18 PANELS

Each panel shall be of the type necessary to provide specified functions. Panels shall be mounted on the engine generator set base by vibration/shock absorbing type mountings. Instruments shall be mounted flush or semi flush. Convenient access to the back of instruments shall be provided to facilitate maintenance. Instruments shall be calibrated using recognized industry calibration standards. Each panel shall be provided with a panel identification plate, which clearly identifies the panel function as indicated. Each instrument and device on the panel shall be provided with a plate that clearly identifies the device and its function as indicated. Panels except the remote alarm panel can be combined into a single panel.

2.18.1 Enclosures

Enclosures shall be designed for the application and environment, conforming to NEMA ICS 6, and provided with locking mechanisms, which are keyed alike.

2.18.2 Analog

Analog electrical indicating instruments shall be in accordance with ANSI C39.1 with semi flush mounting. Switchgear, and control-room panel-mounted instruments shall have 250-degree scales with an accuracy of not less than 1 percent. Unit-mounted instruments shall be the manufacturer's standard with an accuracy of not less than 2 percent. The instrument's operating temperature range shall be minus 20 to plus 65 degrees C. Distorted generator output voltage waveform of a crest factor less than 5 shall not affect metering accuracy for phase voltages, hertz and amps.

2.18.3 Electronic

Electronic indicating instruments shall be true RMS indicating, 100 percent solid state, microprocessor controlled to provide all specified functions. Control, logic, and function devices shall be compatible as a system, sealed, dust and water tight, and shall utilize modular components with metal housings and digital instrumentation. An interface module shall be provided to decode serial link data from the electronic panel and translate alarm, fault and status conditions to set of relay

contacts. Instrument accuracy shall be not less than 2 percent for unit-mounted devices and 1 percent for control room, panel mounted devices, throughout a temperature range of minus 20 to plus 65 degrees C. Data display shall utilize LED or back lit LCD. Additionally, the display shall provide indication of cycle programming and diagnostic codes for troubleshooting. Numeral height shall be at the minimum height of ¼ inch or manufacturer specifications which ever is larger.

2.18.4 Parameter Display

Indication or readouts of the lubricating-oil pressure, ac voltmeter, ac ammeter, frequency meter, and coolant temperature.

2.18.5 Exerciser

The exerciser shall be in accordance with Section 16410 AUTOMATIC TRANSFER.

2.19 SURGE PROTECTION

Electrical and electronic components shall be protected from, or designed to withstand the effects of surges from switching and lightning.

2.20 AUTOMATIC ENGINE-GENERATOR-SET SYSTEM OPERATION

Fully automatic operation shall be provided for the following operations: engine-generator set starting and source transfer upon loss of normal source; retransfer upon restoration of the normal source; sequential starting; and stopping of each engine-generator set after cool down. Devices shall automatically reset after termination of their function.

2.20.1 Automatic Transfer Switch

Automatic transfer switches shall be in accordance with Section 16410 AUTOMATIC TRANSFER.

2.20.2 Monitoring and Transfer

Devices shall be provided to monitor voltage and frequency for the normal power source and each engine generator set, and control transfer from the normal source and retransfer upon restoration of the normal source. Functions, actuation, and

time delays shall be as described in Section 16410 AUTOMATIC TRANSFER.

2.21 MANUAL ENGINE-GENERATOR SET SYSTEM OPERATION

Complete facilities shall be provided for manual starting and testing of each set without load, loading and unloading of each set.

2.22 BASE

The base shall be constructed of steel. The base shall be designed to rigidly support the engine-generator set, ensure permanent alignment of all rotating parts, be arranged to provide easy access to allow changing of lube-oil, and ensure that alignment will be maintained during shipping and normal operation. The base shall permit skidding in any direction during installation and shall be provided with suitable holes for foundation bolts. The base shall also withstand and mitigate the effects of synchronous vibration of the engine and generator, and shall be provided with suitable holes for anchor bolts and jacking screws for leveling. The base shall be mounted on spring isolators rated for Fort Campbell seismic conditions.

2.23 THERMAL INSULATION

Thermal insulation shall be as specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.24 PAINTING AND FINISHING

The engine-generator set shall be cleaned, primed and painted in accordance with the manufacturer's standard color and practice.

2.25 FACTORY INSPECTION AND TESTS

Factory inspection and tests shall be performed on each engine-generator set proposed to meet this specification section. Inspections shall be completed and necessary repairs made prior to testing. Inspectors shall look for leaks, looseness, defects in components, and proper assembly. Factory tests shall be NEMA MG 1 routine tests and the manufacturers routine tests.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION

Installation shall provide clear space for operation and maintenance in accordance with NFPA 70 and IEEE C2. Installation of pipe, duct, conduit, and ancillary equipment shall be configured to facilitate easy removal and replacement of major components and parts of the engine-generator set.

3.2 PIPING INSTALLATION

3.2.1 General

Piping shall be non-welded (threaded). Connections at valves shall be threaded. Connections at equipment shall be threaded to the diesel engine may be threaded if the diesel-engine manufacturer's standard connection is threaded. Except as otherwise specified, threaded fittings shall be utilized to allow for complete dismantling and removal of each piping system from the facility without disconnecting or removing any portion of any other system's equipment or piping. Connections to all equipment shall be made with flexible connectors. Pipes extending through the roof shall be properly flashed. Piping shall be installed clear of windows, doors, and openings to permit thermal expansion and contraction without damage to joints or hangers, and with a 15 mm (1/2 inch) drain valve at each low point.

3.2.2 Supports

Hangers, inserts, and supports shall be of sufficient size to accommodate any insulation and shall conform to MSS SP-58 and MSS SP-69. Supports shall be spaced not more than 2.1 m (6 feet) on center for pipes 50 mm (2 inches) in diameter or less, not more than 3.6 m (12 feet) on center for pipes larger than 50 mm (2 inches) (2 inches) but no larger than 100 mm, (4 inches,) and not more than 5.2 m (17 feet) on center for pipes larger than 100 mm (4 inches) in diameter. Supports shall be provided at pipe bends or change of direction.

3.2.3 Deleted

3.2.4 Cleaning

After fabrication and before assembly, piping interiors shall be manually wiped clean of all debris.

3.2.5 Pipe Sleeves

Pipes passing through construction such as ceilings, floors, or walls shall be fitted with sleeves. Each sleeve shall extend through and be securely fastened in its respective structure and shall be cut flush with each surface. The structure shall be built tightly to the sleeve. The inside diameter of each sleeve shall be 15 mm, (1/2 inch,) and where pipes pass through combustible materials, 25 mm (1 inch) larger than the outside diameter of the passing pipe or pipe covering.

3.3 ELECTRICAL INSTALLATION

Electrical installation shall comply with NFPA 70, IEEE C2, and Section 16415 ELECTRICAL WORK, INTERIOR.

3.3.1 Vibration Isolation

Flexible fittings shall be provided for all conduit, cable trays, and raceways attached to engine-generator sets. Metallic conductor cables installed on the engine generator set and from the engine generator set to equipment not mounted on the engine generator set shall be flexible stranded conductor. Terminations of conductors on the engine generator set shall be crimp-type terminals or lugs.

3.4 FIELD PAINTING

Field painting shall be as specified in Section 09900 PAINTING, GENERAL.

3.5 ONSITE INSPECTION AND TESTS

3.5.1 Test Conditions

3.5.1.1 Data

Measurements shall be made and recorded of parameters necessary to verify that each set meets specified parameters. If the results of any test step are not satisfactory, adjustments or replacements shall be made and the step repeated until satisfactory results are obtained. Unless otherwise indicated, data shall be taken during engine-generator set operation and recorded in 15 minute intervals and shall include: readings of engine-generator set meters and gauges for electrical and power parameters; oil pressure; ambient temperature; and engine temperatures available from meters and gauges supplied as

permanent equipment on the engine-generator set. In the following tests where measurements are to be recorded after stabilization of an engine-generator set parameter (voltage, frequency, current, temperature, etc.), stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings. Electrical measurements shall be performed in accordance with IEEE Std 120. Definitions and terms are in accordance with IEEE Std 100. Temperature limits in the rating of electrical equipment and for the evaluation of electrical insulation shall be in accordance with IEEE Std 1.

3.5.1.2 Power Factor

Engine-generator set operating tests shall be made utilizing a load with 0.8-power factor for all 3-phase installations; a unity of 1.0 power factor shall be used on all single-phase installations.

3.5.1.3 Contractor Supplied Items

The Contractor shall provide all equipment and supplies required for inspections and tests including fuel, test instruments, cables, test leads, and load banks at the specified power factors.

3.5.1.4 Instruments

Readings of panel gauges, meters, displays, and instruments, provided under this specification shall be verified during test runs by test instruments of precision and accuracy greater than the tested items. Test instrument accuracy shall be at least as follows: current, 1.5%; voltage, 1.5%; real power, 1.5%; reactive power, 1.5%; power factor, 3%; frequency, 0.5%. Test instruments shall be calibrated by a recognized standards laboratory within 30 days prior to testing.

3.5.1.5 Sequence

The sequence of testing shall be as specified in the approved testing plan unless variance in authorized by the Contracting Officer and Local Authority Having Jurisdiction. Field-testing shall be performed in the presence of the Contracting Officer and Local Authority Having Jurisdiction. Tests may be scheduled and sequenced in order to optimize run-time periods; however the following general order of testing shall be

followed: Construction Tests; Inspections; Safety run Tests; and Performance Tests and Final Inspection.

3.5.2 Construction Tests

Individual component and equipment functional tests for fuel piping, coolant piping, and lubricating-oil piping, electrical circuit continuity, insulation resistance, circuit protective devices, and equipment not provided by the engine-generator set manufacturer shall be performed prior to connection to the engine-generator set.

3.5.2.1 Piping Test

a. Lube-oil and fuel-oil piping shall be flushed with the same type of fluid intended to flow through the piping, until the out flowing fluid has no obvious sediment or emulsion.

b. Fuel piping which is external to the engine-generator set shall be tested in accordance with NFPA 30. All remaining piping, which is external to the engine generator set shall be pressure tested with air pressure at 150% of the maximum anticipated working pressure, but in no case less than 1 MPa, (150 psig,) for a period of 2 hours to prove the piping has no leaks. If piping is to be insulated, the test shall be performed before the insulation is applied.

3.5.2.2 Electrical Equipment Tests

a. Low-voltage cable insulation integrity tests shall be performed for cables connecting the generator breaker to the [automatic transfer switch] [panel-board] [main disconnect switch] [distribution bus] [_____]. Low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test voltage shall be 500 volts dc, applied for one minute between each conductor and ground and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. The minimum value of insulation shall be:

R in megohms = (rated voltage in kV + 1) x 304,800/(length of cable in meters).

(R in megohms = (rated voltage in kV + 1) x 1000/(length of cable in feet)

Each cable failing this test shall be repaired or replaced. The repaired cable shall be retested until failures have been eliminated.

a. Medium-voltage cable insulation integrity tests shall be performed for cables connecting the generator breaker to the [generator switchgear] [main disconnect switch] [distribution bus]. After insulation and before the operating test or connection to an existing system, the medium-voltage cable system shall be given a high potential test. Direct-current voltage shall be applied on each phase conductor of the system by connecting conductors as one terminal and connecting grounds or metallic shielding or sheaths of the cable as the other terminal for each test. Prior to making the test, the cables shall be isolated by opening applicable protective devices and disconnecting equipment. The test shall be conducted with all splices, connectors, and terminations in place. The method, voltage, length of time, and other characteristics of the test for initial installation shall be in accordance with NEMA WC 7 or NEMA WC 8 for the particular type of cable installed, except that 28 kV and 35 kV insulation test voltages shall be in accordance with either AEIC CS5 or AEIC CS6 as applicable, and shall not exceed the recommendations of IEEE Std 404 for cable joints and IEEE Std 48 for cable terminations unless the cable and accessory manufacturers indicate higher voltages are acceptable for testing. Should any cable fail due to a weakness of conductor insulation or due to defects or injuries incidental to the installation or because of improper installation of cable, cable joints, terminations, or other connections, the contractor shall make necessary repairs or replace cables as directed. Repaired or replaced cables shall be retested.

c. Ground-Resistance Tests. The resistance of [each grounding electrode] [each grounding electrode system] [the ground mat] [the ground ring] shall be measured using the fall-of-potential method defined in IEEE Std 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than

48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

1) Single rod electrode - [25] [_____] ohms.
2) Multiple rod electrodes - [_____] ohms.
3) Ground mat - [_____] ohms.

d. Circuit breakers and switchgear shall be examined and tested in accordance with manufacturer's published instructions for functional testing.

3.5.3 Inspections

The following inspections shall be performed jointly by the Contracting Officer the Contractor and Local Authority Having Jurisdiction, after complete installation of each engine-generator set and its associated equipment, and prior to startup of the engine-generator set. Checks applicable to the installation shall be performed. The results of those which are physical inspections (I) shall be documented by the Contractor and submitted in accordance with paragraph SUBMITTALS. The Contractor shall present manufacturer's data for the inspections designated (D) at the time of inspection. Inspections shall verify that equipment type; features, accessibility, installation and condition are in accordance with the contract specification. Manufacturer's statements shall certify provision of features, which cannot be verified visually.

1. Drive belts. (I)
2. Governor type and features. (I)
3. Engine timing mark. (I)
4. Starting motor. (I)
5. Starting aids. (I)
6. Coolant type and concentration. (D)
7. Radiator drains. (I)
8. Block coolant drains. (I)
9. Coolant fill level. (I)
10. Coolant line connections. (I)
11. Coolant hoses. (I)
12. Combustion air filter. (I)
13. Intake air silencer. (I)
14. Lube oil type. (D)

15. Lube oil drain. (I)
16. Lube-oil filter. (I)
17. Lube-oil-fill level. (I)
18. Lube-oil line connections. (I)
19. Lube-oil lines. (I)
20. Fuel type. (D)
21. Fuel-level. (I)
22. Fuel-line connections. (I)
23. Fuel lines. (I)
24. Fuel filter. (I)
25. Access for maintenance. (I)
26. Voltage regulator. (I)
27. Battery-charger connections. (I)
28. Wiring & terminations. (I)
29. Instrumentation. (I)
30. Hazards to personnel. (I)
31. Base. (I)
32. Nameplates. (I)
33. Paint. (I)
34. Exhaust system. (I)
35. Access provided to controls. (I)
36. Enclosure. (I)
37. Engine & generator mounting bolts (proper application). (I)

3.5.4 Safety Run Tests

a. Perform and record engine manufacturer's recommended pre-starting checks and inspections.

b. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

b. Activate the manual emergency stop switch and verify that the engine stops.

d. Remove the high and pre-high lubricating oil temperature sensing elements from the engine and temporarily install temperature gauge in their normal locations on the engine (required for safety, not for recorded data). Where necessary, provide temporary wiring harness to connect the sensing elements to their permanent electrical leads.

e. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and

inspections and operate the engine generator-set at no load until the output voltage and frequency stabilize. Monitor the temporarily installed temperature gauges. If temperature reading exceeds the value for an alarm condition, activate the manual emergency stop switch.

f. Immerse the elements in a vessel containing controlled-temperature hot oil and record the temperature at which the pre-high alarm activates and the temperature at which the engine shuts down. Remove the temporary temperature gauges and reinstall the temperature sensors on the engine.

g. Remove the high and pre-high coolant temperature sensing elements from the engine and temporarily seal their normal location on the engine and temporarily install temperature gauges in their normal locations on the engine (required for safety, not for recorded data). Where necessary provide temporary wiring harness to connect the sensing elements to their permanent electrical leads.

h. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set at no load until the output voltage and frequency stabilize.

i. Immerse the elements in a vessel containing controlled-temperature hot oil and record the temperature at which the pre-high alarm activates and the temperature at which the engine shuts down. Remove the temporary temperature gauges and reinstall the temperature sensors on the engine.

j. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

k. Operate the engine generator-set for at least 30 minutes at 100 percent of service load.

l. Verify proper operation of the governor and voltage regulator.

m. Verify proper operation and set points of gauges and instruments.

n. Verify proper operation of ancillary equipment.

o. Manually adjust the governor to increase engine speed past the over-speed limit. Record the RPM at which the engine shuts down.

p. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 75 percent of rated load.

q. Manually fill the day tank to a level above the overfill limit. Record the level at which the overfill alarm sounds. Verify shutdown of the fuel transfer pump. Drain the day tank down below the overfill limit.

r. Shut down the engine. Remove the time-delay low lube oil pressure alarm bypass and try to start the engine. Record the results.

s. Attach a manifold to the engine oil system (at the oil sensor pressure port) that contains a shutoff valve in series with a connection for the engine's oil pressure sensor followed by an oil pressure gauge ending with a bleed valve. The engine's oil pressure sensor shall be moved from the engine to the manifold and its normal location on the engine temporarily sealed. The manifold shutoff valve shall be open and bleed valve closed.

t. Start the engine, record the starting time, make and record all engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 75 percent of service load.

u. Close the manifold shutoff valve. Slowly allow the pressure in the manifold to bleed off through the bleed valve while watching the pressure gauge. Record the pressure at which the engine shuts down. Catch oil spillage from the bleed valve in a container. Add the oil from the container back to the engine, remove the manifold, and reinstall the engine's oil pressure sensor on the engine.

v. Start the engine, record the starting time, make and record all engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 100% of service load. Record the maximum sound level in each frequency band at a distance

of 22.9 m ((75 feet)) from the end of the exhaust and air intake piping directly along the path of intake and discharge horizontal piping; or at a radius of [_____] [22.9 m][10.7 m] ([75][35] feet) from the engine at 45 degrees apart in all directions for vertical piping. The measurements should comply with the paragraph SOUND LIMITATIONS. [If a sound limiting enclosure is provided, the enclosure, the muffler, and intake silencer shall be modified or replaced as required to meet the sound requirements contained within this specification.] [If a sound limiting enclosure is not provided, the muffler and air intake silencer shall be modified or replaced as required to meet the sound limitations of this specification. If the sound limitations cannot be obtained by modifying or replacing the muffler and air intact silencer, the contractor shall notify the Contracting Officer and provide a recommendation for meeting the sound limitations.]

w. Manually drain off fuel slowly from the day tank to empty it to below the low fuel level limit and record the level at which the audible alarm sounds. Add fuel back to the day tank to fill it above low-level alarm limits.

3.5.5 Performance Tests

3.5.5.1 Continuous Engine Load Run Test

The engine-generator set and ancillary systems shall be tested at service load to: demonstrate durability; verify that heat of extended operation does not adversely affect or cause failure in any part of the system; and check all parts of the system. If the engine load run test is interrupted for any reason, the entire test shall be repeated. The engine load run test shall be accomplished principally during daylight hours, with an average ambient temperature of 35 degrees C, during the month of July. After each change in load in the following test, measure the vibration at the end bearings (front and back of engine, outboard end of generator) in the horizontal, vertical, and axial directions. Verify that the vibration is within the allowable range. Measurements are to be recorded after stabilization of an engine-generator set parameter (voltage, frequency, current, temperature, etc.). Stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances,

for a minimum of four consecutive readings. Data taken at 15 minutes intervals shall include the following:

a. Electrical: Output amperes, voltage, real and reactive power, power factor, frequency.

b. Pressure: Lube-oil.

c. Temperature: Coolant.
Lube-oil.
Ambient.

(1) Perform and record engine manufacturer's recommended pre-starting checks and inspections. Include as a minimum checking of coolant fluid, fuel, and lube-oil levels.

(2) Start the engine; make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

(3) Operate the engine generator-set for at least 2 hours at 75 percent of service load.

(4) Increase load to 100% of service load and operate the engine generator-set for at least 2 hours.

(5) Remove load from the engine-generator set.

3.5.5.2 Load Acceptance Test

Engine manufacturer's recommended pre-starting checks and inspections shall be performed and recorded. The engine shall be started, and engine manufacturer's after-starting checks and inspections made and recorded during a reasonable warm-up period. For the following steps, the output line-line and line-neutral voltages and frequency shall be recorded after performing each step instruction (after stabilization of voltage and frequency). Stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings.

a. Apply load in steps no larger than the Maximum Step Load Increase to load the engine-generator set to 100 of Service Load.

b. Verify that the engine-generator set responds to the load addition and that the output voltage returns to and stabilizes within the rated bandwidths.

3.5.6 Automatic Operation Tests for Stand-Alone Operation

The automatic loading system shall be tested to demonstrate automatic starting, and loading and unloading of each engine-generator set. The loads for this test shall utilize the actual loads to be served, and the loading sequence shall be the indicated sequence. Perform this test for a minimum of two successive, successful tests. This test shall be for a period of 2 hours. Data taken shall include the following:

a. Ambient temperature (at 15 minute intervals).

b. Generator output current (before and after load changes).

c Generator output voltage (before and after load changes).

d. Generator output frequency (before and after load changes.)

1. Initiate loss of the primary power source and verify automatic sequence of operation.

2. Restore the primary power source and verify sequence of operation.
3. Verify resetting of controls to normal.

3.6 FINAL INSPECTION AND TESTING

During final inspection and testing procedures, Fort Campbell Directorate of Public Works , Authority Having Jurisdiction shall be scheduled and in attendance. Approval shall not occur without this observation and participation. Testing procedures shall include the following:

a. Start the engine, record the starting time, make and record all engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

b. Increase the load in steps no greater than the maximum step load increase to 100% of service load, and operate the engine-generator set for at least 30 minutes.

Measure the vibration at the end bearings (front and back of engine, outboard end of generator) in the horizontal, vertical, and axial directions. Verify that the vibration is within the same range as previous measurements and is within the required range.

c. Remove load and shut down the engine-generator set after the recommended cool down period. Perform the pre-test inspections and take necessary corrective actions.

d. Remove the lube oil filter and have the oil and filter examined by the engine manufacturer for excessive metal, abrasive foreign particles, etc. Any corrective action shall be verified for effectiveness by running the engine for 4 hours at service load, then re-examining the oil and filter.

e. Remove the fuel filter and examine the filter for trash, abrasive foreign particles, etc.

f. Visually inspect and check engine and generator mounting bolts for tightness and visible damage.

g. Replace air, oil, and fuel filters with new filters.

3.7 MANUFACTURER'S FIELD SERVICE

3.7.1 Onsite Training

The Contractor shall conduct training course for Fort Campbell Authority Having Jurisdiction and operating staff as designated by the Contracting Officer. The training period shall consist of a total 4 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance. The course instructions shall cover pertinent points involved in operating, starting, stopping, programming of all components, servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations such as oil change, oil filter change, and air filter change.

3.7.2 Manufacturer's Representative

The engine generator-set manufacturer shall furnish a factory certified, qualified representative to supervise the installation of the engine generator-set, assist in the

performance of the onsite tests, and instruct personnel as to the operational and maintenance features of the equipment.

3.8 INSTRUCTIONS

Two sets of instructions shall be typed and framed under weatherproof laminated plastic, and posted side-by-side where directed before acceptance. First set of instructions shall include a one-line diagram, wiring and control diagrams and a complete layout of the system. Second set of instructions shall include the condensed operating instructions describing manufacturer's pre-start checklist and precautions; start procedures for test-mode, manual-start mode, and automatic-start mode (as applicable); running checks, procedures, and precautions; and shutdown procedures, checks, and precautions. Instructions shall include procedures for interrelated equipment and automatic transfer switches

3.9 ACCEPTANCE

Final acceptance of the engine-generator set will not be given until the Contractor has successfully completed all tests and after all defects in installation material or operation have been corrected.

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SECTION 16370
Electrical Distribution System, Aerial

Ft. Campbell Requirements:

No electric equipment shall be installed within or on any Fort Campbell building, structure, or premises, nor shall any alteration or addition be made in any such existing equipment without first securing an Electrical Permit (FC Form 4183) from the Fort Campbell Electrical Inspector in accordance with Fort Campbell Directorate of Public Works Standing Operating Procedure (SOP) 308, except as provided within said SOP.

Copies of SOP and permits shall be obtained at DPW, Operations and Maintenance Division, Building 867, 16th Street, Fort Campbell, Kentucky.

The distribution level voltage at Fort Campbell is 12.47/7.2 kV.

All new electrical distribution lines shall be installed underground, see Section 16375. If and when overhead service has been approved by the installation, use pinless construction. Should a need for cross arms arise, use fiberglass. Wooden poles with wooden cross arms are NOT to be utilized.

Where distribution lines must be installed overhead:

* Use wooden poles with 20 year life span.

* Use armless, narrow profile construction where practicable.

* Use fiberglass crossarms where crossarms are required.

* Overhead lines shall be ACSR (no copper).

* All fittings shall be compression type.

* All equipment mounts shall be aluminum.

* All overhead switches and cut-outs shall be of the loadbreak type.

Minimize distribution lines installed under pavement.

Generally, when underground electric approaches 350-400 feet in length, provide a manhole.

Underground medium voltage lines shall be concrete encased. Underground service entrance conductors shall be copper installed in conduits. Copper conductors are preferred for overhead service drops, but aluminum conductors are acceptable. However provide copper conductors from meter base to service equipment inside. If meter or disconnect mounted on a pole, run copper conductors from transformer down.

Distribution lines shall be designed for maximum system flexibility. Use loop feed where practicable to create redundancy. In housing areas utilizing underground distribution, run separate feeds from transformer to each apartment.

The following guidance applies to all electrical distribution equipment that contains oil. This is for equipment installed permanently as well as temporary installation for contractor's offices at a job site or in contractor's row next to Roads & Grounds.

- Delta banks shall not be provided for transformer stations.

- Provide adjustable taps on transformers.

- Rebuilt or reconditioned transformers will be not installed.

- A nameplate will be provided on all transformers that says "NON-PCB" or "LESS THAN 1 PPM PCB". In addition to the nameplate PCB-free designation, all transformers will have a "No PCB's" per EPA regulations. Stickers shall be visible from the ground. The sticker shall be 2" wide by 1" high, UV fade resistant, pressure sensitive adhesive backing, blue background with white letters, and suitable for all weather conditions. Source of supply is Style PCNL as manufactured by Labelmaster Hazardous Materials Safety Products, 1996 General Catalog G-110.

  - The following information will be provided to the construction representative to be forwarded to the Environmental Division point of contact Wally Crow for updating of the Fort Campbell database:

    Manufacturer:
    Model Number:
    Serial Number
    Manufacture Date:
    KVA and Phase:
    Primary Voltage:
    Secondary Voltage:
    Installation Date:
    State Installed:
    Location Installed:

Any new oil equipment used shall be non-PCB. All regulated electrical equipment at Fort Campbell should be free of PCB. However, if a contractor should discover a piece of equipment that is not marked, the DPW Environmental Division should be contacted. The POC for PCB is Russ Godsave at (270) 798-9637.

Instructions to Designers:

1. Include all required features and specific equipment features into project design and contract documents specifications as they apply.

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SECTION 16375
Electrical Distribution System, Underground

Ft. Campbell Requirements:

No electric equipment shall be installed within or on any Fort Campbell building, structure, or premises, nor shall any alteration or addition be made in any such existing equipment without first securing an Electrical Permit (FC Form 4183) from the Fort Campbell Electrical Inspector in accordance with Fort Campbell Directorate of Public Works Standing Operating Procedure (SOP) 308, except as provided within said SOP. Copies of SOP and permits shall be obtained at DPW, Operations and Maintenance Division, Building 867, 16th Street, Fort Campbell, Kentucky.

The distribution level voltage at Fort Campbell is 12.47/7.2 kV.

All new electrical distribution lines shall be installed underground. If and when overhead service has been approved by the installation, use pinless construction. Should a need for cross arms arise, use fiberglass. Wooden poles with wooden cross arms are NOT to be utilized.

Minimize distribution lines installed under pavement.

Generally, when underground electric approaches 350-400 feet in length, provide a manhole.

Underground medium voltage lines shall be concrete encased. Underground service entrance conductors shall be copper installed in conduits. Copper conductors are preferred for overhead service drops, but aluminum conductors are acceptable. However provide copper conductors from meter base to service equipment inside. If meter or disconnect mounted on a pole, run copper conductors from transformer down.

Distribution lines shall be designed for maximum system flexibility. Use loop feed where practicable to create redundancy. In housing areas utilizing underground distribution, run separate feeds from transformer to each apartment.

At design meetings, discuss what outages will be needed and for how long. Generally, Ft. Campbell will allow a 4-8 hour utility outage if the utility is not a critical customer need and is properly coordinated and public notification is made to impacted customers. Outages shall be limited to not more than 3-4 to a customer for the contract duration. For a major outage, Ft. Campbell would advertise for at least 2 weeks prior to outage occurrence.

Fort Campbell has a great deal of underground utility lines (both active and abandoned) that do not show up on Base utility maps. Therefore, any utilities to be installed underground must be coordinated with DPW as soon as possible during the design process.

Utility lines installed underground shall be marked with magnetic tape.

Grounding shall not be accomplished at water lines. Use of ground rods is required.

Provide individual meters on gas, water, and electric service lines for all buildings. Meters shall be capable of receiving a device which will allow remote monitoring in the future.

Trenching through roadways shall be avoided to the maximum extent possible. Whenever possible utilities shall be pressure-pumped below roadways. When underground utilities are sleeved under roadways, conduit sleeves shall be extended a minimum of 10 feet beyond the roadway on both sides to protect conductors from penetration by new road signs, poles, etc.

The following guidance applies to all electrical distribution equipment that contains oil. This is for equipment installed permanently as well as temporary installation for contractor's offices at a job site or in contractor's row next to Roads & Grounds.

- Service transformers, for all 15kV, and below, 3-phase underground fed installations, shall be of the pad-mounted type. The high-voltage compartment shall be dead-front construction. Primary switching and protective devices shall include loadbreak switching, fuse protection, medium-voltage separable loadbreak connectors, universal bushing wells and inserts or integral one piece bushings and surge arresters. The nameplate rating for the transformer shall not be less than 90 percent of the KVA demand load calculated for the transformer. Provide copper windings, not aluminum. Enclosure shall be lockable using a padlock. New single phase transformer installations shall utilize a pad mount transformer. Single phase installations for O&M projects shall be coordinated with user as to whether a pole mount or a pad mount transformer should be used. Designer shall coordinate with the DPW as to whether a new or replacement feed is to be run aerially or underground**.**

- Delta banks shall not be provided for transformer stations.

- Provide adjustable taps on transformers.

- Rebuilt or reconditioned transformers will be not installed.

- A nameplate will be provided on all transformers that says "NON-PCB" or "LESS THAN 1 PPM PCB". In addition to the nameplate PCB-free designation, all transformers will have a "No PCB's" per EPA regulations. Stickers shall be visible from the ground. The sticker shall be 2" wide by 1" high, UV fade resistant, pressure

sensitive adhesive backing, blue background with white letters, and suitable for all weather conditions. Source of supply is Style PCNL as manufactured by Labelmaster Hazardous Materials Safety Products, 1996 General Catalog G-110.

- The following information will be provided to the construction representative to be forwarded to the Environmental Division point of contact Wally Crow for updating of the Fort Campbell database:

  Manufacturer:
  Model Number:
  Serial Number
  Manufacture Date:
  KVA and Phase:
  Primary Voltage:
  Secondary Voltage:
  Installation Date:
  State Installed:
  Location Installed:

- Any new oil equipment used shall be non-PCB. All regulated electrical equipment at Fort Campbell should be free of PCB. However, if a contractor should discover a piece of equipment that is not marked, the DPW Environmental Division should be contacted. The POC for PCB is Russ Godsave at (270) 798-9637.

Instructions to Designers:

1. Include all features into project design and contract documents specifications as they apply.

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SECTION 16415
Electrical Work, Interior

Ft. Campbell Requirements:

a. An Electrical Inspection is required for any electrical work, modifications, additions or upgrades to existing electrical systems in any Fort Campbell real property, temporary building or other structures, including mobile homes, temporary office trailers, recreational vehicles, floating buildings; and other premises such as yards, parking, storage, carnival, and other lots and industrial substations.

b. An Electrical Inspection is required for any electrical work, modifications, additions or upgrades during new construction in any Fort Campbell real property, temporary building or other structures, including mobile homes, temporary office trailers, recreational vehicles, floating buildings; and other premises such as yards, parking, storage, carnival, and other lots and industrial substations.

c. An Electrical Inspection is required for any electrical service that is to be connected to the Fort Campbell electrical network.

d. An approved Fort Campbell Electrical Contractor Registration form is required for any person, firm or corporation requiring an Electrical Work Permit. At minimum, but not limited to, a current valid state Electrical Contractors License is required to obtain and maintain approval.

See CAM Reg 420-4, 4 April 2006 for further details click here.

Grounding shall not be accomplished at water lines. Use of ground rods is required.

Provide watt-hour meters and secondary surge arrestors on each new facility. Meters shall be capable of receiving a device to allow future remote monitoring

General:

There shall be an electrical room separate from the mechanical room to protect electrical communications and fire alarm equipment from temperature and humidity normally encountered in a mechanical room. Access to the electrical room shall be either directly from the outside of the building or through the mechanical room.

Do not use wet cell batteries, particularly for exit lights and emergency lights.

Coordinate with mechanical and plumbing disciplines to ensure that proper NEC clearances are maintained around electrical equipment in electrical and mechanical rooms.

Install surface mounted panelboards in unfinished areas of buildings. Install flush or semi-flush panelboards in other areas. Provide spare 1P circuit breakers and spaces for future expansion.

Coordinate plans so that lighting fixtures, smoke detectors, supply and return grilles, and other ceiling mounted equipment do not overlap or interfere with each other.

Do not install timers to control lighting in latrines and showers.

State in the contract that when systems or equipment require special tools or peripheral equipment to repair, operate, maintain, or program that tool or equipment shall be provided to the DPW. This includes laptop computers and/or software. This applies in particular to fire alarm equipment and fiber optic systems. Also state in the contract that the contractor shall provide and schedule appropriate training for DPW personnel to maintain unusual systems and equipment.

Provide reduced voltage starting where motor starting kVA will result in more than a 30% transient voltage dip per DA technical guidance (Technical Manual 5-811-2).

Use 3 phase motors to the maximum extent possible especially for integral (1/2, 3/4 HP) motors that start and stop frequently. (i.e. pumps and air compressors. General rule is less than 1 HP is single phase but single phase motors that start/stop frequently tend to wear out faster).

Provide single-phase protection on all 3-phase motors.

The following guidance applies to all electrical distribution equipment that contains oil. This is for equipment installed permanently as well as temporary installation for contractor's offices at a job site or in contractor's row next to Roads & Grounds.

- Rebuilt or reconditioned transformers will be not installed.
- Delta banks shall not be provided for transformer stations.
- Provide adjustable taps on transformers.
- A nameplate will be provided on all transformers that says "NON-PCB" or "LESS THAN 1 PPM PCB". In addition to the nameplate PCB-free designation, all transformers will have a "No PCB's" per EPA regulations. Stickers shall be visible from the ground. The sticker shall be 2" wide by 1" high, UV fade resistant, pressure sensitive adhesive backing, blue background with white letters, and suitable for all weather conditions. Source of supply is Style PCNL as manufactured by Labelmaster Hazardous Materials Safety Products, 1996 General Catalog G-110.

- The following information will be provided to the construction representative to be forwarded to the Environmental Division point of contact Wally Crow for updating of the Fort Campbell database:

  Manufacturer:
  Model Number:
  Serial Number
  Manufacture Date:
  KVA and Phase:
  Primary Voltage:
  Secondary Voltage:
  Installation Date:
  State Installed:
  Location Installed:

Any new oil equipment used shall be non-PCB. All regulated electrical equipment at Fort Campbell should be free of PCB. However, if a contractor should discover a piece of equipment that is not marked, the DPW Environmental Division should be contacted. The POC for PCB is Russ Godsave at (270) 798-9637.

Instructions to Designers:

1. Include all features into project design and contract documents specifications as they apply.

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SECTION 16528
Exterior Lighting Including Security

Ft. Campbell Requirements:

No electric equipment shall be installed within or on any Fort Campbell building, structure, or premises, nor shall any alteration or addition be made in any such existing equipment without first securing an Electrical Permit (FC Form 4183) from the Fort Campbell Electrical Inspector in accordance with Fort Campbell Directorate of Public Works Standing Operating Procedure (SOP) 308, except as provided within said SOP. Copies of SOP and permits shall be obtained at DPW, Operations and Maintenance Division, Building 867, 16th Street, Fort Campbell, Kentucky.

All exterior lighting (parking lot, street, building, etc.) shall be either 120, 208, or 277 Volt. 480-Volt lighting is not permitted. Safety is an issue when working on this high of a voltage, especially in inclement weather.

Exterior lighting (parking lot, street, building, etc) shall be Metal Halide or 100, 150, or 400 watt Mercury Vapor. Use 1500-watt metal halide on athletic fields. No High-Pressure Sodium lighting will be permitted.

All exterior street and flood lights, which are to be installed within a mile of the CAAF or SABRE airfield boundaries shall have controlled light distribution in the direction thereof and shall be provided with visors as required such that that angle of the beam, when extended, ends a minimum of 300 feet before the area of the affected airfield. The intent is to minimize light pollution in the area and to minimize the chances of pilots looking directly into the beams of nearby lights.

Parking lot lighting control shall be by photocell. Timers will not be permitted. This control shall be by means of one photocell per fixture or one photocell per pole. One photocell per pole is acceptable except for sensitive areas like hospitals, PX, and schools (all lights are out if photocell fails). Provide one photocell per fixture in those areas. Direct burial is acceptable for street light circuits.

Parking lot lighting fixtures shall be COE standard type EH1 and as indicated above.

Instructions to Designer

1. Include all features into project design and contract documents specifications as they apply.

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SECTION 16700+
Telecommunications Systems

Ft. Campbell Requirements:

General:

The Director of the Information Management (DOIM) will enforce the following standards for *Installation Information Infrastructure Policy (I3P).*

- DOIM will review and approve all proposed voice-data communications requirements for fiber, copper, and all requirements for connectivity into Fort Campbell's telecommunications infrastructure.
- DOIM requires all contracts performing telecommunications construction or deconstruction by a civilian contractor utilize the I3P standard requirements. Any and all requirements in these standards apply equally to on-site employees and to US Government contractors.
- DOIM requires designers to coordinate with tenant organizations and ensure that all communications requirements are being met in accordance with this standard.

Contractor Requirements:

- Application to Dig or Connect Buildings: Project plans and specification shall require Contractors to apply to the Director, Information Management for approval of a digging/excavation permit. The Contractor is required to contact the DOIM as required in the I3P prior to connecting any building on Fort Campbell to the infrastructure.
- Plans and specification shall require Contractors to notify the DOIM when renovating, modifying, or deconstructing communications materials in any existing structures on Fort Campbell, KY. This also applies to new facilities or any Major Construction Projects (MCA) at Fort Campbell, KY.

Other:

- Per DAIM-FD Memorandum dated 3 November 2000, Army-wide policy applies to individual subscriber communications (barracks soldier rooms) infrastructure that supports MILCON barracks construction. Project funds are allowable to install the cabling from the individual soldier room to a central telephone closet. Beyond that point, AAFES through their commercial phone service provider, will make connection.
- All exterior communications infrastructure to the designated central closet is the responsibility of AAFES through their designated service provider. This includes all outside cable plant (cable, duct, manholes), equipment shelters, and switches.

Instructions to Designers:

Design Requirements:

1. All detailed requirements contained in the **Fort Campbell Installation Information Infrastructure Policy (I3P) (Appendix H)** document shall be incorporated into all design and construction documents. Any additional requirements not addressed in the document standards will conform to the ANSI/TIA/EIA Standard.

2. All Designs shall be coordinated with DOIM and submitted to DOIM for review and approval prior to start of construction to ensure that the requested or designed wiring is available in the existing system infrastructure.

3. All new data and voice communications lines shall be installed underground. If and when overhead service has been approved by the installation, use pinless construction. Should a need for cross arms arise, use fiberglass. Wooden poles with wooden cross arms are NOT to be utilized.

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Appendix A
Environmental Requirements

PARAGRAPH

A-1 Occupational Health Considerations
A-2 Clean Air Act
A-3 Clean Water Act
A-4 Safe Drinking Water Act
A-5 TSCA
A-6 FIFRA
A-7 Solid Waste Disposal Practices
A-8 Hazardous Waste Disposal Practices
A-9 Emergency Planning and Community Right-To-Know Act
A-10 National emission standards for hazardous air pollutants (NESHAP)

A-1. Occupational Health Considerations

Ft. Campbell has design Standard Operating Procedures for the following items and they shall be used in preparation of a design:

Confined Spaces:

Contractor shall observe OSHA Regulation 29 CFR Part 1910.146 regarding permitting, entry and working within confined spaces. Contractor is required to submit a work plan to the Contracting Officer's representative prior to entering any confined space.

Hazard Communication Program:

Contractor shall observe OSHA Regulation 29 CFR Part 1910.1200 regarding a written hazard communication program for describing how requirements for labels and other forms of warning, material safety data sheets, and employee information and training will be met. The program will also include a list of the hazardous chemicals known to be present and the methods used to inform employees of the hazards of non-routine tasks.

Lock Out, Tag Out Procedures:

Contractor shall observe OSHA Regulation 29 CFR Part 1910.147 regarding the control of hazardous energy (lock-out/tag-out).

Lock-out/Tag-out for Safety: The Contractor shall use a locking device that secures a valve or lever in the "off" position when a repair, inspection, or construction or new installation is required and also to clean or move any equipment. Making any exception to this rule could result in serious injury and death.

Lock-out: Blocking the flow of energy from the power source to the equipment - and keeping it blocked out - is called a lock-out system. A locking device is usually a key or combination lock arrangement.

Tag-out: Tag-out means placing a tag on the power source to warn co-workers or others not to turn the power on. The information on the tag shall include the name of personnel who put it there, the date, time the work begins, and type of work to be performed.

Basic Rules: Before shut down, the Contractor shall ensure that authorized employees know the type, magnitude, and hazards of the energy to be controlled; and shall verify the method or means of the system. He shall inform all affected employees of the lockout. The equipment shall be turned off, and the Contractor shall lockout energy sources and tag-out at the disconnect point. Any stored or residual energy may be released at that time so the equipment can be tested. The Contractor shall restore energy safely.

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A-2 Clean Air Act:

A-2.1 Fort Campbell has specific Environmental points of contact, and requirements. These are available at the following Internet site:
http://www.campbell.army.mil/envdiv/cleanairact.html

A-2.2 Air permit information is to be provided by designers to Ft. Campbell Environmental Division prior to construction start. Construction permits are based on design. Operating permits are based on actual installation. Checklists for **Non-Process Source** and **Vent/Stack** are included at the end of this Appendix for designers' use. Ft. Campbell will obtain construction and operating permits. POC is Patty Lockard at 270-798-9603.

A-2.3 Information on refrigerant equipment must be submitted to Ft. Campbell Environmental. Use of ozone depleting substances (class 1, CFC's, Halon) shall not be used. Class 2 refrigerant may be specified but will be outlawed by the year 2010. Class III HFC's preferred.

A-2.4 Tennessee requires list of all fuel burning equipment, not just items over a million BTU's or above. Permits take 3-6 months to acquire and will be obtained by the Environmental Division from information supplied by designers.

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A-3 Clean Water Act:

A-3.1 Ft. Campbell POC is Dan Etson at 270-798-9784.

A-3.2 Ft. Campbell averages 3 million gallons per day. The high has been 13 million gallons. The desire is to not exceed this.

A-3.3 Water volume calculations need to be submitted. There is a two to three month review time by State. Can walk permit through. Storm water shall not discharge into sanitary sewer.

A-3.4 When sinkholes are encountered close them, and route water to natural storm drainage patterns. Must have permit from Tennessee to close sinkhole. Double sandbag or hay bales if sinkhole is part of the drainage pattern on a construction site.

A-3.5 If water is discharged into Kentucky, then Kentucky permit will be required.

A-3.6 If oil/water separators are used then design shall be the open top type. Ft. Campbell Environmental Division will provide oil/water separator design.

A-3.7 Specifications and sizing data for construction of the grease interceptor are available to the design team. Designer will contact Gary Sewell for this information. State of Tennessee has sizing criteria. Grease interceptors shall be located for ease of access for cleaning by pumper truck.

A-3.8 Pollution prevention plan must be maintained during construction. Notice-of-intent is required prior to moving any earth.

A-3.9 See Specification **Section 01560, Environment Protection**. Specifications must address spill containment for contractor and should contain language for servicing of

construction vehicles. Five copies of Spill Contingency Plans shall be specified. The Contractor shall be required to mail or submit one copy of a Spill Contingency Plan to:

Wayne Lee
Environmental Division, DPW
Building 2186, 13-1/2 Street
Ft. Campbell, KY 42223

And, four copies to the Contacting Officer. The Contractor shall not start work until the Spill Contingency Plan is approved by the Contracting Officer. If the contract does not require any plan for a specific project, he shall apply for an exception to the Contracting Officer with a copy to Mr. Lee, Environmental Division at address indicated above. For further information or guidelines in order to prepare Spill Plan contact Environmental Division, DPW at 270-798-9641.

A-3.10 Dumping of any liquids on the ground will be considered a release.

A-3.11 Floor drains are not to be provided except where required. They will be provided in a judicious manner, only where necessary. Old sewage system cannot take load. Shower drains are okay but wash-down drains are not acceptable. Mud Rooms must go to sanitary sewer. Discharge cannot adversely affect waste treatment. Biggest concern is volume. Ft. Campbell treatment facility almost maxed out. This is the reason shop washdown is not allowed. Must adhere to approved provisions for washing tents or vehicles. Washing must occur on grass areas.

A-3.12 Must pretreat boiler blowdown before discharge due to base sewer toxicity levels being a noted problem.

Return to Chapter 2 **Return to Storm-Drainage System** **Return to Appendix A**

A-4 Safe Drinking Water Act:

A-4.1 Dead end water lines shall not be installed. Lines must be looped and disinfected. POC is Audie Hardin at 270-956-1801.

A-4.2 Backflow prevention is required on domestic water only and must be approved by state of Tennessee.

Return to Chapter 2 **Return to Appendix A**

A-5 Toxic Substances Control Act (TSCA):

A-5.1 Lead paint:

A-5.1.1 Lead-based paint and lead containing paint protection required for working personnel in accordance with OSHA requirements. Lead exposure for air quality will be

tested by an exposure assessment for the first building demolished; this data can then be used for the remainder of buildings. If test results indicate that sirborne lead levels have not exceeded standards as established by the Clean Air Act, additional testing is not required.

A-5.1.2 Lead-Based Paint Notification Requirements for Work in Family Housing:

A-5.1.2.1 There is a new Federal requirement to notify family housing occupants when work in their quarters will disturb known or suspected lead-based paint (LBP). This requirement became effective 1 June 1999 and will affect all Army Family housing built prior to 1978. This final rule is issued under the authority of section 406(b) of the Toxic Substance Control Act (TSCA), 15 U.S.C. 2686(b) as amended by the Residential Lead-Based Paint Hazard Reduction Act of 1992 to add Title IV, entitled Lead Exposure Reduction. The Residential Lead-Based Paint Hazard Reduction Act is also referred to as Title X of the Housing and Community Development Act of 1992, Public Law 102-550. A copy of this requirement can be found in the Federal Register, 1 Jun 98, at **http://www.epa.gov/fedrgstr/EPA-TOX/1998/June/Day-01/t14437.htm**.

A-5.1.2.2 The requirement is that whenever maintenance, repair, or renovation is performed in or on an occupied unit and LBP is disturbed (resulting in flaking or dust) that the worker (both in-house and contractor) must provide the occupant a copy of the pamphlet, "Protect Your Family from Lead in Your Home". The Pamphlet can be obtained at **http://www.hud.gov/lea/leadhelp.html**. This is the same pamphlet that is required to be given to occupants by the housing office when they are assigned to quarters containing lead-based paint (per ACSIM Memo, Subject: Disclosure Requirements for Lead-Based Paint Hazards in Army Family Housing, dated 24 Jul 96). The worker must also attempt to obtain from the occupant a written acknowledgment that the occupant has received the pamphlet (sample language on the above web site). These records must be kept for three years. This requirement also applies when work is done in common areas of occupied multi-unit family housing. The Garrison commander (or designated representative, such as the housing manager), as the owner's representative, must also be notified.

A-5.1.2.3 Contractors working in occupied AFH are also required to issue this pamphlet and this should be verified by the Government inspector. Current contracts should be modified as necessary to comply with this new requirement. Pre-1978 AFH units that are certified as free of lead-based paint and units that are vacant due to major renovation or between occupancy are exempt from this requirement. This requirement does not apply to minor repair and maintenance activities (including minor electrical work and plumbing) that disrupt 2 square feet or less of painted surface per component.

A-5.1.2.4 PAINTER-L is a computerized tool currently available to help manage the presence of LBP and LBP hazards. For more information on this system contact Dr. Ashok Kumar, CERL, at 1-800-USA-CERL.

Return to Chapter 2 **Return to Section 02090** **Return to Appendix A**

A-5.2 Radon:

A-5.1.1 Building design must have Radon protection features. In the specifications, Contractor is to be required to test the building for radon after construction is complete. Also refer to Section 01560, Paragraph 2.1.1g.

Radon mitigation design and testing: All construction performed at Fort Campbell must have passive radon mitigation features implemented into the design. The contractor will install preliminary features as per drawings. The contractor will hire an independent testing company to perform radon monitoring prior to habitation of the building(s). The testing firm must be EPA accredited and approved to perform work in the State of Tennessee (Kentucky). A list of accredited testing firms in the state of TN (KY) can be obtained through the state Radon Program Coordinator (TN 615-532-0733) (KY 502-). In the event radon concentrations greater than 4 pCi/l (pico curries per liter) are revealed, consult Fort Campbell DPW through the Contracting Officer's Representative for guidance pertaining to retesting. If upon further testing unacceptable levels are present, additional mitigation features will be installed followed by more testing. The buildings will not be inhabited until levels of less than 4 pCi/l have been achieved.

Return to Chapter 2 **Return to Appendix A**

A-6 Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA):

A-6.1 Fort Campbell has an approved insecticide and pesticide list contained in the Installation Pest Management Plan (IPMP). The current IPMP's approved list of pesticides will be used in the preparation of the appropriate contract documents. All insecticide and pesticide work on Fort Campbell must comply with the IPMP.

A-6.2 Contractors will submit a report of the pesticides used, type and amounts, on Ft Campbell to the FIFRA program manager. Applicators of pesticides on Ft. Campbell must be licensed in Kentucky and Tennessee.

Return to Chapter 2 **Return to Appendix A**

A-7 Solid Waste Disposal/Diversion Practices:

A-7.1 In the interest of reducing waste, Fort Campbell is actively recycling and reducing waste in all operations to meet the installation's 25 year sustainability goals. Contractors are required to participate in on-post programs. They are encouraged to find ways of reducing waste. Recycling shall be practiced to the maximum extent possible. Refuse materials shall be separated in accordance with installation policies and practices.

A-7.2 Dumpster service is not provided by the installation. Contractors shall arrange for dumpster service at their own expense.

A-7.3 Landfill:

A-7.3.1 Contract specifications shall include contract performance requirements for a 50% minimum diversion of construction and demolition (C&D) waste by weight, from landfill disposal. Contract specifications will include submission of a contractor's C&D Waste Management Plan to be submitted and approved by DPW, preferably prior to the start of a site clearance.

A-7.3.2 Point of contact for landfill issues is DPW Environmental Division at 270-798-9769.

A-7.3.3 Landfill Access:

- Upon award of a contract the name of the contractor, the contract number, project name and the completion date of the contract is furnished to the Directorate of Public Works Environmental Division, which will in turn furnish landfill access passes for the contractor's use in delivering C&D debris materials to the Woodlawn Rd. C&D landfill.

- All loads of debris will be weighed and recorded in the landfill data base. Scales are available at the landfill. Each month, tabulation (by contract number) will be furnished to contracting office indicating the amount of debris generated by that contract, if requested. Trucks and/or trailers shall be weighed coming in and going out of the landfill. The vehicle operator shall have a landfill access pass from the contractor to obtain entrance into the landfill. Other information that will be recorded includes whether the load contained asbestos or any other authorized special waste and whether the load contained recyclable materials.

A-7.4 Materials Handling:

A-7.4.1 Demolition and removal Activities:

- Contract specifications shall require at least a 50% diversion (by weight) of C & D waste materials such as wood, plumbing fixtures, electrical materials (lights and panels), windows, doors, toilet partitions, HVAC equipment, and scrap metals be diverted from the landfill. Diversion can be accomplished by deconstructing the wood buildings and components per instructions below or by moving the structure off-post. Construction specifications shall require a C & D Waste Management Plan to be submitted and approved by DPW.

  A-7.4.1 (a) Salvageable materials shall not to be transported off the installation. Government salvage requirements shall be evaluated on a project by project basis and salvage rights automatically apply for the following equipment:

  Transformers

Cut-outs
Capacitors
Circuit Breakers
Voltage Regulators
Line hardware
Utility Poles

Salvageable metals that are recovered as a result of grinding shall be separated for sale as scrap metal.

• All salvageable materials removed from the project site shall be delivered to DRMO for selling as scrap metal. The Contractor must properly complete the turn in document, DD Form 1348-1a and ensure Fort Campbell funding code (21F3875 1111 76 C S15056 AC 9921) is utilized when materials are turned into DRMO.

A-7.4.1 (b) Nonsalvageable materials shall not be removed from the installation. They shall be taken to the landfill or diverted for recycle as recovered materials.

• Street surfacing (asphalt/concrete), sidewalks, curbs & gutters, etc., and building related concrete and masonry materials shall be ground up at the construction site and transported to an offsite location designated by the COR. Materials to be ground up shall not have foreign items (doors, windows, piping, PVC items, toilet partitions, plumbing fixtures, etc) included that will render the ground products un-useable.

• These materials may also be transported and stockpiled at the Woodlawn C/D landfill for future grinding. However, Ft. Campbell has placed limits on the size of materials (specifically concrete and asphalt pavement) that can be placed in the landfill. These materials shall not exceed more than 2 feet by 3 feet and shall be no thicker than 18 inches.

• Bricks may be delivered whole and recycled to meet diversion goals.

• Land clearing waste (trees, stumps, etc.) shall be mulched at the Bi-County Landfill. Logs cannot exceed a maximum length of 12’ and 20” in diameter.

A-7.4.2 New Construction Activities and Contracts:

• It is the contractor’s responsibility to insure that all new construction C & D materials disposal meets the 50% diversion criteria. Waste recyclable materials, such as cardboard, paper, scrap metals, pallets, etc., shall be recycled and not landfilled. Evidence that this diversion criteria is met shall be maintained in a data log for the duration of the project by the contractor and provided to the project COR or the project

engineer. Assistance in identifying recycler outlets can be obtained from DPW Environmental Division.

A-7.5 Construction projects requiring soil borrow material should be coordinated with DPW Engineering Division at 270-798-3113.

Return to Chapter 2 **Return to Appendix A**

A-8 Hazardous Waste Disposal Practices:

A-8.1 Mercury containing light bulbs such as fluorescent tubes, mercury vapor, metallic halide, and high-pressure sodium lamps shall be considered has hazardous wastes and require special handling. Fluorescent, mercury vapor, metallic halide, and high pressure sodium light bulbs, while not a listed hazardous waste, may be a characteristic hazardous waste and therefore subject to testing and proper disposal as per RCRA. These lamps are a concern at Fort Campbell in regard to their disposal. Disposal of these materials resulting from demolition or other DPW related activities, shall be coordinated with the DPW Environmental Quality Officer for the policy contained in Section 11 of the EQP Handbook.

A-8.2 Low-pressure sodium lamps are not listed hazardous wastes but require special handling.
A-8.3 Refrigerant in air conditioning equipment being demolished must be recovered and transported to the Environmental Division Pollution Prevention Operations Center for reclaiming.

A-8.4 PCB's is a concern for HVAC/Electrical and capacitors. Capacitors in existing air conditioning equipment may contain polychlorinated biphenyl's (PCB's).

A-8.5 Fluorescent ballast in buildings to be demolished may contain PCB's.

A-8.6 Transformers as well as all fluorescent ballasts and HVAC/Electrical capacitors to be removed may contain PCB's. Transformers shall be turned over to DRMO.

A-8.7 Lighting ballast and capacitors are to be placed in 55-gallon drum and delivered to the Environmental Division Pollution Prevention Operations Center..

Return to Chapter 2 Return to Appendix A

A-9 Emergency Planning and Community Right-To-Know Act (EPCRA):

A-9.1 Ft. Campbell is required by Executive Order 12856, "Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements", to comply with the requirements of the Emergency Planning and Community Right-to-Know Act (EPCRA). EPCRA requires Ft. Campbell to identify the amounts of chemicals present on, or released from its facilities, understand the potential problems that hazardous materials pose to the surrounding communities and environment, and provide information to the public and local emergency planning organizations. To comply with EPCRA requirements, Ft. Campbell must track and be accountable for hazardous materials (HM) used throughout the installation. The Contractor must submit information describing hazardous materials (paint, solvents, adhesives, treated lumber, etc) on

FTCKY HAZMAT INVENTORY FORM to the Environmental Division Pollution Prevention Branch. The Contractor will account for the quantity of HM brought to the post, the quantity used or expended during the job, and the leftover quantity to be removed from the installation. This information will be provided on a calendar year basis and must be submitted by the end of January following the year reported. Tracking of hazardous materials used by the Contractor shall be required by the contract.

Return to Chapter 2 **Return to Appendix A**

CHECKLIST FOR NON-PROCESS SOURCE

Organizational Owner/Operator: _____
Date: _____ Interviewer: _____
Facility: _____ Contact: _____ Phone: _____
Bldg. No.: _____ Room No.: _____ Source No.: _____

FOR DPW-E USE ONLY

Permit Status: ☐ Required ☐ Not Required
Permit Type: ☐ Operating ☐ Construction ☐ Relocation ☐ Modification

General

1. Description and designation of source (Boiler #1, Hot Water Heater #1, etc.)
   _____
   _____
   _____

2. Construction date (manufactured) _____ Date commenced operations _____
   Installation date (at site) _____

3. Manufacturer _____
   Model No. _____ Serial No. _____

4. Normal operating hours _____ hrs/day, _____ days/week, _____ weeks/yr.

5. % operating (time) by calendar year per quarter
   _____1st _____2nd _____3rd _____4th.

6. Maximum (potential) operating hours
   _____ hrs/day, _____ days/week, _____ weeks/yr.

7. Fuel type: Primary fuel _____ Standby fuel (if any) _____
   BTU values of fuels: Primary fuel _____ Standby fuel (if any) _____

8. Primary use of heat source _____
   Secondary use of heat source (if any) _____

9. If coal burner, type of firing? _____

10. Maximum rated boiler horsepower (BHP) _____
    Heat input capacity (MMBtu/hr) _____
    Maximum rated electrical Output (kw) _____ (if applicable)

11. Average % load _____ or actual maximum heat input value used _____ MMBtu/hr

12. For fuels other than natural or liquified gases:

CHECKLIST FOR NON-PROCESS SOURCE (continued)

% Sulfur content _____
% Ash _____ (if solid fossil fuel)

13. Average annual fuel consumption: Primary _____ (☐ ft^3 ☐ gal - check one)
    Secondary _____ (☐ ft^3 ☐ gal - check one)

14. Emissions monitoring equipment installed? ☐ Yes ☐ No

    _____

    (If yes, describe above)

[ATTACH COMPLETED CONTROL DEVICE(S)/TECHNIQUE(S) CHECKLIST(S)]

15. Is the source operated under a current operating or construction permit? ☐ Yes ☐ No
    (If yes, obtain copy of permit and attach to this checklist)

16. If fuel oil is used, is the unit served by a fuel storage tank? (check one) ☐ Yes ☐ No
    (If yes, complete and attach Storage Tank Checklist)

17. Is a fuel flow meter installed for
    a. Natural gas (check one): ☐ Yes ☐ No
    b. Other fuel (check one): ☐ Yes ☐ No

[ATTACH COMPLETED STACK/VENT CHECKLIST FOR NON-PROCESS OPERATION]

Comments

Return to Section

VENT/STACK CHECKLIST

Organizational Owner/Operator: _____

Date: _____ Interviewer: _____ Initials: _____

Facility: _____ Contact: _____ Phone: _____

Bldg. No.: _____ Address: _____ Permit No.: _____

General

1. Description of emission (particulate matter, gaseous, mix, species name, etc.)
   _____
   _____
   _____

2. Identify source(s) served _____
   _____

3. Are the emissions air contaminants? (check one) ☐ Yes ☐ No

4. Does the source also have the potential for fugitive emissions? (check one) ☐ Yes ☐ No
   (If yes, describe nature of fugitive emissions in the comment section.)

5. Has there been a stack test for this source? (check one) ☐ Yes ☐ No
   (If yes, attach copy of stack test documents to this form)

6. Has there been a surrogate stack test for this source? (check one) ☐ Yes ☐ No
   (If yes, attach copy of stack test documents to this form)

Pick-up Duct Data

1. Hood Type_____

2. Hood Dimensions Slot Length_____Slot Width_____
   Distance from Hood Face to Contaminant_____
   Hood Face Area _____
   Measured Air Flow at Hood_____
   Measured Face Velocity_____
   Hood Static Pressure_____
   Duct ID_____
   Duct Length to Bldg. Exit_____
   Contaminant Capture Temp._____

3. Contaminant Data

Name	Constituency Portion (list measurement units)
_____	_____

STACKVE.002 (Rev. 02/29/96)

VENT/STACK CHECKLIST (continued)

Vent Information

1. Inside diameter (ID) at exit _____ (ft)

2. Vent height: a. Above ground _____ (ft)
   b. Above roof level _____ (ft)

3. Gas stream exhaust exit temp _____ (°F)

4. Exit velocity _____ (ft/sec), at ____ °F, _____ (air pressure - note measurement units) and standard conditions (68 °F and 1 atm) _____(ft/sec)

5. Exit flow at exit conditions _____(ft^3/min)
   Obtained from (check one): ___ calculations ___ test data
   Exit flow at standard conditions _____ (dscfm)

6. Stack gas moisture percent at exit conditions _____% ___ By Weight Grains Per Dry Standard Cubic Foot (gr/dscf)

7. Exit plume direction (check one): ___ Up ___ Down ___ Horizontal

8. Exhaust fan data: horsepower _____ RPM _____ volume rate _____(ft^3/min)

9. Air pollution controls installed? (check one) ___ yes ___ no
   (If yes, complete and attach Control Device/Technique Checklist)

10. Is there a Bypass Stack? Y or N
    If so, describe and complete vent/stack form for the Bypass Stack.

11. Is this stack equipped with continuous Pollutant Monitoring equipment? Y or N
    If yes, what Pollutants are monitored.

Attach drawing of emission source showing air contaminant flow from process to atmosphere.
Complete the additional applicable process or non-process checklists.

Comments

Return to Section

A-10. National emission standards for hazardous air pollutants (NESHAP)

Ft. Campbell has design Standard Operating Procedures for the NESHAP items and they shall be used in preparation of a design:

State of Kentucky and Tennessee NESHAP Reporting Requirements for Demolition (Defined as the demolition of a building or demolition of a load supporting structure such as a load-bearing wall) shall be followed:

1. In the case of demolition only, the contractor will mail and be postmarked, fax and follow-up with a mailing, or deliver the NESHAP notice 10 working days before demolition begins even if the operation involves removal of "non-regulated" ACM only in any amount, OR even if the operation involves no ACM removal whatsoever!

2. In the case of demolition where asbestos abatement is also involved, the contractor will send in a separate notice for the abatement as required in paragraphs 2.a. through 2.d. below. The abatement notice may also be included on the demolition notice, so that only one notice may be sent. In this case, include the additional notice lead times as identified in paragraphs 2.a. through 2.d.

a. The Contractor is requested by the state to telephone at least 24 hours beforehand if the operation involves RACM that is below 260 LF, 160 SF, or 35 CF. This only applies in the contractor has sent a long-term NESHAP notification to the State.

b. The Contractor will mail and be postmarked, fax and follow-up with a mailing, or deliver the NESHAP notice 10 working days beforehand if the operation involves RACM that is below 260 LF, 160 SF, or 35 CF (and if the contractor has not sent a long-term NESHAP notification to the State).

c. The Contractor is requested (not a regulatory requirement) by the State to mail, fax, deliver a notice, or phone in the notice so that it is received at least 24 hours beforehand if the operation involves non-regulated ACM in any amount. (In any case, the government "project designer" may still specify that the contractor does a NESHAP notice for any asbestos removal actions. This would be advantages to the government.)

d. The Contractor will mail and be postmarked, fax and follow-up with a mailing, or deliver the NESHAP notice at least 10 working days before abatement begins if the operation involves RACM that is at least 260 LF, 160 SF, or 35 CF.

3. All Kentucky notifications are sent to:

Rebecca Bohannoh
Kentucky Division for Air Quality
Asbestos Branch, Paducah Region
4500 Clarks River Road
Paducah, Kentucky 42003
(270) 898-8468 Office
(270) 898-8640 Fax

All Tennessee notifications are sent to:

Mr. Randal Harrison
Tennessee Division Air Pollution Control
9th Floor, L & C Annex, 401 Church St.
Nashville, Tennessee 37243-1531
(615) 532-0554 Office
(615) 532-0614 Fax

Return to Appendix A **Return to Section**

APPENDIX B
State Water/Sewer Submittals

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APPENDIX C
Digging / Excavation Permits

These permits are found on the following 3 pages

Return to Chapter 2

DIGGING PERMIT

(The proponent for this form is DPW)

NAME AND TITLE OF PROJECT OFFICER / REQUESTER	DATE
ORGANIZATION OF REQUESTER	TELEPHONE
LOCATION OF PROPOSED EXCAVATION *(Attach copy of approved work request or plan)*	PROJECTED WORK DATE(S)
PURPOSE OF EXCAVATION *(Project Number / Contract Number / Title / Etc.)*	

PART I (Utilities Coordination)

Digging or excavation work is a requirement within the scope of work to be accomplished. I understand:

* DPW environmental coordination not required for housing occupants.
* My responsibilities in relation to safety, property damage, personal injury and life threatening hazards associated with digging in the vicinity of underground utilities. Verbal approvals may be given by entities on this form. I understand these approvals are based on information I provide.
* Underground utilities which may be encountered while performing digging and excavation work are high voltage electrical cables, high pressure lines, water lines, sewer lines, steam lines, liquid fuel lines, telephone cables, control cables, and refrigerant lines. Digging into any of these lines could result in extensive property damage. Severe injury or death could result from digging into electrical cables, gas lines, liquid fuel lines, and other high pressure lines. I am responsible for any damages caused to persons or property as a result of my fault or negligence.
* All known underground utilities within the project limits will be discussed with me or my representative during the course of this coordination. Exact location may be unknown; therefore, I am responsible for performing such work as may be necessary to determine exact locations. When calling TENNESSEE ONE CALL and KENTUCKY BUD, advise them the locate request is for Fort Campbell, KY (Government Reservation), not county.
* I understand that it is my responsibility to notify the appropriate personnel listed below and request locating and marking underground utilities, and have each person initial this form.
* Please allow a minimum of 3 working days for DPW personnel to locate and mark all utilities in your project area, and 10 workdays for communications lines. Housing area residents are not required to obtain initials for blocks 3, 8, 9,11, 12 and 13.
* Excavation shall not begin until I receive a signed copy of this form from DPW, Contract Management, or their designated representative.
* A copy of this signed form shall be on the job site at all times.

SIGNATURE OF REQUESTER

All known underground utilities within the project limits have been discussed with the requester or the appropriate representative. Exact locations may not be known; however, the requester is responsible for performing such work as may be necessary to determine exact locations.

1. For location of post telephone lines or fiber optic cable, please bring this completed form to DOIM, Telecommunications Division, building 907, Bastogne Avenue, hours 0730 - 1630, (270-956-2201-798-9999).	INITIALS →	DOIM
2. For location of South Central Bell telephone lines in Housing Areas, contact Kentucky BUD (1-800-752-6007).	INITIALS →	SOUTH CENTRAL BELL
3. For location of selected telephone lines in the barracks area (3200, 3600, 3700, 4000, 6700, 6900, 7000 ,7100, 7500 blocks), contact AT&T, Mr. Wayne Howes, telephone (270) 798-9200/(270)-698-1963. No AT&T utilities between Wickham and US 41A from 41st Street to the south end of Fort Campbell.	INITIALS →	BARRACKS TELEPHONE
4. For marking and clearance of underground TV cable, contact Mr. James Phillips or Mr. Gerald Schneider at COMCAST, telephone (931) 431-5633.	INITIALS →	CABLE TV
5. For marking of miscellaneous underground utilities such as, steam, chill water lines call DPW Work Order section 798-1200 (bldg 863, MON-FRI, 0730-1600).	INITIALS →	DPW, MISC UTILITIES
6. For marking of GAS, in housing areas call "TN ONE CALL" 1-800-351-1111. Construction contractors may call 931-542-9600.	INITIALS →	CLARKSVILLE GAS
7. For marking of underground electrical distribution, call DPW Work Order section,798-1600 (bldg 863, MON-FRI, 0730-1600). Note: Coordinate with G3, Range Control, for electric down range on training ranges.	INITIALS →	DPW ELECTRIC
8. Underground control cables at CAAF. Cables are located outside of Perimeter Road around CAAF. Contact ATC/Joe Wooten at 798-6520/3028.	INITIALS →	ATC
9. For location of underground POL lines at SABRE/CAAF airfields and motor pools call (270)-798-6691.	INITIALS →	DPW LIQUID FUELS
10. For marking of underground water and sewer call CH2MHill call (931) 431- 5677.	INITIALS →	WATER & SEWER

FC FORM 4043 (REV), JUNE 2005 (Previous editions of this form are obsolete and will be destroyed)

(PART II (Environmental Coordination)

The requester will observe and enforce the following requirements:

* Inspection of the proposed sites shall be conducted by Directorate of Public Works (DPW) if archeological area is incomplete, or the archeological survey identifies the proposed sites as high risk (where finding of archeological resources is probable). Records of archeological surveys are maintained at DPW, Environmental Division.
* DPW shall monitor the excavation process in high risk areas (where finding of archeological resources is probable).
* If archeological resources are discovered during the course of excavation, this coordination becomes invalid. Excavation or disturbance of site shall be suspended and DPW shall be notified immediately. DPW will evaluate significance of the finding and issue new guidance.
* Solid Waste Management Units (SWMU) have been identified across Fort Campbell (to include the entire CAAF area). SWMUs usually require special instructions that may be provided during the course of this digging permit coordination. I realize I shall follow that guidance. All excavations in and/or near Solid Waste Management Units (SWMUs) must be coordinated with the Restoration Program Manager, 798-9768.
* All work at CAAF must be coordinated with the Restoration Program Manager, 798-9768.
* If potentially contaminated earth (unusual odor or appearance) is discovered during excavation, cease work immediately and contact the Restoration (SWMU) Program Manager, 798-9768.

SIGNATURE OF REQUESTER	
11. ARCHEOLOGY *(MABRY HOUSE Bldg. 6081, 798-7437).* INITIALS →	ARCHEOLOGY
12. LAND MANAGEMENT *(Conservation Branch, Bldg. 2159, 798-9858).* INITIALS →	LAND MANAGEMENT
13. SWMU *(Restoration Program Manager, Bldg. 2186, 798-9768).* INITIALS →	SWMU

Remarks:

if work is not started within 30 days after permit issue, the digging permit will be null and void.

SIGNATURE OF CHIEF, DPW, CONTRACT MANAGEMENT *(Bldg. 846, 270-798-5514)*	DATE

PAGE 2, FC FORM 4043 (REV), JUNE 2005

COORDINATION FOR REAR AREA EXCAVATION

(The proponent of this form is PWBC)

NAME, RANK, AND TITLE OF REQUESTER	DATE
ORGANIZATION OF REQUESTER	TELEPHONE NUMBER
LOCATION OF PROPOSED EXCAVATION *(Attach map or overlay as appropriate).*	PROJECTED WORK DATE(S)
PURPOSE OF EXCAVATION *(Project Number / Contract Number / Title / Etc.).*	

The requester will observe and enforce the following requirements:

* Excavation shall not begin before completion of this coordination.
* Inspection of the proposed sites shall be conducted by Public Works Business Center (PWBC) if archaeological survey of the area is incomplete, or the archaeological survey identifies the proposed sites as high risk (where finding of archaeological resources is probable). Records of archaeological surveys are maintained at PWBC, Environmental Division.
* PWBC shall monitor the excavation process in high risk areas (where finding of archaeological resources is probable).
* If archaeological resources are discovered during the course of an excavation, this coordination becomes invalid. Excavation or disturbance of the site shall be suspended and PWBC shall be notified immediately. PWBC will evaluate the significance of the finding and issue new guidance.
* Excavation sites shall be restored upon termination of usefulness, unless otherwise coordinated with PWBC.
* Solid Waste Management Units (SWMU) have been identified across Fort Campbell (to include the entire CAAF area).

SWMUs usually require special instructions that may be provided during the course of this digging permit coordination. I realize I shall follow that guidance. All excavations in and/or near Solid Waste Management Units (SWMUs) must be coordinated with the Restoration Program Manager, 798-9768.

* All work at CAAF must be coordinated with the Restoration Program Manager, 798-9768.
* If potentially contaminated earth (unusual odor or appearance) is discovered during excavation, cease work immediately and contact the Restoration (SWMU) Program Manager, 798-9768.

SIGNATURE OF REQUESTER

1. For location of post telephone lines or fiber optic cable, please bring this completed form to ITBC, Telecommunications Division, Bldg. 907 Bastogne Ave, hours 0730-1630, 798-9650.	INITIALS →	ITBC
2. For location of underground electric distribution, contact Mr. Tommy Dunn, telephone (270) 798-2119. Note: coordinate with G3, Range Control, for electric down range on training areas.	INITIALS →	PWBC ELECTRIC
3. ARCHEOLOGY *(Mabry House Bldg. 6801, 798-7437).*	INITIALS →	ARCHEOLOGY
4. LAND MANAGEMENT *(Conservation Branch Bldg. 2159, 798-9824/9850).*	INITIALS →	LAND MANAGEMENT
5. SWMU *(Restoration Program Manager, Bldg. 2186, 798-9768).*	INITIALS →	SWMU

In accordance with CAM Regulation 420-3, if work is not started within 30 days after permit issue, this permit is null and void.

SIGNATURE OF NEPA PROGRAM MANAGER *(Bldg. 2159, 13 1/2 Street, 798-9824/9825)*	DATE

FC FORM 4044, JULY 2003

APPENDIX D
Finishes, Exterior and Interior

The following are Ft. Campbell's standard color schedule for **Exterior Finishes** and special items:

STANDING SEAM METAL ROOF AND FASCIA
Manufacturer: Varies
Color: Butler, Kyner 500, color "Terra Brown" or approved equal

METAL SIDING (When approved)
Manufacturer: Varies
Color: Butler, Kyner 500, color "Country Wheat" or approved equal

EXTERIOR DOORS, FRAMES, TRIM AND ANODIZED ALUMINUM WINDOWS
Manufacturer: Varies
Color: Match standing seam metal roof color

BRICK
Manufacturer: Palmetto Brick Company
Color: ".75 Greystone"

Manufacturer: Acme Brick
Color: "Ko-Ko Brown"

ACCENT BRICK
Manufacturer: Acme Brick
Color: "Ko-Ko Plus Chocolate"

Manufacturer: Palmetto Brick Company
Color: "1.25 Greystone"

SPLIT-FACE CONCRETE MASONRY UNITS
Manufacturer: Southland Supply style
Color: Goldenrod, 24H

MORTAR
Manufacturer: Quickrete
Color: Ochre 2

ROOF FIXTURES
Manufacturer: Varies
Color: Match standing seam metal roof

DOWNSPOUTS, GUTTERS, LOUVERS, FLASHING

Manufacturer: Varies
Color: Match standing seam metal roof

EXTERIOR SOFFITS AND CEILING
Manufacturer: Varies
Color: White (factory finish)

The following are Ft. Campbell's standard color schedule for **Interior Finishes** and special items:

Plastic Laminate, Vertical: **Wilsonart, "1500N-60, Grey"**
Wilsonart, "D432-60, Cashmere"

Plastic Laminate, Horizontal: **Wilsonart "4640-60, Dove Moraine"**
Wilsonart "4608-60, Caldera Beige"

Solid Surface Material: **Wilsonart "1521-MG, Light Beige Mirage"**
Wilsonart "D431-MG, Alabaster Mirage"

Vinyl Base: **Azrock, 4" Vinyl Base, "CB-66"**
Flexco, 4" Vinyl Base, "VCB-031 Zephyr"

VCT: **Azrock, 12"xl2"x1/8" "V869, Tundra, Cortina Colors"**
Azrock, 12"xl2"x1/8" "V787, Stratus"

Sheet Flooring: **Tarket, "18319"**

ACT: **USG "2110, 2'x2'x5/8" White, Radar"**

ACT Grid: **USG "Donn DX, 15/16", White"**

Window Blinds: **Valencia Deluxe, "0285, 1" Metal**
Valencia Deluxe, "0023, 1" Metal

Carpet: **Lees, 115 Mauve, Pebble Weave II**
Lees, 305 Cloisonne, Pebble Weave II
Lees, 204 Vienna Woods, Pebble Weave II

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APPENDIX E
Fort Campbell Landscape Plant List

Native Plant Material

(Native) Conifers/Evergreens:

Botanical Name	Common Name
(Native) Tall Trees – (trees over 50 ft. at maturity)	
Pinus echinata	Shortleaf Pine
Tsuga canadensis	Eastern Hemlock
Taxodium distichum	Bald Cypress
(Native) Medium Trees – (trees 25 to 50 ft. at maturity)	
Pinus virginiana	*Virginia Pine*
Juniperus virginiana	Eastern Red Cedar
(Native) Small Trees/Large Shrubs – (10 to 25 ft. at maturity)	
Juniperus virginiana	*Eastern Red Cedar*

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(Native) Deciduous:

Botanical Name	Common Name
(Native) Tall Trees– (trees over 50 ft. at maturity)	
Liriodendron tulipifera	*Yellow or Tulip Poplar*
Sassafras albidum	Sassafras
Liquidambar styraciflua	Sweetgum
Ulmus thomasii	Rock Elm
Celtis occidentalis	Hackberry
Celtis laevigata	Sugarberry
Morus rubra	Red Mulberry
Juglans nigra	Black Walnut
Carya illinoensis	Pecan
Carya cordiformis	Bitternut Hickory
Carya tomentosa	Mockernut Hickory
Carya ovata	Shagbark Hickory
Carya glabra	Pignut Hickory
Fagus grandifolia	American Beech

Botanical Name	Common Name
(Native) Tall Trees– (trees over 50 ft. at maturity) continued	

Botanical Name	Common Name
Quercus alba	White Oak
Quercus stellata	Post Oak
Quercus bicolor	Swamp White Oak
Quercus michauxii	Swamp Chestnut Oak
Quercus prinus	*Chestnut Oak*
Quercus muehlenbergii	Chinkapin Oak
Quercus rubra	*Northern Red Oak*
Quercus palustris	Pin Oak
Quercus falcata	Southern Red Oak
Quercus velutina	Black Oak
Quercus shumardii	Shumard Oak
Quercus coccinia	Scarlet Oak
Quercus phellos	Willow Oak
Tilia americana	American Basswood
Populus deltoides	Eastern Cottonwood
Salix nigra	Black Willow
Diospyros virginiana	Common Persimmon
Prunus serotina	Black Cherry
Gleditsia tracanthos	Honeylocust
Gymnocladus dioica	Kentucky Coffeetree
Nyssa aquatica	Water Tupelo
Nyssa sylvatica	Black Tupelo
Aesculus octandra	Yellow Buckeye
Acer rubrum	Red Maple
Acer saccharinum	Silver Maple
Acer negundo	Box Elder
Fraxinus pennsylvanica	Green Ash
Fraxinus americana	White Ash
(Native) Medium Trees – (trees 25 to 50 ft. at maturity)	
Magnolia tripetala	Umbrella Magnolia
Magnolia macrophylla	Bigleaf Magnolia
Asimina triloba	Pawpaw
Ulmus alata	Winged Elm
Celtis occidentalis	Hackberry
Quercus stellata	Post Oak
Quercus marilandica	Blackjack Oak
Ostrya virginiana	Eastern Hop Hornbeam
Carpinus carolinia	American Hornbeam
Betula lenta	Sweet Birch
Betula nigra	River Birch
Salix nigra	Black Willow
Oxydendron arboreum	Sourwood
Diospyros virginiana	Common Persimmon
Halesia carolina	Carolina Silverbell

Botanical Name	Common Name
(Native) Medium Trees – (trees 25 to 50 ft. at maturity) continued	
Amelanchier arborea	Downey Serviceberry
Ilex opaca	American Holly

Botanical Name	Common Name
Rhamnus caroliniana	Carolina Buckthorn
Aesculus glabra	Ohio Buckeye
Acer negundo	Box Elder
(Native) Small Trees/Large Shrubs – (10 to 25 ft. at maturity)	
Hamamelis virginiana	Witch Hazel
Carpinus carolinia	American Hornbeam
Kalmia latifolia	Mountain Laurel
Prunus americana	American Plum
Crataegus spp.	Hawthorn
Cercis canadensis	Eastern Redbud
Cornus florida	Flowering Dogwood
Euonymus atropurpurens	Eastern Wahoo
Cephalanthus occidentalis	Buttonbush
Sambucus canadensis	American Elder

Return to Exterior Planting Section

Introduced Species (Kentucky Extension Service List)

(Introduced) Evergreen:

Botanical Name	Common Name
(Introduced) Tall Trees– (trees over 50 ft. at maturity)	
Abies nordmanniana	Nordmann Fir
Cedrus libani var. stenocoma	Hardy Cedar of Lebanon
Picea abies	Norway Spruce
Picea glauca 'Densata'	Black Hills Spruce
Picea omorika	Serbian Spruce
Picea orientalis	Oriental Spruce
Picea pungens	Colorado Spruce
Pinus densiflora	Japanese Red Pine
Pinus flexilis	Limber Pine
Pinus resinosa	Red Pine
Pseudotsuga menziesii	Douglas Fir
Thuja occidentalis	American Arborvitae
(Introduced) Medium Trees – (trees 25 to 50 ft. at maturity)	
Abies concolor	White Fir
Chamaecyparis obtusa	Hinoki Cypress
Chamaecyparis pisifera	Thread Cypress
Ilex attenuata 'Fosteri'	Foster No. 2 Holly
Juniperus chinensis	Chinese Juniper
Osmanthus americanus	Devil Wood

Botanical Name	Common Name
(Introduced) Medium Trees – (trees 25 to 50 ft. at maturity) continued	
Pinus bungeana	Lacebark Pine
Pinus cembra	Swiss Stone Pine
Pinus densiflora 'Oculus-draconis'	Japanese Red Pine

Botanical Name	Common Name
Pinus strobus 'Fastigiata'	Columnar White Pine
Pinus strobus 'Pendula'	Weeping White Pine
Pinus sylvestris	Scotch Pine
Platycladus orientalis	Oriental Arborvitae
Taxus baccata	English Yew
Taxus cuspidata 'Capitata'	Upright Japanese Yew
(Introduced) Small Trees/Large Shrubs – (10 to 25 ft. at maturity)	
Abies koreana 'Prostrate Beauty'	Prostrate Korean Fir
Chamaecyparis obtusa 'Torulosa'	Contorted Hinoki Cypress
Ilex aquifolium	English Holly
Ilex crenata 'Noble's Upright'	Noble's Upright Japanese Holly
Ilex pedunculosa	Longstock Holly
Juniperus chinensis	Chinese Juniper
Juniperus scopulorum	Rocky Mountain Juniper
Picea glauca 'Conica'	Dwarf Albert Spruce
Pinus densiflora 'Umbraculifera'	Tanyosho Pine
Pinus mugo	Mugho Pine
Pinus strobus 'Contorta'	Curly White Pine
Pinus sylvestris 'Wateri'	Waterer's Scotch Pine
Rhododendron catawbiense	Rhododendron
Rhododendron azalea	Azalea
Rhododendron maximum	Rosebay Rhododendron
Sciadopitys verticillata	Umbrella Pine
Taxus cuspidata	Japanese Yew
Viburnum pragense	Fragrant Viburnum
(Introduced) Medium Shrubs – (6 to 8 ft. at maturity)	
Chamaecyparis obtusa 'Sanderi'	Sanderi Hinoki False Cypress
Chamaecyparis pisifera	Sawara Cypress
Ilex meserveae	Blue Holly
Juniperus chinensis 'Sea Green'	Sea Green Chinese Juniper
Mahonia aquifolium	Oregon Holly Grape
Pieris japonica	Japanese Pieris
Taxus cuspidata	Japanese Yew
Taxus media	Spreading Yew
(Introduced) Small Shrubs – (4 to 5 ft. at maturity)	
Buxus microphylla	Boxwood
Chamaecyparis pisifera	Gold Thread Cypress
Ilex glabra 'Compacta'	Compact Inkberry
Ilex opaca 'Maryland Dwarf'	Maryland Dwarf American Holly
Juniperus chinensis	Chinese Juniper

Botanical Name	Common Name
(Introduced) Small Shrubs – (4 to 5 ft. at maturity) continued	
Leucothoe fontanesiana	Drooping Leucothoe
Mahonia aquifolium	Oregon Holly Grape
Picea abies	Norway Spruce
Picea pungens	Colorado Spruce

Botanical Name	Common Name
Pinus mugo	Mugho Pine
Pinus strobus 'Nana'	Dwarf White Pine
Pinus sylvestris 'Beuvronensis'	Dwarf Scotch Pine
Rhododendron 'Starry Night'	Starry Night Rhododendron
Taxus baccata 'Repandens'	Spreading English Yew
Tsuga canadensis 'Gentsch'	Gentsch White Canadian Hemlock
(Introduced) Low Shrubs – (2 to 3 ft. at maturity)	
Abies balsamea 'Nana'	Dwarf Balsam Fir
Chamaecyparis obtusa 'Pygmae	Dwarf Hinoki False Cypress
Aurescens'	
Chamaecyparis pisifera	Moss Cypress
Juniperus horizontalis	Compact Juniper
Juniperus sabina	Savin Juniper
Juniperus squamata 'Blue Star'	Blue Star Juniper
Leucothoe fontanesiana	Drooping Leucothoe
Mahonia aquifolium 'Compactum'	Compact Oregon Holly Grape
Picea abies	Dwarf Norway Spruce
Pieris japonica 'Pygmaea'	Pygmy Andromeda
Pinus sylvestris 'Riverside Gem'	Riverside Gem Scotch Pine
Rhododendron obrtusum	Azalea (several varities)

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(Introduced) Deciduous:

Botanical Name	Common Name
(Introduced) Tall Trees– (trees over 50 ft. at maturity)	
Acer platanoides	Norway Maple
Alnus glutinosa	European Alder
Cercidiphylium japonicum	Katusra Tree
Eucommia ulmoides	Hardy Rubber Tree
Fagus sylvatica	European Beech
Ginkgo biloba	Ginkgo or Maidenhair Tree
Larix kaempferi	Japanese Larch
Metasequoia glyptostroboides	Dawn Redwood
Platanus x acerfolia	London Planetree
Quercus acutissima	Sawtooth Oak
Quercus robur	English Oak
Tilia cordata	European Linden

Botanical Name	Common Name
(Introduced) Tall Trees– (trees over 50 ft. at maturity) continued	
Tilia tomentosa	Silver Linden
Ulmus parvifolia	Chinese Elm
Ulmus x	Hybrid Elms
Zelkova serrata	Japanese Zelkova
(Introduced) Medium Trees – (trees 25 to 50 ft. at maturity)	
Acer campestre	Hedge Maple

Botanical Name	Common Name
Acer griseum	Paperbark Maple
Aesculus x carnea	Red Horsechestnut
Aesculus pavia	Red Buckeye
Amelanchier grandiflora	Apple Serviceberry
Amelanchier laevis	Alleganey Serviceberry
Betula populifolia	Gray Birch
Betula maximowicziana	Monarch Birch
Carpinus betulus	European Hornbeam
Castanea mollissima	Chinese Chestnut
Corylus colurna	Turkish Filbert
Franklinia alatamaha	Franklin Tree
Ilex decidua	Possum Haw
Koeireuteria paniculata	Golden Raintree
Larix decidua 'Pendula'	Weeping European Larch
Maackia amurensis	Amur Maackia
Magnolia virginiana	Sweet Bay Magnolia
Phellodendron amurense	Cork Tree
Prunus sargentii	Sargent Cherry
Prunus serrulata 'Kwanzan'	Kwanzan Japanese Cherry
Pyrus fauriei	Korean Pear
Stewarti pseudocamellia	Japanese Stewartia
Syringa pekinensis	Pekin Lilac
Syringa reticulata	Japanese Tree Lilac
Prunus x yedoensis	Yoshino Cherry
Pyrus calleryana	Callery Pear
(Introduced) Small Trees/Large Shrubs – (10 to 25 ft. at maturity)	
Acer buergeranum	Trident Maple
Acer ginnala	Amur Maple
Acer japonicum	Fullmoon Maple
Acer maximowiczianum	Nikko Maple
Acer palmatum	Japanese Maple
Acer tegmentosum	Manchu Striped Maple
Aesculus parviflora	Bottlebrush Buckeye
Buddlela alternifolia	Fountain buddiela
Cercidiphyllum japonicum	Weeping Katsura Tree
Chionanthus retusus	Chinese Fringe Tree
Chionanthus virginicus	Fringe Tree
Cornus alternifolia	Pagoda Dogwood

Botanical Name	Common Name
(Introduced) Small Trees/Large Shrubs – (10 to 25 ft. at maturity) continued	
Cornus kousa	Kousa Dogwood
Cornus mas	Cornelian Cherry Dogwood
Cornus officinalis	Japanese Cornel Dogwood
Cornus racemosa	Gray Dogwood
Corylus avellana 'Cortorta'	Curly European Filbert
Corylus maxima 'Purpurea'	Purple Giant Filbert
Cotoneaster multiflorus	Many-flowered Cotoneaster

Botanical Name	Common Name
Crataegus crus-galli	Cockspur Hawthorn
Crataegus lavallei	Lavalle Hawthorn
Crataegus phaenopyrum	Washington Hawthorn
Crataegus viridis 'Winter King'	Winter King Hawthorn
Deutzia scabra 'Pride of Rochester'	Pride of Rochester Deutzia
Enkianthus campanulatus	Redvein Enkianthus
Euonymus alata	Burning Bush
Forsythia intermedia	Border Forsythia
Fothergilla major	Large Fothergilla
Ilex verticillata	Winterberry
Kolkwitzia amabilis	Beauty Bush
Ligustrum ibolium	Ibolium Privet
Ligustrum ovalifolium	California Privet
Ligustrum vicaryl	Vicary Golden Privet
Lindera benzoin	Spicebush
Lonicera morrowii	Fragrant Honeysuckle
Lonicera tatarica	Tatarian Honeysuckle
Magnolia x	Hybrid Magnolia (several varities)
Magnolia loebneri 'Merrill'	Dr. Merrill Magnolia
Magnolia soulanglana	Saucer Magnolia
Magnolia stellata	Star Magnolia
Malus x spp.	Crabapple
Malus floribunda	Flowering Crabapple
Malus sieboldii var. Zumi	Calocarpa Crabapple
Philadelphus virginalis	Mockorange
Physocarpus opulifolius	Eastern Ninebark
Prunus x 'Hally Jolivette'	Hally Jollivette Cherry
Prunus subhirtella	Higan Cherry
Rhamnus fragula 'Asplenifolia'	Cutleaf Buckthorn
Syringa vulgaris	Common Lilac
Ulmus glabra 'Camperdownii'	Camperdown Elm
Viburnum burkwoodii	Burkwood Viburnum
Viburnum carlcephalum	Fragrant Viburnum
Viburnum dentatum	Arrowwood Viburnum
Viburnum dilatum 'Iroquois'	Iroquois Linden Viburnum
Viburnum lantana	Wayfaring Tree
Viburnum lentago	Nannyberry Viburnum
Viburnum macrocephalum	Chinese Snowball Viburnum
(Introduced) Small Trees/Large Shrubs – (10 to 25 ft. at maturity) continued	
Viburnum opulus	Cranberry Bush Viburnum
Viburnum plicatum var. tomentosum'	Doublefile Viburnum
Viburnum prunifollum	Blackhaw
Viburnum rhytidophylioides	Lantanaphyllum Viburnum
Viburnum sargentii 'Onondaga'	Onondaga Viburnum
Viburnum sieboldii 'Seneca'	Seneca Viburnum
Viburnum setigerum	Tea Viburnum
Viburnum 'Sesquehana'	Sesquehanna Viburnum
(Introduced) Medium Shrubs – (6 to 8 ft. at maturity)	

Botanical Name	Common Name
Acanthopanax sieboldianus	Five-leaved Aralia
Acer palmatum	Japanese Maple
Aronia arbutifolia 'Brilliantissima'	Brilliant Red Chokeberry
Berberis mentorensis	Mentor Barberry
Berberis thunbergii	Japanese Barberry
Buddleia davidii	Orange-eyed Butterfly Bush
Calycanthus floridus	Carolina Allspice
Cercis chinensis	Chinese Redbud
Chaenomeies speciosa	Flowering Quince
Clethra ainifloia	Summer Sweet
Cornus alba	Tatarian Dogwood
Cornus baileyi	Bailey's Dogwood
Cornus florida 'Pygmaea'	Pygmy Dogwood
Cornus sericea 'Flaviramea'	Yellow-twig Dogwood
Cotoneaster divaricata	Spreading Cotoneaster
Deutzia lemoinei	Slender Deutzia
Forsythia intermedia 'Sunrise'	Border Forsythia
Hamamelis vernalis	Vernal Witchhazel
Hibiscus syriacus	Rose of Sharon
Hydrangea quercifolia	Oakleaf Hydrangea
Ilex verticillata	Winterberry
Kerria japonica	Japanese Kerria
Ligustrum vulgare 'Lodense'	Lodense Privet
Lonicera xyldosteum 'Claveyl'	Clavey's Honeysuckle
Malus sargentii	Sargent Crabapple
Morus alba 'Pendula'	Weeping Mulberry
Myrica pensylvanica	Northern Bayberry
Prunus x cistena	Purpleleaf Sand Cherry
Pyracantha coccinea	Scarlet Firethorn
Rhus aromatica	Fragrant Summac
Ribes alpinum	Alpine Currant
Spiraea nipponica 'Snowmound'	Snowmound Spirea
Spiraea x vanhouttei	Vanhoutte Spirea
Viburnum acerfolium	Mapleleaf Viburnum
Viburnum carlesli	Koreanspice
Viburnum juddii	Judd Viburnum
(Introduced) Medium Shrubs – (6 to 8 ft. at maturity) continued	
Viburnum x 'Mohawk'	Mohawk Viburnum
Viburnum x pragense	Prague Viburnum
Weigela florida	Weigela
(Introduced) Small Shrubs – (4 to 5 ft. at maturity)	
Abelia grandiflora	Glossy Abelia
Berberis thunbergii 'Aurea'	Golden Japanese Barberry
Cotoneaster horizontalis	Rockspray Cotoneaster
Deutzia gracilis	Slender Deutzia
Divervilla sessilifolia	Southern Bush Honeysuckle
Hydrangea arborescens	Hills-of-Snow
Hypericum kalm	Kalm St. Johnswort
Ilex verticillata	Winterberry
Itea japonica 'Beppu'	Beppu Sweetspire
Malus sargentii 'Tina'	Tina Crabapple
Physocarpus opulifolius	Eastern Ninebark

Botanical Name	Common Name
Potentilla fruticosa	Bush Cinquefoil
Pyracantha coccinea	Scarlet Firethorn
Syringa meyeri 'Palibin'	Meyer's Lilac
Syringa patula 'Miss Kim'	Littleleaf Lilac
Vibunum opulus 'Nana'	Dwarf Cranberrybush Viburnum
Viburnum trilobum 'Compactum'	Compact American Cranberry Bush
Viburnum utile 'Eskimo'	Eskimo Viburnum
(Introduced) Low Shrubs – (2 to 3 ft. at maturity)	
Berberis thunbergii	Japanese Barberry
Caryopteris clandonensis 'Blue	Blue Mist Bluebeard
Cornus sericea 'Kelseyi'	Kelsey's Dwarf Dogwood
Cotoneaster apiculatus	Cranberry Cotoneaster
Cotoneaster dammeri	Bearberry Cotoneaster
Cotoneaster horizontalis 'Perpusilla'	Perpusilla Rock Cotoneaster
Cotoneaster microphylla	Small Leaf Cotoneaster
Forsythia viridissima 'Bronxensis'	Bronx Forsythia
Forsythia 'Arnold's Dwarf'	Arnold's Dwarf Forsythia
Fothergilla gardenii	Dwarf Fothergilla
Hypericum 'Hidcote'	Hidcote St. Johnswort
Jasminum nudiflorum	Winter Jasmine
Kalmia cuseata 'White Wicky'	White Wicky Mountain Laurel
Kerria japonica 'Picta'	Variegated Japanese Kerria
Physocarpus opulifolius 'Nana'	Dwarf Eastern Ninebark
Rhus aromatica 'Gro-low'	Gro-low Fragrant Summac
Ribes alpinum 'Greenmound'	Greenmound Alpine Currant
Rosa wichuriana	Memorial Rose
Spiraea x bumalda	Bumald Spirea
Spiraea japonica 'Little Princess'	Little Princess Japanese Spirea
Symphoricarpos albus	Snowberry
var. laevigatus	

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Appendix F
Utility Procedures

PARAGRAPH

F-1 Introduction
F-2 Record Drawings
F-3 Metering
F-4 Distribution Lines
F-5 Existing Lines to be Removed
F-6 New Service Lines
F-7 Plans and Specifications
F-8 Utility Cost Estimate
F-9 Utility Company Contracts

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F-1 INTRODUCTION:

The natural gas distribution system, the water distribution system for domestic and fire, and the sewer systems at Fort Campbell are now privately owned and operated by utility companies.

This is an outline of the recommended procedures for dealing with the utility aspects of facility design projects. Variation from this procedure is expected, depending upon the project. However, revised procedures should be agreed upon during the early design stages of a project. Unless noted otherwise in the design scope of work, the utility companies will install new service lines to buildings.

The utility companies are active players in the planning, design, and construction process of each building project.

Utility company contacts are provided below.

F-2 RECORD DRAWINGS:

The utility companies maintain as-built record utility drawings for the installation. To obtain utility drawings, refer to UTILITY COMPANY CONTACTS below.

F-3 METERING:

Metering of gas, steam, heating hot water, electricity, fuel oil, etc. is required by UFC 3-400-01 Energy Conservation.

Metering of water is required for all buildings where potable water demand is estimated to exceed 100,000 gallons per year.

Connection of the meters to the Energy Monitoring and Control System (EMCS) is required.

The gas utility company will install a regulator, an emergency gas connection, a seismic shutoff valve, and a meter with a pulse initiator for EMCS. A typical gas service meter assembly at the building is attached for information. Coordinate the location of this assembly with the utility company and show the location on the drawings and indicate that the installation is by the gas utility company.

Where required, a building domestic water meter will be provided inside the building mechanical room by the water company. Coordinate the location of this meter with the utility company and show the location on the drawings and indicate that the installation is by the water utility company.

The fire sprinkler water will not be metered.

F-4 DISTRIBUTION LINES:

The utility company will determine whether changes to the utility distribution systems will be required. The cost, schedule, and execution of the upgrade to the distribution system will be handled by Fort Campbell and the utility company as a contract action separate from the building project.

F-5 EXISTING LINES TO BE REMOVED:

Unused lines will be removed by the utility company.

F-6 NEW SERVICE LINES:

The building designer determines the required capacity of each service line and the preferred location of the building service entrance.

The building designer determines the required gas pressure into the building (typically 14 inches water column).

The building designer obtains the installation utility record drawings (maps) from the utility company.

The building designer coordinates with the utility companies to determine and share the following information concerning the service lines:

- Flow
- Estimated consumption
- Line size
- Routing
- Tie-in points to the main distribution system
- Location of the utility service entrance to the building
- Location of the gas regulator / meter / emergency connection / seismic shutoff valve assembly
- Location of valves including the post indicator valve for the fire sprinkler system
- Location of the water meter
- The type of backflow preventer on the incoming domestic water service lines, usually a reduced pressure type
- The type of backflow preventer on the incoming fire sprinkler line, usually a double check type. However if there are additives such as antifreeze or foam in the system or if there is a second non-potable water source connected to the sprinkler system, a reduced pressure type is required.
- Location of existing utility lines to be removed

F-7 PLANS AND SPECIFICATIONS:

On the design drawings, the building designer shows:

- The routing of the new utility service lines, noted to be installed by others
- The location of building meters and regulator assemblies, noted to be installed by others
- The location of fire hydrants, noted to be installed by others
- The location of water line valves in the service lines, noted to be installed by others
- The location of post indicator valves, noted to be installed by others
- The location of utility lines to be removed, noted to be removed by others
- The main gas pressure
- The required building gas pressure
- The available static and residual water pressure and associated flow

Utility installation details are not shown.

Fire department connections are included in the contract as part of the sprinkler work.

The backflow preventers for domestic water and for fire sprinkler service are to be located inside the building and will be included in the building construction contract.

The building designer sends the design drawings to the utility companies. This should be done during concept design and during final design.

The utility company reviews the drawings and coordinates any required changes with the building designer.

The building designer includes a provision in the specifications that the building construction contractor must coordinate with the utility companies on the timing and sequence of work for the installation of the utilities. The utility contacts for utility work during construction below are to be included in the design documents.

The design documents must indicate that the utility company applies for all permits from the appropriate state authorities.

F-8 UTILITY COST ESTIMATE:

The building designer has no involvement in the gas and water utility cost estimate.

F-9 UTILITY COMPANY CONTACTS:

NATURAL GAS:

To obtain record drawings, to discuss gas service line capacity, size, routing, and tie-in points to the main distribution system, and for coordination of gas utility work during construction or for inspection of contractor installed lines:

Randall Lewis
Clarksville Gas and Water Co.
Phone: 931-542-9600
Fax: 931-542-9601

WATER AND SEWER:

To obtain water and sewer record drawings, to discuss water and sewer service line capacity, size, routing, and tie-in points to the main distribution system, and for coordination of water and sewer utility work during construction or for inspection of contractor installed lines:

Chris Semler
CH2M Hill Co.
Phone: 931-431-2015
Fax: 931-431-0952

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APPENDIX G
Mold and Humidity Control

PARAGRAPH

G-1 Introduction
G-2 Building Envelope
G-3 Tight Buildings
G-4 Air Infiltration and Vapor Barriers
G-5 Gypsum Board and Wall Finishes
G-6 Attics
G-7 Crawl Spaces
G-8 System Selection / Space Humidity Considerations
G-9 Condensate Leaks
G-10 Barracks

G-1 INTRODUCTION:

Mold grows where mold spores, nutrients, correct temperature, and ample moisture are combined. Controlling moisture is the best approach to avoiding mold. Eliminating mold spores is impractical, the organic materials in buildings offer potential mold nutrients, and the temperature in buildings is conducive to mold growth. Thus minimizing moisture by eliminating leaks, drips, and condensation in the wrong places must be addressed. Undesired water and moisture usually comes from problems in either the building envelope or the building mechanical systems or both. Wet materials and surfaces are not always required for mold to grow. Even high humidity conditions contribute to mold growth. Air conditioning systems must be designed to keep space humidity at reasonable levels.

G-2 BUILDING ENVELOPE

The design of the building envelope must consider removal of all air entry points, cold bridges, multiple vapor barriers and gaps in the insulation system. Attics (with exceptions) and crawl spaces should no longer be ventilated. Interior floor slabs should be separated from foundations by insulated expansion joint materials. Cavity wall insulation should extend down to the footings. Insulated windows should be aligned with cavity wall insulation to remove gaps in the insulation system. Window sills, foundation sills and other veneer wall features should be isolated from the

structural backup wall allowing cavity wall insulation to run continuously. Use only thermally broken windows. When designing with metal stud backup wall, apply minimum 1' rigid insulation over exterior sheathing to improve thermal performance. Consider the use of new insulation products such as Polyicynene which effectively eliminates air infiltration and vapor transmission.

G-3 TIGHT BUILDINGS:

Leaks of unconditioned outdoor bring moisture into the building and lead to condensation on cold surfaces with subsequent wetting of building materials followed by deterioration of the materials and mold growth. Therefore, buildings that are relatively air tight must be the goal. A ventilated attic directly over an insulated lay-in ceiling, for example, does not represent tight building construction. Keep in mind that a slight pressure difference usually exists between inside and outside the building. Insulation batts alone will not stop air flow through the batt if a pressure difference exists from one side if the batt to the other and should therefore not be the only barrier to outdoor air. Mechanical air handling and exhaust systems are typically designed to bring in more air that they exhaust in attempt to pressurize the building to prevent infiltration of outdoor air. This pressurization however is impossible if the building is full of holes. Pay close attention to the details of construction where walls meet roof to eliminate sources of air leaks. Note that building air tightness is not the same as vapor tightness. Buildings may be designed with or without vapor barriers depending on the indoor and outdoor conditions; however, air tightness must always be the goal.

G-4 AIR INFILTRATION AND VAPOR BARRIERS:

Recent studies have shown that air infiltration/exfiltration is a more significant source of moisture accumulation in walls than water vapor diffusion. Air infiltration barriers (such as Tyvek) resist entry of air in walls that can transport moisture and create condensation problems while allowing water vapor to escape. These barriers also resist wind blown rain and water while protecting wall sheathing.

The use of vapor barriers, vapor retarders, and perm ratings for construction materials in the building envelope must be carefully considered for use by the designer. Vinyl wall coverings, bituminous damproofing, certain paint systems all have properties which may create vapor retarders. If used, vapor barriers must be placed at a location where the temperature is above the dewpoint temperature in both the heating and the cooling seasons. It is critical to eliminate multiple vapor retarders in wall systems which can trap moisture and create potential mold conditions.

G-5 GYPSUM BOARD AND WALL FINISHES:

Do not place paper covered gypsum board or other surfaces that may provide nutrients for mold behind wall mounted fan coil units. Condensate drips from the valves and cold piping inside the fan coil cabinet and a small splash occurs with each drip. Because manufacturers provide no rear panel to the fan coil cabinet, the splashed droplets dampen the wall surface behind the fan coil unit. Conventional gypsum board material at this location insures mold growth. Provide a wall liner made of plastic, metal, or other material that will not be a nutrient source for mold behind wall mounted fan coil units.

Do not use vinyl wall coverings on the interior surfaces of exterior walls or wall surfaces opposite kitchens or shower rooms. Moisture from these high humidity spaces will be trapped and condense behind the vinyl. Use of vinyl wallcovering is not permitted in locations with predominant air conditioning loads rather than heating loads.

G-6 ATTICS:

Because mold is becoming more associated with the entry of moisture laiden air in the building envelop, it is strongly recommended that ventilated attics be used only in limited applications. However, if an attic is ventilated, do not use a vapor barrier under the insulation installed on top of the ceiling. This is because in the cooling season, this puts the vapor barrier in a location made cold by air discharging from supply air diffusers.

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G-7 CRAWL SPACES:

Do not ventilate crawl spaces. Doing so introduces moisture to the crawl space which will migrate through floors and condense on the underside of floor coverings. The moisture can also condense on cold pipe surfaces within the crawl space; even the outer surface of the insulation on a chilled water line can easily reach temperatures below the dew point of a ventilated crawl space.

Use a 10 mil vapor barrier on the ground surface to prevent moisture migration from the ground. Cover the vapor barrier with gravel.

G-8 SYSTEM SELECTION / SPACE HUMIDITY CONSIDERATIONS:

Direct humidity control using reheat is rarely necessary except in the most demanding climate control situations such as libraries or museums. Indirect humidity control can reasonably be achieved through thoughtful system design.

The paragraphs below are not meant to dictate equipment or system types. Rather, the goal is to point out the advantages and disadvantages of various systems with regard to space humidity for designer consideration.

Most systems are designed to do a good job of limiting humidity at full cooling load. The problem with high space humidity usually occurs at part load.

Oversized equipment essentially runs at part load all the time, so oversizing must be avoided.

Make sure the occupants needs for temperature and humidity are known.

Design systems to limit space relative humidity to 45% instead of the usual 50% at full load. Use an indoor design condition of 78 degF / 45% RH.

Design systems to limit space relative humidity to 60% at part load conditions.

Size cooling coils handling outdoor air for the design dry bulb temperature day, or the design humidity day which ever gives the greater coil capacity.

Single Zone Systems:

These systems modulate the supply air temperature in response to the space temperature.

Avoid adding safety factor to the cooling loads. Doing so increases the supply airflow, and with excess airflow comes high supply air temperature which leads to high space humidity.

A typical single zone air handling system serving a small office area is an example. Assess the cooling loads carefully and do not arbitrarily increase airflow or oversize the equipment.

Simple single zone systems serving a theater, an auditorium, or a gymnasium can be a problem, particularly if one air handler is used for the entire area. The wide fluctuation in load caused by the wide variation in the occupancy of these facilities leads to problems at part load conditions. In many cases, a single air handling unit sized for full occupancy can maintain space temperature setpoint with a supply air temperature that is within a degree or two of the space temperature when the facility is an minimal occupancy. This insures part load humidity problems.

Get the airflow right and full load humidity problems are less likely. Always consider what will happen to the supply air temperature and the resulting space humidity at part load conditions. Consider the following possible solutions to part load humidity problems when using single zone equipment:

Colder Supply Air – Design for colder supply air. Then at part load the air will be colder than it would otherwise be, more moisture will be removed from the air stream, space humidity at part load will be lower. (Designing for lower space relative humidity will require colder supply air.)

Variable Air Volume Single Zone System – The single zone cooling coil provides constant discharge air temperature while the fan speed is modulated

based on space temperature. After the fan reaches minimum speed the supply air temperature is modulated by decreasing.

Return Air Bypass Single Zone System – Using face and bypass dampers, bypass return air (not mixed air) around the cooling coil as the space cooling load is satisfied while the cooling coil operates with full flow.

Multiple Single Zone Systems – Use more than one air handling system. As the cooling load falls shut down one or more units. This causes the remaining units to supply colder air to maintain the space temperature setpoint.

Multizone Systems:

As with single zone, accurate determination of the cooling loads and zone airflow leads to good humidity control at full load conditions.

During warm weather, many multizone systems are operated without heating water to the heating coil because the boiler is turned off. Then at part load, mixed air is essentially bypassed around the cooling coil through the hot deck. The moisture laden mixed air is then delivered to the space causing a rise in the space humidity.

Improved part load performance space humidity performance can be achieved by resetting the hot deck temperature upward during periods of high humidity. (Of course this requires operating the boiler during the warm weather months.)

A Texas multizone with individual heating coils in the individual zone ducts also offers a possible solution to the part load humidity problem by providing a means of reheat.

Carefully consider the part load space humidity before using a multizone system.

Dual Duct Systems:

These systems typically have a hot and a cold deck and are similar to multizone systems. Instead of zone dampers, modulating dual duct mixing boxes mounted near the space combine the hot and cold air streams from separate ducts then deliver the mixture to the space. The part load humidity problems are the same as with a multizone.

Improved part load space humidity performance can be achieved by resetting the hot deck temperature upward during periods of high humidity. Of course this requires operating the boiler during the warm weather months.

A modified arrangement known as a Dew Point Dual Duct system could be employed for good humidity control. All of the mixed air in the air handler passes through the cooling coil. Then a portion of this air is split off and passes through the hot coil then to the hot duct. Both hot and cold air streams have the same low dew point temperature giving this arrangement its name.

Carefully consider the part load space humidity before using a dual duct system. The system may be more expensive than other alternatives due to the requirement

for two supply main ducts. As with a variable air volume system, terminal boxes are required, and these create additional maintenance.

Variable Air Volume Systems:

Because a VAV air handler maintains cold discharge air, it automatically maintains reasonable space humidity and should be considered where applicable and when budget permits.

However, VAV systems are not a panacea. The valve, heating coil, controls, and often filter and fan inside every VAV box represent additional maintenance. The maintenance aggravation is amplified when the VAV boxes are not easily accessible.

Computer Room Units:

Oversized computer room units are common. Determining the cooling load by summing all the nameplate amp ratings of all the computer equipment will surely result in an oversized unit and cause inefficient operation. Space humidity may not be a problem only because the computer room unit has reheat capability. The unit adds enough heat to make up for the excess in airflow. Size computer room units to accommodate the estimated heat release from the computer equipment; airflows will be decreased, the supply temperatures will be lower for a longer period of time, and the reheat will operate far less frequently. Always consider multiple computer room units to split the cooling load.

Fan Coil Systems:

Fan coils usually handle sensible loads but often fall short on the latent load.

Do not design fan coil units to handle outdoor air because the cooling coils are usually not deep enough, because cycling the coil flow insures periods when no moisture removal occurs, and because local exhaust systems can cause bypass of outdoor air around the cooling coil directly into the space.

In lieu of specifying the total coil load for fan coil units, specify the entering and leaving air conditions, and specify that these conditions must be met at all fan speeds. Where multi-speed fan coil units are used, schedule the maximum airflow at the high fan speed setting.

Fan coil units represent a great maintenance burden. The multiple cooling coils with multiple filters, multiple condensate pans, multiple potential leak sources, and multiple potential locations for mold growth must be considered.

Fan coils shall be installed in a manner that will prevent water from dripping or splashing outside the drain pans. Require back splash panels to contain the splashing cause by drips from coil valves and uninsulated piping within the cabinet enclosure.

Direct Expansion (DX) Equipment

Avoid the use of DX coils in air handlers with constant running fans that handle outdoor air. When the sensible load is satisfied and the compressor turns off,

unconditioned outdoor air is then delivered to the space and any water on the wet cooling coil is evaporated into the supply air and also delivered to the space. The result is poor part load humidity control.

G-9 CONDENSATE LEAKS:

Condensate drain pans and drain lines from air conditioning equipment must be designed to allow access for cleaning and flushing. Blockages in fan coil condensate lines are notorious for causing overflowing drain pans and wet floors, walls, and ceilings.

Improper trapping of condensate discharge in air handling units leads to water hold-up and overflow at the condensate drain pain.

Provide details of the condensate traps on the design drawings. Require adequate slope in two directions on condensate drain pans and drain lines (1/4 inch per foot). Make certain that the equipment curb or equipment frame affords ample elevation of the pan outlet connection above the floor or roof to accommodate the required trap dimensions and drain line slope.

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G-10 BARRACKS:

Barracks have historically had high humidity problems leading to mold growth in the living space.

In barracks, follow the technical design guidance found in TI 800-01 Appendix B Unaccompanied Personnel Housing for the mechanical systems in barracks. This guidance requires that outside air be treated (heated / cooled) by a separate dedicated air handling unit to a neutral temperature, or as necessary to handle the latent load, and ducted to each living / sleeping room (Dedicated Outside Air System, DOAS).

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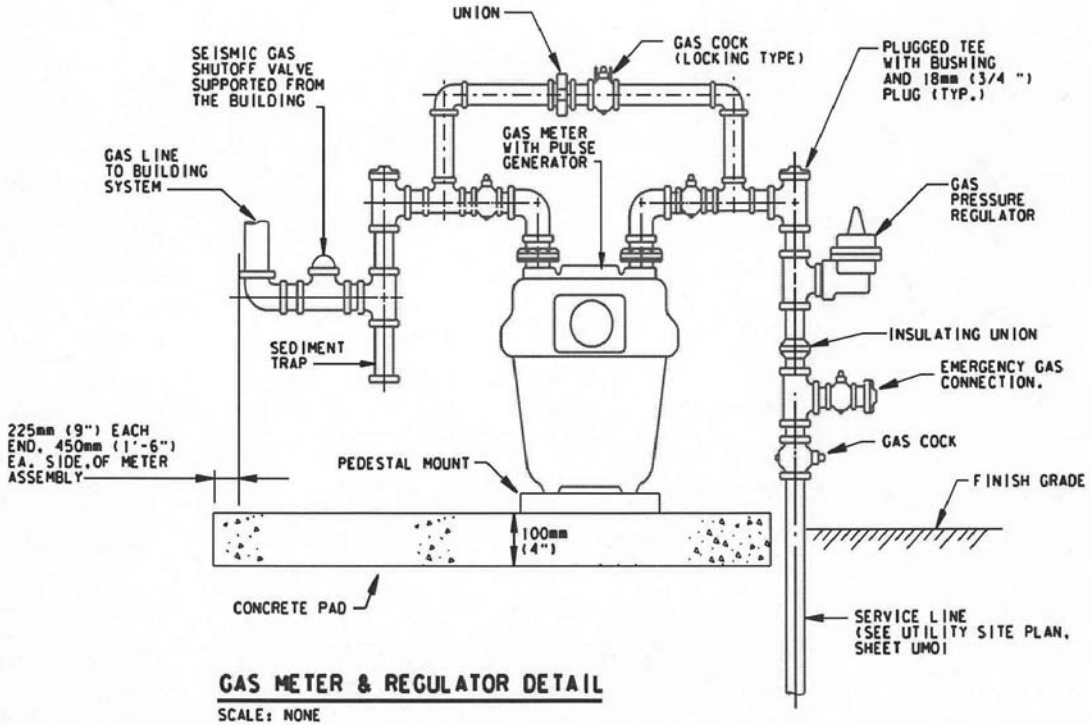

GAS METER & REGULATOR DETAIL

SCALE: NONE

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APPENDIX H

Directorate of Information Management Requirements

Prepared By:
DOIM
907 Bastogne Ave
Fort Campbell, KY 42223

Revised
1Apr 2008

MEMORANDUM FOR Directorate of Contracting

SUBJECT: Fort Campbell Information Technology (IT) Technical Design Guide

1. Purpose. To outline the associated reference documents and identify local deviations for all IT-related construction services provided on Fort Campbell, Kentucky.

2. References. Below are the IT regulations/standards used by the Fort Campbell DOIM to ensure compliance for all unclassified (NIPRnet) and classified (SIPRnet) and IT-related voice and data equipment/services and associated construction efforts:

a. "Technical Guide for Installation Information Infrastructure Architecture (I3A), Department of the Army, U.S. Army Information Systems Engineering Command, Fort Huachuca, AZ", dtd Mar 2006.

b. "Technical Guide for the Integration of Secret Internet Protocol Router Network (SIPRNET), Version 3.2", dtd 21 May 2007.

c. National Security Telecommunications and Information Systems Security (NSTISSI) No. 7003, "Protective Distribution Systems (PDS)", dtd 13 December 1996.

d. NSTISSAM TEMPEST/2-95, "Red/Black Installation Guidance", dtd 12 December 1995.

e. Army Regulation 380-5, "Department of the Army Information Security Program", Chapter 7, Section III, dtd 29 September 2000.

Based on varying environmental, infrastructure density and construction considerations unique to Fort Campbell, the DOIM has identified the need to implement certain deviations from the above listed references as they pertain to IT construction efforts on the installation. These deviations are found at the enclosure and are listed by reference. Each deviation consists of: the Item (paragraph number, page number, Item Name), and verbiage as it appears in the reference; the deviation imposed by the DOIM; followed by a justification for implementing that specific deviation.

3. Applicability: This policy applies to all persons who provide IT construction services to any facility located on Ft. Campbell, Kentucky.

4. This memorandum supersedes "Information Technology (IT) Technical Design Guide, dtd 29 May 07.

5. Point of contact for this document is the Chief, DOIM Plans/Architecture Branch located at Building 6905, 30th Street and A Shau Valley Road, 270.956.2844.

// Original Signed//

Encl JAMES O. WEBB

Deviations

a. "Technical Guide for Installation Information Infrastructure Architecture (I3A), Department of the Army, U.S. Army Information Systems Engineering Command, Fort Huachuca, AZ", dtd Mar 2006.

ITEM: 2.3.1, page 3 - Outlet Box

For standard administrative and medical facility (hospital) outlets use a recess mounted 4- 11/16" by 4-1 1/1 6" double gang electrical box with the faceplate flush with the wall surface. Double gang electrical boxes should be full depth to provide dedicated space for current and possible future fiber optic cable installation. For single connector outlets, such as voice, data, cable television (CATV) or closed circuit television (CCTV), use a full depth, single gang, electrical box recess mounted, with the faceplate flush with the wall surface.

DEVIATION: **Dual jacks will be used instead of a single jack use. Dual jack will be one voice and one data. NO single jacks will be installed without DOIM approval in writing.**

JUSTIFICATION: **All jacks will contain a voice and data, cat 6, so that each desk location will have both. If an office needs more data than voice, jack usage can be adjusted without a lot of additional cost.**

ITEM: 2.3.5, page 4 - Outlet Types and Density

Table 1 shows outlet types that are commonly used in military construction projects. Sketches of these outlets are included in Figure B-7 of Appendix B. The outlet types do not cover all possible user required configurations. The designer must certify that all user-defined outlets have a corresponding valid requirement, such as fiber for various levels of classification. Outlet configurations must comply with this TG, TIA/EIA-568-B, and TIA/EIA-569-B. Outlet densities are provided for planning purposes, when actual outlet locations are not known and cannot be determined with available information. The designer can develop reasonably accurate total outlet count estimates based on the size and dedicated usage of the space. These factors fall within the ranges given in TIA/EIA-5 69-B, and are based on gross area (overall building footprint without deducting for hallways, equipment rooms, restrooms, etc.).

Table 1. Outlet Types

Facility Space Category	Outlet Configuration	Planning Area (SF(SM)) per Outlet
Administrative space, to include classrooms, and medical/clinics	**Two 8-pin modular (RJ45 type) outlet/connector in a double gang outlet faceplate, one connector labeled voice use and one labeled data use.**	**80(7.5)**

Headquarters and special users	**Minimum of two 8-pin modular (RJ45 type) outlet/connector in a double gang outlet faceplate, one connector labeled voice use and one labeled data use, with additional 8- pin modular and/or fiber outlet/connectors as required.**	**80(7.5)**
Systems furniture	**Two 8-pin modular (RJ45 type) outlet/connector in a modular furniture outlet faceplate with outlet box extender, one connector labeled voice use, and one**	**See below**
Non-admin spaces (CDCs, chapels, Recreation centers, etc.)	**Two 8-pin modular (RJ45 type) outlet/connector in a double gang outlet faceplate, one connector labeled voice use and one labeled data use.**	**500(46.5)**
Barracks space/bachelor officer's quarters	**See below**	**See below**
Warehouse space	**Two 8-pin modular (RJ45 type) outlet/connector in a double gang outlet faceplate, one connector labeled voice use and one labeled data use.**	**5000(465)**
Wall and pay telephone outlet	**One 8-pin modular (RJ45 type) connector in a single gang outlet faceplate with mounting lugs, labeled voice use.**	**As needed**
Family housing units	**See below**	**See below**
Wireless access points	**One 8-pin modular (RJ45 type) connectors in a single gang outlet box labeled for data.**	**See below**

2.3.5.1 Family Housing Units.

The designer must determine the minimum outlet quantity for Army Family Housing (AFH) units based upon the number of rooms in the AFH unit. In general, provide one telephone outlet and one CATV outlet (as a minimum) in each of the following: kitchen, living room, dining room, family room/area, each bedroom, and any other logical location deemed appropriate. Copper outlet/connector must be TIA/EIA Cat 6 for U.S. Army and U.S. Air Force projects.

2.3.5.2 BOQ.

For U.S. Army barracks projects, provide one 8-pin modular (RJ45 type) connector in a single gang outlet faceplate, labeled voice use. In Bachelor Enlisted Quarters

(BEQ), BOQ, Senior Enlisted Bachelor Quarters (SEBQ)/etc., provide one single RJ-45 outlet in each room of the suite; i.e., bedroom and living room, configured per TIA/EIA-570.

2.3.5.3 Systems Furniture Wiring.

The designer must specify a minimum of one systems furniture outlet per single occupancy

cubicle. The designer must specify a minimum of two systems furniture outlets per cubicle designated for servers, printers, copiers, or facsimile (FAX) machines. When systems furniture is installed as part of the construction contract, ensure that systems furniture specifications include EIA American National Standards Institute (ANSI)/TIA/EIA-568-B and EIA ANSI/TIA/EIA-569-B cabling and raceway standards.

2.3.5.4 Wireless Access Point (WAP) Cabling.

Wireless access points may be required in some situations. If the project management for IT has approved the inclusion of wireless in the design, the recommendations here should be followed. The designer should specify one-Cat 6, unshielded twisted pair (UTP) cable, each to a standard 8-pin modular connector for each wireless AP outlet. The Cat 6 cable can be used in conjunction with Power over Ethernet (PoE) to provide both power and data to the AP. The TIA/EIA technical committee TR-42 is currently working on a Technical Service Bulletin (TSB- 162) *Telecommunications Cabling Guidelines for Wireless Access Points.* The intent of this TSB is to provide a pre-cabled grid to support 802.11 wireless local area networks (LAN). The current guidance is to place one WAP at the center of each 55 by 55 foot (ft) square grid, for up to 20 users. For grid locations with over 20 users, provide two UTP cables. The TSB is based upon International Standards Organization (ISO)/International Engineering Consortium (IEC) TR 24704 Information Technology Cu*stomer Premises Cabling for Wireless Access Points.* Both TIA and ISO utilize a 39-ft (12 meters (m)) diameter circle for WAP coverage. The designer should note that a wireless survey will be required after the completion of construction to ensure proper wireless coverage. The WAP grid provides a foundation for implementing wireless, but does not eliminate final wireless design.

DEVIATION:

Facility Space Category	(Area) Sq Ft per Outlet
Classroom XXI	50
Administrative/Clerical	50
Technical	50
Warehouse/Motor Pools	200
Hangars	500

JUSTIFICATION: **Because of the lack of work area and the number of personnel**

occupying that space, the increase in the amount of jacks per area help alleviate the connection to voice/data requirements that exist for activities/units.

Item: 2.4.1.1, page 8 – Copper Voice and Data

One Cat 6, for general projects, UTP cable must be installed to each standard 8-pin modular connector provisioned at the outlet. For example, install two 4-pair UTP cables to a standard administrative outlet, or one 4-pair UTP cable to each single connector outlet. Copper cables must not be split between multiple modular connectors. Use only cable that has passed the Underwriters Laboratory (UL) LAN certification program and is labeled with UL acceptable markings. Plenum cables must be provided IAW National Fire Protection Association, Inc. (NFPA) 70, or when directed by the facility safety officer or local building code. Provide terminations IAW the paragraph entitled "Copper Termination" in this TG. The designer must not use 150 ohm shielded twisted pair for new construction. The Cat 5, Cat 5e, and Cat 3 rated cable must not be used in new construction or rehabilitation projects.

Copper Termination.

Terminations must be performed using an 8-pin (RJ45 type) connector, rated for the category of the installed cable. In a standard cabling scheme, horizontal cables are arbitrarily designated "voice" and "data" to identify and differentiate their purpose. Copper distribution cable must be terminated at the TR on 110-type cabinet or rack-mounted patch panels compliant with Cat 6 for general projects. Very small projects (i.e., one or two telephones) may use an EIA/TIA category qualified block or backboard mounted patch panel. Cables from the same outlet must be terminated on the same patch panel and individually identified. All terminations must be wired to the TIA/EIA T568A configuration. Do not use T568B wiring configurations unless specifically requested by the user and approved by the authority having jurisdiction. Copper cables must not be split between multiple modular connectors.

DEVIATION: **Copper jacks will be EIA/TIA Category 6, 9/pin/8 position insulation displacement terminations wired to match existing system (T568A or T568B). If there is no existing wire, they will be wired per T568A (normal). All drops will conform to the following wire color scheme:**

Beige or White – Voice; Green – NIPRnet data; Red – SIPRnet (Secret) data; and Orange – JWICS (Top Secret) data. All faceplates shall be neutral in color. Inserts will be the same color as the wiring used for that particular jack.

JUSTIFICATION: **Some of the older facilities at Ft. Campbell have a termination of T568B instead of T568A. If adding additional drops in those areas, continuing with matching termination. Any NEW infrastructure with no present wiring will be T568A.**

ITEM: 2.4.2.2, page 18 - Copper Termination

Termination must be performed using 110-type connectors, rated for the installed cable. All terminations must be wired IAW TIA/EIA T568A. In a standard cabling scheme, horizontal cables are arbitrarily designated "voice" and "data" to identify and differentiate their purpose. Twisted pair outside plant (OSP) cable is terminated on the Protected Entrance Terminal (PET). See Figures B-5 and B-6 of Appendix B for details. Cross-connects can then be placed from the PET to the first set of 110-type terminal blocks

as needed. The first set of terminal blocks provides connection for all backbones and for outlets served by the main TR. For main TRs that contain a telephone distribution frame, the horizontal main distribution frame (MDF) blocks must serve as the main cross connects. Refer to MDF description in the section on Dial Central Offices (DCO) in the *USAISEC TG for Circuit Switching.* For example, in a three-floor building, one backbone cable must be terminated on 110-type blocks on the same backboard as the PET; one backbone cable should be terminated on 110-type blocks in the second floor TR; and one backbone cable should be terminated on 110-type blocks in the third floor TR. A backbone cable connects a second set of 110-type blocks in each TR to a rack mounted, 8- pin (RJ45 type) connector voice patch panel. This panel can be patched to the distribution patch panel, which in turn terminates the Cat 6 outlet wiring. Cross-connects can be done by the Director of Information Management (DOIM)/telephone personnel, and jumpers can be installed by the user/Information Mission Area (IMA) department, providing the desired connectivity between the OSP and the inside plant wiring. This design allows maximum flexibility for future moves, additions, and changes.

DEVIATION: **Voice cable will be terminated on 110 blocks under the fiber optic cabinet on the rack. DOIM may, however, choose to put 110 blocks on backboard, but only if rack is not feasible for space size. Data cable** will not **be terminated on the same block. A distribution field will be established to organize jumpers and associated wiring on communications backboards. When copper is terminated with new cable, a 0% tolerance for bad cable will be the standard.**

JUSTIFICATION: **Having voice and data terminated on separate blocks provides for ease in troubleshooting and maintenance.**

Item: 2.4.4.6, page 21 - Optical Customer Premise Items

In new construction, particularly in large administrative or medical facility buildings, cable distribution systems must use the cable tray (or duct) and conduit systems as described. In new construction involving small, mixed use (non administrative) facilities, or construction projects involving renovation of existing buildings, use of "J" hooks, flexible cable tray, and alternative support systems specifically certified for Cat 6, cable is permissible, though not desirable. Surface mounted non-metallic raceway may be used in renovation projects where

access to the walls for installation of conduit and outlet boxes is not possible, or where historical requirements prohibit the alteration of the building structure.

ITEM: 2.5.4, page 15 - Room Door

TR doors should be a minimum of 36" wide, 80" tall, hinged to open outward (or slide side to side) and be fitted with a lock to control access to the room.

DEVIATION: **Closet door(s) in Telecommunications room will be keyed separate from other locks in the building IAW DPW standards, with two copies of the key provided to the Supply Section of the DOIM.**

JUSTIFICATION: **Having a separate lock from others in the building provides for additional security and accountability of the expensive IT equipment.**

Item: 2.5.10, page - Fiber Optic Patch Panels (FOPP)

Fiber optic patch panels should be installed in, or adjacent to, the equipment racks or cabinets, which will house LAN equipment. Patch panel connectors and couplers must be the same type and configuration as used elsewhere in the system. Utilize 568SC duplex connectors on 19-inch (475 mm) rack mounted panels, unless otherwise directed. Twenty-three inch (580 mm) rack mounted panels, or minimum 1 2x1 0 in (300x250 mm) wall mounted enclosures may be utilized when necessary, such as at small facilities in U.S. Army projects. A 3-ft (1-meter) slack loop of fiber must be provided within each panel, and panels must provide strain relief for cables. Patch panels must properly provide termination, splice storage, routing, radius limiting, cable fastening, storage, and cross-connection. Provide a minimum spare capacity of 10 percent in the installed patch panels.

DEVIATION: **Fiber Optic patch panels WILL be installed in cabinets or racks that house the LAN equipment. No fiber optic patch panels will be installed on backboards unless specified by the DOIM.**

JUSTIFICATION: **Patch panels need to be within a close proximity of the LAN equipment to make patching cables convenient and neat.**

ITEM: 2.5.15, page 17 – Electrical Power

Provide a minimum of two dedicated 120 volt, 20-ampere duplex receptacles in each TR. Each receptacle must be on a separate 20-ampere branch circuit serving only that receptacle. Additional convenience receptacles must be provided at 6 feet (1800 mm) intervals around the perimeter walls. For all projects, provide a dedicated 20-ampere circuit and a quadraplex receptacle for each 19 inches (480 mm) rack or cabinet. The designer must consult with the electrical designer or facilities engineer if the TR is to house blade servers, PoE switches, PoE mid-span hubs, or large numbers of network switches. The designer should determine estimated power draw of these devices. The electrical designer may have to compensate for the considerable current draw amount of these devices.

Design note for renovations: The designer must specify a disconnecting means as defined in the NEC, Article 645.10, if the existing panel is not collocated or in close proximity of the branch-circuit power panel.

DEVIATION: **A minimum of four dedicated 20 ampere, 110 volt AC outlets will be installed with each equipment rack or cabinet to provide power for installed equipment. Each communication rack will have a 1000 CA UPS installed. Electrician will coordinate with appropriate contractor for location and type of outlet.**

JUSTIFICATION: **Having the outlets on the communication racks allows for ease of use, prevents the use of extension cords to connect switches and UPS and also keeps cords from trailing on the ground causing safety issues.**

ITEM: 3.3.2.1, page 23 – Copper

The number of OSP copper pairs is calculated by multiplying the number of users or jumpers in the building times 1 .5 pairs. This factor will add in some additional pairs for faxes, modems, and special circuits. The cable is then sized to the nearest logical standard cable size. For example, a building with 85 users would require a 200-pair cable (85 x 1 .5 = 128 200 pair).

DEVIATION: **A minimum of 25 pair copper is required.**

JUSTIFICATION: **No less than 25 pair copper will be run to any building. It allows for future growth without expending additional dollars for additions.**

Item: 3.6.2, page 24 – Utility Location

The DOIM or DPW must be responsible for the location and marking of the utilities, unless otherwise stated in the design package. The installer must furnish a schedule of proposed excavation involving utility locations to the DOIM/DPW in sufficient time to allow marking. Since each DOIM/DPW has different operating requirements, the location lead-time must be stated in the design package. An acceptable utility mark must be within 24 inches (600 mm) of the edge of the utility. After the utilities are located and marked, the installer is responsible for maintaining the marks until they are no longer required. The intent is that the utilities must be located and marked only once and not after each rainfall.

DEVIATION: **Cables for the DOIM will be remarked upon justifiable request by the contractor. Contractor is not responsible to maintain the locates.**

JUSTIFICATION: **This practice is being done to cut down on the amount of cables and other utilities cut during the project.**

ITEM: 3.7.2, page 28 – Direct Buried

The DB cable plant system is the preferred method for placement in less congested areas.

Supporting documentation for buried cable installation is available in RUS Bulletins 1751 F-640 (http://www. usda.gov/rus/telecom/publications/1 751 f640.pdf), 641 (http://www. usda.gov/rus/telecom/publications/1 751 f641 .pdf), and 642 (http://www. usda.gov/rus/telecom/publications/1 751 f642.pdf) and TIA/EIA-758, Customer Owned Outside Plant Telecommunications Cabling Standard.

Note: Above sites are located at the following URL under the BULLETINS Table (http://www. usda.gov/rus/telecom/publications/publications. htm)

DEVIATION: **All cable splicing will be done either in manholes, hand holes, or pedestals. NO buried splices will be performed unless stated in writing by the DOIM.**

JUSTIFICATION: **Buried splices do not protect the cable sufficiently, and are subject to freezing and thawing causing excessive unstable environmental**

conditions to the cable. This will allow ease of access for future maintenance requirements.

ITEM: 3.7.3, page 28 – Aerial

Aerial cable plant systems must not be used except as specified in the design package. Exceptions may include range cables or other long runs through undeveloped areas, in cases where underground systems cannot be installed, or in conformance to local mandates. Aerial pathways and spaces may consist of poles, messenger wire, anchoring guy wires, splice closures, and terminals.

DEVIATION: **Aerial cable will not be engineered.**

JUSTIFICATION: **Aerial cable is subject to thermal in the air and also being torn down by heavy equipment and large vehicles.**

Item: 3.8.1.3(c), page 30 – Accessories (locking covers)

Each new MH must be equipped with a lid, sump, pulling-in irons, ground rod, bonding ribbon, cable racks, and hooks. Accessories must be designed for use in a telecommunications MH. Cable hooks must be placed JAW RUS Bulletin 175 1 F-643, RUS Bulletin 1 753F-1 51, and the *AT&T Outside Plant Engineering Handbook,* August 1994, Practices 632- 305-2 15 and 9 19-240-300 to support the weight of the cable and splice case.

Locking Covers – The first MH outside a DCO or wire node, MHs at critical junctions, or MHs equipped with carrier equipment will have lockable cover. Additional MHs may be identified as requiring lockable covers in the Statement of Work (SOW)/Engineering Design Plan (EDP). The preferred lockable lid cover is one that utilizes a lever and clamp mechanism placed into a receiver that is installed into the cover. The mechanism will allow the cover to be replaced without indexing the cover to the frame. When locked, the mechanism will be flush with the frame surface minimizing the potential for the cover to be dislodged. The bolt used to secure the cover is available in many configurations and can only be turned with a socket provided by the manufacturer. The U.S. Government will select the bolt configuration. A disposable tamper evident plastic cap snaps into the lock body covering the recessed bolt head keeping dirt and debris out of the bolt area. An alternative means of securing the MH utilizes an inner, water resistant cover that can be locked by a General Services Administration (GSA)-approved, changeable combination lock. The U.S. Government will provide the locks.

DEVIATION: **Manhole lids will be centered and locking. Three keys will be turned into DOIM supply for one manhole installation. An additional three keys will be required for every 10 manholes set.**

JUSTIFICATION: **The centered manhole lid provides for easier access to the cable inside and also lockable to prevent access by unauthorized personnel.**

Item: 3.8.2, page 32 – Hand holes

Hand holes are reinforced concrete units provided with a lid that permits internal access to the housed components. Hand holes are typically used as pull points for small

diameter cables for building access. A hand hole must not be used in place of a MH or in a main conduit system. Hand holes must not be used for splicing cables without prior U.S. Government approval. Telecommunications hand holes must not be shared with electrical installations. The minimum hand hole size is 4 ft x 4 ft x 4 ft (1.2 m x 1.2 m x 1 .2.m). Larger hand holes (i.e., 1.2 m x 1.8 m x 1 .2 m) are acceptable. Hand holes installed where vehicle traffic may be present must be load rated as H-20 and must be equipped with round MH lids.

DEVIATION: **Hand holes will be no less than 4 x 6 x 6 unless otherwise stated in writing by the DOIM. Hand hole lids must also be locking and three keys furnished to the DOIM.**

JUSTIFICATION: **The larger hand hole allows more room for splice cases and ease of splicing. It also provides additional space for dark cable to be coiled up.**

Item: 3.8.4.5(e), page 35 – Manhole and Duct Bank Sizing

The minimum sizing for new duct banks is listed below. The total number of conduits required must be determined, including existing conduits, conduits installed by this effort, and known future requirements, along with 50 percent of this total for spares.

entrance conduits in minor buildings, as listed in the design package, must be a minimum of one-way, 4 inch (100-mm) ducts if the entrance cables are less than 1-inch (25- mm) diameter and if less than 40 percent of the duct area must be used.

DEVIATION: **Entrance conduits in ALL buildings must be a minimum of two-way, 4 inch ducts.**

JUSTIFICATION: **Due to the number of buildings that are being used in a capacity different than purpose intended we require two ducts so no additional digging would be required for additional infrastructure installation.**

ITEM: 3.8.4.6, page 36 - Depth of Cover.

At least 24" of cover is required above the top of the duct or duct encasement. Less cover is required under roads or sidewalks (if duct is concrete encased).

DEVIATION: **There will be 48" of cover required above the top of the duct or duct encasement.** JUSTIFICATION: **Due to congestion of existing underground utilities.**

ITEM: 3.9.3, page 42 – Warning Signs

Buried cable warning signs or route markers must be provided no less than every 250 feet (76 m) or at each change in route direction, on both sides of street crossings, on pipelines, and on buried power cables. Color-coded warning signs or markers must be orange in color.

DEVIATION: **Wording:**

Underground Cable Communications
Contact DOIM at 798-9650 prior to digging

In addition, the signs should be installed as follows:

- **Sign mounted to steel PSP stake; orange in color preferred**
- **4' below ground in concrete; rising 5' above ground**
- **No more than 1' off the ditch line; perpendicular to the trench line**
- **If there is a change in direction, a sign should be positioned immediately at the turn showing the line**
- **Although I3A states every 250' for those areas that end up being less than 250' we request they be positioned accordingly, even if an additional sign needs to be added**

JUSTIFICATION: **Orange PSP stake and height/depth is due to the height of the grass, especially in rear areas, and the bush hogs used to cut the grass. It will hopefully give us a fighting change of not being hit/damaged or mowed over.**

ITEM: 3.9.4, page 42 – Plowing

Plowing must be used in range environments or other areas where there are no significant obstacles and where cable runs typically exceed 1,000 feet (305 m) between splices. The design package must identify areas in which plowing is deemed feasible.

DEVIATION: **When trenching or excavating in the cantonment area, under no circumstances will rotary trenchers or plowing be allowed. The DOIM prefers the method of open trenching, using bucket type equipment, i.e., backhoe and track hoe. It is however, acceptable to use plowing and rotary trenching equipment in the rear areas. The maximum width of the trench is in accordance with the type of equipment used to dig.**

JUSTIFICATION: **Due to congestion of existing underground utilities.**

ITEM: 3.9.5, page 42 - Trenching

3.9.5.1 Backhoe Trenching.

Trenching with a backhoe must be done only for short distances (i.e., MH to building). The installer must hand dig at all existing MH locations, building entrance points, utility crossings, through tree roots, under curbs, etc.

3.9.5.2 Trencher Trenching.

A maximum trench width of 12 inches (300 mm) must be used in DB applications done by a trencher. The installer must hand dig at all existing MH locations, building entrance points, utility crossings, through tree roots, under curbs, etc.

DEVIATION: **When trenching or excavating in the cantonment area, under no circumstances will rotary trenchers or plowing be allowed. The DOIM prefers the**

method of open trenching, using bucket type equipment, i.e., backhoe and track hoe. It is however, acceptable to use plowing and rotary trenching equipment in the rear areas. The maximum width of the trench is in accordance with the type of equipment used to dig.

JUSTIFICATION: **Due to congestion of existing underground**

utilities. ITEM: 3.9.6, page 50 – Depth of Placement

3.9.6.1 Copper Cable.

The depth of placement for a DB copper cable must provide a minimum top cover of 24 inches (600 mm) in soil, 36 inches (900 mm) at ditch crossings, and 6 inches (150 mm) in solid rock (RUS Bulletin 345-150/RUS Form 515A).

3.9.6.2 FOC.

Direct buried FOG must be placed at a depth providing a minimum top cover of 42 inches (1070 mm). In solid rock, the minimum top cover must be 6 inches (150 mm).

3.9.6.3 Frost Considerations

In areas where frost heaving can be expected, the cable or wire should be buried below the frost line. Movement of OSP housings due to frost heaving can cause damage to the insulated copper conductors, optical fibers, or loss of shield and/or armor continuity. In areas where movement of OSP housings by frost heaving is encountered, the OSP housings should be installed on stub poles. The stub poles should be set below the frost line and IAW the requirements of RUS Form 515.

3.9.6.4 Other Considerations

The DOIM/DPW may have special depth requirements for certain areas (i.e., tank tracks, ranges, etc.), which must be provided in the design package.

DEVIATION: **Depth of cover for all communication cables is 48" of**

cover.

JUSTIFICATION: **Due to congestion of existing underground**

utilities.

Item: 3.9.7, page 51 - DB Cable Splicing

Buried splices must be engineered and installed as identified in the design package. For example, a buried splice may be used for the following conditions with U.S. Government approval:

Electrical or explosion hazard (i.e., ammunition areas)

Vehicular hazard (i.e., motor pool areas)

Security hazard (i.e., within a high security compound)

Only splice cases specifically designed for a buried application must be used. All buried splices must be encapsulated. All other splices in a DB run must be placed in pedestals or MHs. Encapsulation is not required in a pedestal.

DEVIATION: **All cable splicing will be done either in manholes, hand holes, or pedestals. NO buried splices will be performed unless stated in writing by the DOIM.**

JUSTIFICATION: **Buried splices do not protect the cable sufficiently, and the cables**

are subject to freezing and thawing causing excessive unstable environmental conditions

to the cable. This will allow ease of acce

Item: 3.12 – Free Space Optics

The FSO can provide an alternative to FO connectivity, for the "last mile," to EUBs and small enclaves. Typical FSO implementations arise from one of the following factors that prohibit traditional infrastructure– rapid deployment, right of way permit issues, water, railroads, and rough terrain. The FSO is a line-of-sight (LOS), point-to-point, wireless optic technology that uses the transmission of modulated infrared beams through the atmosphere to obtain broadband communications. The FSO operates in the unlicensed near-infrared spectrum 750 nanometer (nm) to 1550 nm wavelength range. The FSO systems can function over distances of several kilometers (km), as long as there is a clear LOS between the source and the destination.

Design Note: For systems operating at 1 .25 gigabits per second (Gbps) the link distance should be kept around 1000 meters. If the FSO system is to operate in an environment of low visibility (fog) a back up system (e.g., MMW, SHDSL, 802.1 1a) should be used.

There are a number of manufacturers producing FSO equipment. The designer should utilize an FSO device that was tested, approved, and recommended by the USAISEC TIC. The FSO equipment must be designed to prevent data loss due to temporary blockages, such as birds, smoke, dust, rain, and light fog. The FSO devices must be FDA and IEC 60825-1 Class 1 M approved to ensure safety. Operational test reports on individual equipment are available from USAISEC TIC, such as TR No. AMSEL-IE-TI 04-009 November 2003 *Free Space Optics (FSO) Comparison Report* and TR No. AMSEL-IE-TI, 05-066, June 2005 *Grafenwoehr Free Space Optics (FSO) Demonstration Report.*
transport the data stream.

DEVIATION: **FSO will not be implemented unless approved in writing by the DOIM.**

JUSTIFICATION: **All non-wired transmission falls under Spectrum Management. This type of equipment operates on an unlicensed frequency.**

ITEM: 3.15.3.3, page 52 – Splices

a. Copper and FOC splicing must be performed IAW RUS Bulletin 1 735F-401, *Standards for Splicing Copper and Fiber Optic Cable,* February 1995.

b. Cable must be spliced into one continuous length. All copper splices must be of the fold-back type to facilitate future work in the splice. Fiber cable must contain splice loops in trays IAW manufacturer's recommendations.

c. Completed splices must meet similar performance and mechanical specifications of a single cable of the same overall length.

d. Self-piercing electrical filled connectors must be used when splicing plastic-insulated conductors. The installer must place and install connectors using a tool specifically designed to place those connectors. In North America, a 25-pair splicing module, 3M-type MS2 or equal must be used. The same modules must be used throughout the project and must be consistent with previously installed connectors to preclude a requirement for a variety of installation tools. B-wire connectors must not be used. In Europe, a 10-pair splicing module system is used.

e. Binder group integrity must be maintained.

f. All dead pairs in a copper cable must be spliced through if the size of the continuing cable must allow a clear and cap at the end. Only UL listed material must be used when capping cable pairs.

g. All underground and buried splice cases must use encapsulant-fillable closures and must be filled with encapsulant upon completion of the splice IAW RUS Bulletin 345-72 (PE-74). Cable sheaths must be bonded at all cable splices with bonding harnesses to assure sheath continuity.

DEVIATION: **"Preform" stainless steel splice cases are Fort Campbell's preferred standard for all copper cable splices, or an equivalent which will be approved by the lead planner or the Service Management Division Chief. DOIM requires submittals for splice cases and splice modules prior to work beginning.**

All splice cases shall be specified for the particular environment in which they will be placed and shall be sized to accommodate the cable count spliced. End plates shall be designed for the number and size of the cables served by the splice and shall be designed to seal around each cable individually. All splice cases shall be re-enterable and shall contain all necessary equipment to be installed properly, adhering to all appropriate electrical codes.

Splices will be done in 710 instead of MS2.

JUSTIFICATION: **Specific splice cases are required in order to protect the cable infrastructure. They have been used on the installation for a number of years with no problems or unsolvable issues. Their durability and reliability has been proven over many years of use. Using 710 splicing is more compact and ease of troubleshooting.**

3.15.3.5 Cable Gauge, Resistance Design.

The cable gauge must be 24-AWG (0.6 mm in Europe), unless otherwise specified in the design package

JUSTIFICATION**: 24 AWG should be used as it is easier to terminate on the 110 block and is a little smaller in diameter potentially allowing more cables in a common cable tray.**

ITEM: 3.17.3.1, page 66 – Fiber Optic Termination

All strands of FOCs, both OSP and inside plant, will be properly terminated on FOPPs. The OSP plant FOC will be extended IAW the NEC standards into the main data closet/location of the building and terminated there. If the main data closet/location cannot be determined, the OSP FOC will be terminated on a lockable patch panel collocated with the copper PET. Inside plant FO riser cables between the main data closet/location and any satellite data closet(s)/location(s) will be terminated at both locations on the FOPPs. All FOPPs will be stenciled with the panel number and the cable count.

DEVIATION: **Fiber optic cable (FOC) entering a facility will be terminated in a rack mounted LIU. If lack of space for sufficient rack; LIU will be mounted on backboard in coordination with DOIM plans.**

JUSTIFICATION: **Some of the older facilities at Ft. Campbell do not have sufficient space to provide a telecommunications room. In those instances a backboard mount is required.**

Item: 3.17.3.2, page 58 – Fiber Terminations

All terminations will be made using SC or ST connectors.

DEVIATION: **All** NEW **terminations will be made using LC connectors. Any connectors already in place in triaged buildings or additional fiber connections in old buildings will be terminated with already present technology.**

JUSTIFICATION: **We are trying to standardize the connectors with the newest**

technology.

b. Army Regulation 380-5, "Department of the Army Information Security Program", Chapter 5, Section I, 5-101, dtd 29 September 2000.

ITEM: Standards for Storage Equipment

The GSA establishes and publishes minimum standards, specifications, and supply schedules for containers, vault doors, alarm systems, and associated security devices suitable for the storage and protection of classified information. Heads of DoD Components may establish additional controls to prevent unauthorized access. Security filing cabinets conforming to federal specifications bear a Test Certification Label on the locking drawer, attesting to the security capabilities of the container and lock. (On some older cabinets the label was affixed on the inside of the locked drawer compartment) Cabinets manufactured after February 1962, indicate "General Services Administration Approved Security Container" on the outside of the top

drawer. The GSA-approved changeable combination padlock built to Federal Specification FF-P1 10 (Sargent and Greenleaf Model 8077A), is intended for use only as an indoor or sheltered area reusable seal.

DEVIATION: **All taclanes will be installed in a steel cage shown at APPENDIX B.**

JUSTIFICATION: **It protects the equipment physically and provides assurance for accountability of the DOIM hand receipt.**

c. "Technical Guide for the Integration of Secret Internet Protocol Router Network (SIPRNET), Version 3.2", dtd 3 May 2006.

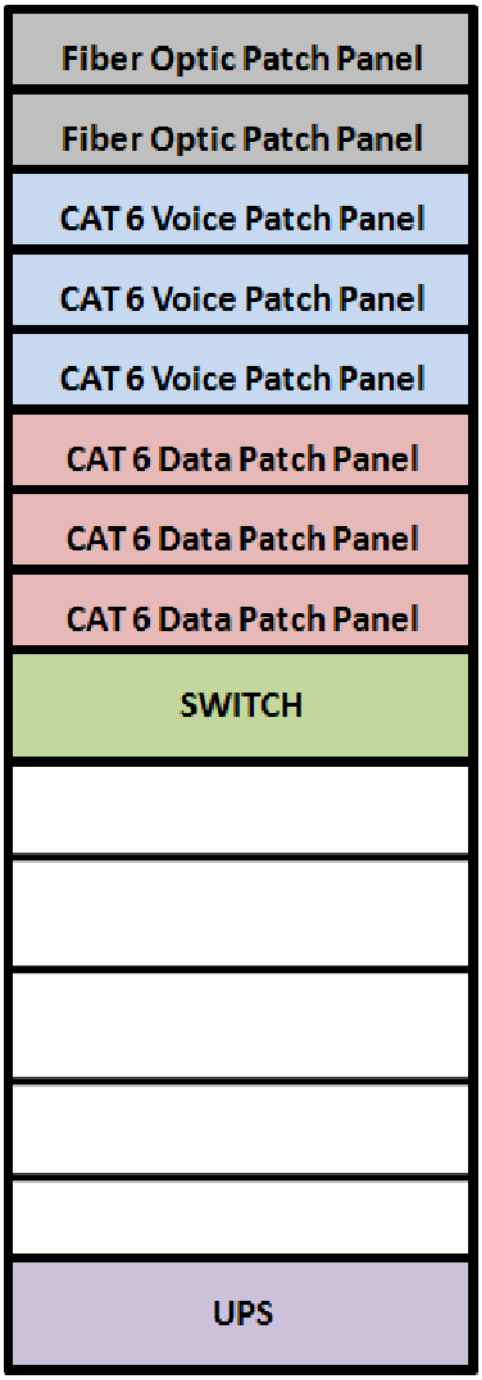
There are currently no deviations to this reference.

d. National Security Telecommunications and Information Systems Security (NSTISSI) No. 7003, "Protective Distribution Systems (PDS)", dtd 13 December 1996.

There are currently no deviations to this reference.

e. NSTISSI TEMPEST/2-95, “Red/Black Installation Guidance”, dtd 12 December 1995. There are currently no deviations to this reference.

APPENDIX B

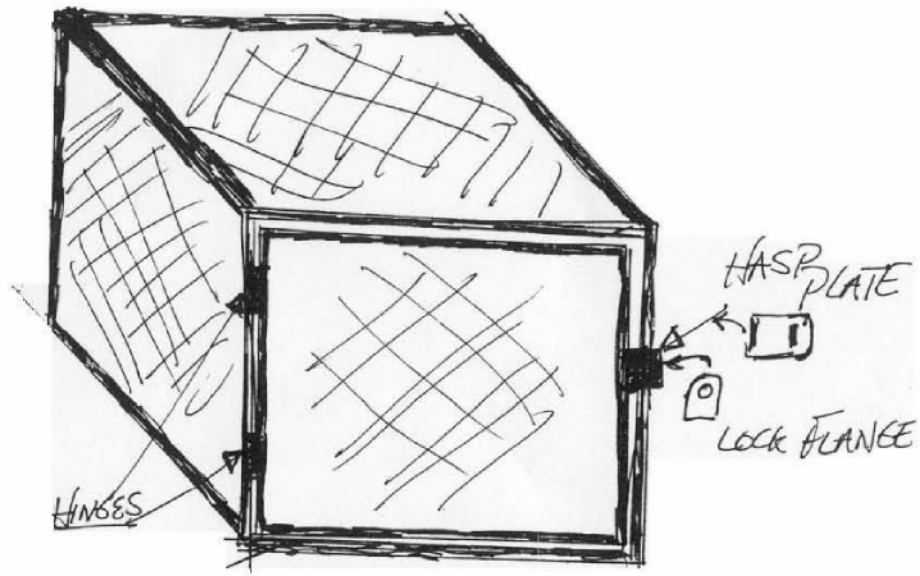


Each rack to come with a wiring and distribution channel, each side.

Depicts a standard 19" rack configuration for the TR.

TACLANE CAGE

① SIZE = 2" X 2' X 2"
② FRAME 1½ X 1½ X ⅛ ANGLE
③ ¾" #9 Flat Mesh WIRE
④ DOOR FRAME 1"X1" 15ga box tube
⑤ 1¼ X 4" 11 ga Hinge (2ea)
⑥ 3X3X¼ plate for Hasp
⑦ 1X2 X ¼ flange for lock
⑧ 12ga Solid metal bottom



NOTE
① All joints must be welded
② Wire mesh welded to Angle Frame and Door Frame
③ Hinge pms tack welded
④ LATCH Plate and flange fabricated and Continuous welded
⑤ 2 coats of Flat black paint

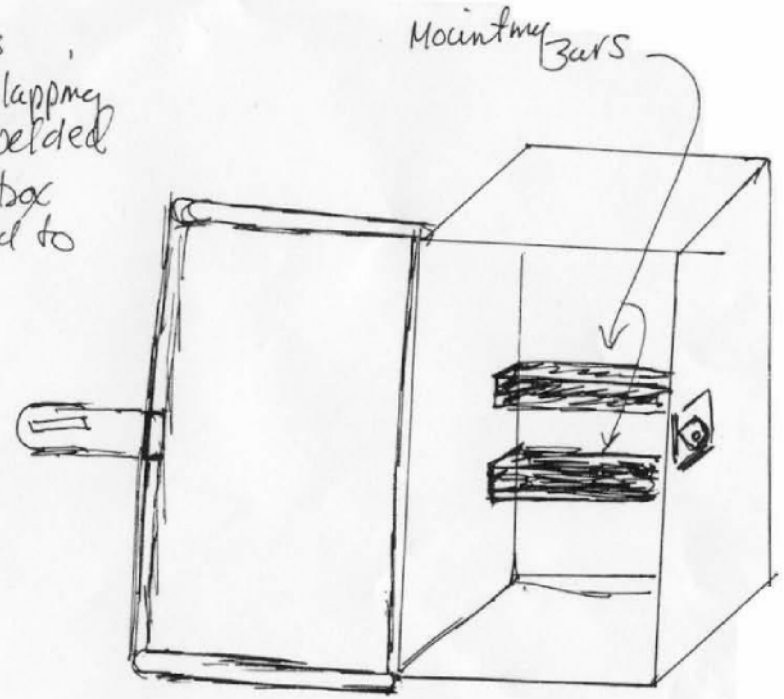
Estimated cost $500 to 750.00

Taclane Cage Drawing Specifications

339

Drop Box Cover

① Box 6 x 8 x 4
② 12 ga welded continous
③ (2) 1x4 box tub mounting Bars
④ LID 6 3/4 x 8 3/4 x 1 overlapping
Corners rounded & welded
⑤ 6" hinge welded pin + too box
⑥ 3 1/2" hasp for lock welded to
Lid + box



NOTE: All seams welded
Continous (this box should
hold water).
② hinge pin welded
③ Fill screw holes in hasp
④ 2 coats Beige or Sand paint

Closed

Est Cost $50.00 - 75.00

SIPRnet Drop Lockbox Drawing Specifications

APPENDIX I
Erosion and Sedimentation Control

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EXECUTIVE SUMMARY

This plan provides information on erosion control for activities that result from opening, operating, and closing borrow pits on the Fort Campbell Military Reservation. This material is intended for use at Fort Campbell, KY by its military units and all authorized subcontractors. It provides step-by-step procedures to help plan, design, and install soil and water Best Management Practices (BMP). It does not override any local, city, county, state, or federal rule, regulation, or law, including job safety and utility safety laws. Where there is a difference between this plan and any language contained in any contractual document, the contractual document must be followed.

The standards and specifications listed in this manual provide criteria for the design, installation, and maintenance of water management and sediment control practices to abate nonpoint source (NPS) Pollution. Those responsible for design of these practices should evaluate the conditions existing on a particular site and determine if the minimum criteria contained in these standards are adequate or if more stringent criteria should be used.

Properly applied, this information will provide an efficient plan to operate the borrow pit site(s) while ensuring maximum safety and minimizing adverse impact to the environment. By following these guidelines, it is the intent of this management tool to furnish a uniform plan that will provide continuity throughout the life of the borrow pit.

CHAPTER 1I–INTRODUCTION

General

It is the intent of this manual to help authorized borrow pit operators understand soil and water management practices. These Best Management Practices (BMP) recommendations are somewhat generalized because of wide variations in topography, geology, soils and plant requirements. Feasible ways to handle water management and to minimize erosion and sedimentation at the site are complex and vary according to each borrow pit location.

These guidelines will address borrow pit operations from site identification through final reclamation. The site manager as well as engineers and contractors must be fully cognizant of the environmental impact and strive to lessen the effect throughout the life of the project. This will also ensure minimal cost at the time of site closure.

Site Selection

After establishing a need for borrow or topsoil, borrow areas shall be coordinated with program manager. A site should be reasonably close to construction areas, yet remote enough not to hinder future development. Access to the site should not create any undue safety problems. The site should be of sufficient size to provide safe operations and years of acceptable material. No previously used impact areas will be considered, due to the threat of unexploded ordnance.

The topography of the area should allow for excavation throughout the construction season. Wetlands shall be avoided, since altering or affecting them is subject to state or federal regulatory oversight and may require mitigation.

The material at the site must be acceptable to provide the fill requirements for projected construction. The initial determinations can be made with the use of soil surveys and the cooperation of the local county U.S. Natural Resource Conservation Service (NRCS). When fill materials appear to be acceptable, core drilling should be done to verify soil profiles. Laboratory testing is necessary to determine the natural moisture content, Atterberg limits, and compaction information.

Site Development

Safety and environmental considerations are paramount in site development. All haul roads should be designed to ensure smooth traffic flow and they should have ample traffic width as well as full shoulders. Grades into and out of the pit area will not exceed safe slope percent of grade or length of slope. Main access roads will require a construction that will allow trafficability in most weather conditions. During dusty conditions, provisions will be made for dust control.

It is necessary to protect the environment throughout the life of the site and restore vegetation as soon as possible after material excavation. Off-site sediment migration must be kept to a minimum. The best way to protect from off-site sediment migration is to protect exposed soil and use sediment and runoff control measures.

The best way to minimize exposed soil is to prevent the pit operations from becoming larger than required for safe and efficient operations. As soon as the excavation of an area is complete, that portion shall be reclaimed and stabilized. If the active excavation area is kept below ten (10) acres then costly control measures such as sedimentation basins do not have to be designed, built, and maintained. However, it is not practical to mulch any of the active areas where borrow still remains because this would hamper fill compaction at the construction site. There are three active borrow pits on Fort Campbell; Patton Road, Angels Road and On-The-Line Road.

Sediment control measures will be constructed to prevent off-site sedimentation. The design size of these structures will be of sufficient size to prevent exposed soil from being transported off-site. Periodic maintenance and evaluation of these controls will be required.

A system of runoff control measures should be used to direct water away from the active borrow area. By diverting surface water from the active pit area, work may continue during rainy periods. These diversions can be constructed when removing vegetation and/or topsoil.

Site Operations

To maintain the continuity of the operation, the Engineer Design Branch of the Directorate of Public Works , will oversee the operation of the borrow pit. This is imperative to control users operating in the pit, coupled with the longevity of the site.

Prior to any borrow excavation, sediment control measures should be designed and constructed. Runoff control measures necessary to ensure that water passes through the basin should also be constructed. An adequate network of roads should be

designed and constructed, keeping in mind that they will be used for the life of the borrow area. One-way roads are preferable for safety and ease of operations.

The pit will be opened at its lowest elevation to ensure positive drainage control. Any marketable timber should be harvested. All forest debris, brush and shrubs must be piled and disposed of in accordance with the procedures described in Chapter 2. Topsoil should be stripped and stockpiled. If there is no pending requirement for topsoil, the topsoil stockpile will be protected from erosion by seeding and mulch. The area of topsoil removal should expose enough borrow material for the projected year's construction. Borrow in the pit must be excavated to a controlled elevation. Reclamation design contours must maximize borrow removal while maintaining positive drainage.

As soon as practical after borrow removal, the area will be stabilized and revegetated. Reclamation should be close behind the pit operations and completed contemporaneously with borrow excavation. Topsoil replacement will expedite revegetation and cover acid forming subsoil. Prior to preparing the soil for seeding, soil tests should be taken and soil amendments applied according to recommendations. If no topsoil is replaced, then the acid forming potential of the subsoil should be considered in lime recommendations. The prepared area will be seeded with a mixture of legumes and warm season grasses. The seeded area will be mulched at the rate of three tons of straw or hay per acre. The mulch will be crimped (or otherwise stabilized) into the soil.

Responsibilities

SITE MANAGER. The site manager is Joseph D. Whitfill, Engineer Design Branch, 798-3113. It is his responsibility of to ensure safe and continuous operations of the site. The site manager will direct the general operations of the contractors and other users operating in the pit area. The site manager will direct all maintenance of roads and control measures. The site manager shall issue a permit to operate in the borrow pit.

CONTRACTOR/USER. The contractor and other users will meet with the site manager prior to operating in the pit. It will be the responsibility of the contractor/user to maintain pit roads and adhere to safe operating procedure.

PROVOST MARSHALL. The Provost Marshall will periodically patrol the area to inspect for unauthorized use of the area.

Stormwater Permitting

Stormwater runoff from construction activities is one facet of water quality and quantity management that is being regulated on construction sites of a certain size through the U.S. Environmental Protection Agency (EPA). The stormwater permit program was enacted by Congress in 1987 in the amendment to The Water Pollution Control Act. This program falls under the National Pollution Discharge Elimination System (NPDES).

The program presently applies only to those construction sites that will disturb five or more acres. The area of disturbance is defined as that portion of the site where ground cover and/or topsoil is removed, as contrasted with areas where tree or shrub clearing is the only activity.

Programs vary from state to state and appropriate state agencies should be consulted before borrow pit activities begin to determine applicability.

The Fort Campbell representative can be contacted at:

Directorate of Directorate of Public Works
Compliance Branch
Storm Water Program Manager
(502) 798-9784

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CHAPTER 2I–BORROW SITE PROCEDURES

Clearing and Grubbing

Description
This work is associated with the clearing, grubbing, removing and disposing of all vegetation and debris. This work shall also include the preservation from injury or defacement of all vegetation and objects designated to remain.

The work under this section shall also consist of removing and disposing of dead, diseased, poorly formed or other trees designated by the site manager to be undesirable and shall include removal and disposal of undergrowth, stumps of uprooted trees, logs, vines, other undesirable vegetation, and all debris designated by the site manager.

Specifications

a) General

1. The site manager will establish borrow pit boundary lines, construction lines and designate all trees, shrubs, plants and other items to remain. Any damage to natural terrain or to vegetation or objects designated to remain shall be repaired, replaced, or otherwise compensated for, as determined by the site manager, at the expense of the Contractor. All cut or scarred surfaces of trees or shrubs shall be treated with an asphaltum base paint especially prepared for tree surgery.
2. All marketable timber within the construction and easement limits which have not been removed prior to the beginning of borrow operations, along with other timber within the right of way designated by the site manager for removal, shall remain the property of the US Government, unless otherwise specified by the plans or proposal.

B) Clearing

1. The area within the construction lines shall be cleared of all surface objects and all trees, stumps, roots and other objectionable obstructions resting on or protruding through the surface of the original ground not designated to be retained.
2. Areas outside the borrow lines shall be selectively cleared of designated dead wood, undergrowth, rubbish and other objectionable matter, designated trees and stumps. This includes trimming and treatment of damaged trees (in accordance with good tree surgery practice). Natural ground cover shall be protected insofar as practical.

c) Grubbing

All areas within the construction lines shall be grubbed of all objectionable matter on or projecting through the ground surface. All fill areas shall be grubbed to a depth at least one foot below the natural ground.

d) Disposal of Materials

1. The Contractor shall submit prior to beginning work, a plan for the satisfactory disposal of material and debris from the clearing and grubbing operations for approval by the site manager.
2. The plan shall provide for the satisfactory disposal of perishable materials and rubbish within 30 days after accumulation, unless a longer period is authorized in writing by the site manager, to prevent infestation of pests. No material may be buried on the Fort Campbell installation.
3. Some acceptable methods of disposal may include:

   a) LANDFILLING

   All materials designated for landfill disposal may be deposited in the nearest permitted off-post landfill.

   b) RECYCLING

   The use of mechanical brush clippers or other recycling methods for vegetation will be considered for approval.

   c) WINDROW

   Biodegradable materials may be windrowed on site.

Topsoil Removal

Description

Topsoil is defined as a natural, workable, friable, loamy soil without a mixture of subsoil, refuse, or foreign materials, reasonably free from hard lumps, stiff clay, hardpan, gravel, noxious weeds, brush, or other undesirable material, and suitable for growing grasses, legumes, or other vegetative ground cover.

Acceptable topsoil shall be well drained and has a healthy vegetative growth, and does not contain toxic amounts of either acid, alkaline, or other phytotoxic elements. The areas from which topsoil is secured shall possess such uniformity of soil depth, color, texture, drainage and other characteristics as to offer assurance that, when removed in quantity, the product will be homogeneous in nature and of acceptable quality**.**

Specifications

a) General

All areas from which topsoil is to be stripped shall be cleaned of all refuse which will hinder or prevent seedbed preparation or growth. When securing topsoil from approved areas, should unforeseen strata or scams of material occur which do not meet the requirements for topsoil, such material shall be removed from the topsoil and disposed of as directed or if directed, the area shall be abandoned.

b) Hauling Topsoil

Topsoil shall be hauled in vehicles suitable for the purpose. Scrapers of reasonable capacity will be considered as acceptable; however, excessive spillage will not be tolerated and loads shall be controlled to prevent such spillage. Topsoil spilled on subgrade or other base or pavement structure layers shall be removed immediately.

c) Maintenance

The topsoil that has been set aside shall be maintained through seeding, sodding, planting, or other work, until final completion of the project. Maintenance shall consist of preserving, protecting, and such other work as may be necessary to keep the work in a satisfactory condition.

d) Topsoil may only be placed in the borrow pit area with the approval of the site manager. All topsoil must be free of any foreign debris. No topsoil will be accepted which has large rock, asphalt, metal or other materials.

Access Roads

Description

Access road design and development shall consider the longevity of the borrow pit operation. Since the entire area is projected for borrow removal, a main access road will be constructed around the perimeter of the site. The road will be designed with drainage and a graveled treadway to serve as an all weather road.

Temporary pit roads from the main access road can be constructed with borrow material. At no time will any road prevent the active borrow site drainage from passing through the sediment basin.

Specifications

a) General

1. Temporary roads shall follow the contour of the natural terrain to the extent possible. Slopes should not exceed 10 percent.
2. Temporary parking areas should be located on naturally flat areas to minimize grading. Grades should be sufficient to provide drainage but should not exceed four (4) percent.
3. Roadbeds should be at least 14 feet wide for one-way traffic and 20 feet wide for two-way traffic.
4. Drainage ditches shall be provided as needed and shall be designed and constructed to carry anticipated storm flows.
5. The roadbed or parking surface shall be cleared of all vegetation, roots and other objectionable material.
6. A 6-inch course of clean aggregate shall be applied immediately after grading. Filter fabric may be applied to the roadbed for additional stability in accordance with fabric manufacturer's specifications.

b) Construction Entrance

1. A gravel construction entrance is a pad of crushed stone that reduces the tracking of mud onto the adjacent road. To construct the pad, place a layer of 2- to 3-inch stone across the full width of the vehicle ingress and egress area. The stone pad should be at least 50 feet long and at least 6 inches thick. Additional stone may have to be added periodically to maintain the proper functioning of the pad.
2. There will be no washing of wheels in the borrow site.

c) Maintenance

Both temporary and permanent roads and parking area may require periodic top dressing with new gravel. Seeded areas adjacent to the roads and parking areas should be checked periodically to insure that a vigorous stand of vegetation is maintained. Roadside ditches and other drainage structures should be checked regularly to ensure that they do not become clogged with silt or other debris. The paved roads in the area will be inspected daily by the contractor/user and all mud/dirt deposits removed. The site manager along with authorized contractors shall maintain all access and pit roads.

Dust and Pollutant Control

Description

Dust and pollutant control measures are implemented to reduce surface and air movement of dust and other pollutants during land disturbing, demolition, and other construction activities. The purpose of these controls is to prevent surface and groundwater contamination and air transport of dust and other pollutants from exposed surfaces and to reduce the presence of airborne substances that may be harmful or injurious to human health, welfare, and safety, or to animals and plant life. This practice is applicable to heavy use areas on the borrow site and to areas subject to surface and air movement of dust where, without treatment, on-site and off-site damage may occur.

Earth moving activities cause the largest amount of construction dust emissions. The less soil exposed at one time, the less potential there is for dust generation. Therefore, dust control should involve phasing of borrow pit activities and utilizing temporary stabilization measures upon completion of grading.

Oil, gasoline, grease, solvents and other pollutants are associated with equipment used on construction sites. The level of equipment maintenance and repair will, of course, depend upon the size and complexity of the project. Whenever equipment must be serviced, special precautions should be taken.

Specifications

a) General

Blowing dust may be controlled permanently or temporarily, depending on the needs of the site. The following summarizes available temporary dust control methods:

b) Temporary Practices

- Mulching: Chemical mulch binders may be used instead of asphalt to bind mulch materials. Binders such as Curasol or Tenatack should be used according to manufacturer's recommendations.
- Vegetative Cover: Refer to Temporary Seeding measures in Chapter 3.
- Spray-on-Adhesives: These are used on mineral soils (not effective on muck soils); traffic should be kept off the area. Apply under proper weather conditions according to manufacturer's directions.
- Wetting: Water can be sprayed by truck or by hand, along the access roads and in the work area to hold down the dust.

c) Permanent Practices

- Permanent Vegetation: Existing trees and large shrubs may afford valuable protection if left in place. Also refer to Permanent Seeding section of this manual (see Chapter 4, B).
- Top soil: This entails covering the surface with less erosive soil material. Refer to section in this manual on Topsoil (see Chapter 4, A).
- Stone: Cover surface with crushed stone or coarse gravel.

Maintenance and repair of equipment should be confined to areas specifically designed for that purpose. These areas should have adequate waste disposal receptacles for liquid as well as solid waste. Take waste oil to designated waste oil collection areas for recycling. On sites where designed areas for equipment servicing is not feasible, special care should be taken to assure that potential pollutants cannot be washed into nearby receiving streams.

Adequate sanitary facilities, such as chemical toilets, should be placed near maintenance areas or other convenient sites on the construction area.

Scrap from maintenance and other construction litter should be placed in containers or otherwise disposed of properly.

Maintenance areas should be inspected and cleaned daily.

Oil and Grease

To eliminate the potential of large spills, no stationary fuel tanks are permitted at the site. Refueling and lubrication of equipment can only be performed at the site by a portable fueling/servicing truck. Unserviceable equipment must be evacuated from the site for repairs**.**

Spoil from Construction Sites

Spoil from construction sites on Fort Campbell will be accepted into the open borrow pit or closed pit located on On the Line Road or recycled per project manager. Spoil must be separated as to topsoil or subsoil. It will contain no asphalt or large rocks, metal or other construction debris. All soil will be placed at a site designated by the site manager, deposited in lifts, capped and temporarily seeded. It is the contractor's responsibility to ensure compliance with this requirement.

Permit to use Borrow Pits.

Any contractor wishing to either excavate soil or dispose of spoil must obtain a permit from the site manager prior to operations. The permit must be maintained by all trucks and equipment operating within the borrow pit. Failure to keep proper documentation within the vehicles could result in fines imposed for improper access and dumping. The contractor must provide at a minimum the contract number, quantity of soil to be moved, type of soil, and the dates of operation. The form is located at App C.

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CHAPTER 3I–EROSION AND SEDIMENTATION CONTROL

Sediment Control Measures

Sedimentation Basin

Description

A sedimentation basin is a temporary barrier or dam constructed across a watercourse or at other suitable locations to retain sediment and other waterborne debris. They are required by the EPA

Temporary sediment basins are used as a means of trapping and storing sediment from eroding areas in order to protect downstream areas from damage resulting from sedimentation and waterborne debris.

Sedimentation basins should be used at sites where:

1. Failure of the structure would not result in loss of life; damage to homes; commercial, or industrial buildings; damage to highways or railroads, or interruption of use or service or private utilities.
2. The height of dam is 25 feet or less, as measured from the natural streambed at the downstream toe of dam to the top of dam.
3. The product of the total volume of storage (acre-feet) and the height of dam (feet) is not greater than 3,000.
4. The drainage area is 100 acres or less.
5. The basin will be removed within a three-year period after construction.

Temporary sediment basins apply where physical site conditions or other restrictions preclude the installation of erosion control measures to adequately control erosion and sedimentation. It may be used downslope from borrow operations that expose areas to erosion. Temporary sediment basins will be removed after the exposed areas are adequately protected against erosion by vegetative or mechanical means.

Regulation

Unless otherwise excepted, all dams with a height of 25 feet or more, or storage of 50 acre-feet or more, require detailed construction plans prior to the start of construction. The height of the dam is measured from the natural streambed at the downstream toe of dam to the top of dam.

Design and construction shall comply with all federal, state and local laws, ordinances, rules and regulations.

Planning Considerations

Sediment basins are typically only 70-80 percent effective in trapping sediment that flows into them. Therefore, they should be used in conjunction with erosion control practices such as temporary seeding, mulching, diversion dikes, etc., to reduce the amount of sediment flowing into the basin.

To improve the effectiveness of the basin, it should be located so as to intercept the largest possible amount of runoff from the disturbed area. The best locations are

generally low areas and natural drainage ways below disturbed areas. Drainage into the basin can be improved by the use of stabilized diversion dikes and ditches. The basin must not be located in a live stream but should be located to trap sediment-laden runoff before it enters the stream. The basin should not be located where its failure would result in the loss of life or interruption of the use or service of public utilities or roads.

Sediment basins may be designed as permanent structures to remain in place after construction is completed. Site conditions may make the use of these structures desirable for stormwater detention purposes. Wherever these structures are to become permanent, or if they exceed the size limitations of the design criteria, they must be approved by the DPW and designed as permanent ponds by a qualified Professional Engineer.

Specifications

(a) Embankment Basin

1. The foundation area shall be cleared of all trees, stumps, roots, and brush boulders, sod, and debris. All channel banks and sharp breaks shall be sloped to no steeper than 1:1. All topsoil containing excessive amounts of organic matter shall be removed. The surface of the foundation area will be thoroughly scarified before placement of the embankment material.
2. The cutoff trench shall be excavated to the lines and grades shown on the plans or as changed during construction because of site conditions, and shall be backfilled with suitable material in the same manner as specified for earth embankment. The trench shall be kept free of standing water during backfill operations.
3. Existing stream channels crossing the foundation area shall be sloped no steeper than 1:1 and deepened and widened as necessary to remove all stones, gravel, sand, roots, and other objectionable material and to accommodate compacting equipment. Such channels shall then be backfilled with suitable material as specified for each embankment.
4. The pipe conduit barrel shall be placed on a firm foundation to the lines and grades shown on the plans. Selected backfill material shall be placed around the conduit in layers, and each layer shall be compacted to at least the same density as the adjacent embankment. All compaction within 2 feet of the pipe spillway will be accomplished with hand-operated tamping equipment.
5. The material placed in the fill shall be free of all sod, roots, frozen soil, stones more than 6 inches in diameter, and other objectionable material. The placing and spreading of the fill material shall be brought up in approximately 6-inch horizontal layers or of such thickness that the required compaction can be obtained with the equipment used. Construction equipment shall be operated over the area of each layer in a way that will result in the required compaction.
6. Special equipment shall be used when the required compaction cannot be obtained without it.

7. The distribution and gradation of materials throughout the fill shall be such that there will be no lenses, pockets, streaks, or layers of material differing substantially in texture or gradation from the surrounding material. Where it is necessary to use materials of varying texture and gradation, the more impervious material shall be placed in the upstream and center portions of the fill.
8. The moisture content of fill material shall be such that the required degree of compaction can be obtained with the equipment used.
9. Fill shall not be placed on frozen, slick or saturated soil.

The topsoil material saved in the site preparation shall be placed as a top dressing on the surface of the emergency spillways, embankments, and borrow areas. It shall be evenly spread to a thickness as specified on the plans.

A protective cover of herbaceous vegetation shall be established on all exposed surfaces of the embankment and spillway to the extent practical under prevailing soil and climatic conditions.

Excavated Basins

The completed excavation shall conform to the lines, grades and elevation shown on the plans.

The material excavated from the basin shall be placed in one of the following ways so that its weight will not endanger the stability of the side slopes and where it will not be washed back into the basin by rainfall:

1. Uniformly spread to a height not exceeding 3 feet with the top graded to a continuous slope away from the basins.
2. Uniformly place or shape with side slopes assuming the natural angle of repose for the excavated material behind a berm width equal to the depth of the basin, but not less than 12 feet.
1. .

Planning Considerations

1. Straw bale barriers that are used in streams and drainage ways with high water velocities and volumes will be destroyed or have diminished effectiveness.
2. Improper placement and installation of the barriers, such as staking the bales directly to the ground with no soil seal or entrenchment, will allow undercutting and end flow. This will result in additions of, rather than removal of, sediment from runoff waters. Inadequate maintenance lowers the effectiveness of these barriers. Trapping efficiencies of carefully installed straw bale barriers can drop from 57 percent to 16 percent in one month due to lack of maintenance.

Specifications

a) Sheet Flow Applications

1. Bales shall be placed in a single row, lengthwise on the contour, with both ends of adjacent bales tightly abutting one another.
2. All bales shall be either wire-bound or string-tied. Straw bales shall be installed so that bindings are oriented around the sides rather than along the tops and bottoms of the bales (in order to prevent deterioration of the bindings).
3. The barrier shall be entrenched and backfilled. A trench shall be excavated the width of a bale and the length of the proposed barrier to a minimum depth of 4 inches. After the bales are staked and chinked, the excavated soil shall be backfilled against the barrier. Backfill soil shall conform to the ground level on the downhill side and shall be built up to 4 inches against the uphill side of the barrier.
4. Each bale shall be securely anchored by at least two stakes or rebars driven through the bale. The first stake in each bale shall be driven toward the previously laid bale to force the bales together. Stakes or rebars shall be driven deep enough into the ground to securely anchor the bales.
5. The gaps between bales shall be chinked (filled by wedging) with straw to prevent water from escaping between the bales. (Loose straw scattered over the area immediately uphill around a straw bale barrier tends to increase barrier efficiency.)
6. Inspection shall be frequent, and repair or replacement shall be made promptly as needed.
7. Straw bale barriers shall be removed when they have served their usefulness, but not before the upslope areas have been permanently stabilized.

b) Channel Flow Applications

1. Bales shall be placed in a single row, lengthwise, oriented perpendicular to the contour, with ends of adjacent bales tightly abutting one another.
2. The remaining steps for installing a straw bale barrier for sheet flow applications apply here, with the following addition:
3. The barrier shall be extended to such a length that the bottoms of the end bales are higher in elevation than the top of the lowest middle bale to assure that sediment laden runoff will flow either through or over the barrier, but not around it.

Maintenance

1. Straw bale barriers shall be inspected immediately after each rainfall and at least daily during prolonged rainfall.
2. Close attention shall be paid to the repair of damaged bales, end runs and undercutting beneath bales.
3. Necessary repairs to barriers to replace bales shall be accomplished promptly.

4. Sediment deposits should be removed after each rainfall. They must be removed when the level of deposition reaches approximately one-half the height of the barrier.
5. Any sediment deposit remaining in place after the straw bale barrier is no longer required shall be dressed to conform to the existing grade, prepared and seeded.

Silt Fence

Description

A silt fence is a temporary barrier to trap sediment that consists of a filter fabric stretched between supporting posts, with the bottom entrenched in the soil. The Silt Fence is a temporary linear filter barrier constructed of synthetic filter fabric, posts, and, depending upon the strength of the fabric used, wire fence for support. The purpose of a silt fence is to intercept and detain small amounts of sediment from disturbed areas during construction operations in order to prevent sediment from leaving the site and damaging streams or entering sinkholes.

Silt fences should be used under the following conditions:

1. Below disturbed areas where erosion would occur in the form of sheet and rill erosion and
2. Where the size of the drainage area is no more than 1/4 acre per 100 feet of silt fence length; the maximum slope length behind the barrier is 100 feet; and the maximum gradient behind the barrier is 50 percent (2:1) and
3. In minor swales or ditch lines where the maximum contributing drainage area is no greater than 2 acres and
4. Under no circumstances should silt fences be constructed in live streams or in swales or ditch lines where flows are likely to exceed 1 cubic foot per second (cfs).

Specifications

a) General

1. Synthetic filter fabric shall be a pervious sheet of propylene, nylon, polyester or ethylene yarn and shall be certified by the manufacturer or supplier.
2. Burlap shall be 10-ounce per square yard fabric.
3. Posts for Silt Fences shall be either 2-inch diameter wood or 1.33 pounds per linear foot steel with a minimum length of 5 feet. Steel posts shall have projections for fastening wire to them. They should be installed 10 feet on center.
4. Wire fence reinforcement for silt fences using standard strength filter cloth shall be a minimum of 42 inches in height, a minimum of 14 gauge and shall have a maximum mesh spacing of 6 inches.
5. A trench shall be excavated approximately 4 inches wide and 4 inches deep along the line of stake and upslope from the barrier.

6. The filter material shall be attached to the stakes, and 8 inches of fabric shall be extended into the trench. Filter material shall not be stapled to existing trees.
7. The trench shall be backfilled and the soil compacted over the filter material.

Maintenance

1. Silt fences shall be inspected immediately after each rainfall and at least daily during prolonged rainfall. Any required repairs shall be made immediately.
2. Should the fabric on a silt fence decompose or become ineffective prior to the end of the expected usable life and the barrier is still necessary, the fabric shall be replaced promptly.
3. Sediment deposits should be removed after each storm event. They must be removed when deposits reach approximately one-half the height of the barrier.
4. Any sediment deposit remaining in place after the silt fence is no longer required shall be dressed to conform with the existing grade, prepared and seeded.

Runoff Control Measures

Diversion

Description

A diversion is a channel constructed across a slope with a supporting ridge on the lower side. The purpose of the structure is to reduce slope length and to intercept and divert stormwater runoff to stabilized outlets at non-erosive velocities.

Diversions should be used under the following conditions:

1. Where runoff from higher areas may damage property, cause erosion, or interfere with the establishment of vegetation on lower areas.
2. Where the slope length needs to be reduced to minimize soil loss.

Planning Considerations

Diversions can be useful tools for managing surface water flows and preventing soil erosion. On moderately sloping areas, they may be placed at intervals to trap and divert sheet flow before it has a chance to concentrate and cause rill and gully erosion. They may be placed at the top of cut or fill slopes to keep runoff from upland drainage areas off the slope. They can also be used to protect structures, parking lots, adjacent properties, and other special areas from flooding.

Diversions are preferable to other types of man-made stormwater conveyance systems because they more closely simulate natural flow patterns and characteristics. Flow velocities are generally kept to a minimum. When properly coordinated into the landscape design of a site, diversions can be visually pleasing as well as functional.

As with any earthen structure, it is very important to establish adequate vegetation as soon as possible after installation. It is equally important to stabilize the drainage area

above the diversion so that sediment will not enter and accumulate in the diversion channel.

A diversion channel must have a minimum capacity to carry the runoff expected from a 10-year frequency storm with a freeboard of at least 0.3 foot.

Specifications

1. All dead furrows, ditches or other depressions to be crossed shall be filled before construction begins or as part of construction, and the earthfill used to fill the depressions will be compacted using the treads of the construction equipment. All old terraces, fence rows, or other obstructions that will interfere with the successful operation of the diversion will be removed.
2. The base for the diversion ridge is to be prepared so that a good bond is obtained between the original ground and the place filled. Vegetation is to be removed and the base thoroughly disked prior to placement of fill.
3. The earth materials used to construct the earth fill portions of the diversions shall be obtained from the diversion channel or other approved source.
4. The earthfill materials used to construct diversions shall be compacted by routing the construction equipment over the fill in such a manner that the entire surface of the fill will be traversed by not less than one tread track of the equipment.
5. The completed diversion shall conform to the cross section and grade shown on the design.
6. Fertilizing, seeding, and mulching shall conform to the recommendations in the applicable vegetative standard and specification.
7. If there is no sediment protection provided on temporary diversion, it should be anticipated that periodic cleanout may be required.
8. Construction operations shall be carried out in such a manner that erosion and air and water pollution will be minimized. State and local laws concerning pollution abatement shall be followed.

Maintenance

Before final stabilization, the diversion should be inspected after every rainfall. Sediment shall be removed from the ditchline and repairs made as necessary. Seeded areas that fail to establish a vegetative cover shall be reseeded as necessary.

Waterway

Description

A waterway is a natural or constructed waterway or outlet shaped or graded and established in suitable vegetation as needed for safe disposal of runoff water. The

purpose of a waterway is to provide for the disposal of excess surface water from construction sites without causing erosion.

Supplemental measures may be required with this practice. These may include such things as (1) grade control structures, (2) subsurface drainage to permit growing suitable vegetation and to eliminate wet spots that may be a nuisance, (3) a paved channel bottom or buried storm drain to handle storm runoff, base flow or snowmelt.

The location of waterway channels is of considerable importance to a good program of erosion and sedimentation control. Wherever possible, the site manager should preserve the natural drainage system. Waterways should generally be located in natural drainageways where water can drain in from all sides. When the establishment of vegetation is required, moisture conditions and soil fertility are usually best in such areas. Waterway channels should be located so that they do not make sharp, unnatural changes in direction of flow.

All waterway channels should have stable outlets with adequate capacity for the designed flow. The outlet may be another vegetated channel, an earth ditch, a structure, or other suitable outlet. In all cases, the outlet must discharge in such a manner as not to cause erosion. Outlets should be constructed and stabilized prior to the operation of the waterway channel. Applicable drainage laws, traditional case law precedent and local ordinances and regulations must be observed in locating waterway channels and outlets.

Specifications

1. All trees, brush, stumps, and other objectionable material shall be removed and disposed of in a manner so that they will not interfere with construction or the proper functioning of the waterway or outlet.
2. The waterway or outlet shall be constructed to the dimensions specified on the design, and the cross section shall be free from bank projections or other irregularities.
3. All ditches or other depressions below the designed grade will be back filled with fill material that is free from brush, roots, sod or other perishable material, and rocks in excess of 6 inches in diameter. Backfill will be placed in approximately uniform horizontal layers of not more than 9 inches in thickness and each layer will be compacted using the treads or tracks of the construction equipment.
4. After the waterway has been constructed to proper grades and cross section with proper allowance for topsoil, the topsoil will be uniformly spread over the area to a minimum depth of 4 inches.
5. Waterways or outlets shall be protected against erosion by vegetative means as soon after construction as practical and before diversions or other channels are released into them. Consideration should be given to sodding channels to provide erosion protection immediately after construction.

Soil Stabilization Measures

The following soil stabilization techniques should be implemented if borrow pit sections are not closed as soon as excavation is complete.

Temporary seeding

Description

Temporary seeding is used to establish a temporary vegetative cover on disturbed areas by seeding with appropriate rapidly growing annual plants. The purpose of temporary seeding is to reduce erosion and sedimentation by stabilizing disturbed areas that will not be brought to final grade for a year or less and to reduce problems associated with mud and dust production from bare soil surfaces during construction.

Temporary seeding is necessary where exposed soil surfaces are not to be fine-graded for periods from 30 days to one year. Such areas include denuded areas, soil stockpiles, sides of sediment basins, temporary roadbanks, etc.

Planning Considerations

Sheet erosion, caused by the impact of rain on bare soil, is the source of most fine particles in sediment. To reduce this sediment load in runoff, the soil surface itself should be protected. The most efficient and economical means of controlling sheet and rill erosion is to establish vegetative cover. Annual plants that sprout rapidly and survive for only one growing season are suitable for establishing temporary vegetative cover.

Temporary seeding may prevent costly maintenance operations on other erosion control systems. For example, sediment basin clean-outs will be reduced if the drainage area of the basin is seeded where excavation is not taking place.

Temporary seeding is essential to preserve the integrity of earthen structures used to control sediment, such as diversions, and the banks and dams of sediment basins.

Specifications

a) General

Prior to seeding, install necessary erosion control practices such as waterways and basins.

b) Plant Selection

Select plants appropriate to the season and site conditions. The local Natural Resource Conservation Service may supply more specific information upon request.

c) Seedbed Preparation

To control erosion on bare soil surfaces, plants must be able to germinate and grow. Seedbed preparation is essential. The following must be considered prior to seeding:

Plant or Plant Mixture	Application Rate per Acre	Plant Dates
Rye	3 bushels	Aug. 15 - Nov. 1
Wheat	2-3 bushels	Sept. 1 - Nov. 1
Annual Ryegrass	30 pounds	Aug. 15 - Nov. 1
Browntop or Pearl Millet	20 pounds	Apr. 1 - July 15
Fescue	10 pounds	Mar 1- May 30
Clover/Red or White	5 pounds	28 Feb -15 Apr 15 Sep - 1 Nov
Warm Season Grasses	3-7 pounds	Apr 1 – Sep 30

1. Liming: Where soils are known to be highly acidic (pH 5.5 and lower), lime should be applied at the rate of two tons of pulverized agricultural limestone per acre, or in accordance with local extension office recommendations.

2. Fertilizer: Shall be applied as 500 pounds/acre of 6-12-12 (10 pounds/1,000 ft^2) or equivalent. Lime and fertilizer shall be incorporated into the top 2 to 4 inches of the soil.

3. Surface Roughening: If the area has been recently loosened or disturbed, no further roughening is required. When the area is compacted, crusted, or hardened, the soil surface shall be loosened by discing, raking, harrowing, or other acceptable means.

4. Tracking: Tracking with bulldozer cleats is most effective on sandy soils.

c) Seeding

Table 1. Guidelines for selecting vegetative cover

Seed shall be evenly applied with a cyclone seeder, drill, cultipacker seeder or hydroseeder. Small grains shall be planted no more than one-inch deep. Grasses and legumes shall be planted no more than 1/4-inch deep.

d) Mulching

1. Seedings made in fall for winter cover shall be mulched.
2. At other times of the year, seedings made on slopes in excess of 4:1, or on adverse soil conditions, or during excessively hot or dry weather, shall be mulched.
3. Seedings made during optimum spring and summer seeding dates, with favorable soil and site conditions, will not require mulch.

Ground Cover

Description

Ground covers are plants that naturally grow very close together, causing severe competition for space, nutrients, and water. They are used to stabilize disturbed areas by establishing vegetative cover with trees, shrubs, or vines. The purpose of ground cover is to aid in stabilizing soil in areas where vegetation other than turf is preferred and provides food and shelter for wildlife where wildlife habitat is desirable.

Ground cover should be used under the following conditions:

1. On steep or rocky slopes, where mowing is not feasible.
2. In shady areas where turf maintenance is difficult.
3. Where woody plants are desirable for soil conservation and the establishment of wildlife habitat.

Planning Considerations

1. Protect the area from excess runoff as necessary with diversions, grass waterways or sediment basins.
2. Evaluate the capabilities and limitations of the soil to be planted. Special attention should be placed on soil pH, texture, internal water movement, steepness, and stability in order to plan the appropriate treatment.
3. The species and type of plant selected should be based on soil type, planned use of the area, and the amount of maintenance that can be devoted to the area in the future.
4. Fertilizer, lime, seedbed preparation, and irrigation should be used as necessary to promote quick establishment.
5. Plantings cannot be expected to provide erosion control and prevent soil slippage on a soil that is not stable due to its structure, water movement, or excessive slope.

Specifications

a) Planting Time:

Planting should be done in early spring if possible, but no later than May 1, for bare root stock. This allows for the maximum root and top development to reduce soil erosion and allow the plant to become established before winter.

(b) Soil Preparation

1. For short slopes, small areas, and mass plantings of close spacing apply a commercial granular fertilizer, such as 6-12-12, and organic supplement, such as composted cow manure, peat, or well-rotted sawdust, and work into the soil prior to planting. Fertilize with 500 pounds per acre. The organic material needed will

depend upon the soil and plant being used. Plants such as pachysandras require a high rate of organic material, about a 2-inch layer worked into the root zone. Depending on the type and steepness of slope, the depth of soil preparation will vary from 4 to 6 inches.

2. For steep slopes and large area plantings, working up the entire planting area would be impractical and would probably induce erosion. Center hole planting, a hole dug for each plant, would be more desirable. If the soil on the slope is poorly suited to the species being planted, incorporate organic material into the slanting hole. Whether organic material is needed or not, fertilize each plant at the rate of one ounce per plant of a complete fertilizer such as 6-12-12. Mix fertilizer with soil below the roots of the plants or place a slow-release pellet or packet in bottom of planting hole.

c) Planting

1. Select the desired type and species of plants based on the suitability of the soil, the planned use, and the characteristics of the site.
2. Soil for ground covers should be well prepared. A well-drained soil high in organic matter is best. If the area to be planted is so large that adding amendments to the soil as a whole would be impractical, organic matter may be added only to each planting hole.
3. Plants such as ivy, pachysandra, and periwinkle should be planted on one-foot centers; large plants such as juniper can be spaced on three-foot centers.
4. The soil between trees and shrubs must be planted with cover vegetation or must be mulched. When establishing ground covers, it is not desirable to plant species that will make maintenance difficult. A thick durable mulch such as shredded bark or wood chips is recommended to prevent erosion and reduce weed problems. Pre-emergent herbicides may be necessary where weeding is not practical.
5. On slopes where erosion may be a problem, jute net or excelsior blankets may be installed prior to planting, and plants tucked into the soil through slits in the net. Such plants should be put in a staggered pattern to minimize erosion.

d) Establishment

1. Some watering, weeding, remulching, and fertilizing may be required of a new planting during the period of establishment. Soil movement is not recommended. This could cause soil erosion and/or root injury. Competing weeds should be controlled.
2. If a controlled-release fertilizer was used at the time of planting, additional fertilizing will not be necessary for several years. Otherwise, fertilize plantings in the spring of the second growing season and thereafter as needed, using 2 to 3 pounds per 100 square feet of a granulated commercial fertilizer such as 6-12-12.

3. Trim old growth as needed to improve the appearance of ground covers. Most covers need once-a-year trimming to promote growth. Maintain mulch cover with additions of mulch where needed.

Riprap

Description

Riprap is a permanent, erosion-resistant ground cover of large, loose, angular stone (see Figures 3 and 4).

The purpose of riprap is:

1. To protect the soil surface from the erosive forces of concentrated runoff.
2. To slow the velocity of concentrated runoff while enhancing the potential for infiltration.
3. To stabilize slopes with seepage problems and/or non-cohesive soils.
4. Riprap shall have geotextile fabric under the stone.

Riprap may be used, as appropriate, at stormdrain outlets, on channel banks and/or bottoms, roadside ditches, drop structures, at the toe of slopes, etc.

Planning Considerations

Riprap is classified as either graded or uniform. A sample of graded riprap would contain a mixture of stones that vary in size from small to large. A sample of uniform riprap would contain stones that are all fairly close in size. For most applications, graded riprap is preferred to uniform riprap. Graded riprap forms a flexible self-healing cover, while uniform riprap is more rigid and cannot withstand movement of the stones. Graded riprap is cheaper to install, requiring only that the stones be dumped so that they remain in a well-graded mass. Hand or mechanical placement of individual stones is limited to that necessary to achieve the proper thickness and line.

Uniform riprap requires placement in a more or less uniform pattern, requiring more hand or mechanical labor. Riprap sizes can be designated by either the diameter or the weight of the stones. It is often misleading to think of riprap in terms of diameter, since the stones should be rectangular instead of spherical. However, it is simpler to specify the diameter of an equivalent size of spherical stone. Table 2 list some typical stones by weight, spherical diameter and the corresponding rectangular dimensions. These stone sizes are based upon an assumed specific weight of 165 pounds/ft^3.

Since graded riprap consists of a variety of stone sizes, a method is needed to specify the size range of the mixture of stone. This is done by specifying a diameter of stone in the mixture for which some percentage, by weight, will be smaller. For example, d_{85} refers to a mixture of stones in which 85 percent of the stone by weight would be smaller than the diameter specified. Most designs are based on d_{50}. In other words, the design is based on the median size of stone in the mixture.

Table 2. Size of riprap stones

Weight (pounds)	Diameter (feet)	Length (feet)	Width, Height (feet)
50	0.8	1.4	0.5
100	1.1	1.75	0.6
150	1.3	2.0	0.67
300	1.6	2.6	0.9
500	1.9	3.0	1.0
1000	2.2	3.7	1.25

Since riprap is used where erosion potential is high, construction must be sequenced so that the riprap is put in place with the minimum possible delay. Disturbance of areas where riprap is to be placed should be undertaken only when final preparation and placement of the riprap can follow immediately behind the initial disturbance. Where riprap is used for outlet protection, the riprap should be placed before or in conjunction with the construction of the pipe or channel so that it is in place when the pipe or channel begins to operate.

Specifications

1. The riprap shall be composed of a well-graded mixture down to the one-inch size particle such that 50 percent of the mixture by weight shall be larger than the d_{50} size as determined from the design procedure. A well-graded mixture as used herein is defined as a mixture composed primarily of the larger stone size with a sufficient mixture of other sizes to fill the progressively smaller voids between the stones. The diameter of the largest stone size in such a mixture shall be 1.5 times the d_{50} size.
2. The site manager, after determining the riprap size that will be stable under the flow conditions shall consider that size to be a minimum size and then, based on riprap gradations actually available in the area, selects the size or sizes that equal or exceed the minimum size.
3. The minimum thickness of the riprap layer shall be 1.5 times the maximum stone diameter but not less than 6 inches.
4. Stone for riprap shall consist of clean or washed field stone or rough unhewn quarry stone of approximately rectangular shape. The stone shall be hard and angular and of such quality that it will not disintegrate on exposure to water or weathering. The specific gravity of the individual stones shall be at least 2.5.
5. Riprap for channel stabilization shall be designed to be stable for the condition of bank-full flow in the reach of channel being stabilized. Riprap shall extend up the

banks of the channel to a height equal to the maximum depth of flow or to a point where vegetation can be established to adequately protect the channel.

Maintenance

Once a riprap installation has been completed, it should require very little maintenance. It should, however, be inspected periodically to determine if high flows have caused scour beneath the riprap or dislodged any of the stone. If repairs are needed, they should be accomplished immediately.

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CHAPTER 4I–RECLAMATION

Upon completion of borrow activities, the site should be brought to the desired final grade and stockpiled topsoil should be applied. Final contours should resemble original contours as closely as possible with slopes not to exceed 2:1. Measures should be taken to provide permanent ground cover through seeding or sprigging. Temporary erosion controls should be removed after establishment of permanent ground cover.

Topsoil Application

After the application of the topsoil to such a depth as needed, the area shall be harrowed and disked entirely through the layer of topsoil and into the subsoil to a depth of at least 2 inches in order to secure proper bond of the topsoil with the subsoil. At this stage all large lumps, large rocks, roots, or other objectionable matter shall be gathered up and disposed. On such areas where the application of topsoil involves primarily the backfilling of rills or small washes, ground preparation may be delayed until just before the application of fertilizer and grassing operations.

Permanent Seeding

Description

Permanent seeding is the establishment of permanent vegetation on disturbed areas by planting seed. The purpose of permanent seeding is to reduce erosion and decrease sediment yield from disturbed areas and stabilize disturbed areas in a manner that is economical, adaptable to site conditions, and allows selection of the most appropriate plant materials.

Permanent seeding should be applied to disturbed areas where permanent, long-lived vegetative cover is needed to stabilize the soil and rough graded areas that will not be brought to final grade for several months or more.

Planning Considerations

1. Protect the area from excess runoff as necessary with diversions, waterways, or sediment basins.
2. Evaluate the capabilities and limitations of the soil to be seeded. Special attention needs to be given to soil pH, texture, internal water movement, steepness, and stability in order to plan the appropriate treatment.
3. Plant species should be selected on the basis of timing of establishment, planned use of the area, and the amount or degree of maintenance that can be devoted to the area in the future.
4. Fertilizer, lime, seedbed preparation, seed coverage, mulch, and irrigation should be used as necessary to promote quick plant growth.

Specifications

a) Site Preparation

1. Soil materials should be capable of supporting permanent vegetation and have at least 25 percent silt and clay to provide an adequate amount of moisture holding capacity. An excessive amount of porous sand will not consistently provide sufficient moisture for good growth regardless of other soil factors.
2. Where compacted soils occur, they should be broken up sufficiently to create a favorable rooting depth of 6-8 inches.
3. Stockpile topsoil to apply to sites that are otherwise unsuited for establishing vegetation.
4. Grade as needed and feasible to permit the use of conventional equipment for seedbed preparation, seeding, mulch application and anchoring, and maintenance. After the grading operation, spread topsoil where needed.
5. Install the needed erosion control practices such as diversions, waterways, and sediment basins.

b) Seedbed Preparation

The seedbed is prepared using the same guidelines detailed in Chapter 3, C (Soil Stabilization Measures).

c) Seed Application

After seedbed preparation, seed may be applied by drilling, broadcasting or hand application. All broadcast seed shall have straw mulch placed over the area to promote

water retention, soil stabilization and seed germination. All seeding on slopes will be covered with straw mulch and crimped in use dozer track or disk harrow running cross slope. This will provide adequate stabilization to the slopes until seed germination can occur.

Maintenance

Maintenance is a vital factor in maintaining an adequate vegetative erosion control cover.

- Irrigation - If soil moisture is deficient, supply new seedings with adequate water for plant growth until they are firmly established. This is especially true when seedings are made late in the planting season, in abnormally dry and hot season, or on adverse sites.
- Repairs - Inspect all seeded areas for failures and make necessary repairs, replacements, reseedings, and remulching within the planting season.

    1. If stand is inadequate, (less than 85 percent groundcover) overseed, fertilize, using half of rates originally applied, and mulch.

    2. If stand is more than 60 percent damaged, reestablish following original seedbed preparation methods, seeding and mulching recommendations and apply lime and fertilizer as needed according to a soil test.

Table 3. Guidelines for selecting permanent seeding

Permanent Plant Mixtures	Application Rate Per Acre	Plant Dates
Tall Fescue White Clover	45 Pounds 3 Pounds	Feb. 15 - Apr. 15 Sep. 15 - Oct. 15
Crownvetch Tall Fescue	20 Pounds 30 Pounds	Feb. 15 - Apr. 15 Aug. 15 - Oct. 15
Korean or Kobe Lespedeza	8 Pounds	Mar. 1 - May 15 Aug 15 – Oct 15
Warm Season Grasses	3 – 7 pounds	May 1 – Sep 30

Hydroseeding

Description

Hydroseeding is the application of seed, fertilizer, necessary organic soil amendments, fiberous mulch, and a tachifier. The products are applied as a single, uniformly applied, sprayed slurry under pressure over the entire area.

Specifications

a) Seed Classification.

State approved seed of the latest season's crop shall be provided in original sealed packages bearing the producer's guaranteed analysis for percentages of mixture, purity, germination, hard seed, weed seed content, and inert material. Labels shall be in conformance with AMS-01 and applicable state seed laws.

b) Seed Mixtures.

Seed will be applied at a rate of 45 lbs per acre and shall be proportioned by weight as follows:

Name	Mixture Percent by Weight
Korean Lespedeza	10%
White Clover	8%
KY31 Fescue, Fungus Free	82%

c) Fertilizer.

Fertilizer shall be commercial grade, free flowing, uniform in composition and conforming to CID A-A-1909. Granular Fertilizer shall be applied at a rate of 500 lbs per acre with a guaranteed analysis of 6-12-12.

d) Wood Cellulose Fiber Mulch.

Wood cellulose fiber shall not contain any growth or germination-inhibiting factors and shall be dyed an appropriate color to facilitate visual metering during application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 4.5 to 6.0.

e) Tachifier.

A biodegradable tachifier shall be applied at a rate of 100 lbs per acre.

f) Seeding Time.

The hydroseeding operation should be conducted from 15 February to 1 May to obtain the best results.

G) Tillage.

Soil on slopes gentler than 3-horizontal-to-1-vertical shall be tilled to a minimum depth of four inches. On slopes between 3-horizontal-to-1-vertical and 1-horizontal-to-1 vertical, the soil shall be tilled to a minimum depth of 2 inches by scarifying with heavy rakes, or other method. Rototillers shall be used where soil conditions and length of slope permit. On slopes 1-horizontal-to-1 vertical and steeper, no tillage is required.

h) Final Grade Preparation.

Turf areas shall be filled as needed or have surplus soil removed to attain the finished grade. Drainage patterns shall be maintained as indicated on drawings. Turf areas compacted by construction operations shall be completely pulverized by tillage. Soil

used for repair of erosion or grade deficiencies shall conform to topsoil requirements specified by the grading requirements. Finished grade shall be 1 inch below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas.

i) Satisfactory Stand of Turf.

A satisfactory stand of turf from the seeding operation is defined as a minimum of 10 grass plants per square foot. The total bare spots shall not exceed 2 percent of the total seeded area**.**

Maintenance During Establishment Period

Maintenance of the turfed areas shall include eradicating weeds, eradicating insects and diseases, protecting embankments and ditches from erosion, maintaining erosion control materials and mulch, protecting turfed areas from traffic, mowing, watering, and post-fertilization.

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REFERENCES

Kentucky Division of Conservation and Division of Water. August 1994. Kentucky Best Management Practices for Construction Activities. Kentucky Division of Conservation and Division of Water.

Tennessee Department of Environment and Conservation. July 1992. Tennessee Erosion & Sediment Control Handbook: A Guide for Protection of State Waters through Effective Management Practices during Construction Activities. Tennessee Department of Environment and Conservation.

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IMSE-CAM-DPW-E-R

Contract#_____

Contractor:_____

Vehicle Tag #_____

Material: Excavation
Disposition

Material Type: Topsoil
Fill

Dates of Excavation:_____

Quantity to be moved:_____

Authorized by Joseph D. Whitfill
Date: _____
Signature_____

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Appendix J
Energy Conservation Requirements

3.1 Introduction

3.1.1 The Building Design Standards encompass the function and character of the buildings as well as the arrangement of buildings to one another and to their environment. Use architectural style, materials, and colors indigenous to the region. Preserve the historically and culturally significant structures to add to an installations character and provide a sense of heritage. Incorporate energy conservation and sustainability in all structures[1].

3.4 Building Design Standards

3.4.3 Energy Conservation Standards follow:

3.4.3.1 Design buildings to be at least 30% better than current private sector standards (ASHRAE 90.1-2004 per the requirements of the Energy Policy Act (EPACT) 2005). See 10 CFR Parts 433, 435, and 436 for guidance. Energy conservation mandated by EPACT is directly related to the achievement of LEED®-NC EA Credit 1, Optimize Energy Performance points.

3.4.3.2 Use sustainable design principles for siting, orientation design, and construction. Follow the requirements of EO 13423.

3.4.3.3 Plan to meter all energy service to buildings. Plan to analyze building energy use.

3.5 Structural Character standards

3.5.5.1 Colors to match the standards will be implemented during normally scheduled paint cycles (See Appendix L, Exterior Color Charts.) (Fig. 1-3.4).

- Relate buildings with compatible material and similar colors.
- Select colors for material from the Army Standards Color Palette based on the desired function, appearance, attractiveness of the building, and its compatibility with adjacent building colors.
- Limit exterior building colors to the Army Standard Color Palette. This provides each area a coordinated palette of similar colors that are subdued and harmonious. Avoid the misuse of strong, loud colors.

Color, especially roof color, has an impact on energy usage. Reflective “cool roofs” which reduce the building cooling load, are available in many colors besides white. For more information on “cool roofs” see Chapter 3 Energy Appendix 3.4

[1] In sections 3.1 through 3.15 highlighted text indicates proposed changes. Section 3.18 is new.

3.5.7.5. Use Energy Star roofing materials (see Chapter 3 Energy Appendix 3.4). Use "Cool roof" materials for climate zones 1-5.

3.5.8 **Fenestration.** Building fenestration includes features such as doors, windows, shading devices, and building decoration details. These features should be similar in arrangement, design, size, and proportion for architectural compatibility and visual consistency and continuity. ASHRAE Standard 90.1-2007 sets absolute minimum requirements for fenestration, however, most Army buildings shall have even more stringent requirements if they are to meet the 30% energy reduction requirement (see Section 3-18.6).

3.5.10 Awnings and Canopies. Awnings and canopies are authorized to protect entrances, interior surfaces, and personnel from the effects of weather. Refer to AR 420-70. While awning and canopies provide shading for energy efficiency as well, awnings and canopies are not credited towards 30% energy savings in the Federal standards because they are not permanent. Permanent shading devices such as overhangs can count towards the necessary savings.

3.14.6.1 Artificial lighting and natural daylight will be incorporated into designs taking into consideration the work activities involved. When possible use lower level of general lighting, supplemented by task lighting and use architectural lighting in entrances, corridors, waiting rooms, and other spaces to light artwork and provide interest. All lighting should be occupancy sensored and daylighting controlled including task lighting. LEED credits related to lighting include those concerned with energy efficiency, controllability of systems, and the Light Pollution Reduction Credit. Lights should be located and controlled in a way that does not cause light pollution to emanate from the building.

3.14.6.2 Army installation buildings shall provide a high quality, energy efficient lighting environment. The lighting equipment/systems selected must satisfy both performance and aesthetics (Fig 1-3.8). Factors for consideration in this selection will be based on the following characteristics: glare, lumens per watt, color temperature, color rendering index, life and lumen maintenance, availability, switching, dimming capability, lighting power density, cost, and natural day lighting.

3.15 MECHANICAL SYSTEMS

3.15.1 This section shall consist of Plumbing and HVAC systems. For energy conservation criteria, see Chapter 3 Energy Appendices 4-15. Additional standards are being developed.

3.15.2. The absolute minimum requirements for service water heating and HVAC systems are found in Sections 7.4 and 6.4 of ASHRAE Standard 90.1-2007.

3.18 ENERGY CONSERVATION

3.18.1 All new Army facilities and all major renovations of existing Army facilities shall comply with the requirement of EPACT 2005 to reduce energy consumption by 30% compared to a facility designed in accordance with ASHRAE 90.1-2004. Building modifications should be classified as a major renovation if the cost of renovation project exceeds 25% of the building value with the project including all or some of the following elements: alteration of overall features of the building's envelope, substantial replacement of the building's lighting, plumbing, electrical, and heating, ventilating, and air conditioning (HVAC) systems in combination with other significant alterations of the building's spaces. Other modifications to a building may be categorized as a major renovation depending on the overall magnitude and scope of the work to be accomplished. Buildings classified as major renovation projects will comply with all energy and water conservation requirements (EO 13423), and all methods and standards applicable to new construction. All building components and systems being renovated or replaced must comply with their respective energy and water conservation criteria. Major upgrades to "new building" energy and water conservation levels should be planned for funding as early as possible on DD Form 1391. Funding requirements to implement energy and water conservation measures will be an integral part of the concept design.

3.18.2. The target energy consumption budget (excluding plug and process loads) developed in compliance with the requirements of EPACT 2005 for selected tier 1 Army facilities and different DOE Climate Zones in kBtu per ft^2 per year not to be exceeded are listed in the *Chapter 3 Energy Conservation Appendix 1.2*. The use of the Prescriptive Technology Solution Set, listed in the Energy Appendix, will result in an annual energy consumption less than or equal to the target energy budget figure, meets life cycle cost effectiveness requirements and does not require calculations according to the ASHRAE Standard 90.1 Appendix G. When Prescriptive Technology Solution Sets are used, mandatory requirements of the ASHRAE Standard 90.1-2007 shall also be met. For the building types addressed in the *Chapter 3 Energy Conservation Appendices 14-17*, requirements of the EPACT 2005 can be also met using designer developed specific .technology sets. In this case to prove that target energy consumption budgets are met, calculations prescribed in the ASHRAE Standard 90.1 Appendix G shall be performed and life cycle cost effectiveness analysis be provided.

3.18.3. Energy efficient and sustainable building design shall be a collaborative and coordinated effort of architects, electrical, mechanical and structural engineers. It can not be achieved through analysis and optimization of the individual components and subsystems. A holistic "whole building" design approach shall collaboratively integrate different building elements and systems to optimize the overall project sustainability, water and energy efficiency. Creative design of the building floor plan and configuration, envelope, orientation and fenestration can minimize energy needed to ventilate, condition and light the facility. Integration of the mechanical systems design must be coordinated with the designs of other involved building systems and features including the building envelope, lighting system, and occupant activities. Understanding how one

system (or individual components within a given system) affects another is essential to making the most of the available opportunities for energy savings.

3.18.4. A building's cooling and heating needs are affected by the performance of interrelated building systems and characteristics, including building envelope characteristics; passive solar design elements, such as daylighting, lighting systems, plug-in and other internal loads. The appropriate HVAC design solution shall be determined only after the requirements and contributing thermal loads of these interrelated systems have been thoroughly reviewed and all possible efficiency gains through sustainable design strategies have been carefully considered.

3.18.5 In all new Army facilities and all major renovations only Energy Star or FEMP designated products shall be used. The term "Energy Star product" means a product that is rated for energy efficiency under an Energy Star program. The term "FEMP designated product" means a product that is designated under the Federal Energy Management Program of the Department of Energy as being among the highest 25 percent of equivalent products for energy efficiency. When selecting integral sized electric motors, choose NEMA PREMIUM type motors that conform to NEMA MG 1, minimum Class F insulation system. Motors with efficiencies lower than the NEMA PREMIUM standard may only be used in unique applications that require a high constant torque speed ratio (e.g., inverter duty or vector duty type motors that conform to NEMA MG 1, Part 30 or Part 31).

3.18.6. Building envelope insulation is critical in reducing heating and cooling loads throughout the year round performance. Levels of the building envelop insulation for new construction and major renovation shall meet requirements listed in The *Chapter 3 Energy Conservation Appendix 3.1*

3.18.7. Windows are a critical design component of an energy efficient and sustainable building envelope. They affect the building's thermal performance as well as provide natural daylight to enter the structure. Windows for new Army facilities and major renovations shall meet requirements specified in the *Chapter 3 Energy Conservation Appendix 3.2*

3.18.8. Building envelopes for new office buildings, office portions of mixed office and open space (e.g., company operations facilities), dining, barracks and instructional/training facilities and undergoing major renovations shall be designed and constructed with a continuous air barrier to control air leakage into, or out of, the conditioned space. Mandatory requirements for the continuous air barrier design and construction are provided in *Chapter 3 Energy Conservation Appendix 3.5*

Performance of the continuous air barrier for the opaque building envelope shall be demonstrated by the following tests:

(a) Test the completed building and demonstrate that the air leakage rate of the building envelope does not exceed 0.25cfm/ft2 at a pressure differential of 0.3" w.g. (75 Pa) in accordance with ASTM's E 779 (2003) or E-1827-96 (2002). Accomplish tests using

either pressurization or depressurization or both. Divide the volume of air leakage in CFM @ 0.3" w.g. (L/s @ 75 Pa) by the area of the pressure boundary of the building, including roof or ceiling, walls and floor to produce the air leakage rate in cfm/ft2 @ 0.3" w.g. (L/s.m2 @ 75 Pa). Do not test the building until verifying that the continuous air barrier is in place and installed without failures in accordance with installation instructions so that repairs to the continuous air barrier, if needed to comply with the required air leakage rate, can be done in a timely manner.

(b) Test the completed building using Infrared Thermography testing. Use infrared cameras with a resolution of 0.1deg C or better. Perform testing on the building envelope in accordance with ISO 6781:1983 and ASTM C1060-90(1997). Determine air leakage pathways using ASTM E 1186-03 Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems, and perform corrective work as necessary to achieve the whole building air leakage rate specified in (a) above. (c) Notify the Government at least three working days prior to the tests to provide the Government the opportunity to witness the tests. Provide the Government written test results confirming the results of all tests.

3.18.9. Lighting systems in new, retrofitted or acquired buildings shall have the correct light level for the tasks being performed (*Chapter 3 Energy Conservation Appendix 2.3*) and be equipped with Energy Star or FEMP designated lighting technologies.

3.18.10 Energy conservation and sustainability criteria for new and renovated Army facilities are shown in the *Chapter 3 Energy Conservation Appendix 1.3*.

3.18. 11 New buildings and buildings undergoing major renovations shall be designed so that the fossil fuel-generated energy consumption of the buildings is reduced, as compared with such energy consumption by a similar building in fiscal year 2003 (as measured by Commercial Buildings Energy Consumption Survey or Residential Energy Consumption Survey data from the Energy Information Agency), by the percentage specified in the following table [EISA2007]:

Fiscal Year	Percentage Reduction
2010	55
2015	65
2020	80
2025	90
2030	100

Unless it is demonstrated to be not LCC effective, reduce energy consumption beyond the requirement of EPACT 2005 (Section 1.18.1) and use renewable energy to the extend specified in the above table.

3.18.12. Not less than 30 percent of the hot water demand for each new Federal building or Federal building undergoing a major renovation will be met through the installation and use of solar hot water heaters [IESA 2007] unless demonstrated to not be lifecycle cost-effective. The amount that is cost effective will be installed.

Energy Conservation Appendices

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    - 1.2. Baseline and target energy budgets to meet EPACT 2005 requirements to new construction
    - 1.3 LEED "Energy and Atmosphere" and "Indoor Environmental Quality" Credits
- Appendix 2. Requirements for Thermal Comfort, Ventilation rates, and Lighting
    - 2.1. Thermal Requirements
    - 2.2. Ventilation rates
    - 2.3. Lighting intensity
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    - 3.2. Windows and Skylights
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    - 3.6 Building and Window Orientation (TBD/FA[2])

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    - 4.2. Duct sealing technology
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- Appendix 13. Energy Metering (to be developed)

[2] To be developed given additional funds available

- Appendix 14. Prescriptive set and optional energy saving technologies for barracks
- Appendix 15. Prescriptive set and optional energy saving technologies for administrative facilities (to be completed)
- Appendix 16. Prescriptive set and optional energy saving technologies for Tactical Equipment Maintenance Facilities (TEMF)
- Appendix 17. Prescriptive set and optional energy saving technologies for dining facilities (to be completed)

Appendix 1: Energy Policies

1.1. Current Polices and Directives on Energy Conservation

New and existing Federal buildings will be more energy efficient. There are many policies, regulations, executive orders, and legislative mandates driving both energy conservation and green buildings to make it feasible to ignore energy conservation.

The three most significant drivers of energy efficiency in the DOD and other Federal buildings are (listed chronologically):

- The Energy Policy Act of 2005
- *Army Energy Strategy for Installations* of 2005
- Executive Order 13423
- The Energy Independence and Security Act of 2007

1.1.1. The Energy Policy Act of 2005 has 11 sections in Title 1 – Energy Efficiency, Subtitle A – Federal Programs that impact Federal agencies. See http://thomas.loc.gov/cgi-bin/bdquery/z?d109:h.r.00006: for complete text. From a building manager standpoint, the important requirements are:

- Percentage reduction in buildings energy use (Section 102)
- Energy use measurement (Section 103)
- Procurement of energy efficient products (Section 104)
- Use of energy saving performance contracts (Section 105)
- Voluntary reductions in industrial energy intensity (Section 106)
- Increased use of recovered mineral component in projects involving cement or concrete (Section 108)
- New Federal building energy efficiency and sustainability standards (Section 109)

1.1.2. Executive Order 13423 – Strengthening Federal Environmental, Energy, and Transportation Management – provides a number of goals for agencies in Section 2. See http://www.whitehouse.gov/news/releases/2007/01/20070124-2.html for complete text. Many of these goals are relevant to building managers, including:

- Improve energy efficiency and reduce greenhouse gas emissions
- Increase renewable energy use
- Reduce water consumption intensity
- Use of sustainable environmental practices
- Reduction of hazardous and toxic chemical disposal
- Use of the Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings set forth in the Federal Leadership in High Performance and Sustainable Building Memorandum of Understanding

1.1.3. The Energy Independence and Security Act of 2007 has 9 sections that impact Federal agencies in Title 1 - Energy Savings in Buildings and Industry, Subtitle C – High Performance Federal Buildings. See http://thomas.loc.gov/cgi-

bin/bdquery/z?d110:h.r.00006: for complete text. From a building manager standpoint, the important requirements are:

- Increased percentage reduction in buildings energy use (Section 431)
- Energy and water evaluations every four years (Section 432)
- Identification of commissioning and retro-commissioning opportunities (Section 432)
- Use of an energy benchmarking system (Section 432)
- Fossil fuel reduction targets for selected buildings (Section 433)
- Requirement that capital energy investments that are not major renovations be life cycle cost-effective (Section 434)
- Requirement for Energy Star label on leased buildings (Section 435)
- Audits of Federal green building performance (Section 437)
- Specific requirement for storm water runoff on facilities more than 5000 square feet in footprint (Section 438)
- Increase in public building lifetime from 25 to 40 years (Section 441)

1.1.4. Army Energy Strategy for Installations. The Strategy sets the general direction for the Army in five major initiatives (http://army-energy.hqda.pentagon.mil/programs/plan.asp) :

1. Eliminate energy waste in existing facilities
   Eliminate and reduce energy inefficiencies that waste natural and financial resources, and do so in a manner that does not adversely impact comfort and quality of the facilities in which Soldiers, families, civilians and contractors work and live.
2. Increase energy efficiency in new construction and renovations
   Increase the use of energy technologies that provide the greatest cost-effectiveness, energy efficiency and support environmental considerations.
3. Reduce dependence on fossil fuels
   Increase the use of clean, renewable energy to reduce dependency on fossil fuels and to optimize environmental benefits and sustainability.
4. Conserve water resources
   Reduce water use to conserve water resources for drinking and domestic purposes.
5. Improve energy security
   Provide for the security and reliability of energy and water systems in order to provide dependable utility services.

The Strategy sets forth the Army's energy goals for 25 years and the Campaign Plan defines the intermediate actions, approaches, initiatives, and funding over the 25 years to ensure the Army successfully achieves long-range energy and water management goals. The Army Energy and Water Campaign Plan for Installations was implemented in late 2005 and used in the FY 2008-2013 POM development process. This version is the current update to support the FY 2010-2015 POM development. The Army Energy and

Water Campaign Plan will be reviewed for updates every two calendar years during odd years.

The bottom line from all these documents is that the Army and other Federal buildings will be built to be more efficient and more sustainable, that these buildings' energy usage will decrease, and that design engineers, contractors and building managers are expected to play an active role in reducing energy and water usage.

1.2. Baseline and target energy budgets to meet EPACT 2005 requirements to new construction

The 2005 Energy Policy Act requires that Federal facilities be built to achieve at least a 30 percent energy savings over the 2004 International Energy Code or ASHRAE Standard 90.1-2004 as appropriate, and that energy efficient designs must be life cycle cost effective. A team comprised of researchers and engineers of Engineer Research and Development Center, Construction Engineering Research Laboratory (ERDC-CERL), Department of Energy National Renewable Energy Laboratory, USACE Centers of Standardization and the Military Technology Group of the American Society of Heating Refrigeration and Air-Conditioning Engineers has developed design guides to achieve 30 percent energy savings over a baseline built to the minimum requirements of ANSI/ASHRAE/IESNA Standard 90.1-2004 for new buildings to be constructed under Military Transformation Program.

Phase 1 of this project addresses four building types: basic training barracks, unaccompanied enlisted personal housing (UEPH) barracks, battalion headquarters (BHQ), and tactical equipment maintenance facilities (TEMF). Phase 2 of this project is studying dining facilities (DFAC), child development centers (CDC), company operations facilities (COF) and reserve centers. To develop a baseline for target energy budgets which reflect the requirements of the EPACT 2005, typical buildings representing each category of the tier 1 facilities were selected and requirements of the ASHRAE Standard 90.1 2004 to the building envelope and energy consuming systems were defined. Based on this information a computer analysis was performed using EnergyPlus version 2 (DOE 2007) which resulted in baseline and target energy budgets for all DOE 15 climate zones (Figure 1-1) for each facility type. These results are summarized in Table 1-1.

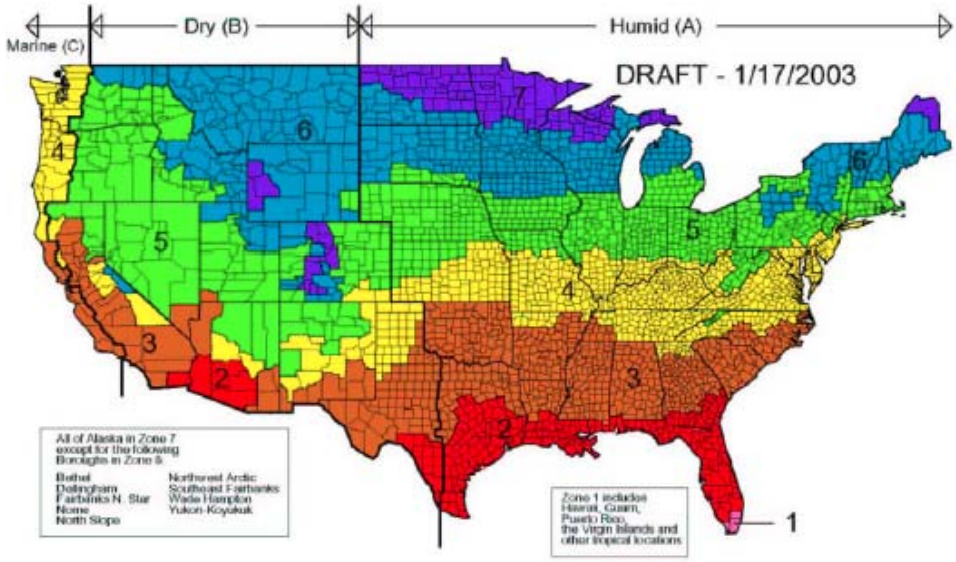


Figure 1-1. DOE Climate zones

Table 1-1. Baseline and target energy budgets (not including plug/process loads)

UEPH Climate zone	90.1 Baseline Annual Energy Budget (w/o process loads) (KBTU/sq ft-yr)	30% Better Target Energy Budget (w/o process loads) (KBTU/sq ft-yr)	Annual Process Loads (KBTU/sq ft-yr)
Miami, 1A	82	58	20
Houston, 2A	82	57	20
Phoenix, 2B	45	32	20
Memphis, 3A	71	50	20
El Paso, 3B	42	30	20
San Francisco, 3C	47	33	20
Baltimore, 4A	75	52	20
Albuquerque, 4B	48	34	20
Seattle, 4C	60	42	20
Chicago, 5A	77	54	20
Colo. Springs, 5B	54	38	20
Burlington, 6A	83	58	20
Helena, 6B	68	47	20
Duluth, 7A	91	64	20
Fairbanks, 8A	123	86	20

Training Barracks Climate zone	90.1 Baseline Annual Energy Budget (w/o process loads) (KBTU/sq ft-yr)	30% Better Target Energy Budget (w/o process loads) (KBTU/sq ft-yr)	Annual Process Loads (KBTU/sq ft-yr)
Miami, 1A	120	84	3
Houston, 2A	119	83	3
Phoenix, 2B	69	48	3
Memphis, 3A	122	85	3
El Paso, 3B	76	53	3
San Francisco, 3C	96	67	3
Baltimore, 4A	135	95	3
Albuquerque, 4B	93	65	3
Seattle, 4C	117	82	3
Chicago, 5A	146	102	3
Colo. Springs, 5B	111	78	3
Burlington, 6A	159	111	3
Helena, 6B	133	93	3
Duluth, 7A	176	123	3
Fairbanks, 8A	225	158	3

BHQ Climate zone	90.1 Baseline Annual Energy Budget (w/o process loads) (KBTU/sq ft-yr)	30% Better Target Energy Budget (w/o process loads) (KBTU/sq ft-yr)	Annual Process Loads (KBTU/sq ft-yr)
Miami, 1A	31	22	10
Houston, 2A	30	21	10
Phoenix, 2B	31	22	10
Memphis, 3A	33	23	10
El Paso, 3B	28	20	10
San Francisco, 3C	25	18	10
Baltimore, 4A	37	26	10
Albuquerque, 4B	31	22	10
Seattle, 4C	32	22	10
Chicago, 5A	44	31	10
Colo. Springs, 5B	37	26	10
Burlington, 6A	51	36	10
Helena, 6B	47	33	10
Duluth, 7A	60	42	10
Fairbanks, 8A	92	65	10

TEMF Climate zone	90.1 Baseline Annual Energy Budget (w/o process loads) (KBTU/sq ft-yr)	30% Better Target Energy Budget (w/o process loads) (KBTU/sq ft-yr)	Annual Process Loads (KBTU/sq ft-yr)
Miami, 1A	36	25	7
Houston, 2A	45	32	7
Phoenix, 2B	42	29	7
Memphis, 3A	56	39	7
El Paso, 3B	47	33	7
San Francisco, 3C	43	30	7
Baltimore, 4A	75	52	7
Albuquerque, 4B	61	43	7
Seattle, 4C	64	45	7
Chicago, 5A	93	65	7
Colo. Springs, 5B	80	56	7
Burlington, 6A	108	75	7
Helena, 6B	99	69	7
Duluth, 7A	134	94	7
Fairbanks, 8A	207	145	7

DFAC - draft Climate zone	90.1 Baseline Annual Energy Budget (w/o process loads) (KBTU/sq ft-yr)	30% Better Target Energy Budget (w/o process loads) (KBTU/sq ft-yr)	Annual Process Loads (KBTU/sq ft-yr)
Miami, 1A	242	170	113
Houston, 2A	250	175	112
Phoenix, 2B	236	165	112
Memphis, 3A	263	184	112
El Paso, 3B	243	170	112
San Francisco, 3C	220	154	111
Baltimore, 4A	291	204	111
Albuquerque, 4B	257	180	111
Seattle, 4C	261	182	111
Chicago, 5A	322	225	111
Colo. Springs, 5B	282	198	111
Burlington, 6A	353	247	111
Helena, 6B	324	227	111
Duluth, 7A	397	278	111
Fairbanks, 8A	519	364	111

Results for CDC, COF, and Reserve Centers will be included in Table 1-1 when complete.

The study also recommended a set of energy efficient solutions for each type of facilities and climate zone (see Appendices 14-17) that enable the 30 percent energy savings, and create more productive environments that provide better thermal conditions and indoor air quality to soldiers and workers.

1.3 LEED Energy Credits

1.3.1 U. S. Green Building Council Leadership in Energy and Environmental Design – New Construction (LEED®-NC). All vertical construction projects with climate control, beginning with the FY08 military construction program (except family housing), are required to be certifiable at a minimum of the Silver level of the LEED®**-NC**.

1.3.2 LEED certification and EPACT compliance. For new Army facilities that will be self-certified in LEED, all applicable results from the EPACT 2005 30% better study discussed above may be used to determine applicable LEED credits without the need for further energy analyses.

Achieving the EPACT 2005 mandated 30% improvement in energy consumption compared to a minimum ASHRAE 90.1-2004 facility will directly facilitate achievement of maximum credit for LEED credits EA1 "Optimize Energy Performance" which has 10 possible points. EPACT 2005 requires a 30% reduction in energy consumption <u>not including</u> plug or process loads. LEED EA1 requires percentage reductions in energy cost savings <u>including</u> plug and process loads. For self-certified Army projects, the LEED evaluation team may substitute site energy consumption, as determined in the EPACT 2005 30% Better energy analyses, for energy cost savings but must consider the plug and process loads in the calculations. Army buildings generally have small process loads. For all those buildings, a 30% savings in accordance with EPACT 2005 rules will equate to better than a 28% savings according to LEED NC rules which equates to a minimum of 6 LEED points for EA1.

The prescriptive solutions discussed in Appendices 14-17 generally result in savings significantly greater than 30%. Many of these cases result in the maximum of 10 LEED EA1 points. These prescriptive solutions also contribute to LEED points for credits EQ6.2 and EQ7.1.

Appendix 2: Requirements for Thermal Comfort, Ventilation rates, and Lighting levels

The simplest, most cost-effective, and easiest way to save energy in a building is to turn off all the lights, all the heating and cooling systems, and unplug all the appliance and equipment. This building would use no energy whatsoever, but it would be uncomfortably cold and hot, inadequately ventilated, dimly lit by whatever light comes in the windows, and a very unpleasant place to work. Freezing in the dark is not the object of energy conservation.

The object of energy conservation is to use the minimal amount of energy necessary to perform the required work in a building in a safe and efficient manner. The amount of energy a building uses depends upon its size (small Vs. large), the location (hot climate like Miami, FL; moderate climate like Washington, DC; or cold climate like Anchorage AK), and the type of building (barrack, office, warehouse, laboratory). For any given building, factors like ventilation rates, thermostat set points, and lighting levels have a significant impact on the energy consumption. All other things being equal, a building with higher ventilation rates will usually use more energy than a building with lower ventilation rates. A building with lower light levels will use less energy than a building with higher light levels. And a building with higher heating set points and lower cooling set points will use more energy than a building with lower heating set points and higher cooling set points.

It is important that engineers and O&M personnel design for and use appropriate rates and set points to maintain occupant comfort, health, and productivity AND minimize energy usage. Setting these rates and set points can be as much an art as a science, but there are a number of standard references that are used to help in the operation of the building. The following references provide guidance on the suggested values.

2.1. Thermal Requirements

Thermal requirements include criteria for thermal comfort and health, process needs, and criteria preventing mold mildew and other damage to he building materials or furnishings.

2.1.1. Thermal comfort and health criteria primarily involve the temperature and humidity conditions in the building. Too high a temperature means that occupants are uncomfortably hot. Too low a temperature means that occupants are uncomfortably cold. The wrong humidity means that occupants feel damp or sweaty or too dry. Thermal comfort is defined by ASHRAE Standard 55 Thermal Environmental Conditions for Human Occupancy. The latest version of Standard 55 was published in 2004 and is available from ASHRAE.

The following Dry Bulb room air temperatures are within the ASHRAE Standard 55 range and shall not be exceeded [IDG Benelux]:

Cooling Period: The DBT in occupied spaces shall not be set below 70oF (21oC) with the RH maintained below 50%. When the space is unoccupied during the

short period of time, room thermostat shall be reset to 85oF (29oC) with the relative humidity maintained below 50%. In space unoccupied for an extended period of time, temperature shall not be controlled but the building air RH shall be maintained below 50%.

Heating period: Relative humidity of ALL building air shall be maintained below 50% and above 30% at all times (unless required differently for health reasons at the hospitals, day care facilities or by processes). The DBT in occupied spaces shall not exceed the following:

(1) Barracks and other living quarters: 70oF (21oC) Monday through Friday from 0500-2200 and 65ºF (18oC) from 2200-0500. Temperature settings for barracks Saturday and Sunday 70º (21oC) from 0600-2200 and 65ºF (18oC) from 2200-0600.

(2)Offices, warehouses, etc. where personnel work seated or in standing position involving little or no exercise: 70oF (21oC) during working hours and not more than 55oF (12.80C) during non-working hours.

(3) Child Care facilities: 72oF (22.2oC) during working hours.

(4) Issue and similar rooms: 60 oF/15.5oC.

(5) Special process rooms, such as paint shops and drying rooms: 80oF (26.6oC) allowed, or the one required by the process.

(6) Shops, hangars and other buildings where employees work in a standing position or exercise moderately, such as sorting, or light packing or crating: 60 oF/15.5oC during the day; 40oF (4.4oC) during night time.

(7)Shops, warehouses and the like, where employees do work involving considerable exercise, such as foundries, heavy packing, crating, and stacking, or where heat is required to protect material or installed equipment from freezing: 40oF (4.4oC). <u>EXCEPTION:</u> Localized heat, not to exceed 55oF (13oC) may be furnished in areas where the work requires medium or light personnel activity.

(8) Heat will not be permitted in warehouse areas that do not contain material or equipment requiring protection from freezing or condensation, and warehousing of stored goods is the only operation. Heat for the prevention of condensation on stored machinery and material will be supplied after a thorough survey of all conditions and the approval of the major Army or operating agency (DeCA, AAFES, etc.) manager.

(9) Buildings other than those specified above will not be heated to temperatures higher than 65ºF (18oC) without approval (in writing) from the subordinate garrison or garrison DPW.

When the space is unoccupied during the short period of time, room thermostat shall be set back to 55oF (13oC) with the relative humidity maintained below 50%. In space unoccupied for an extended period of time, temperature shall be controlled at 40oF (5oC) to prevent freezing with the building air RH maintained under 50%.

2.1.2. Process related criteria include temperature and humidity needed to perform the process housed in the building (e.g., painting, printing) or to operate process equipment such as electronics. While new design guidance for computer systems indicates a much higher tolerance for high temperatures than previously thought, there are specialized electronic and laboratory equipment that have fairly tight temperature and humidity requirements. An archival storage of important documents also involves relatively tight tolerances for temperature and humidity.

2.1.3. Building materials and furnishings requirements

The environmental conditions (temperature and humidity) maintained in indoor spaces determines not only the comfort of the occupants of those spaces but also the long-term "health" of the building itself. Historically, only the dry-bulb temperature of indoor spaces was controlled to achieve comfortable indoor conditions for the occupants. Little attention was given to control of moisture/humidity in the spaces. As a result, many existing Army buildings have significant mold/mildew problems.

Eliminating mold/mildew from Army buildings requires year-round control of both the dry-bulb temperature and the dew point temperature (or air relative humidity) in the indoor spaces. Control of indoor humidity will also significantly improve the comfort of Army building occupants.

Building materials and furnishing damage occurs when humid air meets a cold surface. Mold/mildew grows on a surface in a building when that surface's relative humidity is above 85% for extended periods. This condition easily occurs in buildings even with low average air relative humidity when cold spots exist on poorly insulated supply air ducts and chilled water pipes, supply air diffusers and poorly insulated and not air tight building envelope elements and the areas with thermal bridges, etc. Careful design and operation of the building envelope and the HVAC, ventilation, and exhaust systems is required to eliminate the potential for mold growth in Army buildings. By controlling ALL the air inside the building above the dew point will reduce potential moisture related problems. According to the ASHRAE Humidity Control Design Guide, the suggested dew point limits which meet both health and mold problems requirements are < 57oF in summer and > 35oF in winter.

It is important, that designers and O&M personnel design and maintain the building and HVAC systems, to satisfy all three categories of requirements. In most of cases, thermal comfort requirements satisfy the process. Preventing moisture related problems require special attention to the design and building operation. Energy conservation shall not be achieved at expense of health, occupant's wellbeing and building sustainability. Certain strategies and technologies can minimize or eliminate premium energy use.

2.1.4. Thermal requirements to unoccupied spaces.

Requirements for temperatures and relative humidity discussed above are developed for occupied spaces (Table 2-1). Many DOD and other government buildings are not occupied at night or on weekends. Some DOD facilities including barracks, administrative and dining facilities may be unoccupied for an extended period of time due to training and deployment. So, one of energy conservation strategies may be to set back temperatures for heating or set up for cooling. One source of guidance on set back or set up temperatures is ANSI/ASHRAE/IESNA Standard 90.1-2004 *Energy Standard for Buildings Except Low-Rise Residential Buildings*. Standard 90.1-2007 does not regulate thermostat set backs or set ups, but it does regulate the capabilities of thermostats installed in buildings. Section 6.4.3.3.2 of Standard 90.1-2004 Setback Controls – requires that heating systems in all parts of the US outside of Miami FL and the tropical islands (zones 2-8) must have a capability to be set back to 55°F. Heating systems in zone 1 are assumed to have minimal usage and therefore no need of setbacks. Cooling systems in hot dry areas (zones 1b, 2b, and 3b) must have the capability to be set up to 90°F. However, cooling systems in hot and humid climates (zones 1a, 2a, and 3a) are not required to have cooling setbacks due to potential for moisture problems. It is wasteful to cool DOD facilities left unoccupied for an extended period of time, which are located in hot and humid climates. Significant energy savings can be achieved without damage to building materials and furnishing if a combination of measures (discussed in Appendix 14) related to the building envelope and HVAC maintain the requirements for ALL the air inside the building.

Table 2-1. Requirements to dry bulb temperature and relative humidity for occupied and unoccupied facilities to reduce the risk of moisture related problems.

Occupancy/Use	Humidity not to exceed	Maximum Dry Bulb Temp	Minimum Dry Bulb Temp
Occupied	50%	75 °F	70 °F
Unoccupied (Short term)	50%	85 °F	55 °F
Unoccupied (long term)	50%	No Max	40 °F
Critical Equipment	50% or equip requirement if less	Equip max allowed	Equip min allowed

2.2. Ventilation rates

The key design considerations for maintaining adequate indoor air quality (IAQ) include providing adequate outdoor air rates which satisfy three major requirements: contaminant control, make-up air needs and building pressurization.

2.2.1. ASHRAE Standard 62-2007 specifies minimum outside air ventilation rates for residential, commercial, institutional, and industrial spaces. These rates for representative buildings at Army Installations are presented in Table 2-2.

2.2.2. Industrial buildings (i.e., motor pools, paint booths, plating tanks, etc.) require make-up air to replace the large volumes of air exhausted by process enclosures and open hoods. Make-up air rates depend upon the type and number of equipment requiring exhaust ventilation and efficiency of local exhausts. Minimum exhaust rates (and respective make-up air rates) are listed in Table 2-3, which is based on the ASHRAE Standard 62.1-2007 Table 6-4. and ASHRAE HVAC Applications Handbook (ASHRAE 2007), Kitchen Ventilation chapter.

Table 2-2. Minimum exhaust rates

Equipment /facility Category	Exhaust Rate, cfm/unit (L/s m^2)	Remarks
Educational Science Laboratory	1.00 cfm/ft2	ASHRAE Std 62.1-2007, Table 6-4
Janitor Closets, trash rooms	1.00 cfm/ft2	ASHRAE Std 62.1-2007, Table 6-4
Kitchenettes	0.3 cfm/ft2	ASHRAE Std 62.1-2007, Table 6-4
Kitchens – commercial	See Table 6	ASHRAE Standard 154
Motor Pools	1.5cfm/ft2	General exhaust ASHRAE Std 62.1-2007, Table 6-4
Motor Pools (vehicle exhaust	See Table	
Showers	60 cfm/unit	EN 15251, Table B5
	25/50 cfm/unit	ASHRAE Std 62.1-2007, Table 6-4
Toilets – private	25/50 cfm/unit	ASHRAE Std 62.1-2007, Table 6-4
Toilets –public	50/70 cfm/unit	ASHRAE Std 62.1-2007, Table 6-4
Laboratory hoods	ASHRAE Std 110 Method of Testing Performance of Laboratory Fume Hoods	ASHRAE HVAC Applications Handbook (ASHRAE 2007), Kitchen Laboratories Chapter, Table 2

Table 2-3. Exhaust flow rates by unlisted and listed cooking hood type.

Type of Hood		Minimum Exhaust Flow Rate (cfm per linear foot of hood)			
		Light Duty Equipment	Medium Duty Equipment	Heavy Duty Equipment	Extra Heavy Duty Equipment
Wall-mounted canopy,	unlisted	200	300	400	550
	listed	150 - 200	200 - 300	200 - 400	350+
Single island canopy,	unlisted	400	500	600	700
	listed	250 - 300	300 - 400	300 - 600	550+
Double island canopy,	unlisted	250	300	400	
	listed	150 - 200	200 - 300	250 - 400	500+
Eyebrow, unlisted		250	250	Not allowed	Not allowed
	listed	150 - 250	150 - 250	—	—
Backshelf/proximity,	unlisted	300	300	400	Not allowed
	listed	100 - 200	200 - 300	300 - 400	Not recommended
Source: ASHRAE Standard 154					

Mechanical codes recognize exceptions for hoods that have been tested against a recognized standard, such as Underwriters Laboratories (UL) Standard 710. Part of the UL standard is a “cooking smoke and flair up” test. This test is essentially a cooking effluent capture and containment (C&C) test where “no evidence of smoke or flame escaping outside the exhaust hood” must be observed. Hoods bearing a recognized laboratory mark are called *listed* hoods, while those constructed to the prescriptive requirements of the building code are called *unlisted* hoods.

As reflected by the range in exhaust rates in the table, a *listed* hood can be operated at a lower exhaust rate than an *unlisted* hood of comparable style and size over the same cook line. Lower exhaust rates may be proven by laboratory testing with specific hood(s) and appliance lineup using the test protocol described in ASTM Standard F-1704, *Test Method for Performance of Commercial Kitchen Ventilation Systems*. This process is sometimes referred to as “custom-engineering” a hood and is the foundation of this ECM. Within the specification to maximize hood performance and minimize exhaust rate are construction or installation details that include the addition of partial side panels, minimizing the gap between the appliances and the back wall and, in the case of canopy hoods, increasing the amount of overhang (e.g., from 6 to 18 in). These detailed specifications can permit a listed hood to operate satisfactorily at the lower end of the cfm range show (e.g., 200 cfm vs. 300 cfm) for a 30% or more saving over the Code values and or standard design practice).

ASHRAE Standard 154 categorizes cooking appliances as light-, medium-, heavy-, and extra heavy-duty, depending on the strength of the thermal plume and the quantity of grease, smoke, heat, water vapor, and combustion products produced. The strength of the thermal plume is a major factor in determining the exhaust rate. By their nature, these thermal plumes rise by natural convection, but they are turbulent and different cooking processes have different “surge” characteristics.

Appliance Duty Classifications from ASHRAE Standard 154

Light Duty

- Gas and electric ovens (including standard, bake, roasting, revolving, retherm, convection, combination convection/steamer, conveyor, deck or deck-style pizza, and pas-try)
- Electric and gas steam-jacketed kettles
- Electric and gas compartment steamers (both pressure and atmospheric)
- Electric and gas cheesemelters
- Electric and gas rethermalizers

Medium Duty

- Electric discrete element ranges (with or without oven)
- Electric and gas hot-top ranges
- Electric and gas griddles
- Electric and gas double-sided griddles
- Electric and gas fryers (including open deep-fat fryers, donut fryers, kettle fryers, and pressure fryers)
- Electric and gas pasta cookers

- Electric and gas conveyor (pizza) ovens
- Electric and gas tilting skillets /braising pans
- Electric and gas rotisseries

Heavy Duty

- Electric and gas underfired broilers
- Electric and gas chain (conveyor) broilers
- Gas open-burner ranges (with or without oven)
- Electric and gas wok ranges
- Electric and gas overfired (upright) broilers
- Salamanders

Extra Heavy Duty

Appliances using solid fuel such as wood, charcoal, briquettes, and mesquite provide all or part of the heat source for cooking.

Local exhausts and make-up air systems are significant energy consumers, required for heating and cooling the outside air and for transportation of supply and exhaust air. To extend it is feasible, change processes or use equipment with reduced contaminant and heat release into the space. To minimize hood exhaust airflow

- Use enclosed vs. open hoods when possible (e.g., over plating tanks, vehicle exhaust hoods, etc.). Otherwise, use high efficiency proximity hoods.
- Select location or co-location of process equipment (e.g., kitchen equipment) to increase local exhaust capture efficiency (Figure 2-2):
  - Position equipment (i.e., cooking appliances) close to the walls, avoid island installations when possible
  - Enclose appliances with the walls
- Use demand based exhaust ventilation systems (e.g., welding exhaust systems, kitchen hoods, see Figure 2-3)
- Use efficient hood configurations to to reduce exhaust flow (Figure 2-4)
- Avoid cross-drafts (i.e., in kitchen space, welding shops, laboratories, etc.)

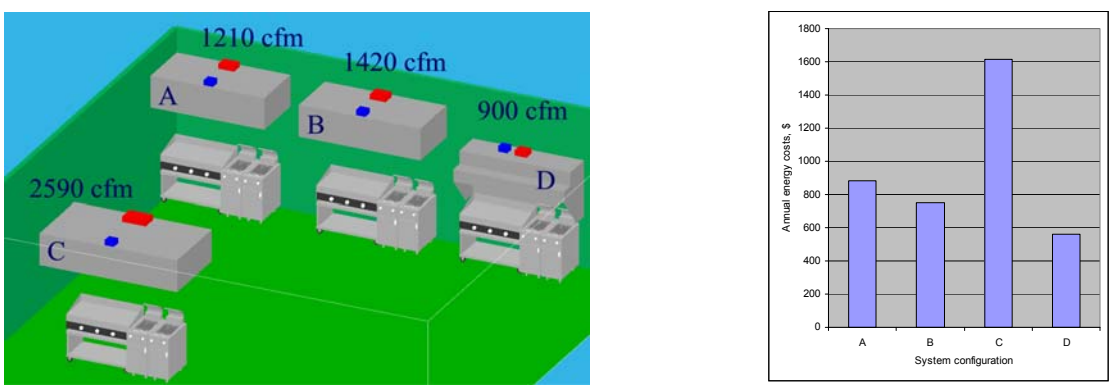


Figure 2-2. Effect of appliance position on the energy cost: A – appliances in the corner with canopy wall hood; B – appliances at the wall with canopy wall hood; C – appliances in the middle of the space with canopy island hood; D – appliances at the wall with close proximity back-shelf hood (Livchak Workshop 2007).

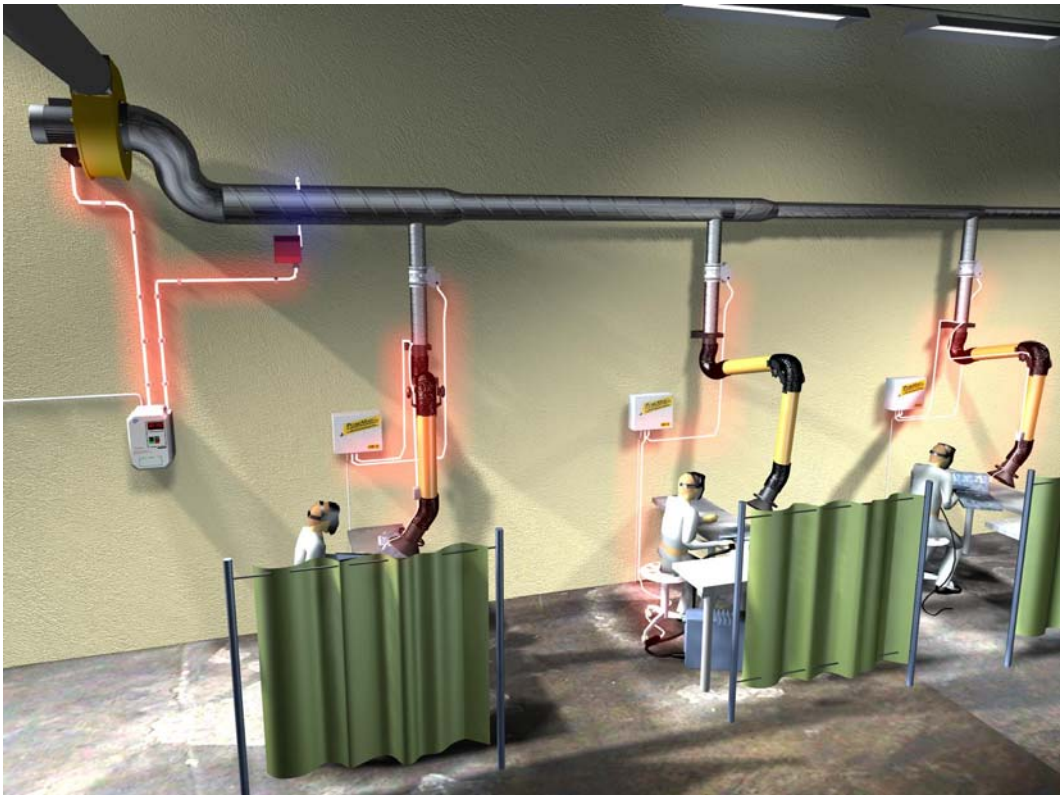


Figure 2-3. Schematic of the demand based exhaust ventilation system in welding shop (Annex 46 Fact Sheet).

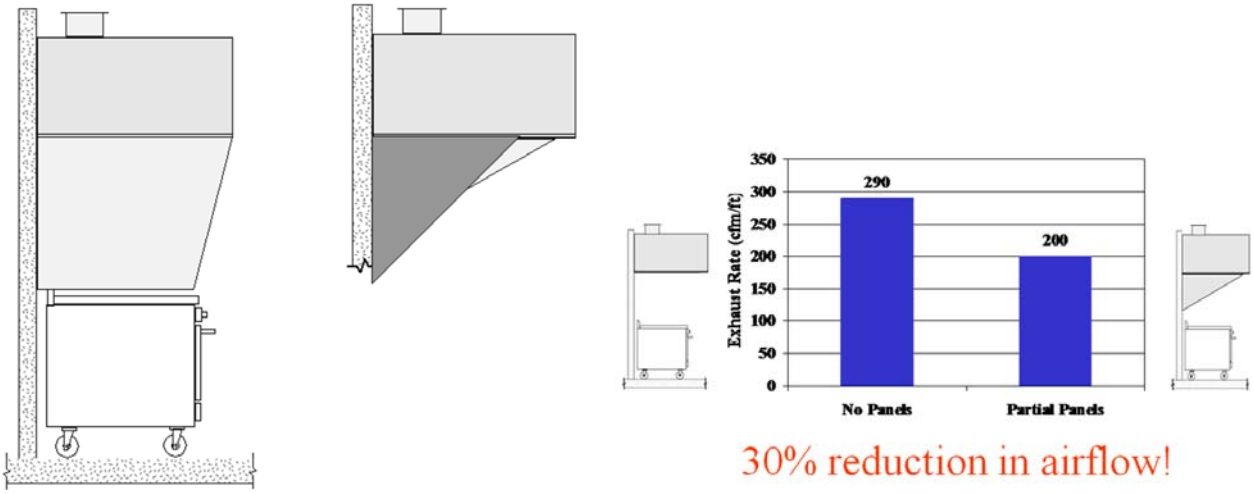


Figure 2-4. Incorporating partial side panels or end walls in different configuration of kitchen hoods allows exhaust flow reduction (www.Fishnick.org)

2.2.3. Outside airflow rate required for building pressurization depends upon the building air tightness. The tighter the building envelope, the smaller airflow rate is required to prevent infiltration of cold/warm air into the building, which reduces the sensible and latent heat load on HVAC systems. ASHRAE is considering implementing in standard 90.1 an overall building air leakage maximum requirement that is that building air

leakage is not to exceed 0.4cfm/ft2 at a pressure difference of 75 Pa. The Army has implemented a more stringent requirement for total building air leakage not to exceed 0.25cfm/ft2 at a pressure difference of 75Pa.

In existing buildings air leakage can be determined using the “Blower door” technique in accordance with NFRC 400 and be calculated using the *power law flow* function of the form ($Q = C(\Delta P)^n$. During a blower door test, the two parameters that quantitatively describe the building air leakage, the flow coefficient ,C (CFM/Pa), and the dimensionless flow exponent ,n, can be determined experimentally for a specific building.

The same power law function can be used to estimate the total air flow from infiltration which needs to be overcome to pressurize the building. To accomplish this, the total infiltration rate (Q_{75}) in CFM at 0.3 in w.g. (75Pa) is calculated based on the total wall, floor, and roof area of the building and the assumed overall maximum allowed air leakage rate of .25 CFM/ft2. Assuming that the building is pressurized to 0.02 in w.g. by the building ventilation system, the Power Law flow function can be used to determine the total air leakage rate (Q_5) in CFM at 0.02 in w.g. (5 Pa) assuming a flow coefficient of 0.65:

$$Q_5 = Q_{75} * (5/75)^{.65}$$
$$Q_5 = Q_{75} * .17$$

The mechanical ventilation system has to provide outside air to the building equal to the building exhaust plus Q_5, the air leakage rate at 0.02 in w.g. The infiltration leakage rate is about 10% higher than the outdoor ventilation rates required by ASHRAE Standard 62.1-2004.

2.3. Lighting intensity

Lighting systems are designed based on lighting intensity in buildings recommended to meet OSHA can be found in the IESNA Handbook (IESNA stands for the Illuminating Engineering Society of North America). There are many types of spaces that are overlit for various reasons.

Office spaces are often over-lit as a result of having been installed prior to 1985, when overhead lighting was the only light source and light levels were designed for paper-based reading tasks, using 750-1000 lux as the lighting criteria due to the poor reprographics available at that time; now office lighting designs are based on computer tasks and higher quality printed tasks, so overhead lighting can be reduced to between 300 and 500 lux.

Recent findings show that when the spectral properties of the peripheral lighting are shifted to include more blue, our eyes respond the same as if the lighting levels were increased – the pupils of our eyes get smaller, spaces seem brighter, and we see things more clearly. Thus, additional energy savings can be obtainable through the use of spectrally enhanced lighting and extra-efficient electronic ballasts.

One of the easiest and most cost effective methods for saving energy is to design lighting systems to the correct light level for the tasks being performed, and not over-lighting spaces.

Another parameter used in the lighting systems design is Lighting Power Density which is limited by Section 9 of ASHRAE/IESNA Standard 90.1 2007 with the modifications and additions required by CHAPTER 7 of BSR/ASHRAE/USGBC/IESNA Standard 189.1P ASHRAE Standard 90.1 limits lighting power consumption by defining limits for Lighting Power Densities (LPD) in Watts per sq. Fort The Standard does this by using IESNA lighting recommendations for light levels and calculating the wattage that would be consumed by energy-efficient lighting systems in specific building types. The LPD's in Standard 90.1 are based on standard lamps and ballasts, and do not include the latest in ballast technologies or any spectral contributions.

Table 2-4 provides current requirements for Lighting intensities a for typical Army facilities.

Table 2-4. Examples of design illumination levels for some Army buildings and spaces from EN 12464.

Type of building	Space	Maintained luminance, Ê m, at working areas, lx	UGR	Ra	Remarks
Barracks/Dormitories					
Educational Buildings	Play room, nursery, classroom	300	19	80	
	Lecture hall	500	19	80	
	Computer practice rooms (menu driven)	300	19	80	
Office buildings	Single offices	500	19	80	at 0,8 m
	Open plan offices	500	19	80	at 0,8 m
	Conference rooms	500	19	80	at 0,8 m
Educational buildings	Classrooms	300	19	80	at 0,8 m
	Classrooms for adult education	500	19	80	at 0,8 m
	Lecture hall	500	19	80	at 0,8 m
Hospitals	General ward lighting	100	19	80	at 0,8 m
	Simple examination	300	19	80	at 0,8 m
	Examination and treatment	1000	19	90	at 0,8 m
Hotels and restaurants	Self-service restaurant, dining room	200	22	80	at 0,8 m
	Kitchen	500	22	80	
	Buffet	300	22	80	
Sport facilities	Sports halls	300	22	80	at 0,1 m

Type of building	Space	Maintained luminance, Ê m, at working areas, lx	UGR	Ra	Remarks
Wholesale and retail premises	Sales area	300	22	80	at 0,8 m
	Till area	500	19	80	at 0,8 m
Circulation areas	Corridor	100	28	40	at 0,1 m
	Stairs	150	25	40	at 0,1 m
	Restrooms	100	22	80	
	Cloakrooms, washrooms, bathrooms, toilets	200	25	80	
Industrial	Metal working/ welding	300	25	60	
	Assembly				
	Rough	200	25	80	
	Medium	300	25	80	
	Fine	500	22	80	
	precision	750	19	80	
Central Plant	Boiler house	100	28	40	
	Machine Halls	200	25	80	
	Side rooms, e.g. pump rooms, condenser rooms etc.	200	25	60	
	Control rooms	500	16	80	
Vehicle Construction/ Maintenance	Body work and assembly	500	22	80	
	Painting, spraying and polishing	750	22	80	
	Painting, touch-up, inspection	1000	19	90	
Wood working and processing	Saw frame	300	25	60	
	Work at joiner's bench, gluing, assembly	300	25	80	
	Polishing, painting, fancy joinery	750	22	80	
	Work on wood working machines e.g. turning, fluting, dressing, rebating, grooving, cutting, sawing, sinking	500	19	80	

EN 12464-1 Light and lighting – Lighting of work places – Part 1: Indoor work places. Approved by CEN on 16 October 2002.
http://www.voltimum.it/news/4666//Illumination-levels-for-inside--zones---tasks-and-activity-according-to-EN-12464-1.html

Appendix 3: Building Envelope

3.1. Insulation

The building envelope performs various tasks, which includes weather protection from wind, rain, irradiation, heat and cold, visibility and glare protection, fire protection, noise protection and protection against burglary. At the same time, the building envelope must fulfill internal space requirements, which include thermal conditions, acoustic, and visual comfort along with requirements for humidity conditions for both comfort and mold and mildew growth prevention.

Thermal performance of the building envelope influences the energy demand of a building in two ways. It effects annual energy consumption and thus, operating costs for building heating, cooling and humidity control. It also influences peak loads which consequently determine the size of heating, cooling and energy generation equipment and in this way has an impact on investment costs. In addition to energy saving and investment cost reduction, a better insulated building provides other significant advantages. Higher thermal comfort because of warmer surface temperatures on the interior surfaces in winter and lower temperatures in summer. This also results in a lower risk of mold growth on internal surfaces.

ASHRAE Standard 90.1-2007 prescriptive requirements for building envelope as a function of assembly type, climate zone, and building type are listed in Section 5.5 and Tables 5.5-1 to 5.5-8.

Requirements for building envelopes of small office buildings, small retail buildings, K-12 school buildings and Small Warehouses and Self-Storage Buildings, which allow in combination with other energy conservation measures to achieve 30% energy savings over ANSI/ASHRAE/IESNA Standard 90.1-1999 are listed in respective Advanced Energy Design Guides, which can be obtained from the ASHRAE or downloaded from the following website: http://www.ashrae.org/technology/page/938

Studies conducted by USACE in collaboration with DOE and ASHRAE [B, T, O, DF,CDC] resulted in prescriptive thermal properties (Tables 3-1 to 3-5) of the building envelop components which shall be followed to meet the EPAct 2005 requirement for 30% over the ASHRAE Standard 90.1-2004 building energy performance. These requirements shall be met with all new construction and major renovation projects.

Table 3-1. Barracks – UEPH

Item	Component	Climate Zones							
		1	2	3	4	5	6	7	8
Roof	Attic R (ft^2hF/Btu)	40	40	40	50	50	60	60	60
	Surface reflectance	.27	.27	.27	.27	.27	.27	.27	,.27
Walls	Light Weight Construction R (ft^2hF/Btu)	20	20	20	25	25	30	30	30
Exposed Floors	Mass R (ft^2hF/Btu)	5	10	10	20	20	30	30	30
Slabs	Unheated R (ft^2hF/Btu)	NR	NR	NR	NR	NR	NR	NR	10
Doors	Swinging	NR	NR	NR	NR	NR	NR	NR	NR
	Non-swinging	NR	NR	NR	NR	NR	NR	NR	NR
Vertical Glazing	Window to Wall Area Ratio (%)	20%	20%	20%	20%	20%	20%	20%	20%

Table 3-2. Training barracks

Item	Component	Climate Zones							
		1	2	3	4	5	6	7	8
Roof	Attic R (ft^2hF/Btu)	40	40	40	50	50	60	60	60
	Surface reflectance	.27	.27	.27	.27	.27	.27	.27	,.27
Walls	Light Weight Construction R (ft^2hF/Btu)	20	20	20	25	25	30	30	30
Exposed Floors	Mass R (ft^2hF/Btu)	5	10	10	20	20	30	30	30
Slabs	Unheated R (ft^2hF/Btu)	NR	NR	NR	NR	NR	NR	NR	10
Doors	Swinging	NR	NR	NR	NR	NR	NR	NR	NR
	Non-swinging	NR	NR	NR	NR	NR	NR	NR	NR
Vertical Glazing	Window to Wall Ratio (%)	20%	20%	20%	20%	20%	20%	20%	20%

Table 3-3. Admin buildings

Item	Component	Climate Zones							
		1	2	3	4	5	6	7	8
Roof	Attic R (ft^2hF/Btu)	30	38	38	38	44	44	60	60
	Surface reflectance	.27	.27	.27	.27	.27	.27	.27	,.27
Walls	Light Weight Construction R (ft^2hF/Btu)	13	13	13	13+7.5	13+7.5	13+7.5	13+15	13+20
Exposed Floors	Mass R (ft^2hF/Btu)	NR	NR	NR	NR	NR	NR	NR	NR
Slabs	Unheated R (ft^2hF/Btu)	NR	NR	NR	NR	NR	10	15	20
Doors	Swinging	NR	NR	NR	NR	NR	NR	NR	NR
	Non-swinging	NR	NR	NR	NR	NR	NR	NR	NR
Vertical Glazing	Window to Wall Ratio (%)	40-ns 20-ew	40-ns 20-ew	40-ns 20-ew	40-ns 20-ew	40-ns 20-ew	40-ns 20-ew	40-ns 20-ew	40-ns 20-ew

Table 3-4. Tactical equipment maintenance facilities

Item	Component	Climate Zones							
		1	2	3	4	5	6	7	8
Roof	Attic R (ft^2hF/Btu)	19	19	13+13	13+19	13+19	13+19	13+19	19+13
	Surface reflectance	.27	.27	.27	.27	.27	.08	.09	.08
Walls	Light Weight Construction R (ft^2hF/Btu)	13	13	13	13	13+13	13+13	13+13	13+16
Exposed Floors	Mass R (ft^2hF/Btu)	NR	NR	NR	NR	NR	NR	NR	NR
Slabs	Unheated R (ft^2hF/Btu)	NR	NR	NR	NR	NR	NR	NR	20
Doors	Swinging U (Btu/ft^2hF)	U-.70	U-.70	U-.70	U-.70	U-.70	U-.70	U-.70	U-.70
	Non-swinging U (Btu/ft^2hF)	U-.25	U-.25	U-.25	U-.25	U-.25	U-.25	U-.25	U-.25
Vertical Glazing	Window to Wall Ratio (%)	<10%	<10%	<10%	<10%	<10%	<10%	<10%	<10%

Table 3-5. Dining facilities

Item	Component	Climate Zones							
		1	2	3	4	5	6	7	8
Roof	Roof R (ft^2hF/Btu)	15	15	20	20	20	20	20	30
	Surface reflectance	.65	.65	.65	.3	.3	.3	.3	.3
Walls	Light Weight Construction R (ft^2hF/Btu)	13	13	13+3.8	13+7.5	13+7.5	13+7.5	13+7.5	13+22
Exposed Floors	Mass	NR	NR	NR	NR	NR	NR	NR	NR
Slabs	Unheated R (ft^2hF/Btu)	NR	NR	NR	NR	NR	NR	15	20
Doors	Swinging	NR	NR	NR	NR	NR	NR	NR	NR
	Non-swinging	NR	NR	NR	NR	NR	NR	NR	NR
Vertical Glazing	Window to Wall Ratio	NR	NR	NR	NR	NR	NR	NR	NR

In building retrofit projects, buildings can be insulated from inside or outside. Technically, the best way to insulate a building component is on the outside as this reduces problems with thermal bridges and does not reduce the usable floor area. With the sufficient exterior insulation, the dew point temperature will not fall within the wall cavity - reducing the risk of condensation. With current insulation technologies external insulation offers different color and texture options and improves the look of the façade (Figure 3-1).

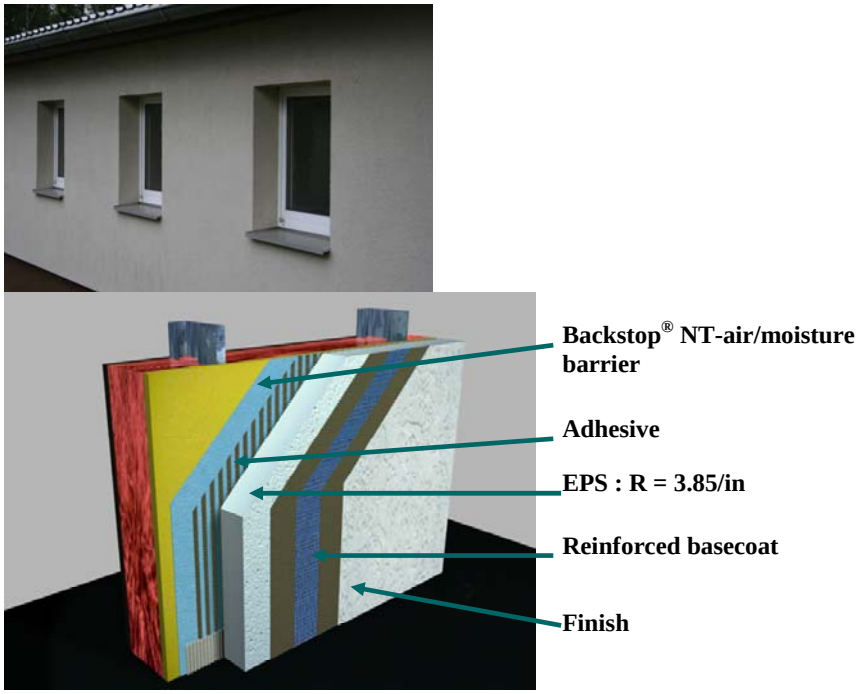


Figure 3-1. Reinsulated Army barrack and schematic of exterior insulation and finish systems

However, with some buildings (e.g., historic buildings) external insulation may be not be approved and, therefore internal insulation shall be used. Internal insulation reduces usable floor area, may have a poorer aesthetics and requires interruption of the space usage (Figure 3-2).

Figure 3-2. Internal insulation of the administrative building at the Rock Island Arsenal.

3.2. Windows

For new designs and major retrofits selecting windows will be selected to improve visual and thermal comfort and provide an opportunity for energy savings. While window replacement for energy conservation reason only is typically not cost efficient, energy efficient windows for new construction and major retrofit projects which include window replacement requirement is cost efficient and shall be specified. The selection of windows for cold climates shall be based on a window's ability to retain heat inside the building and reduce infiltration, whereas in warm climates – on the capacity to block heat gain from the sun and reduced infiltration. The main energy related parameters of a window are its insulation value, transparency to solar radiation, and air tightness.

The **U-factor** expresses a window's insulation value, its resistance to heat flow when there is a difference between inside and outside temperature. The U-factor is measured in Btu/hr-sq ft-°F (W/sq m-°C). The lower the U-factor, the greater a window's resistance to heat flow.

A window's transparency to the heat carried by solar radiation is expressed in the **solar heat gain coefficient (SHGC).** The SHGC is the fraction of solar heat admitted by the window on a range of 0 to 1. A window's transparency to visible light is expressed as its **visible transmittance (VT)** on a range of 0 to 1 (cf. Figure 3-3)**.**

The **air-leakage (AL)** rating of a window indicates its air tightness. It expresses the rate of air-leakage around a window at a specific pressure difference in units of cubic feet

per minute per square foot of frame area (cfm/sq ft) or cubic meters per minute per square meter of frame area.(cmm/sq m).

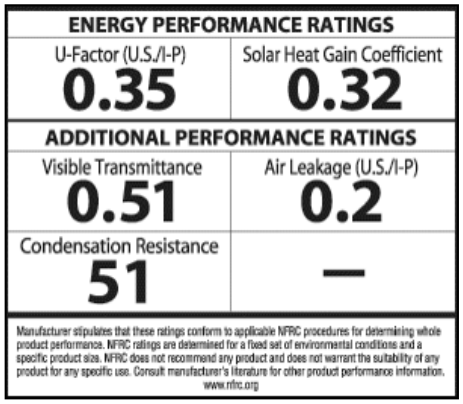


Figure 3-3. Example of the label verifying that the energy properties of windows are rated according to nationally accepted standards and certified by the National Fenestration Rating Council (NFRC).

Table 3-6 shows a range of energy efficient window options (A through F) to be used in barracks located in different climates.

Table 3-6. Window options with default values for barracks buildings

Window Options with Default Performance Values						
#	**Glazing type**	**Frame type**	**U-factor (imp./metric)**	**SHGC**	**VT**	**AL (imp./metric)**
A	2-pane, low-solar-gain low-E	Aluminum, thermal break	0.47 / 2.7	0.33	0.55	0.2 / 0.06
B	2-pane, low-solar-gain low-E	Non-metal	0.34 / 1.9	0.30	0.51	0.2 / 0.06
C	2-pane, high-solar-gain low-E	Non-metal	0.36 / 2.0	0.49	0.54	0.2 / 0.06
D	3-pane, low-solar-gain low-E	Non-metal	0.26 / 1.4	0.25	0.40	0.1 / 0.03
E	3-pane, high-solar-gain low-E	Non-metal	0.27 / 1.5	0.38	0.47	0.1 / 0.03
F	3-pane, high-solar-gain low-E	Non-metal, insulated	0.18 / 1.0	0.40	0.50	0.1 / 0.03

Table 3-7 lists window options for barracks that shall be considered in different climates. Efficient window options are recommended based on the climate-specific considerations —a low SHGC for warm climates and a low U-factor for cold climates. Aluminum-framed window A is among the recommended options for regions where hurricane considerations might require the sturdiness of aluminum (1A, 2A, 2B, 3A).

Table 3-7. Window options recommended for barracks located in different US climates

Zone	Climate	Efficient window options
1A	Very hot	A, B
2A,B	Hot	A, B,
3A,B,C	Warm	A, B
4A,B,C	Mixed	B, C
5A,B	Cool	B, C, D, E
6A,B	Cold	C, D, E
7	Very cold	C, E, F
8	Subarctic	E, F

Operable windows provide building occupants with a connection to the outdoors and can serve to provide additional natural ventilation (under appropriate outdoor conditions) if the mechanical systems are shut down because of problems or servicing. Operable window shall not be used in hot and humid climates (Zones 1a, 2a, and 3a) to prevent mold problems.
The ventilation characteristics of a window that provides a modest connection to the outdoors are different from a window that can provide a portion of the cooling requirements for the interior space. The ventilation function of an operable sash must be incorporated into the total fenestration design. It may not be feasible or necessary to make all windows operable in office or commercial buildings. A small awning or sliding window below a fixed window can provide the desired effect. All operable windows must have appropriate switches to disarm air-conditioning systems controlling sensible load (DOAS controlling latent load shall be operated all the time).

Table 3-8 shows a range of window options (A through D) and their energy related characteristics for administrative buildings which provide energy-efficiency benefits in different climates.

Table 3-8. Window options with default values for administrative buildings

Window Options with Default Performance Values						
#	Glazing type	Frame type	U-factor (imp./metric)	SHGC	VT	Incremental cost ($ per ft^2)
A	2-pane, reflective coating	Aluminum, thermal break	0.54 / 3.1	0.17	0.10	$1.25
B	2-pane, low-E, tinted	Aluminum, thermal break	0.46 / 2.6	0.27	0.43	$1.75
C	2-pane, low-E	Aluminum, thermal break	0.46 / 2.6	0.34	0.57	$1.50
D	3-pane, low-E	Insulated	0.20 / 1.1	0.22	0.37	$8.00

Table 3-9 lists window options for administrative buildings that shall be considered in different climates. Efficient window options are recommended based on the climate-specific considerations —a low SHGC for warm climates and a low U-factor for cold

climates. Aluminum-framed window A is among the recommended options for regions where hurricane considerations might require the sturdiness of aluminum (1A, 2A, 2B, 3A).

Table 3-9. Window options recommended for administrative buildings located in different U.S. climates

Zone	Climate	Efficient window options
1A	Very hot – humid	A, B
2A,B	Hot	A, B
3A	Warm -humid	B
3B,C	Warm (dry, marine)	B, C
4A,B,C	Mixed	B, C
5A,B	Cool	B, C
6A,B	Cold	B, C, D
7	Very cold	C, D
8	Subarctic	C, D

3.3. Doors. Exterior doors shall have infiltration rates not exceeding 0.3 cubic feet per minute per square foot (cfm/ft^2) of window area, 0.3 cfm/ft^2 of door area for residential doors, 0.3 cfm/ft^2 of door area for nonresidential single doors (swinging and sliding), and 1.0 cfm/ft^2 for nonresidential double door (swinging) when tested according to NFRC-400 or ASTM E 283 at a pressure differential of 75 Pascals or 1.57 pounds per square foot.

For a solid wood exterior door, the required U-factor is less than or equal to 0.40 Btu/hr-ft^2-F. Weather-stripping along the top, jambs, and bottom sweeps is required to minimize air infiltration around exterior doors. All glass in exterior doors shall have a U-factor or energy efficiency rating less than or equal to 0.65 Btu/hr-ft^2-F.

3.4. Roofs. Roofs are vulnerable to solar gain in summer and heat loss in winter. Dark, non-reflective roofing surfaces create heat island effects by absorbing energy from the sun and radiating it as heat. High-reflectance and high emissivity, roofs (often referred to as “cool roofs”) that can reflect heat instead of absorbing it, thereby reducing the building’s interior temperature and the running time of the air conditioning system. In winter “cool” roofs might have a negative effect on the building energy consumption by increasing load on the heating system compared to standard roofs. Studies conducted under the IEA ECBCS Annex 46 showed that “cool roofs” are cost effective over air-conditioned spaces only for buildings located in climate zones 1-5. In these locations, a minimum of 75% of the entire roof surface not used for roof penetrations, renewable energy power systems (e.g. photovoltaics or solar thermal collectors), harvesting

systems for rainwater to be used on-site, buildings shall be covered with roofing products that comply with one or more of the following:

(a) have a minimum initial *SRI* of 0.78 for a low-sloped roof (a slope less than or equal to 2:12) and a minimum initial *SRI* of 0.29 for a steep-sloped roof (a slope of more than 2:12).

(b) comply with the criteria for the USEPA's Energy Star Program Requirements for Roof Products – Eligibility Criteria.

In the case of industrial ventilated and heated, but not air-conditioned buildings, "cool roofs" reduce indoor air temperature during the hot part of the year and therefore improves worker's comfort and productivity and is cost effective in all climates.

The *solar reflective index (SRI)* shall be calculated in accordance with ASTM E1980 for medium-speed wind conditions. The SRI shall be based upon solar reflectance as measured in accordance with ASTM E1918 or ASTM C1549, and the thermal emittance as measured in accordance with ASTM E408 or ASTM C1371. For roofing products, the values for solar reflectance and thermal emittance shall be determined by a laboratory accredited by a nationally recognized accreditation organization, such as the Cool Roof Rating Council CRRC-1 Product Rating Program, and shall be labeled and certified by the manufacturer.

Solar reflectance is the fraction of solar energy that a roof reflects. Thermal emittance is a measure of the roof's ability to radiate any heat absorbed back into the air, rather than the building below. Both properties are measured on a scale of zero to one; the higher the values, the cooler the roof.

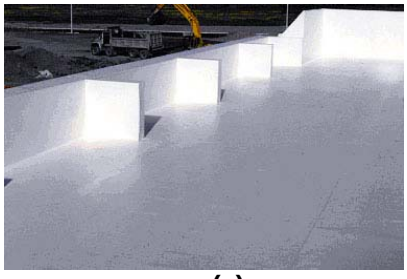
Cool roof options exist for many traditional roofing materials. Each cool roof product offers a different level of reflectance and emissivity, as well as different costs. For flat-roofed industrial buildings membranes are feasible options since based on the NAVFAC Technology evaluation program study there is no difference in first cost between the cool roof and the regular roof options. For sloped residential and non-residential roofs metal roofs, reflective tiles and architectural shingles are feasible.

Metal Roofs: Several metal roof products have earned the ENERGY STAR® label, thanks to the development of pigments that make metal roofs highly reflective. The cost of "cool" and standard painted metal roofing materials is practically the same.
Membranes (single-ply): These flexible or semi-flexible pre-fabricated sheets consist of EPDM (ethylene-propylene-dieneterpolymer), PVC (polyvinyl chloride) or TPO (thermoplastic polyolefin). They can be applied over existing low-slope roofs using heat-sealed seams or caulk. Some are self-cleaning and mold resistant.

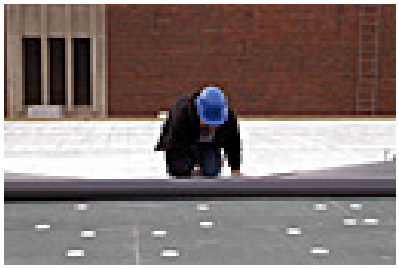
Coatings: There elastomeric, polyurethane or acrylic liquids are the consistency of thick paint. They can be applied over existing low-slope roofs with a roller or power sprayer and last from 10 to 20 years.

Reflective Tiles: Clay or concrete tiles can incorporate special pigments that reflect solar energy while mimicking traditional colors, including green, brown and terra cotta. These tiles are extremely durable and especially suitable for new homes or for construction projects where a white roof might be aesthetically unacceptable.

Architectural shingles: These products resemble traditional roofing shingles but have the reflective properties characteristic of other cool roof materials (Figures 3-4 and 3-5). The shingles are available in a variety of colors, and the difference in cost between architectural shingles and conventional asphalt shingles is minimal.



(a)



(b)

Figure 3-4. Reflective roof coating (a), and reflective roof membrane (b).

(a)

(b)

©

Figure 3-5. White metal roof (a), roof tile coatings (b), and architectural shingles (c) (http://www.elkcorp.com).

Reflective "cool roofs" which reduce the building cooling load, are available in many colors besides white, though roof color, has an impact on energy usage. Table 3-10 shows the reflectance and emittance values by roof type and color for new and aged roofing materials (ORNL).

Table 3-10. Reflectance and emittance values by roof type and color for new and aged roofing materials

Roofing Type	Color	New Solar Reflectance	Aged Solar Reflectance	New Thermal Emittance
Roof Coatings	White	0.70 – 0.85	0.50 –0.65	0.85
Roof Coatings	Grey or Tan	0.70	0.50	0.85
Roof Coatings	Terra Cotta or Brown	0.40	0.30	0.85
Roof Coatings	Aluminized	0.50	0.40	0.50
Metal Paint	Red	0.25	0.25	0.83
Metal Paint	Terra Cotta	0.35	0.35	0.83
Metal Paint	Bright Red	0.35	0.35	0.83

Roofing Type	Color	New Solar Reflectance	Aged Solar Reflectance	New Thermal Emittance
Metal Paint	Beige/Off White	0.55	0.55	0.83
Metal Paint	Tan	0.45	0.45	0.83
Metal Paint	Dark Blue	0.25	0.25	0.83
Metal Paint	Medium to Light Blue	0.32	0.32	0.83
Metal Paint	Dark Brown	0.25	0.25	0.83
Metal Paint	Medium to Light Brown	0.32	0.32	0.83
Metal Paint	Dark Green	0.25	0.25	0.83
Metal Paint	Medium to Light Green	0.32	0.32	0.83
Metal Paint	White	0.65	0.65	0.83
Metal Paint	Bright White	0.70	0.70	0.83
Metal Paint	Black	0.25	0.25	0.83
Metal Paint	Dark Grey	0.25	0.25	0.83
Metal Paint	Medium to Light Grey	0.35	0.35	0.83
Metal Paint	Pearlescent Colors	0.35	0.35	0.75
Galvalume	Unpainted	0.65	0.55	0.05
Copper Metal	Unpainted	0.85	0.18	0.03
Galvanized Steel	Unpainted	0.40	0.20	0.50
EPDM Membrane	Black	0.05	0.10	0.85
TPO Membrane	White	0.80	0.60	0.85
TPO Membrane	Grey	0.50	0.40	0.85
PVC Membrane	White	0.80	0.60	0.85
PVC Membrane	Grey	0.50	0.40	0.85
Asphalt Shingle	Dark Color	0.10	0.10	0.85
Asphalt Shingle	Light Color	0.25	0.25	0.85
Modified Bitumen Cap Sheet	Dark Color	0.10	0.10	0.85
Modified Bitumen Cap Sheet	Light Color	0.25	0.25	0.85
Modified Bitumen Cap Sheet	White	0.50-0.60	0.40 – 0.45	0.85

3.5 Air Tightness. The airtightness of the building enclosure or envelope becomes an increasingly significant factor in the overall energy consumption of buildings. The energy required to heat, cool and maintain humidity control in buildings is increased significantly due to uncontrolled air transfer through the enclosure, as well as by convection. Investigations of building enclosure problems have led many building science consultants, investigators and researchers to conclude that air leakage is the leading cause of moisture problems in exterior building enclosures. These problems include mold and durability problems in exterior walls and other cavities connected to the exterior, excessive rain penetration into wall cavities, poor indoor temperature and humidity control, high heating and air conditioning costs and compromised Noise, fire and smoke control measures. In colder climates the problems of air leakage include icicles on exterior facades, spalling of masonry, premature corrosion of metal parts in exterior walls, high wood moisture contents and rot, excessive rain penetration and indoor temperature and humidity control problems (Figure 3-6). In hot humid climates infiltrating air can cause mold due to condensation on cold air conditioned surfaces.

Figure 3-6. Cold climate exfiltration problems (left) and hot humid air infiltration problems (right)

Where are the leaks? When the building does not have assemblies with a designated layer selected as the airtight layer “an air barrier,” and when the airtight layer of adjacent assemblies are not joined together, air leakage is the result. The most common problems show up in between adjacent assemblies, in particular, the wall-to-roof juncture, canopies and soffits, wall to foundation connection and window-to-wall air barrier; these kinds of problems cause “orifice” and “channel” air flow (Figures 3-7 and 3-8). Occasionally building materials are selected that are not tight enough by air barrier standards, causing “diffuse” air flow through them (Figure 3-9). In existing buildings, operable windows and doors generally are a target for either replacement or re-gasketing and weather stripping (Figure 3-10).

Figure 3-7. Examples and unsealed chases between floors and the attic

Figure 3-8. Examples of unsealed pipe penetrations through walls and floors

Figure 3-9. Blow-door tests complemented by thermography identify problems with building air tightness and areas with poor insulation where leakage occurs (red and white areas in photos to the right).

Figure 3-10. Penetration through the walls designed to accommodate outdoor air supply to individual room's fan-coil units.

Application of air barrier theory in a building design requires the selection of a component or layer in an assembly to serve as the airtight layer.

Design and construct the building envelopes of office buildings, office portions of mixed office and open space (e.g., company operations facilities), dining, barracks and instructional/training facilities with a continuous air barrier to control air leakage into, or out of, the conditioned space. Clearly identify all air barrier components of each envelope assembly on construction documents and detail the joints, interconnections and penetrations of the air barrier components. Clearly identify the boundary limits of the building air barriers, and of the zone or zones to be tested for building air tightness on the drawings.

Trace a continuous plane of air-tightness throughout the building envelope and make flexible and seal all moving joints. The air barrier material(s) must have an air permeance not to exceed 0.004 cfm / sf at 0.3" wg [0.02 L/s.m2 @ 75 Pa] when tested in accordance with ASTM E 2178. Join and seal the air barrier material of each assembly in a flexible manner to the air barrier material of adjacent assemblies, allowing for the relative movement of these assemblies and components.

Support the air barrier so as to withstand the maximum positive and negative air pressure to be placed on the building without displacement, or damage, and transfer the load to the structure. Seal all penetrations of the air barrier. If any unavoidable penetrations of the air barrier by electrical boxes, plumbing fixture boxes, and other assemblies are not airtight, make them airtight by sealing the assembly and the interface between the assembly and the air barrier or by extending the air barrier over the assembly. The air barrier must be durable to last the anticipated service life of the assembly. Do not install lighting fixtures with ventilation holes through the air barrier

Provide a motorized damper in the closed position and connected to the fire alarm system to open on call and fail in the open position for any fixed open louvers such as at elevator shafts. Damper and control to close all ventilation or make-up air intakes and exhausts, atrium smoke exhausts and intakes, etc when leakage can occur during inactive periods. Compartmentalize garages under buildings by providing air-tight vestibules at building access points. Provide air-tight vestibules at building entrances with high traffic (Figures 3-11, 3-12, and 3-13.)

Figure 3-11. Unprotected building entrances with a high traffic.

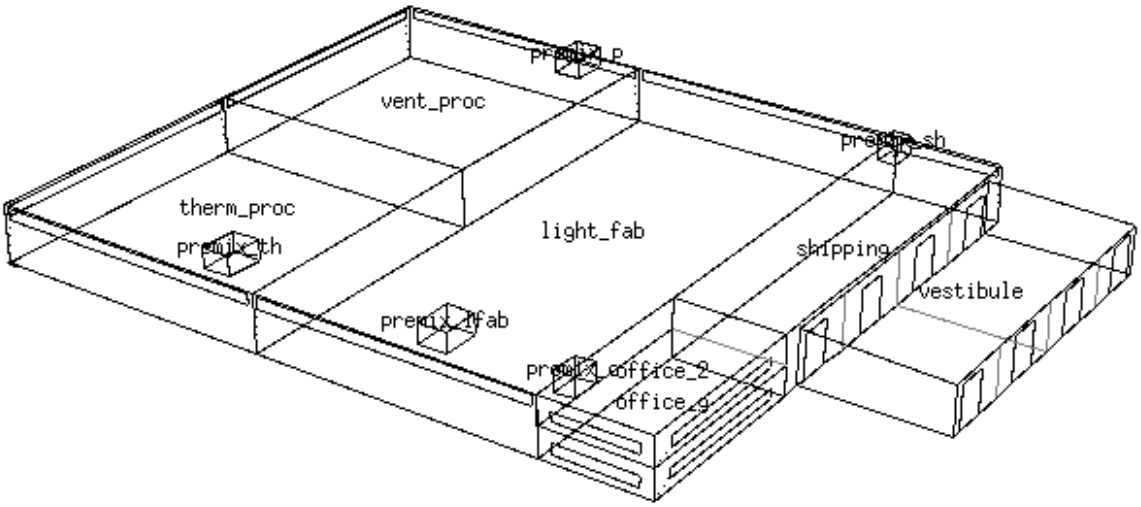


Figure 3-12. Schematic of external vestibule for an industrial building shipping entrance

Figure 3-13. Examples of vestibules at the high traffic doors of admin buildings (a,b) and the dining facility (c)

Compartmentalize spaces under negative pressure such as boiler rooms and provide make-up air for combustion.

Performance Criteria and Substantiation: Submit the qualifications and experience of the testing entity for approval. Demonstrate performance of the continuous air barrier for the opaque building envelope by the following tests:

(a) Test the completed building and demonstrate that the air leakage rate of the building envelope does not exceed 0.25cfm/ft2 at a pressure differential of 0.3” w.g.(75 Pa) in accordance with ASTM’s E 779 (2003) or E-1827-96 (2002). Accomplish tests using either pressurization or depressurization or both. Divide the volume of air leakage in cfm @ 0.3” w.g. (L/s @ 75 Pa) by the area of the pressure boundary of the building, including roof or ceiling, walls and floor to produce the air leakage rate in cfm/ft2 @ 0.3”

w.g. (L/s.m2 @ 75 Pa). Do not test the building until verifying that the continuous air barrier is in place and installed without failures in accordance with installation instructions so that repairs to the continuous air barrier, if needed to comply with the required air leakage rate, can be done in a timely manner.

(b) Test the completed building using Infrared Thermography testing. Use infrared cameras with a resolution of 0.1deg C or better. Perform testing on the building envelope in accordance with ISO 6781:1983 and ASTM C1060-90(1997). Determine air leakage pathways using ASTM E 1186-03 Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems, and perform corrective work as necessary to achieve the whole building air leakage rate specified in (a) above. (c) Notify the Government at least three working days prior to the tests to provide the Government the opportunity to witness the tests. Provide the Government written test results confirming the results of all tests.

Figure 3-14 illustrates some visualization techniques which can be used to identify location or leaks

Figure 3-14. Identification of leakage pathways using smoke pencil (left), theatrical fog and infra-red thermography (right)

Existing buildings undergoing major renovations especially the ones located in cold or hot and humid climates shall be sealed to the same standard as newly constructed ones.

The need for and reasonableness of destructive analysis of the state of exiting air barrier shall be evaluated based on the type of renovation considering related cost issues. This can be challenging due to difficulty in accessing gaps through hard or expensive finishes. Removable ceiling tiles allow easy access to problem areas; walls require destructive access through finishes to expose gaps such as around windows; occasionally if a gap is discovered it may be possible to blind-seal with spray polyurethane foam injected through holes drilled in the drywall. For large holes, bulkheads can be built out of studs and drywall sealed with spray polyurethane foam (SPF); smaller gaps up to 50 mm (2”) can be sealed with one part SPF; larger gaps can be sealed with two-component SPF. Note that stuffing glass-fiber insulation in cracks is not useful, because glass-fiber merely acts as a dust filter and allows air under a pressure differential to pass through it. Air leaks shall be sealed in the following order of priority:

1. Top of building
    - Attics
    - Roof/wall intersections and plenum spaces
    - Mechanical penthouse doors and walls
    - HVAC equipment
    - Other roof penetrations
2. Bottom of Building
    - Soffits and ground floor access doors
    - Underground parking access doors
    - Exhaust and air intake vents
    - Pipe, duct, cable and other service penetrations into core of building
    - Sprinkler hangar penetrations, inspection hatches and other holes
    - Seal core wall to floor slab
    - Crawl spaces
3. Vertical shafts
    - Gasket stairwell fire doors
    - Fire hose cabinets or toilet room recessed accessories connected to shafts
    - Plumbing, electrical, cable and other penetrations within service rooms
    - Elevator rooms, electric rooms- reduce size of cable holes, firestop and seal bus bar openings
4. Exterior Walls
    - Weather-strip windows, doors, including balcony/patio doors and seal window trim
    - Exhaust fans and ducting
    - All service penetrations
    - Baseboard heaters
    - Electrical receptacles
    - Baseboards
5. Compartmentalize
    - Garages
    - Vented mechanical rooms
    - Garbage compactor rooms
    - Emergency generator rooms
    - High voltage rooms
    - Shipping docks
    - Elevator rooms
    - Workshops

Potential energy conservation due to reduced energy used for building heating, cooling and dehumidification is demonstrated by the graph shown in Figure 3-15. The data based on the study of computer simulation of the typical barrack building located in different US climate zones show that air leakage reduction from 1cfm/ft2 at a pressure differential of 0.3” w.g. (75 Pa) to 0.25cfm/ft2 results in the total building energy conservation between 5% and 45% depending on climate zone. In addition,

to energy conservation tighter building envelop results in decreased O&M costs for mold problems remediation.

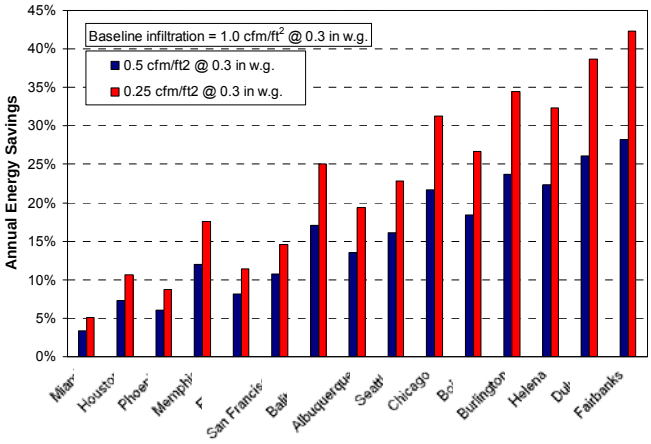


Figure 3-15. Annual energy savings calculated for a typical barrack building for different US climate zones.

A list of air barrier contractors and manufacturers can be found on the Air Barrier Association's website http://www.airbarrier.org

Appendix 4: Ducts and Pipes

4.1. Insulation and seal levels. Duct and pipes convey heated or cooled fluids (air, water, or other fluids) from HVAC or service water heating equipment to the place where that fluid is used in the building. Section 109 of the Energy Policy Act of 2005 sets the absolute minimum duct and piping requirements for commercial buildings at the level of ANSI/ASHRAE/IESNA Standard 90.1-2004. However, Federal agencies are also required to achieve 30% lower energy consumption, if cost-effective, so the levels in Standard 90.1-2004 really only provide the basis for this calculation.

Standard 90.1-2007 provides one type of requirement for ducts and pipes – mandatory:

- Ducts, plenums, and piping must be insulated (Section 6.4.4.1.1).
- Duct should be sealed. (Section 6.4.4.2)
- Service hot water piping insulation should be insulated. (Section 7.4.3)

ASHRAE Advanced Energy Design Guides have developed a set of requirements, including ducts and pipes, for buildings that are considerably more stringent than Standard 90.1-2007, although not necessarily 30% better as required for Federal agencies.

For ducts, the Advanced Energy Design Guides impose four additional requirements on ducts that will all lead to increased energy savings:

1. Low friction rate for ducting (0.08 in. w.c./1000 feet) – this reduces the energy needed to move air through the ducts.
2. Duct seal class B for all ducts – this ensures that ducts deliver the air to where it is needed
3. Ducts located in interior spaces only – this ensures that any duct leakage that does occur takes place in conditioned spaces and not to the outside air. And it reduces the need for insulation.
4. Duct insulated to R-6 – this ensures that heat gain or loss to the air in the ducts is minimized

For piping, the Advanced Energy Design Guide recommends additional service water heating piping insulation beyond what is required for Standard 90.1-2004.

When the building is located in hot and humid climates (zones 1a, 2a, and 3a), in addition to energy conservation consideration, the level of chilled and cold water pipes and supply air ducts insulation shall be designed such, that the surface temperature of the insulated pipe or duct anywhere inside the interior space of the building (including duct and pipe chases) is above the dew point, to prevent condensation and mold problems

4.2. Duct sealing technology

ASHRAE Standard 189 requires that the ducts shall be sealed to a Level A, which surpasses requirements of the ASHRAE Standard 90.1.

Supply and exhaust ducts which don't meet this criteria in the buildings undergoing major retrofits shall be sealed. When the leaky supply duct passes through unconditioned space, air leaks result in a waste of heating and cooling energy. If ductwork is behind barriers, such as within a plenum above suspended ceilings, heating and cooling are not delivered effectively to occupants. In either case, more fan power is required to move air to achieve desired ambient temperatures. Leaks in exhaust ducts result either in ineffective removal of contaminants from the ventilated spaces or in more fan power. Sealing leaks saves both the energy required to heat and cool air, and the energy required to move it to occupants. It may also alleviate occupant comfort problems, if inadequate conditioned air reaches certain locations due to ductwork leakage. Aerosol duct sealing technology seals leaks from the inside out, using a process that is somewhat similar to self-sealing automobile tires.

This technology seals leaks in ductwork from the inside by pressurizing the duct system with a fog of atomized sealant particles. By temporarily blocking all of the normal exits from the duct system (as well as any coils or fans), the fog is forced to the leaks. The acceleration of the air through the leaks causes the sealant particles to leave the air stream and deposit on the leak edges. The right choice of particle size ensures duct flow rate and duct pressure so that the particles remain suspended as they travel through the duct system; thus only a very small fraction of the particles deposit on the duct walls. The Figure 3-16 shows a duct sealing system applied to a small laboratory exhaust system.

The aerosol sealing technology allows leaks that had previously been inaccessible to be sealed. Aerosol sealing has been commercially available for single-family residences since 1999, and became commercially available for large buildings in 2003 with the introduction of a new atomization technology that significantly increases sealing rates, and allows sealant to be atomized inside the ductwork instead of externally.

The technology was developed at Lawrence Berkeley Laboratory (LBNL) by Carrie and Modera (Carrie and Modera 1993, Modera et al. 1996).

The energy savings resulting from implementation of the duct sealing technology can vary considerably depending on the location, length, and condition of the ducts. Tests performed by LBNL on 10 buildings indicated an average leakage of 23% of fan flow, and showed that aerosol sealant injection sealed 87% of that leakage.

The U. S. Navy Technology Validation (TechVal) program conducted evaluation and test installations of duct sealing, and provides the following rules of thumb to help decide whether duct sealing is appropriate for a given facility:

- Laboratory Supply and Laboratory Exhaust systems are worth sealing whenever it can be confirmed that they leak because of the large flow rates, the high fan power, and the heating/cooling loads associated with 100% outside air.

- Large Office Supply systems often benefit from sealing, particularly downstream of terminal boxes, as leakage in these duct sections is often not sealed very well at initial construction.
- Constant Volume Packaged Systems are usually worth sealing as long as the ducts are located above a ceiling, and there is insulation on the ceiling. A lack of additional insulation on the roof, or the existence of vents on the roof, makes these applications even more cost effective.
- Toilet/Shower Exhaust, Ventilation Supply or Exhaust systems are often not very well sealed at initial construction and are usually worth sealing, particularly if there are multiple vertical shafts to be sealed from the same roof or penthouse (Figure 4-1).

Figure 4-1. Duct sealing system.

Energy Savings calculated by assuming a duct leakage rate (20%) and a duct sealing rate (85%) showed, that in industrial buildings with ventilation and heating needs and no cooling in summer, 17% of fan power energy and gas can be saved. energy for the industrial building prototype. With the cost of sealing the entire system estimated at $0.45/sq ft floor area, a simple payback period varies between 2.5 and 8.0 years based on the climate (Figure 4-2). In air conditioned buildings, savings in compressor power are typically much greater than fan power use, and electrical savings in hot climates are considerably higher, resulting in a shorter payback (Figure 4-2).

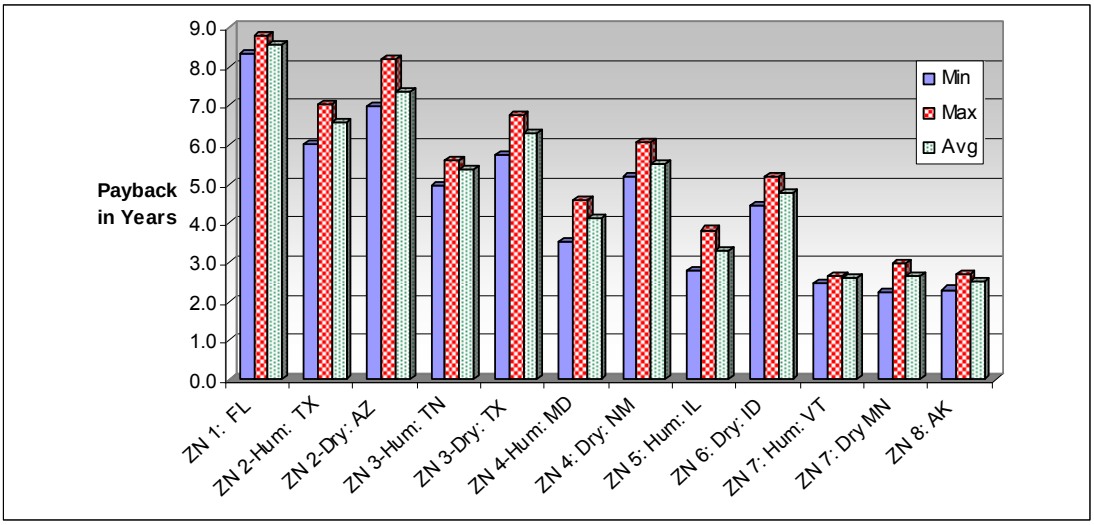


Figure 4-2. Estimated payback due to duct sealing.

The technology was developed for residential application in 1993 and for commercial application in 2003. Duct sealing technology is suitable for all climates.

Contacts and Major Manufacturers: Xetex, RenewAire, Fantech

Appendix 5: Heating and Cooling

5.1 Heating and Cooling Generation and Distribution Systems

5.1.1. Central Vs decentralized Systems. Heating and cooling generation and distribution are among the major contributors to the installations' energy waste and inefficiency. With new construction and major retrofits projects as well as major utility modernization projects central systems are economical and shall be used for the whole installation or a part of it if the heating density is higher than 40,000 MBtu/ (h × sq. mile), and the cooling density is higher than 68,700 MBtu/ (h × sq. mi.) or 5,750 tons/ (h × sq. mile).

When not proven otherwise, central plants shall be designed for combined heat and power (CHP) generation or tri-generation (heating, cooling and power generation), which has an enormous potential for increased thermal efficiency, fuel reliability and reduced environmental impacts.

Central plants with multiple cooling units are preferred, to permit loss of the largest unit while maintaining at least 65% design capacity. Where the master plan calls for multiple buildings in an area, in the design provide for future expansion of the central plant. Water cooled compressors are preferred over air cooled systems and when feasible rejected heat shall be utilized.

5.1.2. Heating Systems. With utility modernization projects, existing heating systems currently using steam as a heating media shall be converted to variable-temperature-variable-flow medium (<270°F) or low temperature (<190°F) hot water. Thus reducing operation and maintenance costs, and allowing the use of less expensive, more efficient piping material. Systems with condensing boilers are to be designed with lower operating return hot water temperatures, i.e. <55 C (130 °F), and use hot water reset to take advantage of the higher efficiencies of condensing boilers.

Steam needs shall be evaluated and, when absolutely necessary, provided by local steam boilers. Use onboard steam generators on equipment requiring steam or a small steam boiler just for the year-round steam load. Hot water system experience fewer problems related to expansion and contraction, have fewer corrosion problems, and are much easier to control, all of which result in low maintenance costs. Use boiler with the thermal efficiency ≥ 90% E_t. Solar-assisted systems shall be considered as alternatives or to compliment conventional boiler systems.

Conversion of steam systems may require some changes in the pipe distribution and new requirements for heat exchange equipment at the customer interface and in the central heating plant. In new construction and steam to hot water conversion projects, a so-called indirect compact substation shall be used. Figure 5-1 shows an example of the building interface installation:

The main parts of the customer interface are:

1. DH control for the secondary side (Figure 5-1, component a)
2. Control valve (Figure 5-1, component b)
3. Differential pressure control, flow rate control (Figure 5-1, component c)

4. Heat meter (Figure 5-1, component d)
5. Plate heat exchanger (Figure 5-1, component e).

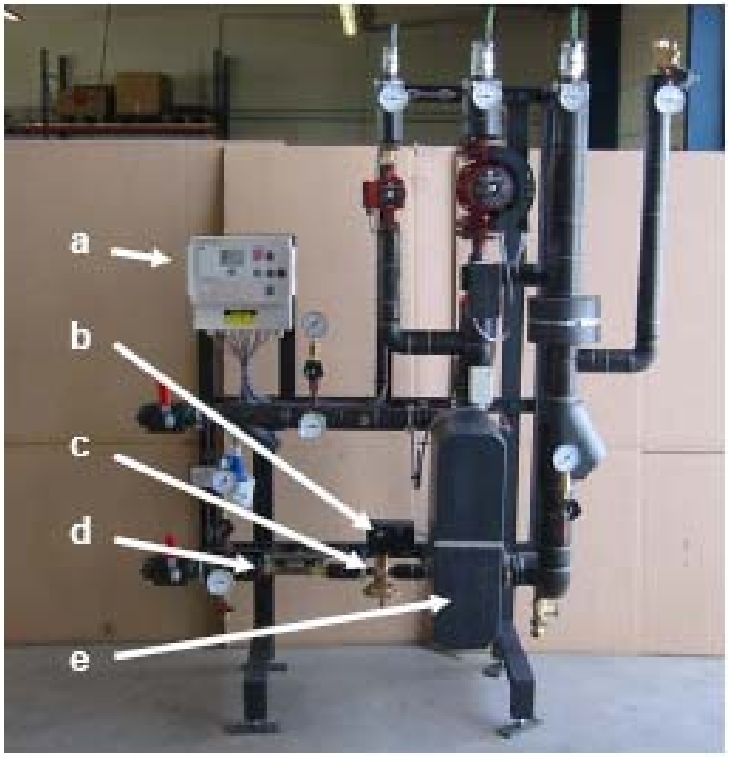


Figure 5-1. Photo of a modern, state-of-the-art DH compact station.

Both the DH control for the secondary side (a) and the control valve (b) regulate the secondary system flow according to the ambient temperature.

Furthermore, the control valve is used to program a time-dependent adjustment, e.g., the day/night shift, the so called night-time heating reduction.

The differential pressure control, flow rate control (c), is used to control the flow rate. Therefore, a certain flow rate limitation is fixed while the differential pressure is variable. When the differential pressure increases, the controller shuts according to its setpoint; similarly when the differential pressure decreases, the controller opens.

The heat meter (d) is used both for billing and to control the flow rate. Typically, at OCONUS installations, the utility owns the heat meter while the customer owns the compact station.

The plate heat exchanger (e) is used to decouple the primary DH distribution system from the secondary building side. This is important since the secondary building piping cannot bear up the relative high temperatures and pressures of the primary DH side.

Hot water in the building can be supplied either to radiators or to coils of the air heating systems. An “admix control” reduces the flow temperature in the secondary loop according to the ambient temperature. The secondary loop can handle different control programs, e.g., for weekend or nighttime heating reduction.

With the central heating system, domestic hot water preparation is also an “admix” operation controlled by the DH control unit for the secondary loop (e). In this loop, the lowest temperature is limited by hygienic conditions. Thus, the lowest flow temperature in the DH system is limited to 160 °F (70 °C) since the domestic hot water must have a temperature higher than 140°F (60 °C). The flow temperature must periodically be raised to 175°F (80 °C) to boost the domestic hot water to 160 °F (70 °C) (the required temperature to kill legionella) for thermal disinfection.

5.1.3. Pipes for Hot Water Distribution Systems. Pre-insulated bounded pipes shall be used for both medium and low temperature hot water systems. These pipes consist of a steel medium pipe and a plastic (i.e., polyethylene) jacket pipe. The insulation between the two pipes is made from a polyurethane (PUR) heat insulation foam. The pipes are pre-insulated in the factory and the PUR foam is a rigid material that bonds the outer jacket with the intermedium pipe.

Using these pipes will reduce the number of manholes and the size of the manholes which are currently about 15×15 Fort In addition, the manholes can be covered by an iron cap. Currently the existing manholes are open due to ventilation. Thus surface water and rain can easily flood the manholes and reduce the lifetime of the pipes due to external corrosion.

Figure 5-2 shows a photo of pre-insulated bounded pipes (pipe on the left is unused and is equipped with a leak detection system; pipe on the right was in use for about 30 years in a DH system with sliding flow temperatures [about 80 °C/130 °C]). The unused pipe is equipped with a leak detection system, indicated by the two wires seen on the far end of the pipe.

The most important limitation of the pipe is its maximum temperature restriction of 285 °F, which minimizes the aging of the PUR foam caused by exposure to the high temperatures.

The pipes are buried in frost-free depth in an open trench (Figure 5-3). After the laying of the pipe with a length of some 15 to 30 ft, the single pipes are connected through welding. Those weld joins are tested with radiation and evacuation tests. Afterwards, the PE jacket pipes are connected with shrinking bushings. Finally, the space between the medium pipe and bushings is foamed in place. Figure 5-4 shows different precast fittings, elbows and branches. Finally, the trench is filled with sand and compressed to bury the pipes. When the pipes are completely buried, the trench is further filled and prepared for the desired surface, which may be a street, pathway or grassland.

Figure 5-2. Pre-insulated bounded pipes (new and used)

Figure 5-3. Trench/canal for a buried pre-insulated pipe.

Figure 5-4. Pre-cast fittings and elbows of pre-insulated bounded pipes.

It is absolutely critical, that QC and QA be provided during the pipe installation to ensure the proper installation. Sensible issues are the bevel seams, the bushings and the foaming in back, the sand bed, the proper connection of the leak detection system and the expansion cushions.

5.1.4. Cooling Systems. ASHRAE Standard 90.1-2007 provides mandatory efficiency

requirements to cooling equipment (section 6.8). Equipment must meet or exceed the seasonal energy efficiency ratio (SEER) or energy efficiency ratio (EER) for the required capacity. The cooling equipment should also meet or exceed the integrated part-load value (IPLV) where applicable. However, requirements to use in Federal Buildings only Energy Star or FEMP designated products are considerably more stringent than Standard 90.1-2007.
(http://www1.eere.energy.gov/femp/procurement/eep_requirements.html)

For central refrigeration air-conditioning systems, provide freeze protection for all exposed piping and components for outdoor packaged chiller units.

Air handling units of the single zone building cooling systems in hot and humid climates (zones 1a, 2a, and 3a) shall be designed with a reheat coil to ensure that the supply air temperature is above the dew point. Variable temperature chilled water single zone units are also not acceptable without a reheat coil.

5.2. Hot Water

The use of hot water has a significant impact on energy consumption. Therefore, it is essential to reduce hot water use. The following should be standard procedure:

Hot Water Temperatures: The following temperatures are the authorized maximum at point of use:

1. Administrative use or general cleaning: 35 °C /95 °F.
2. Shower facilities: 43.3 °C / 110 °F.
3. Automatic dishwashing in dining facilities: 60 °C / 140 °F.
4. Final rinsing of dishes and kitchen utensils in dining and diet kitchen: 82.2 °C / 180 °F.
5. Hot water is not authorized in the following areas:
    a. Retail areas, except for food handling areas.
    b. Warehouses.

For maximum water efficiency and energy conservation:

Shower heads with a flow rate of less than 2.5 gpm shall be used. There are two basic types of low-flow showerheads: aerating and laminar-flow. Aerating showerheads mix air with water, forming a misty spray. Laminar-flow showerheads form individual streams of water. In a humid climate, use of a laminar-flow showerhead is preferable because it won't create as much steam and moisture as an aerating one;

For dishwashing, use low-flow pre-rinse spray valves with a flow rate of 1.6 gallons per minute or less, and a cleanability performance of 26 seconds per plate or less, based on the ASTM *Standard Test Method for Performance of Pre-Rinse Spray Valves*.
Cold water will be used in lieu of hot water whenever possible.
Report all water leaks to the DPW for immediate repair. A faucet dripping at the rate of one drop per second will waste 3,000 gallons of water per year.

Appendix 6: Lighting systems. (To be completed)

Appendix 7: HVAC Control Systems

7.1. Background. A direct digital control (DDC) system consists of microprocessor based hardware used to control a building's mechanical and electrical systems, particularly the Heating, Ventilating and Air Conditioning (HVAC) system. While a DDC system can function independently (or standalone) at the building-level, it is usually combined with a Utility Monitoring Control System (UMCS) consisting of one or more operator workstation computers used to monitor and manage the connected DDC systems. Within the context of this document, the UMCS along with its connected DDC systems is referred to a building automation system (BAS).

A longstanding goal of most Army installations is to implement a single and cohesive post wide BAS as opposed to multiple separate and independent BASs. Unfortunately most Army Installations procure DDC systems on a case-by-case (building-by-building or system-by-system) basis where the controls are installed under separate contracts and by different contractors and without the planning, preparation and training needed to procure a successful post wide BAS. A successful BAS will:

- Provide a single user interface with a consistent "look and feel" even though it consists of DDC products from different manufacturers installed by different contractors. A key requirement is that the DDC systems must inter-operate with each other and with a UMCS through the use of an Open communications protocol.
- Be expandable without sole-source procurement and supportable over the long term without involvement of the original installing contractors.
- Use standardized and consistent control systems and strategies to achieve a degree of commonality and familiarity for designers, construction quality verification staff, and O&M personnel.
- Support the needs of the building occupants, operations and maintenance (O&M) staff, and management. Therefore it must provide reliable environmental control, be useful to the O&M staff, and provide energy savings capability and functions.

Section 109 of the Energy Policy Act of 2005 sets the absolute minimum building control requirements for commercial buildings at the level of ANSI/ASHRAE/IESNA Standard 90.1-2004. However, Federal agencies are also required to achieve 30% lower energy consumption, if cost-effective, so the levels in Standard 90.1-2004 really only provide the basis for this calculation.

7.2. Requirements and Guidance

Two unified facilities guide specifications (UFGSs) for BASs were released in 2004. The specifications are geared towards multi-vendor, interoperable, and energy efficient DDC systems that integrate with a UMCS (http://www.wbdg.org/):

- The DDC guide spec, UFGS 23 09 23 (previously UFGS 15951): Direct Digital Control for HVAC and Other Building Systems specifies controls at the building level.
- The UMCS guide spec, UFGS 25 10 10 (previously UFGS 13801): Utility Monitoring and Control System (UMCS) specifies the supervisory and post wide system.

These two specifications are intended to work together such that a single UMCS serves as a base wide interface to many building-level DDC systems, regardless of the manufacturer or installer of the building controls. Related design guidance, control system drawings and UMCS drawings are available at: https://eko.usace.army.mil/fa/bAS/

The DDC and UMCS specifications are based on LONWORKS® technology[3] including the use of ANSI/CEA standards 709.1B and 852 (sometimes referred to as LonTalk®) for Open device communications and, LONWORKS® Network Services (LNS®) network operating system in support of Open network management and the LonMark Interoperability Guidelines. These elements and requirements lead to the procurement of an Open system - one where there is no future dependence on the original installing Contractor. For the purposes of procurement, this means that there is no sole source dependence on any Contractor for future system additions, upgrades, or modifications.

The specifications include energy savings requirements in line with the requirements defined in ANSI/ASHRAE/IESNA Standard 90.1-2004.

The goal of a single BAS translates directly into the one-time procurement of a single UMCS from a single vendor. The specifications require the UMCS to be installed and licensed to the Government such that it remains Open, and in concept all future integration of DDC systems into the UMCS can be competitively procured. In practice, however, the UMCS manufacturer/installer will be best able to perform the integration of DDC systems so in many cases installations will seek to procure integration services through the installing contractor. Regardless of who is performing the integration the building-level DDC systems can and should be procured competitively. A method for procuring and then expanding the UMCS must be identified and is discussed in ERDC/CERL Technical Report TR-07-16.

Figure 7-1 illustrates a UMCS/DDC system where multiple building DDC systems have been integrated into a single UMCS that provides multiple operator workstations ("UMCS Client"). Figure 7-2 also shows the UMCS/DDC system and further distinguishes between the UMCS and DDC elements specified by the two guide specifications.

Some of the benefits and capabilities of an Open multi-vendor BAS include:

- Competitive procurement, most notably at the building and sub-system level.
- Management of base-wide system operations such as: remote alarm reporting, remote scheduling (on/off control), remote set point override, data logging and reports, energy management including load shedding, utilities monitoring/measurement for the purpose of monitoring energy performance contracts, and initial diagnosis of service calls. Section 109 of the Energy Policy Act of 2005 sets the absolute minimum building control requirements for commercial buildings at the level of ANSI/ASHRAE/IESNA Standard 90.1-2004. However, Federal agencies are also required to achieve 30% lower energy consumption, if cost-effective, so the levels in Standard 90.1-2004 really only provide the basis for this calculation.
- A graphical user interface that provides for the same look and feel for monitoring and control regardless of which vendor's DDC system or sub-system an operator is viewing. As a result, system operators and managers need only become proficient with one user interface to efficiently and effectively manage base-wide operations..

[3] The term LONWORKS® is used to loosely describe a collection of technologies (including hardware, and software), vendors and installers relating to or based on the ANSI/CEA-709.1 communications protocol

- A “whole-building” or “intelligent-building” approach to systems integration where multiple building systems are integrated into one, including the efficient inter-connection of HVAC control sub-systems. For example, terminal unit equipment such as VAV boxes can be readily interfaced to the servicing air handler to turn the air handler on when needed. In addition, the whole-building approach provides the capability for integrating HVAC and non-HVAC systems such as lighting. For example, the same occupancy sensor that tells a VAV box to cool a room can also turn on the lights in the room.

BACnet® is an alternative communications protocol that may be used where implementation planning has been completed and an implementation strategy has been documented. There is no Army-approved UFGS for BACnet, so design of BACnet systems should use the requirements found in the MILCON Transformation Model RFP and ERDC/CER TR-07-03 as described in ECB 2007-8.

Related BAS implementation guidance and information is available in Engineering Construction Bulletin (ECB) 2004-11, ECB 2005-17, ECB 2007-8, and ERDC/CERL Technical Reports TR-05-14 and TR-07-03, and TR-07-16.

Summary

Army Installation BAS design standards include the use of LONWORKS® technology, LONWORKS® Network Services, ANSI/CEA 709.1 communications protocol, and ANSI/CEA-852 communications protocol, and ANSI/ASHRAE/IESNA Standard 90.1-2004. This approach applies to all HVAC control system and energy monitoring system projects including additions and retrofits. Designers should also strive to include these standards in lighting control projects notably including those where occupancy sensors are used. Designers should consider the use of these standards for water and sanitary sewer systems, electrical systems, and other utility systems. BACnet® is an alternative communications protocol that may be used where implementation planning has been completed and an implementation strategy has been documented. There is no Army-approved UFGS for BACnet, so design of BACnet systems should use the requirements found in the MILCON Transformation Model RFP and ERDC/CER TR-07-03 as described in ECB 2007-8.

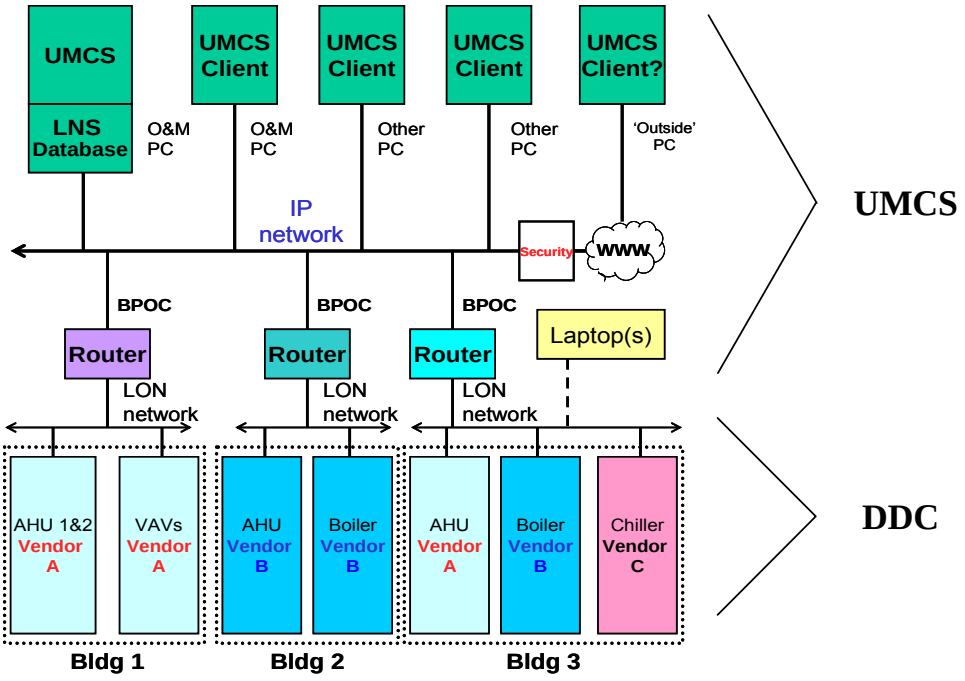


Figure 7-1. Basewide LonWorks® BAS—including a UMCS and multiple-vendor DDC systems.

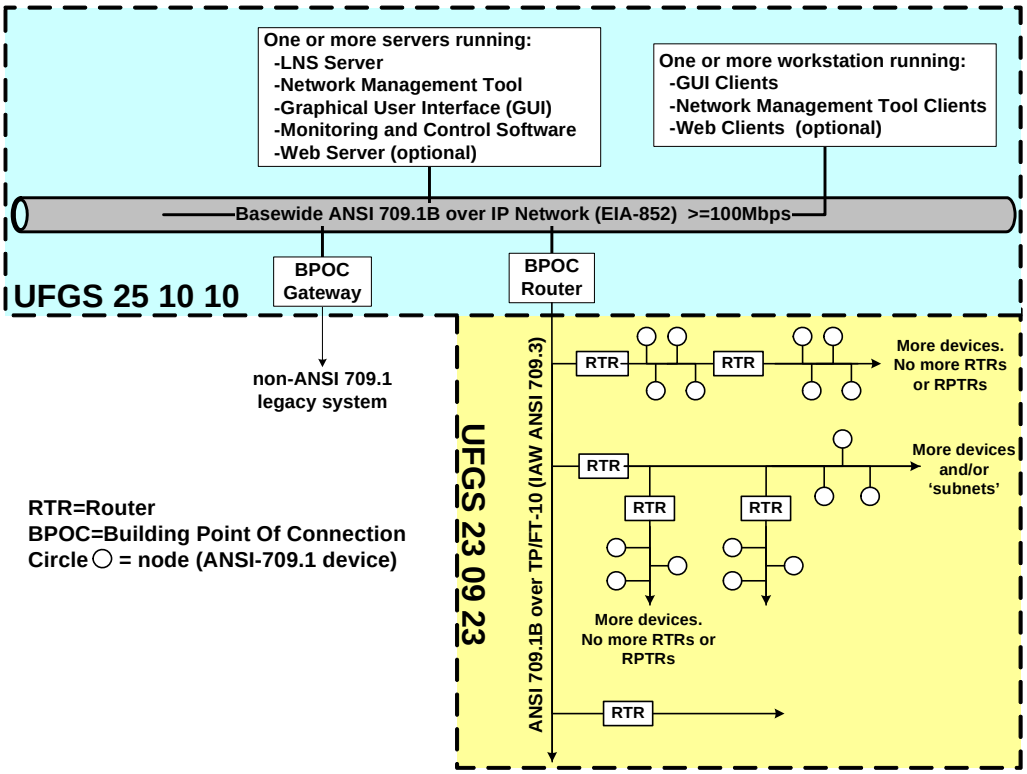


Figure 7-2. BAS comprised of UMCS and DDC systems.

Appendix 8: Appliances

In all new Army facilities and all major renovations only Energy Star or FEMP designated appliances shall be used. The term “Energy Star product” means a product that is rated for energy efficiency under an Energy Star program. The term “FEMP designated product” means a product that is designated under the Federal Energy Management Program of the Department of Energy as being among the highest 25 percent of equivalent products for energy efficiency. When selecting integral sized electric motors, choose NEMA PREMIUM type motors that conform to NEMA MG 1, minimum Class F insulation system. Motors with efficiencies lower than the NEMA PREMIUM standard may only be used in unique applications that require a high constant torque speed ratio (e.g., inverter duty or vector duty type motors that conform to NEMA MG 1, Part 30 or Part 31).

Transformers represent large electrical consumption sources and should be unplugged when not required.

Dryers represent large electricity expenditure. Dryers should only be used with full loads. Dryers should not be set to operate in excess of 60 minutes (overheating can also degrade clothing). The use of clothes racks or lines is encouraged for drying clothes and will extend their useful life.

No appliances or transformers shall be left on when rooms are unoccupied, except for ovens, dryers, washers and refrigerators. Appliances with a spliced or damaged cord will not be used.

Appendix 9: HVAC Equipment Performance Efficiencies Considerations

9.1. Regulatory requirements for HVAC Systems. HVAC system requirements address the heating, ventilating, and air-conditions in the building. These systems typically are the largest energy users in most buildings and the proper design of these systems is necessary to achieve minimal energy usage. Section 109 of the Energy Policy Act of 2005 sets the absolute minimum HVAC system requirements for commercial buildings at the level of ANSI/ASHRAE/IESNA Standard 90.1-2004. However, Federal agencies are also required to achieve 30% lower energy consumption, if cost-effective, so the levels in Standard 90.1-2004 really only provide the basis for this calculation.

ASHRAE Standard 90.1-2007 provides two types of requirements for HVAC systems – mandatory and simplified, prescriptive, some of them are more stringent than the ones in the previous, 2004, addition. Standard has different requirements for systems installed in new buildings and to additions and replacements of HVAC systems in existing buildings, *Standard 90.1-2007 Mandatory HVAC Requirements include minimum* HVAC equipment performance efficiencies (Section 6.4.1). *Standard 90.1-2007 Prescriptive HVAC Requirements* discussed in Section 6.5 are a function of HVAC system.

ASHRAE Advanced Energy Design Guides include requirements to HVAC systems, that are considerably more stringent than Standard 90.1-2007, although not necessarily 30% better as required for Federal agencies by EPAct 2005. These requirements are also a function of HVAC system. The guides recommend higher HVAC efficiencies for air conditioners, gas furnaces, and heat pumps. (THESE EFFICIENCIES NEED TO BE CHECKED AGAINST FEMP-DESIGNATED AND ENERGY STAR AS REQUIRED FOR FEDERAL AGENCIES). For HVAC systems, the guides recommend economizers for air conditioners and heat pumps if the cooling capacity is greater than 54 kBtuh.

HVAC equipment must meet or exceed the seasonal energy efficiency ratio (SEER) or energy efficiency ratio (EER) values of Energy Star or FEMP designated products, which are considerably more stringent than Standard 90.1-2007 (http://www1.eere.energy.gov/femp/procurement/eep_requirements.html)

US Army Corps of Engineers Prescriptive Requirements to HVAC equipment which are listed in design guides to achieve 30 percent energy savings over a baseline built to the minimum requirements of ANSI/ASHRAE/IESNA Standard 90.1-2004 for new buildings to be constructed under Military Transformation Program. These requirements are listed in Tables ???

Appendix 10: Heating Systems Efficiencies. (to be developed)

Appendix 11: Cooling Systems Efficiencies (to be developed)

Appendix 12: HVAC Motor Considerations (to be developed)

Appendix 13: Energy Metering (to be developed)

Appendix 14: Prescriptive and optional energy saving technologies for barracks

14.1 Prescriptive Technology Solution Sets

As part of the EPACT 2005 energy study discussed in Appendix 1, a prescriptive technology solution set was developed for the UEPH barracks for each climate zone to achieve at least a 30% energy consumption reduction compared to an ASHRAE 90.1-2004 minimum baseline building. The general energy conservation measures used to achieve the 30% reduction are listed in Table 14-1.

Table 14-1. General energy conservation measures used to achieve the 30% reduction

ECM	Baseline Models	Efficient Models
Wall Insulation	Standard 90.1-2004	Higher R-Values (see Tables 3-1 to 3-5).
Roof Insulation	Standard 90.1-2004	Higher R-Values (see Tables 3-1 to 3-5).
Roof Solar Reflectance	0.08	0.27
Window-to-Wall Ratio	20%	20%
Window Construction	Standard 90.1-2004	ASHRAE AEDG 30% Small Offices
Infiltration	0.4 cfm/ft^2 @ 75 Pa	0.25 cfm/ft^2 @ 75 Pa
Ventilation	Exhaust plus make-up air for infiltration at 5 Pa	Same as baseline but reduced make-up air for the tighter building
Lighting	1.1 W/ft^2 in rooms, 0.5 in corridors, 0.6 in stairwells	0.9 W/ft^2 in rooms, 0.45 in corridors, 0.54 in stairwells
SWH Boiler Efficiency	80%	95%
Grey water heat recovery	None	Assumed 30% savings on shower hot water
HVAC Systems	Packaged Single Zone with DX coil (3.05 COP) for cooling and natural gas coil (80% efficient) for heating	DOAS with DX coil (3.5 COP) and ERV (75%-70% sensible effectiveness) and hot water coil, 4-pipe fan coil with central chiller and boiler

The specific prescriptive technology solution set for UEPH in each climate zone is shown below:

Climate Zone 1A, Prescriptive Technology Solution Table

Item	Component	Baseline (1)	30% Solution
Roof	Attic	R-30	R-40
	Surface reflectance	0.08	0.27
Walls	Light Weight Construction	R-13	R-20
Exposed Floors	Mass	R-4.2 c.i.	R-5 c.i.
Slabs	Unheated	NR (2)	NR (2)
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-1.45	U-1.45
Infiltration		0.4 cfm/ft^2 @ 75 Pa	0.25 cfm/ft^2 @ 75 Pa (3)
Vertical Glazing	Window to Wall Ratio (WWR)	10% - 20%	10% - 20%
	Thermal transmittance	U-1.22	U-0.45
	Solar heat gain coefficient (SHGC)	0.25	0.31
Interior Lighting	Lighting Power Density (LPD)	1.1 W/ft^2	0.9 W/ft^2
	Ballast		Electronic ballast
HVAC	Air Conditioner	PSZ-AC 12.0 SEER (3.05 COP)	4-Pipe Fan Coil with central chiller and boiler plus DOAS (4) with 14.0 SEER DX coil (3.52 COP) and HHW coil on central boiler SAT control 55ºF – 62ºF with OAT 75º – 54ºF
	Gas Furnace	80% E_t	none
	ERV	None	70% - 75% sensible effectiveness
Economizer		no	no
Ventilation	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	NR
	Laundry Room		Decoupled (5)
Ducts	Friction Rate		0.08 in. w.c./100 feet
	Sealing		Seal class B
	Location		Interior only
	Insulation level		R-6 (6)
Service Water Heating	Gas storage	80% E_t	90% E_t

Climate Zone 2A, Prescriptive Technology Solution Table

Item	Component	Baseline (1)	30% Solution
Roof	Attic	R-30	R-40
	Surface reflectance	0.08	0.27
Walls	Light Weight Construction	R-13	R-20
Exposed Floors	Mass	R-4.2 c.i.	R-10 c.i.
Slabs	Unheated	NR (2)	NR (2)
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-1.45	U-1.45
Infiltration		0.4 cfm/ft^2 @ 75 Pa	0.25 cfm/ft^2 @ 75 Pa (3)
Vertical Glazing	Window to Wall Ratio (WWR)	10% - 20%	10% - 20%
	Thermal transmittance	U-1.22	U-0.45
	Solar heat gain coefficient (SHGC)	0.25	0.31
Interior Lighting	Lighting Power Density (LPD)	1.1 W/ft^2	0.9 W/ft^2
	Ballast		Electronic ballast
HVAC	Air Conditioner	PSZ-AC 12.0 SEER (3.05 COP)	4-Pipe Fan Coil with central chiller and boiler plus DOAS (4) with 14.0 SEER DX coil (3.52 COP) and HHW coil on central boiler SAT control 55ºF – 62ºF with OAT 75º – 54ºF
	Gas Furnace	80% E_t	none
	ERV	None	70% - 75% sensible effectiveness
Economizer		no	no
Ventilation	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	NR
	Laundry Room		Decoupled (5)
Ducts	Friction Rate		0.08 in. w.c./100 feet
	Sealing		Seal class B
	Location		Interior only
	Insulation level		R-6 (6)
Service Water Heating	Gas storage	80% E_t	90% E_t

Climate Zone 2B, Prescriptive Technology Solution Table

Item	Component	Baseline (1)	30% Solution
Roof	Attic	R-30	R-40
	Surface reflectance	0.08	0.27
Walls	Light Weight Construction	R-13	R-20
Exposed Floors	Mass	R-4.2 c.i.	R-10 c.i.
Slabs	Unheated	NR (2)	NR (2)
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-1.45	U-1.45
Infiltration		0.4 cfm/ft^2 @ 75 Pa	0.25 cfm/ft^2 @ 75 Pa (3)
Vertical Glazing	Window to Wall Ratio (WWR)	10% - 20%	10% - 20%
	Thermal transmittance	U-1.22	U-0.45
	Solar heat gain coefficient (SHGC)	0.25	0.31
Interior Lighting	Lighting Power Density (LPD)	1.1 W/ft^2	0.9 W/ft^2
	Ballast		Electronic ballast
HVAC	Air Conditioner	PSZ-AC 12.0 SEER (3.05 COP)	4-Pipe Fan Coil with central chiller and boiler plus DOAS (4) with 14.0 SEER DX coil (3.52 COP) and HHW coil on central boiler SAT control 55ºF – 62ºF with OAT 75º – 54ºF
	Gas Furnace	80% E_t	none
	ERV	None	70% - 75% sensible effectiveness
Economizer		yes	yes
Ventilation	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	NR
	Laundry Room		Decoupled (5)
Ducts	Friction Rate		0.08 in. w.c./100 feet
	Sealing		Seal class B
	Location		Interior only
	Insulation level		R-6 (6)
Service Water Heating	Gas storage	80% E_t	90% E_t

Climate Zone 3A, Prescriptive Technology Solution Table

Item	Component	Baseline (1)	30% Solution
Roof	Attic	R-30	R-40
	Surface reflectance	0.08	0.27
Walls	Light Weight Construction	R-13	R-20
Exposed Floors	Mass	R-4.2 c.i.	R-10 c.i.
Slabs	Unheated	NR (2)	NR (2)
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-1.45	U-1.45
Infiltration		0.4 cfm/ft^2 @ 75 Pa	0.25 cfm/ft^2 @ 75 Pa (3)
Vertical Glazing	Window to Wall Ratio (WWR)	10% - 20%	10% - 20%
	Thermal transmittance	U-0.57	U-0.45
	Solar heat gain coefficient (SHGC)	0.37	0.31
Interior Lighting	Lighting Power Density (LPD)	1.1 W/ft^2	0.9 W/ft^2
	Ballast		Electronic ballast
HVAC	Air Conditioner	PSZ-AC 12.0 SEER (3.05 COP)	4-Pipe Fan Coil with central chiller and boiler plus DOAS (4) with 14.0 SEER DX coil (3.52 COP) and HHW coil on central boiler SAT control 55ºF – 62ºF with OAT 75º – 54ºF
	Gas Furnace	80% E_t	none
	ERV	None	70% - 75% sensible effectiveness
Economizer		no	no
Ventilation	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	NR
	Laundry Room		Decoupled (5)
Ducts	Friction Rate		0.08 in. w.c./100 feet
	Sealing		Seal class B
	Location		Interior only
	Insulation level		R-6 (6)
Service Water Heating	Gas storage	80% E_t	90% E_t

Climate Zone 3B, Prescriptive Technology Solution Table

Item	Component	Baseline (1)	30% Solution
Roof	Attic	R-30	R-40
	Surface reflectance	0.08	0.27
Walls	Light Weight Construction	R-13	R-20
Exposed Floors	Mass	R-4.2 c.i.	R-10 c.i.
Slabs	Unheated	NR (2)	NR (2)
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-1.45	U-1.45
Infiltration		0.4 cfm/ft^2 @ 75 Pa	0.25 cfm/ft^2 @ 75 Pa (3)
Vertical Glazing	Window to Wall Ratio (WWR)	10% - 20%	10% - 20%
	Thermal transmittance	U-0.57	U-0.45
	Solar heat gain coefficient (SHGC)	0.37	0.31
Interior Lighting	Lighting Power Density (LPD)	1.1 W/ft^2	0.9 W/ft^2
	Ballast		Electronic ballast
HVAC	Air Conditioner	PSZ-AC 12.0 SEER (3.05 COP)	4-Pipe Fan Coil with central chiller and boiler plus DOAS (4) with 14.0 SEER DX coil (3.52 COP) and HHW coil on central boiler SAT control 55ºF – 62ºF with OAT 75º – 54ºF
	Gas Furnace	80% E_t	none
	ERV	None	70% - 75% sensible effectiveness
Economizer		yes	yes
Ventilation	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	NR
	Laundry Room		Decoupled (5)
Ducts	Friction Rate		0.08 in. w.c./100 feet
	Sealing		Seal class B
	Location		Interior only
	Insulation level		R-6 (6)
Service Water Heating	Gas storage	80% E_t	90% E_t

Climate Zone 3C, Prescriptive Technology Solution Table

Item	Component	Baseline (1)	30% Solution
Roof	Attic	R-30	R-40
	Surface reflectance	0.08	0.27
Walls	Light Weight Construction	R-13	R-20
Exposed Floors	Mass	R-4.2 c.i.	R-10 c.i.
Slabs	Unheated	NR (2)	NR (2)
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-1.45	U-1.45
Infiltration		0.4 cfm/ft^2 @ 75 Pa	0.25 cfm/ft^2 @ 75 Pa (3)
Vertical Glazing	Window to Wall Ratio (WWR)	10% - 20%	10% - 20%
	Thermal transmittance	U-1.22	U-0.45
	Solar heat gain coefficient (SHGC)	0.39	0.31
Interior Lighting	Lighting Power Density (LPD)	1.1 W/ft^2	0.9 W/ft^2
	Ballast		Electronic ballast
HVAC	Air Conditioner	PSZ-AC 12.0 SEER (3.05 COP)	4-Pipe Fan Coil with central chiller and boiler plus DOAS (4) with 14.0 SEER DX coil (3.52 COP) and HHW coil on central boiler SAT control 55ºF – 62ºF with OAT 75º – 54ºF
	Gas Furnace	80% E_t	none
	ERV	None	70% - 75% sensible effectiveness
Economizer		yes	yes
Ventilation	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	NR
	Laundry Room		Decoupled (5)
Ducts	Friction Rate		0.08 in. w.c./100 feet
	Sealing		Seal class B
	Location		Interior only
	Insulation level		R-6 (6)
Service Water Heating	Gas storage	80% E_t	90% E_t

Climate Zone 4A, Prescriptive Technology Solution Table

Item	Component	Baseline (1)	30% Solution
Roof	Attic	R-30	R-50
	Surface reflectance	0.08	0.27
Walls	Light Weight Construction	R-13	R-20
Exposed Floors	Mass	R-4.2 c.i.	R-20
Slabs	Unheated	NR (2)	NR (2)
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-1.45	U-1.45
Infiltration		0.4 cfm/ft^2 @ 75 Pa	0.25 cfm/ft^2 @ 75 Pa (3)
Vertical Glazing	Window to Wall Ratio (WWR)	10% - 20%	10% - 20%
	Thermal transmittance	U-0.57	U-0.45
	Solar heat gain coefficient (SHGC)	0.39	0.31
Interior Lighting	Lighting Power Density (LPD)	1.1 W/ft^2	0.9 W/ft^2
	Ballast		Electronic ballast
HVAC	Air Conditioner	PSZ-AC 12.0 SEER (3.05 COP)	4-Pipe Fan Coil with central chiller and boiler plus DOAS (4) with 14.0 SEER DX coil (3.52 COP) and HHW coil on central boiler SAT control 55ºF – 62ºF with OAT 75º – 54ºF
	Gas Furnace	80% E_t	none
	ERV	None	70% - 75% sensible effectiveness
Economizer		no	no
Ventilation	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	NR
	Laundry Room		Decoupled (5)
Ducts	Friction Rate		0.08 in. w.c./100 feet
	Sealing		Seal class B
	Location		Interior only
	Insulation level		R-6 (6)
Service Water Heating	Gas storage	80% E_t	90% E_t

Climate Zone 4B, Prescriptive Technology Solution Table

Item	Component	Baseline (1)	30% Solution
Roof	Attic	R-30	R-50
	Surface reflectance	0.08	0.27
Walls	Light Weight Construction	R-13	R-25
Exposed Floors	Mass	R-4.2 c.i.	R-20
Slabs	Unheated	NR (2)	NR (2)
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-1.45	U-1.45
Infiltration		0.4 cfm/ft^2 @ 75 Pa	0.25 cfm/ft^2 @ 75 Pa (3)
Vertical Glazing	Window to Wall Ratio (WWR)	10% - 20%	10% - 20%
	Thermal transmittance	U-0.57	U-0.42
	Solar heat gain coefficient (SHGC)	0.39	0.46
Interior Lighting	Lighting Power Density (LPD)	1.1 W/ft^2	0.9 W/ft^2
	Ballast		Electronic ballast
HVAC	Air Conditioner	PSZ-AC 12.0 SEER (3.05 COP)	4-Pipe Fan Coil with central chiller and boiler plus DOAS (4) with 14.0 SEER DX coil (3.52 COP) and HHW coil on central boiler SAT control 55ºF – 62ºF with OAT 75º – 54ºF
	Gas Furnace	80% E_t	none
	ERV	None	70% - 75% sensible effectiveness
Economizer		yes	yes
Ventilation	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	NR
	Laundry Room		Decoupled (5)
Ducts	Friction Rate		0.08 in. w.c./100 feet
	Sealing		Seal class B
	Location		Interior only
	Insulation level		R-6 (6)
Service Water Heating	Gas storage	80% E_t	90% E_t

Climate Zone 4C, Prescriptive Technology Solution Table

Item	Component	Baseline (1)	30% Solution
Roof	Attic	R-30	R-50
	Surface reflectance	0.08	0.27
Walls	Light Weight Construction	R-13	R-25
Exposed Floors	Mass	R-4.2 c.i.	R-20
Slabs	Unheated	NR (2)	NR (2)
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-1.45	U-1.45
Infiltration		0.4 cfm/ft^2 @ 75 Pa	0.25 cfm/ft^2 @ 75 Pa (3)
Vertical Glazing	Window to Wall Ratio (WWR)	10% - 20%	10% - 20%
	Thermal transmittance	U-0.57	U-0.42
	Solar heat gain coefficient (SHGC)	0.39	0.46
Interior Lighting	Lighting Power Density (LPD)	1.1 W/ft^2	0.9 W/ft^2
	Ballast		Electronic ballast
HVAC	Air Conditioner	PSZ-AC 12.0 SEER (3.05 COP)	4-Pipe Fan Coil with central chiller and boiler plus DOAS (4) with 14.0 SEER DX coil (3.52 COP) and HHW coil on central boiler SAT control 55ºF – 62ºF with OAT 75º – 54ºF
	Gas Furnace	80% E_t	none
	ERV	None	70% - 75% sensible effectiveness
Economizer		yes	yes
Ventilation	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	NR
	Laundry Room		Decoupled (5)
Ducts	Friction Rate		0.08 in. w.c./100 feet
	Sealing		Seal class B
	Location		Interior only
	Insulation level		R-6 (6)
Service Water Heating	Gas storage	80% E_t	90% E_t

Climate Zone 5A, Prescriptive Technology Solution Table

Item	Component	Baseline (1)	30% Solution
Roof	Attic	R-30	R-50
	Surface reflectance	0.08	0.27
Walls	Light Weight Construction	R-13 + 3.8 c.i.	R-25
Exposed Floors	Mass	R-4.2 c.i.	R-20
Slabs	Unheated	NR (2)	NR (2)
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-1.45	U-1.45
Infiltration		0.4 cfm/ft^2 @ 75 Pa	0.25 cfm/ft^2 @ 75 Pa (3)
Vertical Glazing	Window to Wall Ratio (WWR)	10% - 20%	10% - 20%
	Thermal transmittance	U-0.57	U-0.42
	Solar heat gain coefficient (SHGC)	0.39	0.46
Interior Lighting	Lighting Power Density (LPD)	1.1 W/ft^2	0.9 W/ft^2
	Ballast		Electronic ballast
HVAC	Air Conditioner	PSZ-AC 12.0 SEER (3.05 COP)	4-Pipe Fan Coil with central chiller and boiler plus DOAS (4) with 14.0 SEER DX coil (3.52 COP) and HHW coil on central boiler SAT control 55ºF – 62ºF with OAT 75º – 54ºF
	Gas Furnace	80% E_t	none
	ERV	None	70% - 75% sensible effectiveness
Economizer		yes	yes
Ventilation	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	NR
	Laundry Room		Decoupled (5)
Ducts	Friction Rate		0.08 in. w.c./100 feet
	Sealing		Seal class B
	Location		Interior only
	Insulation level		R-6 (6)
Service Water Heating	Gas storage	80% E_t	90% E_t

Climate Zone 5B, Prescriptive Technology Solution Table

Item	Component	Baseline (1)	30% Solution
Roof	Attic	R-30	R-50
	Surface reflectance	0.08	0.27
Walls	Light Weight Construction	R-13 + 3.8 c.i.	R-25
Exposed Floors	Mass	R-4.2 c.i.	R-20
Slabs	Unheated	NR (2)	NR (2)
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-1.45	U-1.45
Infiltration		0.4 cfm/ft^2 @ 75 Pa	0.25 cfm/ft^2 @ 75 Pa (3)
Vertical Glazing	Window to Wall Ratio (WWR)	10% - 20%	10% - 20%
	Thermal transmittance	U-0.57	U-0.42
	Solar heat gain coefficient (SHGC)	0.39	0.46
Interior Lighting	Lighting Power Density (LPD)	1.1 W/ft^2	0.9 W/ft^2
	Ballast		Electronic ballast
HVAC	Air Conditioner	PSZ-AC 12.0 SEER (3.05 COP)	4-Pipe Fan Coil with central chiller and boiler plus DOAS (4) with 14.0 SEER DX coil (3.52 COP) and HHW coil on central boiler SAT control 55ºF – 62ºF with OAT 75º – 54ºF
	Gas Furnace	80% E_t	none
	ERV	None	70% - 75% sensible effectiveness
Economizer		yes	yes
Ventilation	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	NR
	Laundry Room		Decoupled (5)
Ducts	Friction Rate		0.08 in. w.c./100 feet
	Sealing		Seal class B
	Location		Interior only
	Insulation level		R-6 (6)
Service Water Heating	Gas storage	80% E_t	90% E_t

Climate Zone 6A, Prescriptive Technology Solution Table

Item	Component	Baseline (1)	30% Solution
Roof	Attic	R-30	R-60
	Surface reflectance	0.08	0.27
Walls	Light Weight Construction	R-13 + 3.8 c.i.	R-30
Exposed Floors	Mass	R-4.2 c.i.	R-30
Slabs	Unheated	NR (2)	NR (2)
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-1.45	U-1.45
Infiltration		0.4 cfm/ft^2 @ 75 Pa	0.25 cfm/ft^2 @ 75 Pa (3)
Vertical Glazing	Window to Wall Ratio (WWR)	10% - 20%	10% - 20%
	Thermal transmittance	U-0.57	U-0.42
	Solar heat gain coefficient (SHGC)	0.39	0.46
Interior Lighting	Lighting Power Density (LPD)	1.1 W/ft^2	0.9 W/ft^2
	Ballast		Electronic ballast
HVAC	Air Conditioner	PSZ-AC 12.0 SEER (3.05 COP)	4-Pipe Fan Coil with central chiller and boiler plus DOAS (4) with 14.0 SEER DX coil (3.52 COP) and HHW coil on central boiler SAT control 55ºF – 62ºF with OAT 75º – 54ºF
	Gas Furnace	80% E_t	none
	ERV	None	70% - 75% sensible effectiveness
Economizer		yes	yes
Ventilation	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	NR
	Laundry Room		Decoupled (5)
Ducts	Friction Rate		0.08 in. w.c./100 feet
	Sealing		Seal class B
	Location		Interior only
	Insulation level		R-6 (6)
Service Water Heating	Gas storage	80% E_t	90% E_t

Climate Zone 6B, Prescriptive Technology Solution Table

Item	Component	Baseline (1)	30% Solution
Roof	Attic	R-30	R-60
	Surface reflectance	0.08	0.27
Walls	Light Weight Construction	R-13 + 3.8 c.i.	R-30
Exposed Floors	Mass	R-4.2 c.i.	R-30
Slabs	Unheated	NR (2)	NR (2)
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-1.45	U-0.50
Infiltration		0.4 cfm/ft^2 @ 75 Pa	0.25 cfm/ft^2 @ 75 Pa (3)
Vertical Glazing	Window to Wall Ratio (WWR)	10% - 20%	10% - 20%
	Thermal transmittance	U-0.57	U-0.42
	Solar heat gain coefficient (SHGC)	0.39	0.46
Interior Lighting	Lighting Power Density (LPD)	1.1 W/ft^2	0.9 W/ft^2
	Ballast		Electronic ballast
HVAC	Air Conditioner	PSZ-AC 12.0 SEER (3.05 COP)	4-Pipe Fan Coil with central chiller and boiler plus DOAS (4) with 14.0 SEER DX coil (3.52 COP) and HHW coil on central boiler SAT control 55ºF – 62ºF with OAT 75º – 54ºF
	Gas Furnace	80% E_t	none
	ERV	None	70% - 75% sensible effectiveness
Economizer		yes	yes
Ventilation	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	NR
	Laundry Room		Decoupled (5)
Ducts	Friction Rate		0.08 in. w.c./100 feet
	Sealing		Seal class B
	Location		Interior only
	Insulation level		R-6 (6)
Service Water Heating	Gas storage	80% E_t	90% E_t

Climate Zone 7A, Prescriptive Technology Solution Table

Item	Component	Baseline (1)	30% Solution
Roof	Attic	R-30	R-60
	Surface reflectance	0.08	0.27
Walls	Light Weight Construction	R-13 + 7.5 c.i.	R-3 0
Exposed Floors	Mass	R-4.2 c.i.	R-30.
Slabs	Unheated	NR (2)	NR (2)
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-1.45	U-0.50
Infiltration		0.4 cfm/ft^2 @ 75 Pa	0.25 cfm/ft^2 @ 75 Pa (3)
Vertical Glazing	Window to Wall Ratio (WWR)	10% - 20%	10% - 20%
	Thermal transmittance	U-0.57	U-0.33
	Solar heat gain coefficient (SHGC)	0.49	NR
Interior Lighting	Lighting Power Density (LPD)	1.1 W/ft^2	0.9 W/ft^2
	Ballast		Electronic ballast
HVAC	Air Conditioner	PSZ-AC 12.0 SEER (3.05 COP)	4-Pipe Fan Coil with central chiller and boiler plus DOAS (4) with 14.0 SEER DX coil (3.52 COP) and HHW coil on central boiler SAT control 55ºF – 62ºF with OAT 75º – 54ºF
	Gas Furnace	80% E_t	none
	ERV	None	70% - 75% sensible effectiveness
Economizer		yes	yes
Ventilation	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	NR
	Laundry Room		Decoupled (5)
Ducts	Friction Rate		0.08 in. w.c./100 feet
	Sealing		Seal class B
	Location		Interior only
	Insulation level		R-6 (6)
Service Water Heating	Gas storage	80% E_t	90% E_t

Climate Zone 8A, Prescriptive Technology Solution Table

Item	Component	Baseline (1)	30% Solution
Roof	Attic	R-30	R-60
	Surface reflectance	0.08	0.27
Walls	Light Weight Construction	R-13 + 7.5 c.i.	R-30
Exposed Floors	Mass	R-4.2 c.i.	R-30
Slabs	Unheated	10	10
Doors	Swinging	U-0.46	U-0.70
	Non-Swinging	NR	U-0.50
Infiltration		0.4 cfm/ft^2 @ 75 Pa	0.25 cfm/ft^2 @ 75 Pa (3)
Vertical Glazing	Window to Wall Ratio (WWR)	10% - 20%	10% - 20%
	Thermal transmittance	U-0.46	U-0.33
	Solar heat gain coefficient (SHGC)	NR	0.31
Interior Lighting	Lighting Power Density (LPD)	1.1 W/ft^2	0.9 W/ft^2
	Ballast		Electronic ballast
HVAC	Air Conditioner	PSZ-AC 12.0 SEER (3.05 COP)	4-Pipe Fan Coil with central chiller and boiler plus DOAS (4) with 14.0 SEER DX coil (3.52 COP) and HHW coil on central boiler SAT control 55ºF – 62ºF with OAT 75º – 54ºF
	Gas Furnace	80% E_t	none
	ERV	None	70% - 75% sensible effectiveness
Economizer		yes	yes
Ventilation	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	NR
	Laundry Room		Decoupled (5)
Ducts	Friction Rate		0.08 in. w.c./100 feet
	Sealing		Seal class B
	Location		Interior only
	Insulation level		R-6 (6)
Service Water Heating	Gas storage	80% E_t	90% E_t

Prescriptive Technology Solution Table Notes (#):

1. Baseline requirements are from ANSI/ASHRAE/IESNA Standard 90.1-2004.
2. NR means there is no requirement or recommendation for a component in this climate.
3. **Increased Building Air tightness.** Building air leakage (measured in cfm/ft^2) is the average volume of air(measured in cubic feet per minute) that passes through a unit area of the *building envelope* (measured in square feet) when the building is maintained at a specified internal pressure (measured in Pascals). Testing requirements are specified in Chapter 5..
4. **Dedicated Outdoor Air System**. A central dedicated outdoor air system (DOAS) providing the following:
   a. outside air for building indoor air quality and humidity control, (the amount needed is typically less than the amount exhausted from the bathroom and kitchen)
   b. make-up air for bathroom and kitchen exhausts
   c. Building pressurization to prevent infiltration which allows for reduction of heating/cooling and moisture loads on the system.
   NOTE: The Central DOAS does not provide sensible heating or cooling. Sensible loads are provided by a complementing heating and cooling system
5. **Decoupling exhaust and supply systems for laundry rooms**. To reduce unneeded energy use for heating and cooling of the make-up air and for air transportation of supply and exhausted air from the dryers, laundry exhaust and supply systems are separated in the efficient building model from the rest of the building exhaust and supply systems. Laundry exhaust system and corresponding make-up systems operate only when dryers are operating.
6. The duct and pipe insulation values are from the ASHRAE Advanced Energy Design Guide for Small Offices.

14.2 Energy Savings Results Achieved

Table 14-2 shows the energy consumption reductions (without plug/process loads) achieved using the above prescriptive technology solution sets compared to a minimum ASHRAE 90.1-2004 compliant UEPH.

Table 14-2. Energy consumption reductions achieved using prescriptive technology solution sets described.

Zone	City	Baseline (kBtu/ft^2)	Prescriptive Technology Solution Set	
			(kBtu/ft^2)	Savings
1A	Miami, FL	82	40	51%
2A	Houston, TX	82	37	55%
2B	Phoenix, AZ	45	32	30%

3A	Memphis, TN	71	35	51%
3B	El Paso, TX	42	30	30%
3C	San Francisco, CA	47	26	45%
4A	Baltimore, MD	75	32	57%
4B	Albuquerque, NM	48	29	40%
4C	Seattle, WA	60	27	55%
5A	Chicago, IL	77	32	58%
5B	Colorado Springs, CO	54	28	48%
6A	Burlington, VT	83	32	61%
6B	Helena, MT	68	29	57%
7A	Duluth, MN	91	33	64%
8A	Fairbanks, AK	123	42	66%

The following are descriptions of some of the technologies used in the prescriptive solution sets described above:

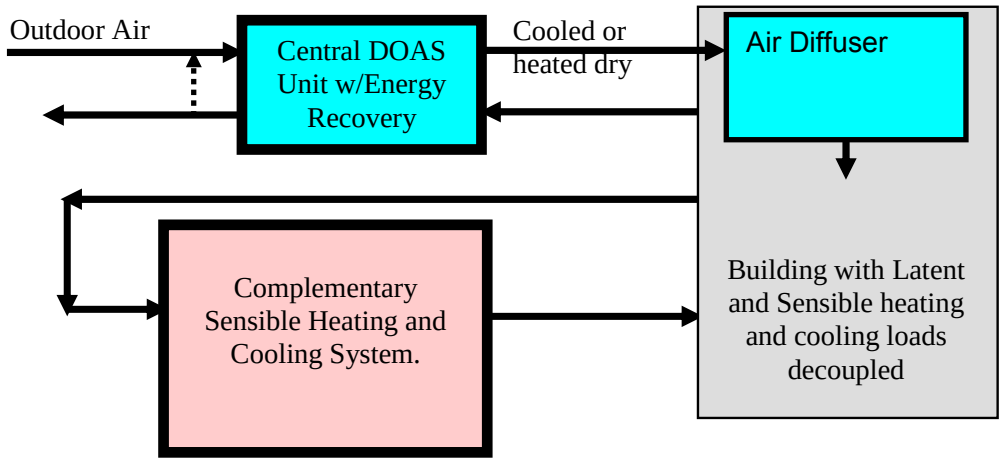
14.3 Dedicated outdoor air system

Three fundamental requirements for elimination of mold in Army facilities are:

- Minimize air leakage through the building envelope (discussed in a separate section of this document)
- Control the dew point temperature/relative humidity of the space with a central Dedicated Outdoor Air System (DOAS)
- Provide only room dry bulb temperature control with the in-room air conditioning system.

Figure 14-1 shows a central dedicated outdoor air system (DOAS). The DOAS will provide the following:

- outside air for building indoor air quality and humidity control, (the amount needed is typically less than the amount exhausted from the bathroom and kitchen)
- make-up air for bathroom and kitchen exhausts
- building pressurization to prevent infiltration which allows for reduction of heating/cooling and moisture loads on the system.



DOAS Schematic

Figure 14-1. Central dedicated outdoor air system (DOAS).

Central DOAS does not provide heating or sensible cooling. This is provided by a complementing heating and cooling system, which will be taking care of only sensible loads. Complementing system can be radiant ceiling system or a conventional convective HVAC system. If a convective HVAC system is used, the system must not deliver conditioned air to any space in the building at a dry bulb temperature which is below the dew point temperature in the space. All chilled water piping in the building must be properly insulated and all air conditioning units with ANY potential for condensation on the unit must have full coverage condensate drain systems.

Dedicated outdoor air system shall operate and provided the dew point temperature/relative humidity and a positive building pressure when building spaces are occupied or non-occupied for a short or long periods of time. Indoor conditions to be maintained in all spaces in all climate zones are shown in Appendix 2..

DOAS can have different configurations capable of providing deep outdoor air dehumidification. Figure 14-2 shows a detailed schematic of all-electric DX/desiccant DOAS unit installed in the Building 637 at Fort Stewart. In the figure, the leaving dew point temperature (DPT) from the DX coils is shown to be 50 F (10.0 C). This assumes that the air leaving the DX coils is saturated. The desiccant wheel further dehumidifies and reheats the air, resulting in a supply air dry bulb temperature (DBT) of 64.9 F (18.3 C) and a supply air relative humidity of 39.8% (which is equivalent to a supply air dew point temperature of 39.9 F (4.4 C). This dry air is then delivered to the occupant rooms via air distribution ductwork. This system delivers 4500 CFM, about 25 percent more ventilation air than the original system in an effort to maintain positive pressurization of the occupant rooms and prevent infiltration of hot, humid outdoor air.

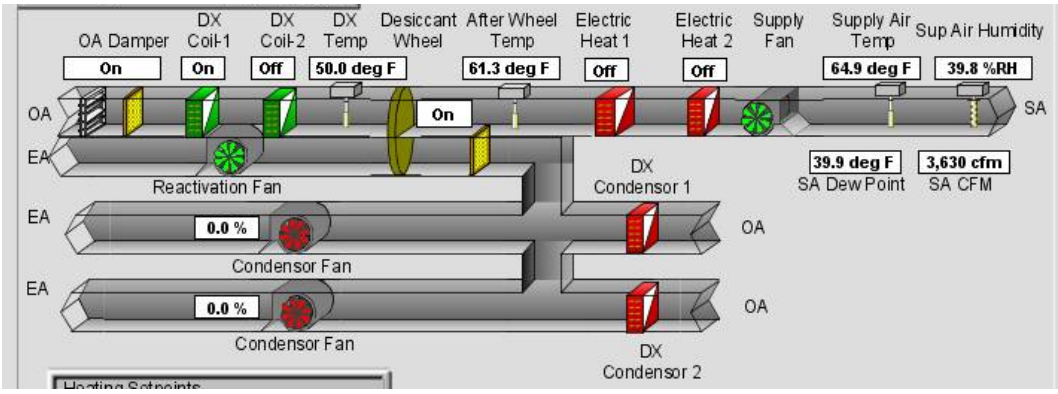


Figure 14-2. All-electric DX/desiccant DOAS unit installed in the Building 637 at Fort Stewart

Figure 14-3 shows schematic of a DOAS system used in a retrofit project of the Barrack 631 at Fort Stewart with a York Solutions AHU. Downstream of air filters, a preheat coil and a chilled water cooling coil, the AHU includes a DX cooling coil and an air-cooled condenser. The leaving dew point temperature (DPT) from the chilled water cooling coil is about 58 F (14.4 C). The DX cooling coil further dehumidifies the air, with a leaving DPT of approximately 40 F (4.4 C). This dry air is then reheated by the air-cooled condenser coil before being delivered to the occupant rooms at approximately 62 F (16.7 C) dry bulb temperature (DBT) and 40 F (4.4 C) DPT. As in the case with the system installed in the Building 637, this system delivers 4500 CFM, about 25 percent more ventilation air than the original system in an effort to maintain positive pressurization of the occupant rooms and prevent infiltration of hot, humid outdoor air.

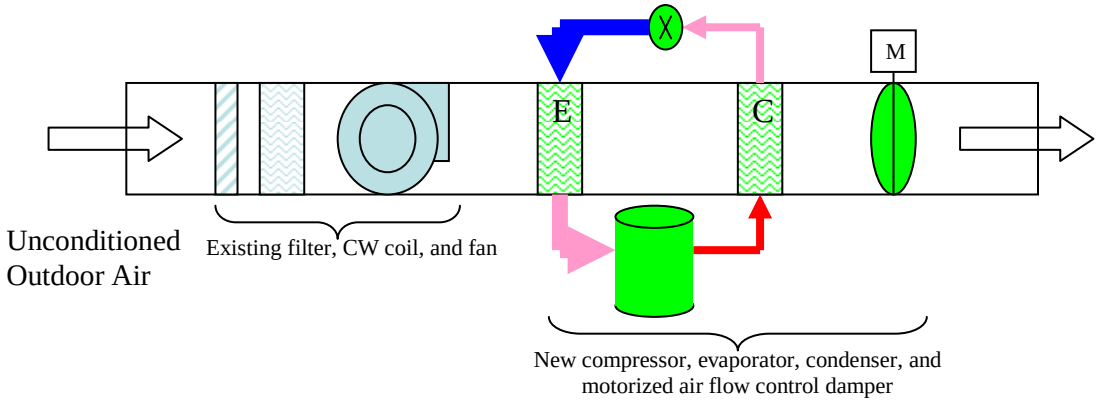


Figure 14-3. DOAS system used in a retrofit project of the Barrack 631 at Fort Stewart with a York Solutions AHU

14.4 Grey Water Heat Recovery

Domestic hot water (DHW) is one of the major heating energy users in the Army barrack buildings. Approximately 80-90% of hot water energy goes down the drain. Gravity Film heat eXchanger (GFX) technology was developed on a US Department of Energy (DOE) grant to capture heat carried by hot water and in 2002 received a Green Product Award. This technology is compatible with all types of water heating systems, including solar water heating systems. While shower water usage per a single shower head in

Permanent Party Barracks may be comparable with a shower water usage in residential buildings, it may be significantly higher in training barracks. Same applies to billets with common shower area. Thus, one can expect a payback period for such barracks to be shorter.

Gravity-Film Heat Exchanger (GFX) is a vertical counterflow heat exchanger that extracts heat out of drain water and applies it to preheat the cold water be mixed with hot water to be used in the shower (Figure 14-4). The CFX consists of a 2 to 4-inch central cooper pipe (that carries the warm wastewater) with ½-in.cooper coils wound around the central pipe. Heat is transferred from the wastewater passing through the large, central pipe to the cold water simultaneously moving upward through the coils on the outside of the pipe. The coils are flattened a little to increase the contact area and improve heat transfer. The system is beneficial for use with showers where the use of hot and cold water and the production of waste-water from the shower occur at the same time.

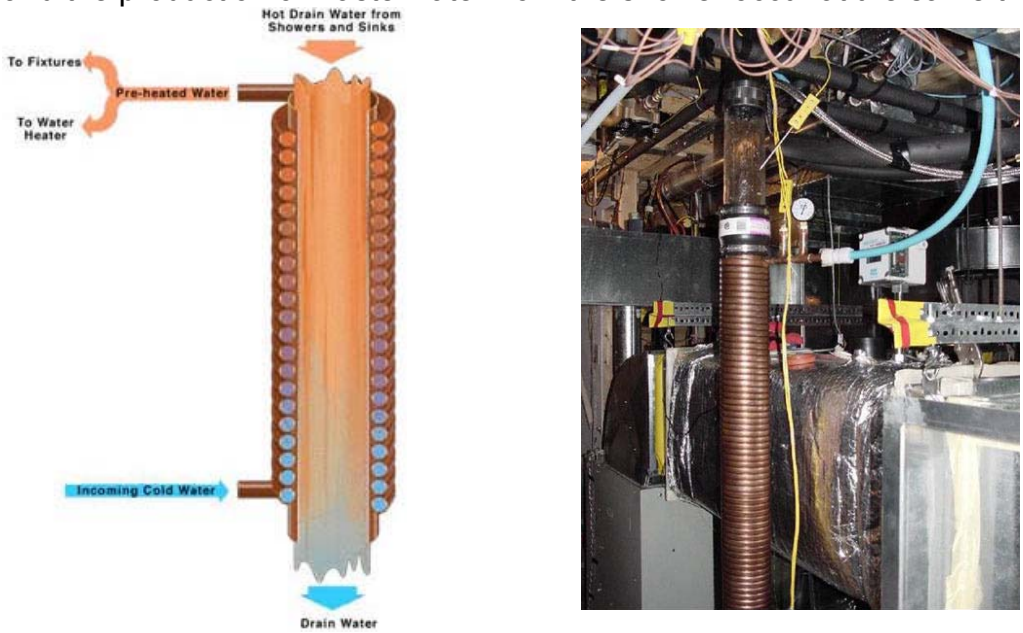


Figure 14-4. GFX system schematics and installation example

Energy savings occur due to use of waste water heat to preheat the cold water be mixed with hot water to be used in the shower. Cold water preheating results in reduction of the hot water usage. In addition to energy conservation GFX allows size reduction of the hot water storage tanks and (in the case of solar water heating) size reduction of solar water heaters.
According to Oak Ridge National Laboratory, this technology has been found to save 25–30 percent of total water-heating energy needed for showers. With an average usage rate of 30gal/day per occupant at 110°F (43°C), depending upon location and climate, DHW can consume more up to 60% of the total annual heating energy supplied to barrack buildings and be the dominant hot water consumer during the non-heating season.

An annual energy use and savings were analyzed for a barrack/dormitory baseline building built to meet the minimum requirements of ASHRAE Standard 90.1-1989. The

prototype building is three stories high, has an area of 30,465 ft^2, 40 2-bedroom apartment units, lobby on the main floor, and laundry rooms on each floor. For the payback calculations, it was assumed, that each GFX system serves 20 apartments and the average cost of each of two systems' retrofit including the cost of 4" heat recovery unit and drain lines, its transportation and installation is about $850.

Energy savings (Figure 14-5) differ between climates varying between 3% and 7% of the total barrack building energy use (at 25% energy recovery). While placing of GFX system for each shower is not cost efficient, installation of one heat exchanger for a group of showers produce a reasonable pay-back of 2 to 5 years (Figure 14-6).

Gravity Film heat eXchanger (GFX) technology has been developed over the last 7 years.

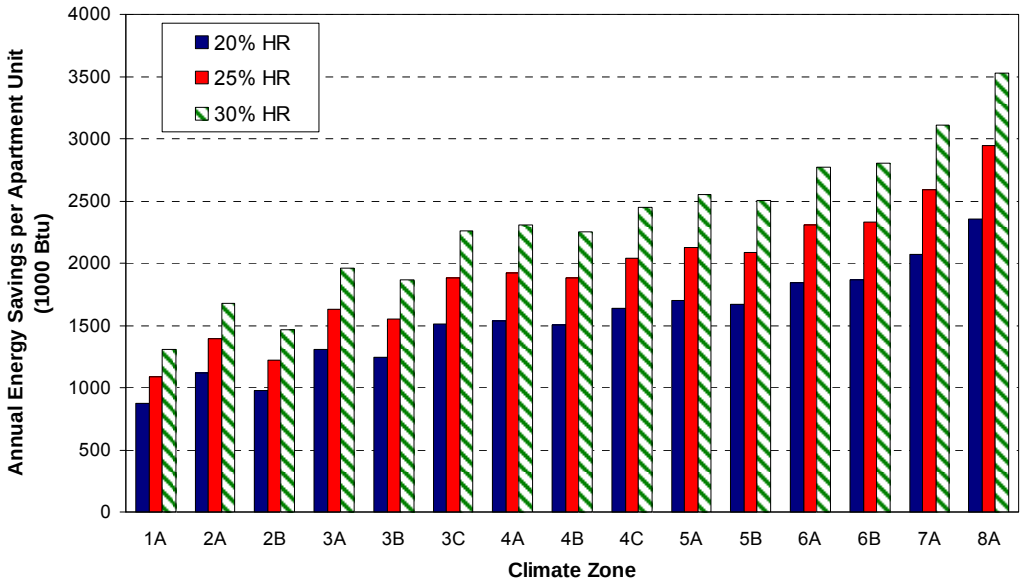


Figure 14-5. Annual energy savings per apartment unit with different heat recovery efficiency.

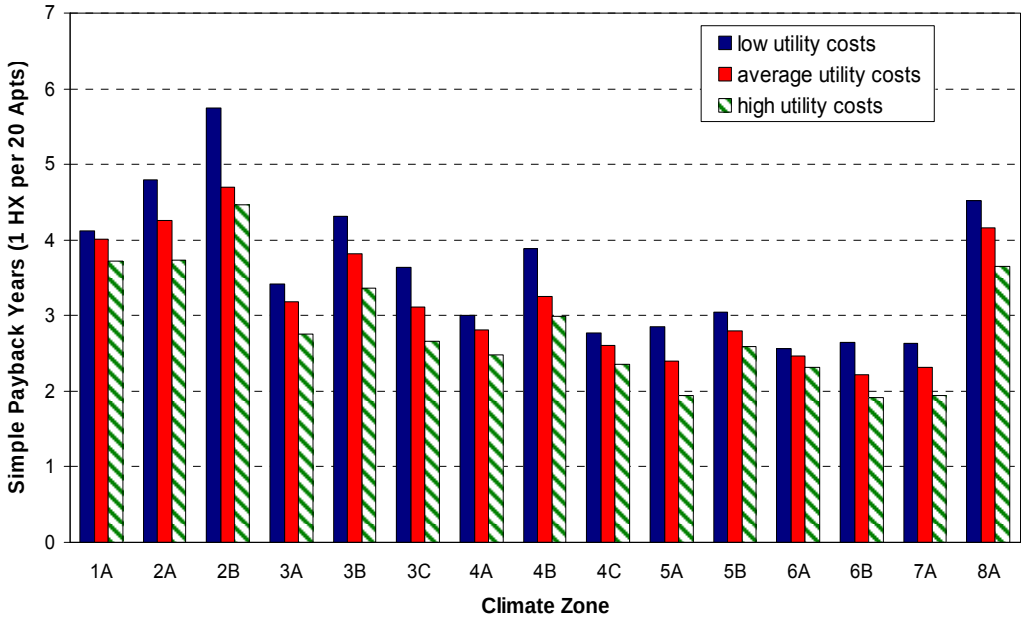


Figure 14-6. Simple payback, years with low, average and high utility rates for the heat recovery system servicing 20 apartments.

Appendix 15: Prescriptive and optional energy saving technologies for administrative facilities (To be completed)

Appendix 16: Prescriptive and optional energy saving technologies for Tactical Equipment maintenance Facilities

16.1 Prescriptive Technology Solution Sets

As part of the EPACT 2005 energy study discussed in Appendix 1, a prescriptive technology solution set was developed for the TEMF for each climate zone to achieve at least a 30% energy consumption reduction compared to an ASHRAE 90.1-2004 minimum baseline building. The general energy conservation measures used to achieve the 30% reduction are shown below:

Building Component	Baseline Building Model	Efficient Building Model
Area	49,920 ft^2 (4,638 m^2)	Same as baseline
Floors	2	Same as baseline
Aspect ratio	4.4	Same as baseline
Fenestration type	Standard 90.1-2004	Improved
Wall construction	steel frame	Metal building
Wall insulation	Standard 90.1-2004 steel frame	Improved
Roof construction	Flat built up roof	Metal building roof
Roof insulation	Standard 90.1-2004 equal to the "insulation entirely above deck"	Improved
Roof albedo	0.3	0.65 (CZ 1-5) 0.3 (CZ 6-8)
Infiltration	0.5 ACH	0.5 ACH
Temp set points	70ºF heating; 75ºF cooling – set back when unoccupied to 55ºF heating; 91ºF cooling Repair bays, vehicle corridor, and storage 1: 55ºF heating, no cooling	Same as baseline
HVAC	PSZ with DX-AC (3.05 COP) and gas furnace (0.8 E_t); packaged make-up air units for exhaust make-up air and gas fired unit heaters for the repair bays, vehicle corridor, and consolidated bench	Increased efficiency of the baseline HVAC system to 3.52 COP, 0.9 E_t, and efficient fans. Energy recovery on repair bay, vehicle corridor, and consolidated bench exhaust systems. Assumed sensible heat recovery at 70% to 75% effectiveness. Reduced ventilation requirement using demand controlled ventilation.
DHW	Natural gas boiler (0.8 E_t)	Natural gas boiler (0.9 E_t)

The specific prescriptive technology solution set for TEMF in each climate zone is shown below:

Climate Zone 1A, Prescriptive Technology Solution Table

Item	Component	Baseline1	Recommendation
Roof	Insulation above deck	R-15 ci	
	Metal building roof		R-19
	Surface reflectance	0.3	0.65
Walls	Steel-framed	R-13	
	Metal building		R-13
Slabs	Unheated	NR[2]	NR
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-1.45	U-0.25
Infiltration		0.5 ACH	0.5 ACH
Vertical Glazing	Window to Wall Ratio (WWR)	< 10%	< 10%
	Thermal transmittance	U-1.22	U-0.56
	Solar heat gain coefficient (SHGC)	0.25	0.49 – N; 0.35 – S, E, W
	South Overhangs	None	NR
Skylights	Percent roof area	None	2%
	Thermal transmittance		U-1.36
	SHGC		0.19
Interior Lighting	Lighting Power Density	See note 3	See note 3
	Ballast		Electronic ballast
	Daylighting controls [4]	none	Yes
	Occupancy controls	NR	all unoccupied spaces
HVAC	Make up Air Unit Fans	See Fan Efficiency Table	See Fan Efficiency Table
	Air Conditioner	PSZ-AC 12.0 SEER	PSZ-AC 14.0 SEER
	Gas Coil	80% E_t	90% E_t
	Hydronic radiant floor heat	None	None
	ERV	None	None
Economizer		NR	NR
Ventilation	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	NR
	Transpired Solar Coll.	None	None
Ducts	Sealing		Seal class B
	Location		Interior only
	Insulation level [5]		R-6
Service Water Heating	Gas storage	80% E_t	90% E_t

Climate Zone 2A, Prescriptive Technology Solution Table

Item	Component	Baseline[1]	Recommendation
Roof	Insulation above deck	R-15 ci	
	Metal building roof		R-19
	Surface reflectance	0.3	0.65
Walls	Steel-framed	R-13	
	Metal building		R-13
Slabs	Unheated	NR[2]	NR
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-1.45	U-0.25
Infiltration		0.5 ACH	0.5 ACH
Vertical Glazing	Window to Wall Ratio (WWR)	< 10%	< 10%
	Thermal transmittance	U-1.22	U-0.45
	Solar heat gain coefficient (SHGC)	0.25	0.44 – N; 0.31 – S, E, W
	South Overhangs	None	NR
Skylights	Percent roof area	None	2%
	Thermal transmittance		U-1.36
	SHGC		0.19
Interior Lighting	Lighting Power Density	See Note 3	See Note 3
	Ballast		Electronic ballast
	Daylighting controls [4]	none	Yes
	Occupancy controls	NR	all unoccupied spaces
HVAC	Make up Air Unit Fans	See Fan Efficiency Table	See Fan Efficiency Table
	Air Conditioner	PSZ-AC 12.0 SEER	PSZ-AC 14.0 SEER
	Gas Coil	80% E_t	90% E_t
	Hydronic radiant floor heat	None	Ground floor
	ERV	None	None
Economizer		NR	NR
Ventilation	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	NR
	Transpired Solar Coll.	None	None
Ducts	Sealing		Seal class B
	Location		Interior only
	Insulation level[5]		R-6
Service Water Heating	Gas storage	80% E_t	90% E_t

Climate Zone 2B, Prescriptive Technology Solution Table

Item	Component	Baseline[1]	Recommendation
Roof	Insulation above deck	R-15 ci	
	Metal building roof		R-19
	Surface reflectance	0.3	0.65
Walls	Steel-framed	R-13	
	Metal building		R-13
Slabs	Unheated	NR[2]	NR
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-1.45	U-0.25
Infiltration		0.5 ACH	0.5 ACH
Vertical Glazing	Window to Wall Ratio (WWR)	< 10%	< 10%
	Thermal transmittance	U-1.22	U-0.45
	Solar heat gain coefficient (SHGC)	0.25	0.44 – N; 0.31 – S, E, W
	South Overhangs	None	NR
Skylights	Percent roof area	None	2%
	Thermal transmittance		U-1.36
	SHGC		0.19
Interior Lighting	Lighting Power Density	See Note 3	See Note 3
	Ballast		Electronic ballast
	Daylighting controls [4]	none	Yes
	Occupancy controls	NR	all unoccupied spaces
HVAC	Make up Air Unit Fans	See Fan Efficiency Table	See Fan Efficiency Table
	Air Conditioner	PSZ-AC 12.0 SEER	PSZ-AC 14.0 SEER
	Gas Coil	80% E_t	90% E_t
	Hydronic radiant floor heat	None	Ground floor
	ERV	None	None
Economizer		NR	NR
Ventilation	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	NR
	Transpired Solar Coll.	None	None
Ducts	Sealing		Seal class B
	Location		Interior only
	Insulation level[5]		R-6
Service Water Heating	Gas storage	80% E_t	90% E_t

Climate Zone 3A, Prescriptive Technology Solution Table

Item	Component	Baseline[1]	Recommendation
Roof	Insulation above deck	R-15 ci	
	Metal building roof		R-13 + R-13
	Surface reflectance	0.3	0.65
Walls	Steel-framed	R-13	
	Metal building		R-13
Slabs	Unheated	NR[2]	NR
	Heated	R-7.5 for 12 in	R-10
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-1.45	U-0.25
Infiltration		0.5 ACH	0.5 ACH
Vertical Glazing	Window to Wall Ratio (WWR)	< 10%	< 10%
	Thermal transmittance	U-0.57	U-0.45
	Solar heat gain coefficient (SHGC)	0.37	0.44 – N; 0.31 – S, E, W
	South Overhangs	None	NR
Skylights	Percent roof area	None	2%
	Thermal transmittance		U-0.69
	SHGC		0.19
Interior Lighting	Lighting Power Density	See Note 3	See Note 3
	Ballast		Electronic ballast
	Daylighting controls [4]	none	Yes
	Occupancy controls	NR	all unoccupied spaces
HVAC	Make up Air Unit Fans	See Fan Efficiency Table	See Fan Efficiency Table
	Air Conditioner	PSZ-AC 12.0 SEER	PSZ-AC 14.0 SEER
	Gas Coil	80% E_t	90% E_t
	Hydronic radiant floor heat	None	Ground floor
	ERV	None	Yes
Economizer		NR	NR
Ventilation	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	NR
	Transpired Solar Coll.	None	Yes
Ducts	Sealing		Seal class B
	Location		Interior only
	Insulation level [5]		R-6
Service Water Heating	Gas storage	80% E_t	90% E_t

Climate Zone 3B, Prescriptive Technology Solution Table

Item	Component	Baseline[1]	Recommendation
Roof	Insulation above deck	R-15 ci	
	Metal building roof		R-13 + R-13
	Surface reflectance	0.3	0.65
Walls	Steel-framed	R-13	
	Metal building		R-13
Slabs	Unheated	NR[2]	NR
	Heated	R-7.5 for 12 in	R-10
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-1.45	U-0.25
Infiltration		0.5 ACH	0.5 ACH
Vertical Glazing	Window to Wall Ratio (WWR)	< 10%	< 10%
	Thermal transmittance	U-0.57	U-0.45
	Solar heat gain coefficient (SHGC)	0.37	0.44 – N; 0.31 – S, E, W
	South Overhangs	None	NR
Skylights	Percent roof area	None	2%
	Thermal transmittance		U-0.69
	SHGC		0.19
Interior Lighting	Lighting Power Density	See Note 3	See Note 3
	Ballast		Electronic ballast
	Daylighting controls [4]	none	Yes
	Occupancy controls	NR	all unoccupied spaces
HVAC	Make up Air Unit Fans	See Fan Efficiency Table	See Fan Efficiency Table
	Air Conditioner	PSZ-AC 12.0 SEER	PSZ-AC 14.0 SEER
	Gas Coil	80% E_t	90% E_t
	Hydronic radiant floor heat	None	Ground floor
	ERV	None	Yes
Economizer		NR	NR
Ventilation	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	NR
	Transpired Solar Coll.	None	Yes
Ducts	Sealing		Seal class B
	Location		Interior only
	Insulation level [5]		R-6
Service Water Heating	Gas storage	80% E_t	90% E_t

Climate Zone 3C, Prescriptive Technology Solution Table

Item	Component	Baseline[1]	Recommendation
Roof	Insulation above deck	R-15 ci	
	Metal building roof		R-13 + R-13
	Surface reflectance	0.3	0.65
Walls	Steel-framed	R-13	
	Metal building		R-13
Slabs	Unheated	NR[2]	NR
	Heated	R-7.5 for 12 in	R-10
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-1.45	U-0.25
Infiltration		0.5 ACH	0.5 ACH
Vertical Glazing	Window to Wall Ratio (WWR)	< 10%	< 10%
	Thermal transmittance	U-1.22	U-0.45
	Solar heat gain coefficient (SHGC)	0.39	0.6
	South Overhangs	None	NR
Skylights	Percent roof area	None	2%
	Thermal transmittance		U-1.36
	SHGC		0.19
Interior Lighting	Lighting Power Density	See Note 3	See Note 3
	Ballast		Electronic ballast
	Daylighting controls[4]	none	Yes
	Occupancy controls	NR	all unoccupied spaces
HVAC	Make up Air Unit Fans	See Fan Efficiency Table	See Fan Efficiency Table
	Air Conditioner	PSZ-AC 12.0 SEER	PSZ-AC 14.0 SEER
	Gas Coil	80% E_t	90% E_t
	Hydronic radiant floor heat	None	Ground floor
	ERV	None	Yes
Economizer		NR	NR
Ventilation	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	NR
	Transpired Solar Coll.	None	None
Ducts	Sealing		Seal class B
	Location		Interior only
	Insulation level [5]		R-6
Service Water Heating	Gas storage	80% E_t	90% E_t

Climate Zone 4A, Prescriptive Technology Solution Table

Item	Component	Baseline[1]	Recommendation
Roof	Insulation above deck	R-15 ci	
	Metal building roof		R-13 + R-19
	Surface reflectance	0.3	0.65
Walls	Steel-framed	R-13	
	Metal building		R-13
Slabs	Unheated	NR[2]	NR
	Heated	R-7.5 for 24 in	R-10
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-1.45	U-0.25
Infiltration		0.5 ACH	0.5 ACH
Vertical Glazing	Window to Wall Ratio (WWR)	< 10%	< 10%
	Thermal transmittance	U-0.57	U-0.42
	Solar heat gain coefficient (SHGC)	0.39	0.46
	South Overhangs	None	NR
Skylights	Percent roof area	None	2%
	Thermal transmittance		U-0.69
	SHGC		0.34
Interior Lighting	Lighting Power Density	See Note 3	See Note 3
	Ballast		Electronic ballast
	Daylighting controls [4]	none	Yes
	Occupancy controls	NR	all unoccupied spaces
HVAC	Make up Air Unit Fans	See Fan Efficiency Table	See Fan Efficiency Table
	Air Conditioner	PSZ-AC 12.0 SEER	PSZ-AC 14.0 SEER
	Gas Coil	80% E_t	90% E_t
	Hydronic radiant floor heat	None	Ground floor
	ERV	None	Yes
Economizer		NR	NR
Ventilation	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	Yes
	Transpired Solar Coll.	None	Yes
	Transpired Solar Coll.	None	Yes
Ducts	Sealing		Seal class B
	Location		Interior only
	Insulation level [5]		R-6
Service Water Heating	Gas storage	80% E_t	90% E_t

Climate Zone 4B, Prescriptive Technology Solution Table

Item	Component	Baseline[1]	Recommendation
Roof	Insulation above deck	R-15 ci	
	Metal building roof		R-13 + R-19
	Surface reflectance	0.3	0.65
Walls	Steel-framed	R-13	
	Metal building		R-13
Slabs	Unheated	NR[2]	NR
	Heated	R-7.5 for 24 in	R-10
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-1.45	U-0.25
Infiltration		0.5 ACH	0.5 ACH
Vertical Glazing	Window to Wall Ratio (WWR)	< 10%	< 10%
	Thermal transmittance	U-0.57	U-0.42
	Solar heat gain coefficient (SHGC)	0.39	0.46
	South Overhangs	None	NR
Skylights	Percent roof area	None	2%
	Thermal transmittance		U-0.69
	SHGC		0.34
Interior Lighting	Lighting Power Density	See Note 3	See Note 3
	Ballast		Electronic ballast
	Daylighting controls [4]	none	Yes
	Occupancy controls	NR	all unoccupied spaces
HVAC	Make up Air Unit Fans	See Fan Efficiency Table	See Fan Efficiency Table
	Air Conditioner	PSZ-AC 12.0 SEER	PSZ-AC 14.0 SEER
	Gas Coil	80% E_t	90% E_t
	Hydronic radiant floor heat	None	Ground floor
	ERV	None	Yes
Economizer		NR	NR
Ventilation	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	Yes
	Transpired Solar Coll.	None	Yes
	Transpired Solar Coll.	None	Yes
Ducts	Sealing		Seal class B
	Location		Interior only
	Insulation level [5]		R-6
Service Water Heating	Gas storage	80% E_t	90% E_t

Climate Zone 4C, Prescriptive Technology Solution Table

Item	Component	Baseline[1]	Recommendation
Roof	Insulation above deck	R-15 ci	
	Metal building roof		R-13 + R-19
	Surface reflectance	0.3	0.65
Walls	Steel-framed	R-13	
	Metal building		R-13
Slabs	Unheated	NR[2]	NR
	Heated	R-7.5 for 24 in	R-10
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-1.45	U-0.25
Infiltration		0.5 ACH	0.5 ACH
Vertical Glazing	Window to Wall Ratio (WWR)	< 10%	< 10%
	Thermal transmittance	U-0.57	U-0.42
	Solar heat gain coefficient (SHGC)	0.39	0.46
	South Overhangs	None	NR
Skylights	Percent roof area	None	2%
	Thermal transmittance		U-0.69
	SHGC		0.34
Interior Lighting	Lighting Power Density	See Note 3	See Note 3
	Ballast		Electronic ballast
	Daylighting controls [4]	none	Yes
	Occupancy controls	NR	all unoccupied spaces
HVAC	Make up Air Unit Fans	See Fan Efficiency Table	See Fan Efficiency Table
	Air Conditioner	PSZ-AC 12.0 SEER	PSZ-AC 14.0 SEER
	Gas Coil	80% E_t	90% E_t
	Hydronic radiant floor heat	None	Ground floor
	ERV	None	Yes
Economizer		NR	NR
Ventilation	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	Yes
	Transpired Solar Coll.	None	Yes
	Transpired Solar Coll.	None	Yes
Ducts	Sealing		Seal class B
	Location		Interior only
	Insulation level [5]		R-6
Service Water Heating	Gas storage	80% E_t	90% E_t

Climate Zone 5A, Prescriptive Technology Solution Table

Item	Component	Baseline[1]	Recommendation
Roof	Insulation above deck	R-15 ci	
	Metal building roof		R-13 + R-19
	Surface reflectance	0.3	0.3
Walls	Steel-framed	R-13 + 3.8 c.i.	
	Metal building		R-13 + R-13
Slabs	Unheated	NR[2]	NR
	Heated	R-10 for 24 in	R-10
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-1.45	U-0.25
Infiltration		0.5 ACH	0.5 ACH
Vertical Glazing	Window to Wall Ratio (WWR)	< 10%	< 10%
	Thermal transmittance	U-0.57	U-0.42
	Solar heat gain coefficient (SHGC)	0.39	0.6
	South Overhangs	None	NR
Skylights	Percent roof area	None	2%
	Thermal transmittance		U-0.69
	SHGC		0.39
Interior Lighting	Lighting Power Density	See Note 3	See Note 3
	Ballast		Electronic ballast
	Daylighting controls[4]	none	Yes
	Occupancy controls	NR	all unoccupied spaces
HVAC	Make up Air Unit Fans	See Fan Efficiency Table	See Fan Efficiency Table
	Air Conditioner	PSZ-AC 12.0 SEER	PSZ-AC 14.0 SEER
	Gas Coil	80% E_t	90% E_t
	Hydronic radiant floor heat	None	Ground floor
	ERV	None	Yes
Economizer		NR	NR
Ventilation	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	Yes
	Transpired Solar Coll.	None	Yes
Ducts	Sealing		Seal class B
	Location		Interior only
	Insulation level [5]		R-6
Service Water Heating	Gas storage	80% E_t	90% E_t

Climate Zone 5B, Prescriptive Technology Solution Table

Item	Component	Baseline[1]	Recommendation
Roof	Insulation above deck	R-15 ci	
	Metal building roof		R-13 + R-19
	Surface reflectance	0.3	0.3
Walls	Steel-framed	R-13 + 3.8 c.i.	
	Metal building		R-13 + R-13
Slabs	Unheated	NR[2]	NR
	Heated	R-10 for 24 in	R-10
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-1.45	U-0.25
Infiltration		0.5 ACH	0.5 ACH
Vertical Glazing	Window to Wall Ratio (WWR)	< 10%	< 10%
	Thermal transmittance	U-0.57	U-0.42
	Solar heat gain coefficient (SHGC)	0.39	0.6
	South Overhangs	None	NR
Skylights	Percent roof area	None	2%
	Thermal transmittance		U-0.69
	SHGC		0.39
Interior Lighting	Lighting Power Density	See Note 3	See Note 3
	Ballast		Electronic ballast
	Daylighting controls[4]	none	Yes
	Occupancy controls	NR	all unoccupied spaces
HVAC	Make up Air Unit Fans	See Fan Efficiency Table	See Fan Efficiency Table
	Air Conditioner	PSZ-AC 12.0 SEER	PSZ-AC 14.0 SEER
	Gas Coil	80% E_t	90% E_t
	Hydronic radiant floor heat	None	Ground floor
	ERV	None	Yes
Economizer		NR	NR
Ventilation	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	Yes
	Transpired Solar Coll.	None	Yes
Ducts	Sealing		Seal class B
	Location		Interior only
	Insulation level [5]		R-6
Service Water Heating	Gas storage	80% E_t	90% E_t

Climate Zone 6A, Prescriptive Technology Solution Table

Item	Component	Baseline[1]	Recommendation
Roof	Insulation above deck	R-15 ci	
	Metal building roof		R-13 + R-19
	Surface reflectance	0.3	0.3
Walls	Steel-framed	R-13 + 3.8 c.i.	
	Metal building		R-13 + R-13
Slabs	Unheated	NR[2]	R-10, 24 in. horizontal
	Heated	R-10 for 36 in	R-10
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-0.50	U-0.25
Infiltration		0.5 ACH	0.5 ACH
Vertical Glazing	Window to Wall Ratio (WWR)	< 10%	< 10%
	Thermal transmittance	U-0.57	U-0.42
	Solar heat gain coefficient (SHGC)	0.39	0.6
	South Overhangs	None	NR
Skylights	Percent roof area	None	2%
	Thermal transmittance		U-0.69
	SHGC		0.49
Interior Lighting	Lighting Power Density	See Note 3	See Note 3
	Ballast		Electronic ballast
	Daylighting controls [4]	none	Yes
	Occupancy controls	NR	all unoccupied spaces
HVAC	Air Conditioner	PSZ-AC 12.0 SEER	PSZ-AC 14.0 SEER
	Gas Coil	80% E_t	90% E_t
	Hydronic radiant floor heat	None	Ground floor
	ERV	None	Yes
Economizer		NR	NR
Ventilation	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	Yes
	Transpired Solar Coll.	None	Yes
Ducts	Sealing		Seal class B
	Location		Interior only
	Insulation level [5]		R-6
Service Water Heating	Gas storage	80% E_t	90% E_t

Climate Zone 6B, Prescriptive Technology Solution Table

Item	Component	Baseline[1]	Recommendation
Roof	Insulation above deck	R-15 ci	
	Metal building roof		R-13 + R-19
	Surface reflectance	0.3	0.3
Walls	Steel-framed	R-13 + 3.8 c.i.	
	Metal building		R-13 + R-13
Slabs	Unheated	NR[2]	R-10, 24 in. horizontal
	Heated	R-10 for 36 in	R-10
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-0.50	U-0.25
Infiltration		0.5 ACH	0.5 ACH
Vertical Glazing	Window to Wall Ratio (WWR)	< 10%	< 10%
	Thermal transmittance	U-0.57	U-0.42
	Solar heat gain coefficient (SHGC)	0.39	0.6
	South Overhangs	None	NR
Skylights	Percent roof area	None	2%
	Thermal transmittance		U-0.69
	SHGC		0.49
Interior Lighting	Lighting Power Density	See Note 3	See Note 3
	Ballast		Electronic ballast
	Daylighting controls [4]	none	Yes
	Occupancy controls	NR	all unoccupied spaces
HVAC	Air Conditioner	PSZ-AC 12.0 SEER	PSZ-AC 14.0 SEER
	Gas Coil	80% E_t	90% E_t
	Hydronic radiant floor heat	None	Ground floor
	ERV	None	Yes
Economizer		NR	NR
Ventilation	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	Yes
	Transpired Solar Coll.	None	Yes
Ducts	Sealing		Seal class B
	Location		Interior only
	Insulation level [5]		R-6
Service Water Heating	Gas storage	80% E_t	90% E_t

Climate Zone 7A, Prescriptive Technology Solution Table

Item	Component	Baseline[1]	Recommendation
Roof	Insulation above deck	R-15 ci	
	Metal building roof		R-13 + R-19
	Surface reflectance	0.3	0.3
Walls	Steel-framed	R-13 + 7.5 c.i.	
	Metal building		R-13 + R-13
Slabs	Unheated	NR[2]	R-15, 24 in. horizontal
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-0.50	U-0.25
Infiltration		0.5 ACH	0.5 ACH
Vertical Glazing	Window to Wall Ratio (WWR)	< 10%	< 10%
	Thermal transmittance	U-0.57	U-0.33
	Solar heat gain coefficient (SHGC)	0.49	NR
	South Overhangs	None	NR
Skylights	Percent roof area	None	2%
	Thermal transmittance		U-0.69
	SHGC		0.64
Interior Lighting	Lighting Power Density	See Note 3	See Note 3
	Ballast		Electronic ballast
	Daylighting controls [4]	none	Yes
	Occupancy controls	NR	all unoccupied spaces
HVAC	Air Conditioner	PSZ-AC 12.0 SEER	PSZ-AC 14.0 SEER
	Gas Coil	80% E_t	90% E_t
	Hydronic radiant floor heat	None	Ground floor
	ERV	None	Yes
Economizer		NR	NR
Ventilation	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	Yes
	Transpired Solar Coll.	None	None
Ducts	Sealing		Seal class B
	Location		Interior only
	Insulation level [5]		R-6
Service Water Heating	Gas storage	80% E_t	90% E_t

Climate Zone 8A, Prescriptive Technology Solution Table

Item	Component	Baseline[1]	Recommendation
Roof	Insulation above deck	R-20 ci	
	Metal building roof		R-19 + R-19
	Surface reflectance	0.3	0.3
Walls	Steel-framed	R-13 + 7.5 c.i.	
	Metal building		R-13 + R-16
Slabs	Unheated	R-10, 24 in. horizontal	R-20, 24 in. horizontal
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-0.50	U-0.25
Infiltration		0.5 ACH	0.5 ACH
Vertical Glazing	Window to Wall Ratio (WWR)	< 10%	< 10%
	Thermal transmittance	U-0.46	U-0.33
	Solar heat gain coefficient	NR[2]	NR
	South Overhangs	None	NR
Skylights	Percent roof area	None	2%
	Thermal transmittance		U-0.58
	SHGC		NR
Interior Lighting	Lighting Power Density	See Note 3	See Note 3
	Ballast		Electronic ballast
	Daylighting controls[4]	none	Yes
	Occupancy controls	NR	all unoccupied spaces
HVAC	Air Conditioner	PSZ-AC 12.0 SEER	PSZ-AC 14.0 SEER
	Gas Coil	80% E_t	90% E_t
	Hydronic radiant floor heat	None	Ground floor
	ERV	None	Yes
Economizer		NR	NR
Ventilation	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	Yes
	Transpired Solar Coll.	None	None
Ducts	Sealing		Seal class B
	Location		Interior only
	Insulation level [5]		R-8
Service Water Heating	Gas storage	80% E_t	90% E_t

Notes about prescriptive technology solution sets:

Baseline requirements are from ANSI/ASHRAE/IESNA Standard 90.1-2004.

1. NR means there is no requirement or recommendation for a component in this climate.
2. Lighting levels in accordance with the following table:

Zone	Baseline	Recommendation
Repair Bay	0.7 W/ft^2 (7.5 W/m^2)	0.7 W/ft^2 (7.5 W/m^2)
Vehicle Corridor	0.7 W/ft^2 (7.5 W/m^2)	0.7 W/ft^2 (7.5 W/m^2)
Showers	0.6 W/ft^2 (6.5 W/m^2)	0.6 W/ft^2 (6.5 W/m^2)
Storage 1	0.9 W/ft^2 (9.7 W/m^2)	0.9 W/ft^2 (9.7 W/m^2)
Consolidated Bench	1.9 W/ft^2 (20.5 W/m^2)	1.3 W/ft^2 (14.0 W/m^2)
Storage 2	0.9 W/ft^2 (9.7 W/m^2)	0.9 W/ft^2 (9.7 W/m^2)
Office	1.0 W/ft^2 (10.8 W/m^2)	0.9 W/ft^2 (9.7 W/m^2)

3. Daylighting should be included in the repair bays, vehicle corridor, and office.
4. The duct and pipe insulation values are from the ASHRAE Advanced Energy Design Guide for Small Offices.

16.2 Energy Savings Results Achieved

The following table shows the energy consumption reductions (without plug/process loads) achieved using the above prescriptive technology solution sets compared to a minimum ASHRAE 90.1-2004 compliant UEPH:

Table 16-1. Energy consumption reductions using prescription technology tables (without plug loads)

CZ	City	Baseline (kBtu/ft^2)	Final Energy Efficient Solution (kBtu/ft^2)	Energy Savings
1A	Miami, FL	36	15	59%
2A	Houston, TX	45	19	58%
2B	Phoenix, AZ	42	17	59%
3A	Memphis, TN	56	25	56%
3B	El Paso, TX	47	20	58%
3C	San Francisco, CA	43	17	59%
4A	Baltimore, MD	75	35	53%
4B	Albuquerque, NM	61	27	56%
4C	Seattle, WA	64	29	54%
5A	Chicago, IL	93	45	52%
5B	Colorado Springs, CO	80	36	55%
6A	Burlington, VT	108	54	50%
6B	Helena, MT	99	49	50%
7A	Duluth, MN	134	65	51%
8A	Fairbanks, AK	207	105	49%

Descriptions of technologies used in the prescriptive technology solution sets follow:

16.3 Cool Roofs

In TEMF, which are conditioned in warm season only by ventilation, cool roofs do not save energy. However they can improve comfort conditions (and hence productivity) in the space (Figure 16-1). In cold climates, a cool roof can increase the heating load, since the solar radiation reflected by the cool roof would otherwise be absorbed, resulting in a warmer roof. Cool roof materials are available as

- white coatings
- single-ply white membrane or
- painted metal (white, cool colored).

The EPA and DOE established the ENERGY STAR Roof Products Program to distinguish those products that are energy efficient. The criteria for an ENERGY STAR labeled roof product are based on the initial and aged total solar reflectance (TSR) the initial and aged total solar reflectance (TSR). The ENERGY STAR criteria vary for low and steep slope applications. Table 16-2 lists the Total Solar Reflectance (TSR) required.

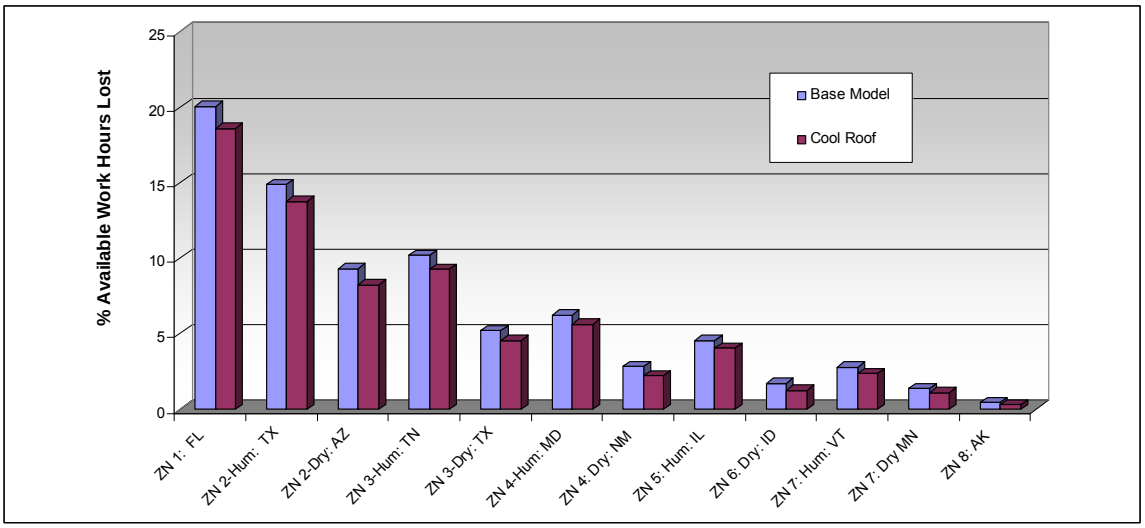


Figure 16-1. Percent of work hours lost in the base industrial building and in the building with a "cool roof" (based on the analysis under the Annex 46 study).

Table 16-2. Total Solar Reflectance (TSR) required.

	Minimum initial TSR	3-year Aged TSR
Low slope roofing (≤ 2:12)	0.65	0.50
Steep slope roofing (>2:12)	0.25	0.15

Based on the analysis conducted by CERL and NAVFAC, the first cost of most of Energy Star Roof Products that can be used for TEMF does not exceed the cost of regular (not "cool" roofing materials). For TEMF roofs with high reflectivity (0.65) are recommended for climate zones 1–5.

16.4 Lighting Density Reduction and Daylighting

The lighting power density in the office and consolidated bench spaces and daylighting controls were included in the office, repair bay, and in the east half of the vehicle corridor. Repair bays and warehouses are good candidates for hybrid lighting systems, which include a combination of electrical lighting and daylighting (Figure 16-2). Installing skylights to reducing lighting costs is not a new concept. Skylight technology, however, has advanced significantly in recent years (Figure 16-3). Modern 'passive' skylights include a reflective tube that channels the light into the work area and a lens that diffuses the light evenly to produce a uniformly illuminated area (Figure 16-4). 'Active' systems may include a rotating mirror assembly that tracks the sun.

Figure 16-2. Maintenance facility with a daylighting system.

Figure 16-3. Warehouse application without (left) and with (right) skylights.

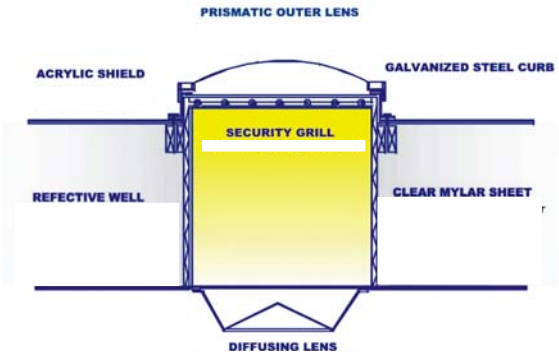


Figure 16-4. Schematic of modern skylight installation details (Source: www.daylighttechnology.com).

To automatically dim the lights, a photoelectric sensor measures the amount of light in a zone. If the specified amount of light has been reached, the controller turns off a bank of lights. Systems can be obtained to control only lights near windows or an entire building.

Small controllers can control the banks of lights near windows and larger systems can control an entire building that is illuminated by natural lighting. The controls can be set to dim the lights once a certain level of light has been achieved. Proper lighting levels can be found in the IESNA Lighting Ready Reference. Controls systems can typically either perform “step” dimming, which simply turns off certain banks of lights or linear dimming, and which linearly dims the lights until a minimum power level has been reached. Linear dimming, however, requires special dimming ballasts that are quite expensive and less efficient than standards ballasts above 50 percent. Figure 16-5 shows energy savings for a hybrid system. Based on the simulation results from the Annex 46 study, for the ventilated industrial building with no air conditioning, average pay-back ranges from 4–9 years (Figure 16-5).

16.5 Close Capture Evacuation System for Vehicle Exhaust Fumes

Vehicle exhaust ventilation system can mitigate and reduce exposure to Diesel and gasoline fumes generated by moving vehicles. Vehicle exhaust ventilation systems can be adapted to specific conditions of the maintenance facility (e.g., maintenance bay, drive-through corridor) and allow a range of exhausted air volume and withstand temperature ranges specific to variety of vehicles/tactical equipment serviced or repaired in these facilities. For the biggest vehicles the military needs to service, exhaust flow varies from 1700 to 3300cfm at temperatures of 650 up to 1200 °F.

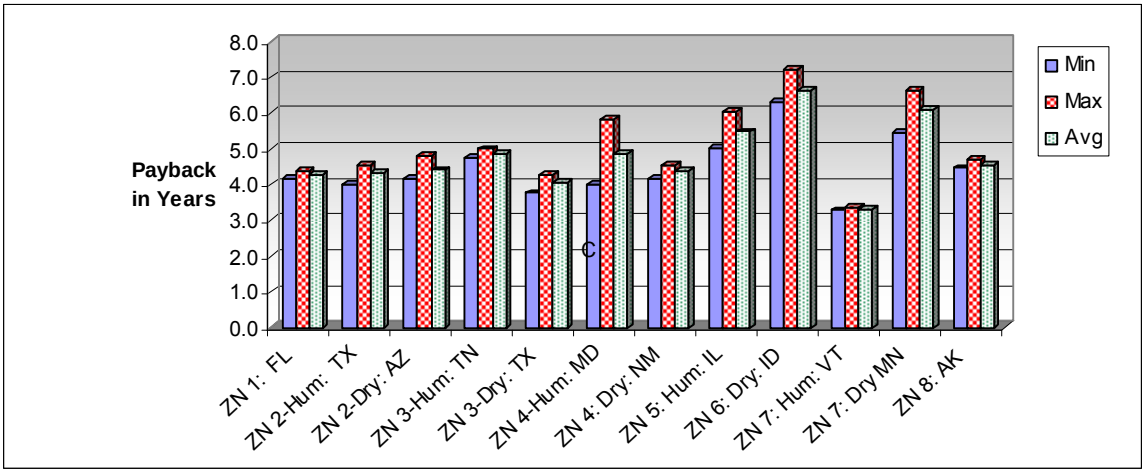


Figure 16-5. Estimated payback in years for hybrid lighting system.

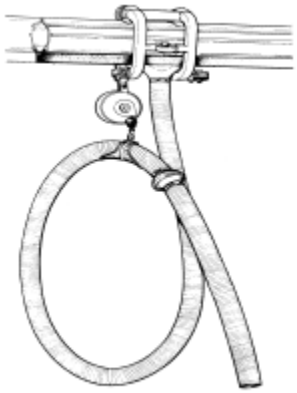
Vehicle exhaust capture systems trap and remove by-products of the engine combustion process (gas or Diesel) without contaminating the building air. Vehicle exhaust fumes contain hydrocarbons (HC), nitrogen oxides (NOx), carbon monoxide (CO), sulfur dioxides (SOx), carbon dioxide (CO2) and approximately 100 other volatile organic and acidic compounds.

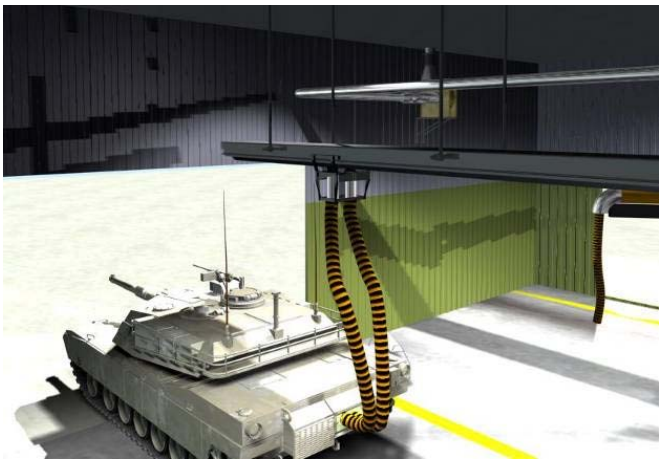
Traditional ventilation systems for maintenance facilities include a general dilution system sized for approximately 1.5 cfm of outside air per sq ft of floor area. This flow rate is based on ASHRAE Std. 62 and assumes that running vehicles are entering the building prior to attachment of the stationary close capture exhaust system. If the close capture system is attached before the vehicle enters the building, the general dilution rate can be assumed to be similar to mechanical or assembly shops (~0.75 cfm/sq ft) (Ventilation Guide for Automotive Industry, HPAC Engineering, 2000). The reduction could be achieved through demand controlled exhaust and make-up air systems and using the exhaust air from the office space as part of the make-up air. Conditioning the make-up air is the largest single energy use in the TEMF. This ECM results in the most significant energy savings in all climate zones.

Figure 16-6 shows a stationary hose reel type system (requiring ~1.5 cfm/sq ft of outside air).

Figure 16-6. Stationary hose reel type system.

Reduction in the general dilution rate can be achieved by means of well designed suction rail or pivoting boom systems (Figure 16-7). Vehicles are connected to these systems prior to entering the facility and remain attached while moving in and out of the facility.





Suction Rail Systems

Boom Systems

Figure 16-7. Well designed suction rail or pivoting boom systems.

Vehicle Exhaust Extraction systems can be classified as non-enclosing or enclosing. Enclosing type exhaust systems typically have a flexible hose with a tail-pipe adapter. The hose can be mounted on a stationary reel, an overhead rail extraction system or a swinging boom. Enclosing systems are normally classified as ‘sealed’ or ‘non-sealed’.

Sealed type exhaust systems use a tailpipe adapter, which makes an airtight seal between the exhaust tailpipe and the flexible exhaust ventilation hose. The attachment of this nozzle is usually through the use of an air-filled bladder made of synthetic rubber, which conforms to the size of the vehicle’s tailpipe. This eliminates the escape of exhaust gases when the vehicle is being accelerated or run at high idle. This system has a low operating air volume flow rate. Table 16-3 lists approximate airflow rates to be extracted per vehicle from the exhaust pipe using a sealed-fit tailpipe adapter. The capture effectiveness of sealed exhaust systems is high and for design purposes can be considered 90 percent or higher.

Table 16-3. Airflow rates to be extracted per vehicle from the tail pipe using a sealed fit tailpipe adapter (Source: Ventilation Guide for Automotive Industry, HPAC Engineering, 2000).

Sealed Fit Tailpipe Adapter			
Veh. Type **	**Engine Power (h.p.)**	**Airflow rate cfm (m3 /h)**	**Hose size (in.)**
LDGV	<130	300 (510)	3
LDGT	< 175	450 (765)	4
HDGV	< 250	500 (850)	4
LDDV	< 325	500 (850)	4
LDDT	< 400	500 (850)	4
HDDV	< 500	750 (1275)	5
ORV	< 600	1000 (1700)	6-8

Non-sealed systems use a loosely fitting tailpipe adapter. This system requires a higher air flow rate than a sealed system to maintain negative pressure control of the exhaust gases emitted by the vehicle. The nozzle is usually attached by means of a mechanical device such as a vice-grip clamp or spring clip.

For non-sealed exhaust systems, the capture effectiveness is below 75 percent. Table 16-4 lists approximate airflow rates to be extracted per vehicle from the exhaust pipe using a non-sealed fit tailpipe adapter.

Table 16-4. Airflow rates to be extracted per vehicle from the exhaust pipe using an open-fit non-sealing tailpipe adapter (Source Ventilation Guide for Automotive Industry, HPAC Engineering, 2000).

Non-sealed Fit Tailpipe Adapter			
Veh. Type*	**Engine Power (h.p.)**	**Airflow rate cfm (m3 /h)**	**Hose size (in.)**
LDGV	< 130	450 (765)	4
LDGT	< 175	600 (900)	5
HDGV	< 250	750 (1250)	5
LDDV	< 325	750 (1275)	5
LDDT	< 400	750 (1275)	5
HDDV	< 500	1125 (1910)	6
ORV	< 600	1500 (2500)	8

*Notes:
LDGV: Light-duty gasoline-fueled vehicles, up to 6000 lb GVW
LDGT: Light-duty gasoline-fueled trucks, up to 8500 lb GVW
HDGV: Heavy-duty gasoline-fueled vehicles, 8501+ lb GVW
LDDV: Light-duty Diesel vehicles, up to 6000 lb GVW
LDDT: Light-duty Diesel trucks, up to 8500 lb GVW
HDDV: Heavy-duty Diesel vehicles, 8501+ lb GVW

Selection of the hose for a particular application depends on exhaust temperature and flow rate. Selection of the nozzle depends on the size and configuration of the tail-pipe or exhaust grill (cf. Appendix D).

In most small vehicle maintenance and repair facilities, it is uncommon for several vehicles to drive in or out of the facility simultaneously. Likewise, it is uncommon to run all the engines in the facility at the same time. Typically a demand controlled local exhaust system is sized for a maximum duty cycle of 50 percent of the total available capacity thereby reducing the size of the exhaust duct, fan as well as its operating airflow rate. The exhaust airflow rate is controlled using a variable frequency drive (VFD) and a pressure sensor installed in the main duct.

Demand based control of the local exhaust system is initiated by a mechanical damper that opens when the hose is pulled down from the reel. Each of these mechanical dampers initiates the activation of air flow from a specific hose reel during maintenance operations. The system fan ramps up or down to accommodate the number of hose reels activated without affecting the airflow through other reels.

Figures 16-8 and 16-9 show the simple payback for both the rail and boom systems based on the simulation results conducted under the Annex 46 study. For both systems in all climates, the payback is less than 4.5 years. The significant reduction in outside air flow rate is responsible for the savings.

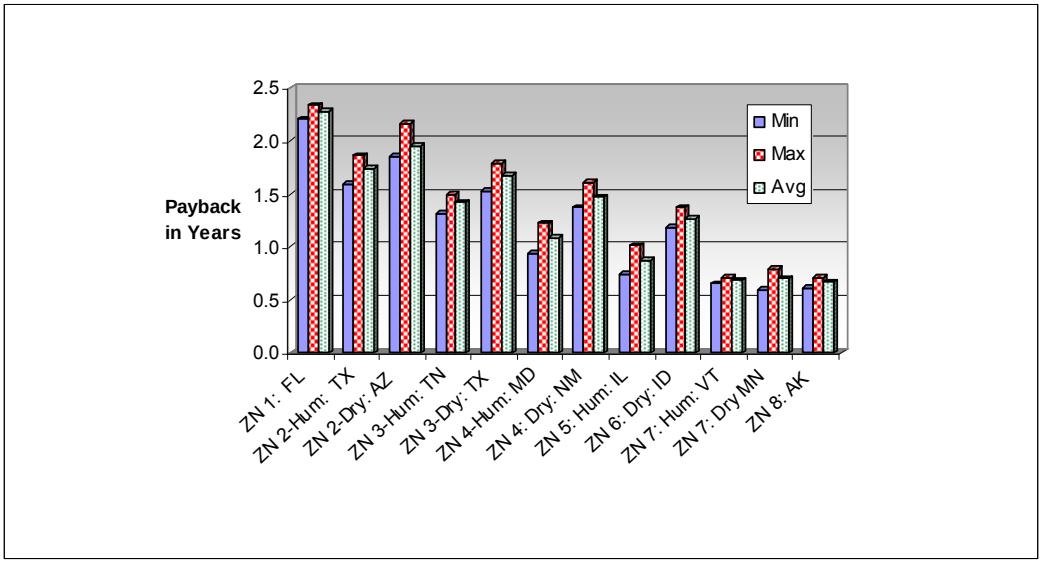


Figure 16-8. Estimated simple payback for rail system.

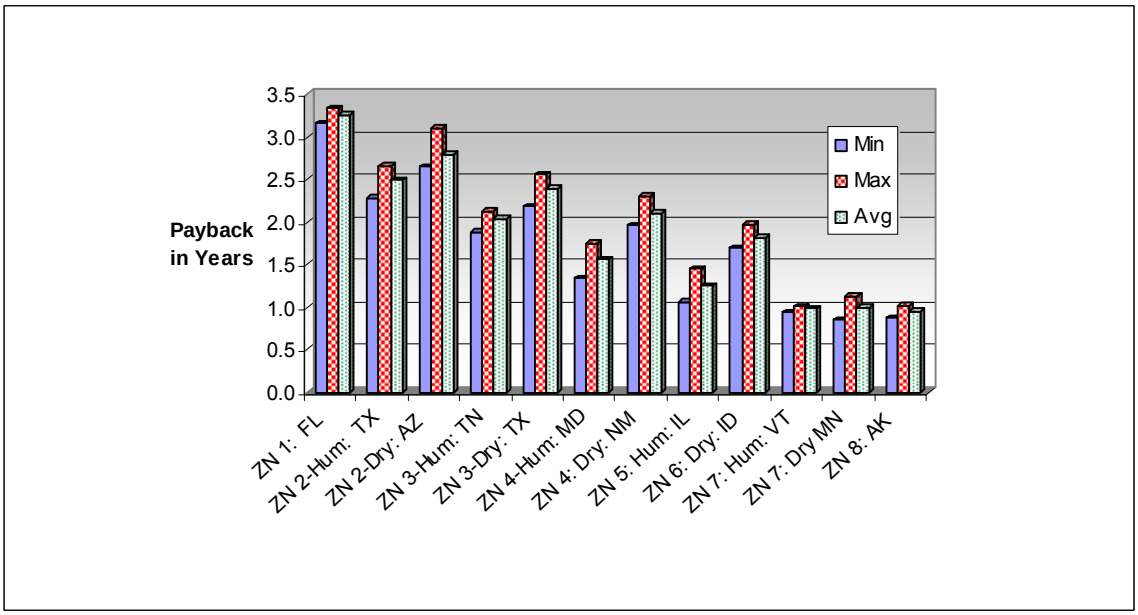


Figure 16-9. Estimated simple payback for boom system.

16.6 General Ventilation

General supply and exhaust ventilation shall be designed to respond maintain indoor air quality and provide a make-up air for local exhaust systems. Demand controlled ventilation with variable frequency drives (VFD) and CO and NOx sensors to control residual fumes from gasoline, can be implemented following the indoor air quality (IAQ) procedure in ASHRAE Standard 62.1-2007.

Cascading air from offices to maintenance bays and vehicle corridor pressurizes office areas and prevents odors/contaminants from more polluted zones to office spaces. It also provides heated or cooled air for the repair bays area and results in energy

conservation. Since vehicle exhaust fume are heavier that the air and tend to stay close to the floor, two-thirds of air shall be exhausted by general exhaust system from within 1 ft from the floor level, and the rest from the upper zone. If TEMF has a pit, it shall be ventilated by supplying air directly into the pit and have an exhaust from its bottom.

16.7 HVAC equipment efficiency improvement

Compared to the ASHRAE Standard 90.1 minimum requirement, the cooling equipment efficiencies were increased by 20 percent, the gas burner efficiencies were increased to 0.9, and the fan efficiencies were improved (Table 16-5).

The improved efficiency fan performance numbers are based on available high efficiency fans. The last column shows the pressure increase in the fan system for the inclusion of the energy recovery ventilator (ERV). The fan pressure was increased by 50 Pa when the transpired solar collector was included. For the cases with reduced ventilation, the pressures were reduced by 15 percent for the repair bays, vehicle corridor, and the consolidated bench.

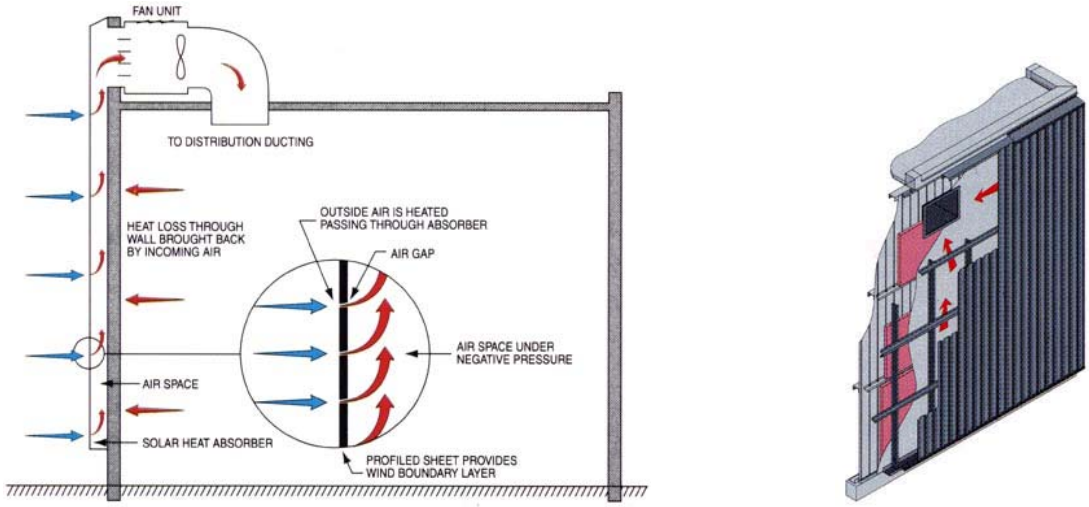
Table 16-5. Improved fan model assumptions.

System	Flow (m^3/s)	Pressure Rise (Pa)	Baseline Efficiency		Improved Efficiency		ERV Pressure Drop (Pa)
			Fan Motor	Total Fan	Fan Motor	Total Fan	
Repair bay	15.52	400	0.8	0.27	0.9	0.45	200
Vehicle corridor	4.28	300	0.8	0.19	0.9	0.45	150
Showers	0.78	250	0.8	0.20	0.85	0.34	
Storage 1	0.54	250	0.8	0.20	0.85	0.34	
Consolidated bench	2.14	300	0.8	0.19	0.9	0.45	150
Storage 2	1.19	250	0.8	0.20	0.85	0.34	
Office	2.49	250	0.8	0.20	0.85	0.34	
Fan coil units	Varies	75	0.8	0.30	0.85	0.34	

The fan improvements had the larges affect in the climate zones 1 to 3.

16.8 Ventilation air preheating in transpired solar collector

A transpired solar collector or a “solar wall” preheats ventilation air by drawing make-up air through a perforated steel or aluminum plate that is warmed by solar radiation. The solar wall consists of perforated steel or aluminum cladding attached to the south façade of a building with an air gap between the existing wall and the cladding. The solar wall is dark-colored to absorb the maximum amount of solar radiation. Air is drawn through the small holes in the wall and heated at the same time (Figure 16-10). The warm air rises to the top of the wall and is drawn into the building’s ventilation system as shown in the figure below. Figure 16-11 shows a solar wall installed on the maintenance facility at Fort Drum, NY.



a. b.

Figure 16-10. Schematic of air flows through (a) a solar wall and (b) typical installation.

a. b.

Figure 16-11. Solar wall installed on (a) the maintenance facility at Fort Drum, detail showing (b) perforated panel element

The performance of a “solar wall” depends primarily on four parameters: the solar reflectance of the wall, the orientation of the wall, the size and spacing of the perforations in the wall, and the pressure drop maintained by the ventilation system across the wall. The solar reflectance is primarily affected by the coating applied to the solar wall. In general, darker colors have a lower reflectance, and thus absorb a greater fraction of incident solar radiation.

The orientation of the wall also greatly affects its performance The intensity of the incident solar radiation is dependent on the cosine of the ‘angle of incidence’, the angle between the outward facing normal of the surface and the ‘line of sight’ to the sun. Walls that more directly face the sun will receive more solar radiation. In winter months in the northern hemisphere, south facing walls perform best. The cost effectiveness of applying solar collectors to East and West facing walls (to catch morning and afternoon sun) must be analyzed on a case by case basis.

The size and spacing of the perforations along with the pressure drop across the wall due to the operation of the ventilation system largely determines the impact of wind speed and wind direction on the solar wall performance. For a properly designed wall with small closely spaced perforations and a relatively high pressure drop, the laminar boundary layer created by suction at the wall will largely negate the effects of changing wind speed and wind direction. For the improved model building a 2,280 sq ft transpired solar collector on the south wall of the repair bays was simulated. This collector occupies the top 10 ft of the wall and is slightly undersized for the exhaust air requirements of this zone. The collector should be sized for the flow to be 7 to 10 cfm/sq ft.

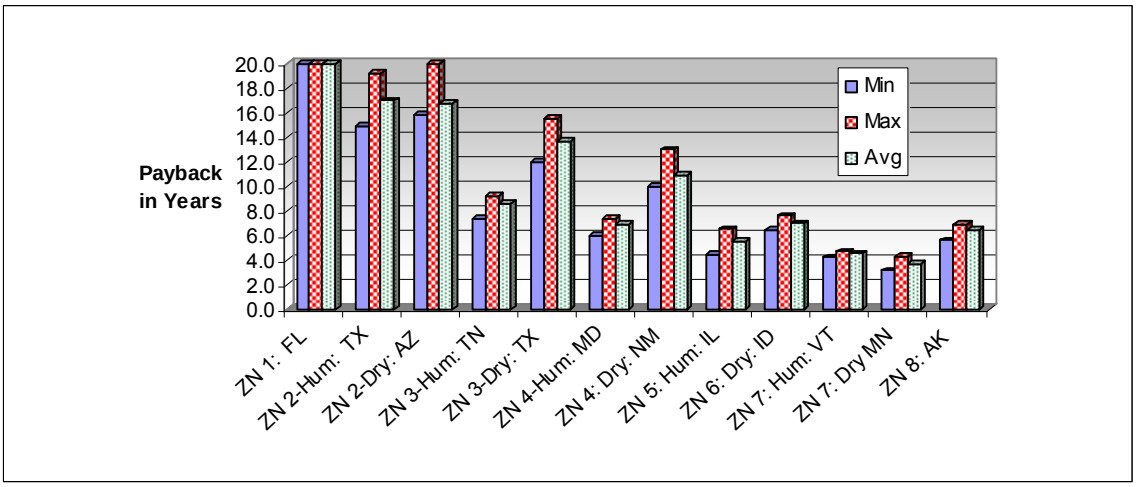


Figure 16-12. Transpired solar wall estimated payback shown for high, medium and low energy rates.

Figure 16-12 shows a simple payback from installation of the “solar wall.” The data was received through simulation of “solar wall” conducted under the IEA Annex 46 study. The simple pay back is under 6 years for all heating dominated climates.

16.9 Energy recovery ventilators

Heating energy recovery from the stream of air exhausted from repair bays, vehicle corridor, and consolidated bench can be used to preheat supply air. Use of ERV results in the increased pressure drop in the supply air system. There is also a need for better duct insulation to reduce heat losses in the return duct. Given these additional costs and losses, according to Airways [2002] ERVs are not cost efficient in mild climates (with HDD < 2500). Considering that exhaust air may contain sticky particulates, ERVs were selected with a plate heat exchangers (Figure 16-13), which are 75 to 70 percent effective for flows ranging from 70 to 100 percent.

Figure 16-13. Plate heat exchanger.

16.10 Hydronic radiant floor heating

Low intensity hydronic radiant floor heating systems are commonly used in industrial facilities, hangars, warehouses, garages, gymnasiums, hospitals, kindergartens, apartments, and in different other types of buildings. Heat to the space is provided by hot water supplied through pipes embedded in floors. Thermal energy is exchanged by at least 50% by radiation between the room and people present in the space and the heated floor surface. Transfer from the hot water pipes to the surface of the floor is the important consideration. Figure 16-14 shows the installation of plastic piping for a radiant floor heating system, and Figure 16-15 shows a radiant floor heating system installed in a TEMF at Fort Lewis, WA.

The uniform temperature distribution from floor heating increases comfort and reduces room air temperature stratification especially in high ceiling buildings. Low intensity radiant heating provides greater comfort for mechanics working near or on the floor. Radiant energy transmitted to the cold (sometimes snow-covered) vehicles results in rapid conditioning of the vehicles for service, which improves workers' productivity and adds to their comfort.

Figure 16-14. Installation of plastic piping for the radiant floor heating system (Uponor, 2007)

Figure 16-15. Radiant floor heating system installed in a TEMF at Fort Lewis, WA.

Radiant floor systems are more energy efficient.

1. Compared to warm air heating systems traditionally used in TEMF, a radiant floor system provides the same comfort level in the working zone at a lower room air temperature during the heating season. This results in reduced ventilation and infiltration losses.
2. In hydronic radiant floor systems, energy is transported by water instead of air. Auxiliary energy for circulation pumps is less than for fans.
3. The system uses lower water temperature for heating, than the warm air heating systems. This allows for using return water for radiant floor system, which increases energy performance of boilers (condensing boilers) and heat pumps.
4. Reduced air temperature stratification along the room height results in heating energy saving, typically at least by 25 to 30 percent.

With the introduction of polybutelene tubing and new design techniques, as well as reduced energy losses due elimination of room air temperature stratification, the first cost of radiant floor system became comparable or even lower than the warm air system.

Application of radiant floor systems requires under the slab insulation with 2 in. of EPS insulation (R-10) for climate zones 1 to 7 and 3 in. (R-15) for climate zone 8 (Figure 16-16).

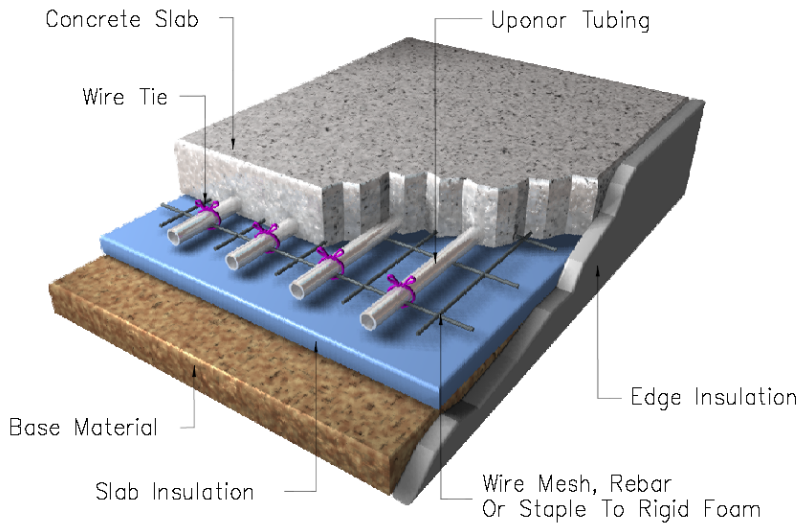


Figure 16-16. Concrete floor radiant heating system with edge and slab insulation (Uponor 2008).

16.11 Optional ECMs

16.11.1 Vestibules with airlocks

Vestibule with an air lock (Figure 16-17) prevents cold air drafts into the building and allows heating the vehicle prior to bringing it in. The building is protected from outdoor air by two sequentially installed doors with an enclosed space ("air lock"). There is only one door open at a time to let a vehicle in or out the building. After the vehicle enters the "air lock" the first door closes and the second one opens.

Figure 16-18 shows a simple payback from installation of the vestibule. The data was received through simulation of "vehicle vestibules" conducted under the IEA Annex 46 study. The simple pay back is under 4 years for all heating dominated climates.

Figure 16-17. Example vestibule at auto manufacturing plant.

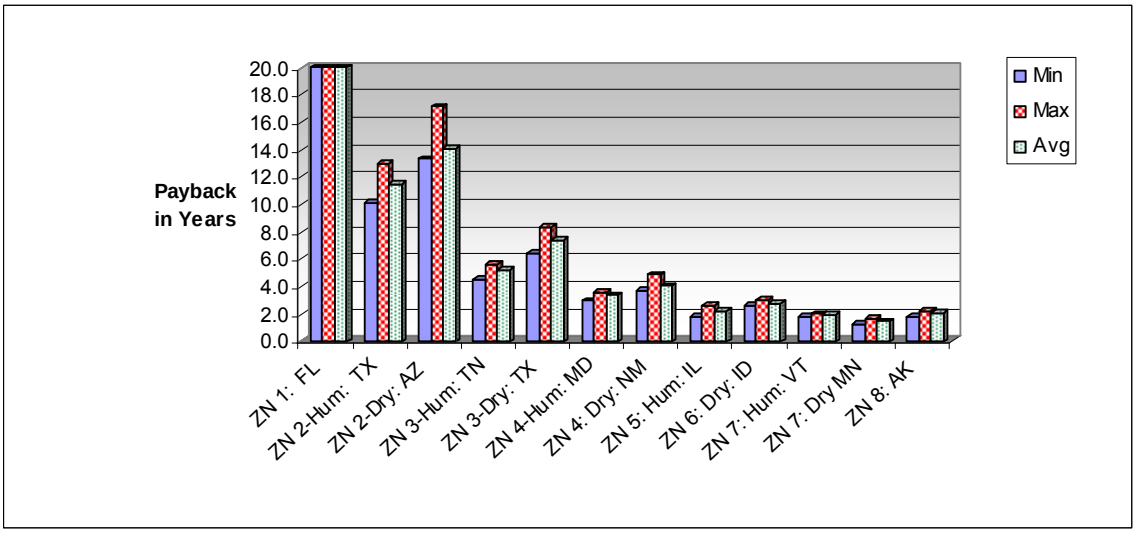


Figure 16-18. Simple payback from installation of the vestibule.

16.11.2 Evaporative Cooling

The Wet Bulb Globe Temperature (WBGT) offers a useful first order index of the environmental contribution to heat stress. It is influenced by air temperature, radiant heat, and humidity. WBGT values are calculated using one of the following equations: with direct exposure to sunlight:

$$WGBT_{out} = 0.7\ T_{nwb} + 0.2\ T_g + 0.1\ T_{db}$$

without direct exposure to the sun:

$$WBGT_{in} = 0.7\ T_{nwb} + 0.3\ T_g$$

where:

T_{nwb} = natural wet bulb temperature (sometimes called NWB)
T_g = globe temperature (sometimes called GT)
T_{db}= dry bulb (air) temperature (sometimes called DB).

Because WBGT is only an index of the environment, the screen criteria are adjusted for the contributions of work demands and clothing as well as state of acclimatization. Table 16-6 lists ACGIH (American Conference of Governmental Industrial Hygienists) rest-work guidelines for hot-humid climates. It provides screening criteria for heat stress exposure (WBGT values in °F).

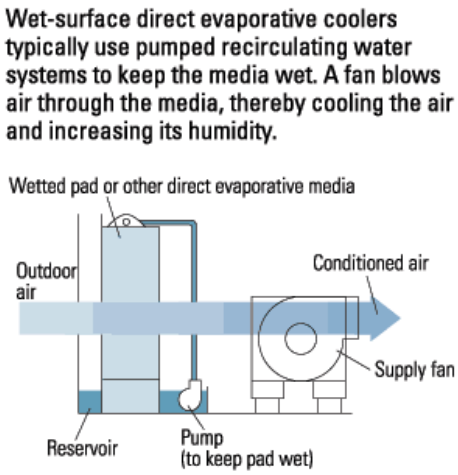
Table 16-6. ACGIH rest-work guidelines for hot-humid climates.

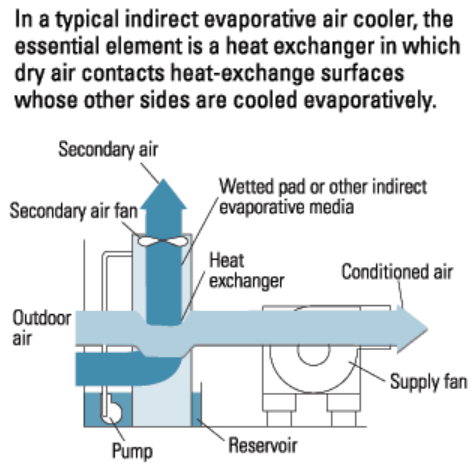
	Acclimatized Employee		Unacclimatized Employee	
Work Demands	Light (WBGT °F)	Moderate (WBGT, °F)	Light (WBGT, °F)	Moderate (WBGT, °F)
100% Work	85.1	81.5	81.5	77
75% Work 25% Rest	86.9	83.3	84.2	79.7
50% Work 50% Rest	88.7	85.1	86	82.4
25% Work 75% Rest	90.5	87.8	87.8	84.2

Based on the information provided in Table 16-6, to avoid heat stress in an environment where the humidity and temperature exceeds 85 °F wet bulb globe temperature, workers should be given rest time of 15 minutes per hour or more. Thus, height WBGT results not only in workers discomfort but in a reduced productivity.

For TEMF cooled only by ventilation, an evaporative cooler installed in the outside air duct can improve indoor working conditions during the cooling season. For this type of system, a comfort analysis allows to see the effect of the technology. Evaporative coolers can also be used to pre-cool outside air used by a mechanical cooling system. For this type of system, an energy analysis shows the cost/benefit of the system.

There are two main categories of evaporative coolers; direct and indirect (Figure 16-19). Direct coolers spray water through the incoming air stream, cooling the air to a temperature much closer to the wet bulb temperature. The largest draw back of a direct evaporative cooler is that it dramatically increases the relative humidity of the incoming air. In hot, working conditions, a direct evaporative cooler can lower the thermal comfort by creating a warm, humid environment. Indirect coolers, on the other hand, operate much more like a common heat exchanger. Water is sprayed on a water-proof membrane letting outside air evaporate on it, while the intake air is passed on the other side of the membrane. Unlike a direct cooler, the humidity of the inlet air is unchanged. Figure 16-19 shows the two types of evaporative coolers. Many companies produce roof-top evaporators to temper incoming air. The indirect evaporative cooler shown in Figure 16-19 is an evaporative heat recovery heat exchanger.





a. Direct Evaporative Cooler **b. Indirect Evaporative Cooler**

Figure 16-19. Two types of evaporative coolers (source: http://www.xcelenergy.com).

During the cooling season, water misters in the relief air stream evaporatively cool the relief air before it leaves the system. The Fresh air is drawn through a counterflow heat exchanger and heat is transferred from the fresh air stream to the evaporatively cooled relief air stream. Evaporative coolers do not save energy if the building is cooled by ventilation only. More than that, application of evaporative cooling results in increased water and electrical energy usage.

However, significant cost reduction results from improved thermal environment and respective increase in worker productivity. The indirect evaporative cooler lowers the dry bulb temperature in the space resulting in a corresponding improvement in both worker comfort and productivity. The annual savings in man-hours is shown in the plot below for the indirect evaporative cooler.

The data received through simulation of indirect evaporative cooling conducted under the IEA Annex 46 study, shows, it is cost efficient in every climate except for the climate zones 7 and 8 with a simple payback under 2 years (Figure 16-20).

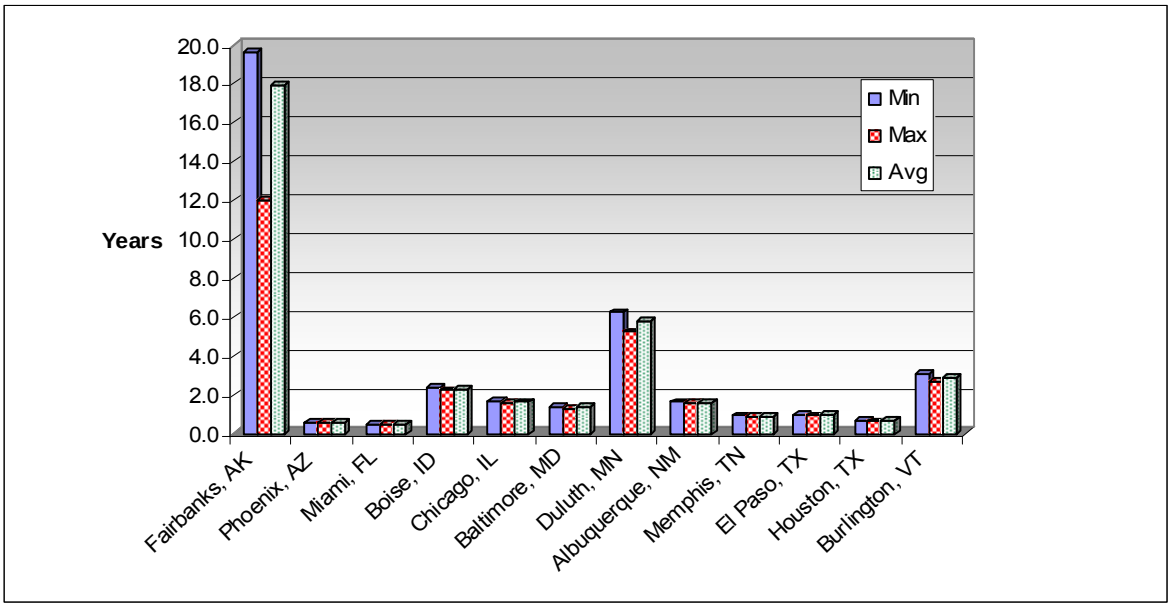


Figure 16-20. Simple payback for indirect evaporative cooling in various climate zones.

Appendix 17: Prescriptive and optional energy saving technologies for dining facilities

17.1. Prescriptive Technology Solution Sets

As part of the EPACT 2005 energy study discussed in Appendix 1, a prescriptive technology solution set is being developed for dining facilities for each climate one to achieve at least a 30% energy consumption reduction compared to an ASHRAE 90.1-2004 minimum baseline building. These prescriptive sets will be included here when completed. The general prescriptive energy saving technologies for dining facilities include:

Building envelope air tightness: 0.25 cfm/ft^2 at 0.3 in w.g. The savings from this measure are significant in climate zones 6 to 8.

Building envelope insulation: buildings located in climate zones 1 and 2 have the same insulation values as required by the ASHRAE Standard 90.1-2004, in other location – per the ASHRAE 30% Small Office Advanced Energy Design Guide. This measure produces insignificant savings in the climate zone 3 and significant energy savings in colder climates.

The windows are per the ASHRAE 30% Small Office Advanced Energy Design Guide. They have a lower U-value and a higher SHGC than Standard 90.1-2004 windows.

“Cool Roof” with a solar reflectance = 0.65 for buildings in climate zones 1, 2, 3A and 4B. There are no requirements to use “cool roof” in other climate zones due to negative energy savings.

Reduced LPD: in buildings located in all climates zones

Table 17-1. Daylighting and reduced LPD in the dining, servery, carryout, and office areas.

Zone	Baseline		Efficient Model		90.1-2004 Space Type
	W/ft^2	W	W/ft^2	W	
Dining	0.9	7,183	0.8	6,383	Dining area
Storage/Receiving	0.8	2,098	0.8	2,098	Active Storage
Dishwash	1.2	1,344	1.0	1,120	Food Preparation
Kitchen	1.2	3,315	1.1	3,039	Food Preparation
Servery	1.2	5,131	1.0	4,276	Food Preparation
Entry/Circulation	1.3	4,277	1.0	3,290	Lobby
Carryout	1.2	1,253	1.0	1,044	Food Preparation
Office	1.1	1,588	0.9	1,300	Office
Utility	1.5	1,580	1.0	1,053	Elec/Mech
Total		**27,759**		**23,596**	

This measure results in energy savings in all climate zones; however, the savings gets smaller as the climate gets colder.

Install partial end panels on the kitchen hood and all wall-mounted hoods in the servery, bake shop, and carryout areas. This measure shows significant energy savings in all climate zones, especially in the cold climates.

Replace Single-Island Hoods with Wall-Mounted Hoods in Servery. This measure ECM shows smaller energy savings in the warm climates and significant savings in the cold climates.

Use Demand Controlled Ventilation Hoods in the Servery and Carryout. Use of DCV technology in hoods located in the Servery and Carryout allows reduction of the airflow by half and fan power by one fourth (e.g., for 2 hours in the morning and 2 hours in the afternoon.) This technology saves energy in every climate, especially in warm and the cold climates. Savings associated with this measure strongly depend on the number of hours with reduced flow and the rate of the airflow reduction.

Use Demand Controlled Ventilation Hoods in the Kitchen allows reduction of the airflow by half and the fan power by one fourth (e.g., for three hours in the morning, two hours midmorning, and two hours in the afternoon.). This technology shows significant energy savings in climate zones 3 through 8 and smaller savings in climate zones 1 and 2.

High Efficiency HVAC. : PSZ-AC, 12.0 EER (3.52 COP); 0.9 E_t gas heater; 0.94 E_t gas boiler Vs PSZ-AC, 9.7 EER (2.84 COP); 0.8 E_t gas heater; 0.8 E_t gas boiler in the baseline case per the ASHRAE Standard 90.1-2004 requirements. This measure shows significant energy savings in all climates. It shows the highest savings for climate zones 1 through 3 and 4B.

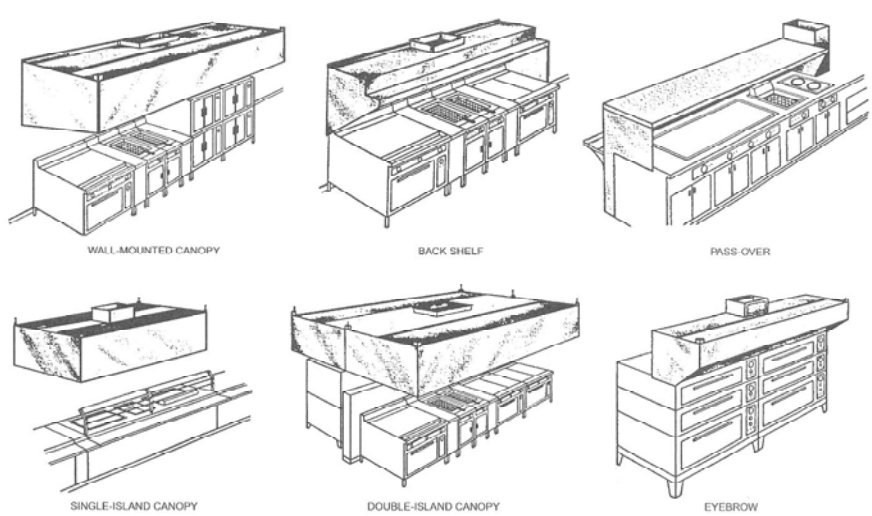
Low-Flow Pre-Rinse Nozzles. Use 1.2 gpm rinsing nozzles in each of the storage and receiving, dish wash, and kitchen zones. This ECM is very easy to implement and shows energy savings in all climates.

17.2. Energy Efficient Kitchen Ventilation

17.2.1. Optimized Selection and Installation of UL Listed Exhaust Hoods

Description

The design exhaust rate for kitchen ventilation systems depends on the hood style along with subtle construction features and enhancements (e.g., return flanges along the inside edge of the hood, integral side skirts). Wall-mounted canopy hoods, island (single or double) canopy hoods, and proximity (backshelf, pass-over, or eyebrow) hoods all have different capture areas and are mounted at different heights and horizontal positions relative to the cooking equipment (see Figure 17-1). Generally, for the identical (thermal plume) challenge, a single-island canopy hood requires more exhaust than a wall-mounted canopy hood, and a wall-mounted canopy hood requires more exhaust than a proximity (backshelf) hood. The performance of a double-island canopy tends to emulate the performance of two back-to-back wall-canopy hoods, although the lack of a physical barrier between the two hood sections makes the configuration more susceptible to cross drafts.



Source: ASHRAE Standard 154

Figure 17-1. Types of kitchen ventilation systems

Building codes distinguish between cooking processes that create smoke and grease (e.g., frying, griddling, or charbroiling) and those that produce only heat and moisture (e.g., dishwashing and some baking and steaming operations). Cooking that produces smoke and grease requires liquid-tight construction with a built-in fire suppression system (Type I hood), while operations such as dishwashers that produce only heat and moisture do not require liquid-tight construction or a fire suppression system (Type II hood).

ASHRAE Standard 154 categorizes cooking appliances as light-, medium-, heavy-, and extra heavy-duty, depending on the strength of the thermal plume and the quantity of grease, smoke, heat, water vapor, and combustion products produced. The strength of the thermal plume is a major factor in determining the exhaust rate. By their nature, these thermal plumes rise by natural convection, but they are turbulent and different cooking processes have different "surge" characteristics.

Mechanical codes recognize exceptions for hoods that have been tested against a recognized standard, such as Underwriters Laboratories (UL) Standard 710. Part of the UL standard is a "cooking smoke and flair up" test. This test is essentially a cooking effluent capture and containment (C&C) test where "no evidence of smoke or flame escaping outside the exhaust hood" must be observed. Hoods bearing a recognized laboratory mark are called *listed* hoods, while those constructed to the prescriptive requirements of the building code are called *unlisted* hoods.

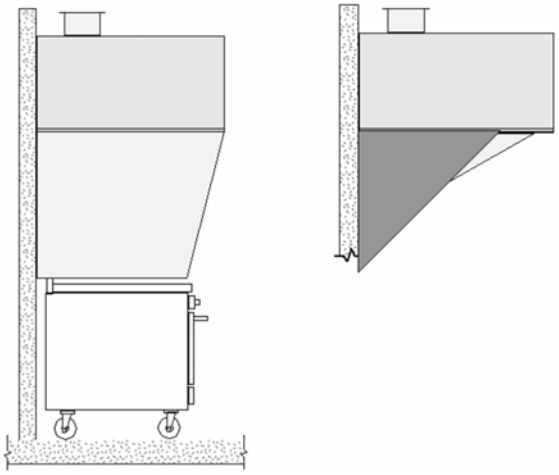
As reflected by the range in exhaust rates in the Table 7-1, a *listed* hood can be operated at a lower exhaust rate than an *unlisted* hood of comparable style and size over the same cook line. Lower exhaust rates may be proven by laboratory testing with specific hood(s) and appliance lineup using the test protocol described in ASTM Standard F-1704, *Test Method for Performance of Commercial Kitchen Ventilation Systems*. This process is sometimes referred to as "custom-engineering" a hood and is the foundation of this ECM. Within the specification to maximize hood performance and minimize exhaust rate are construction or installation details that include the addition of partial side panels, minimizing the gap between the appliances and the back wall and, in the case of canopy hoods, increasing the amount of overhang (e.g., from 6 to 18 in). These detailed specifications can permit a listed hood to operate satisfactorily at the lower end of the cfm range show (e.g., 200 cfm vs. 300 cfm) for a 30% or more saving over the Code values and or standard design practice).

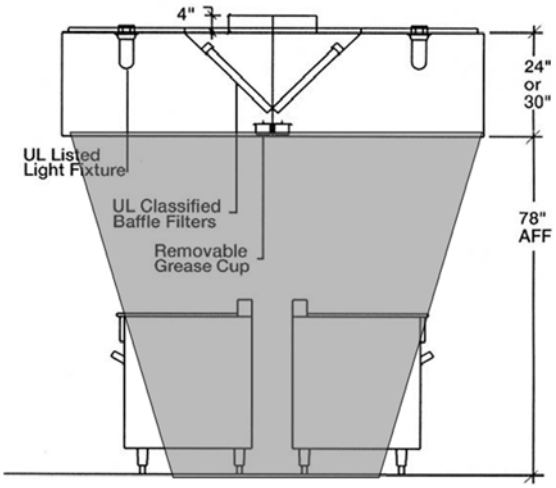
Energy Efficiency Specifications

Specify exhaust hoods based on performance data provided by the manufacturer of a *listed* hood that will minimize the exhaust ventilation rate for a given cooking equipment line or duty (as reflected in the above table). In general, this will permit exhaust ventilation rates that are at least 30% below the prescriptive code requirements with proportional energy savings.

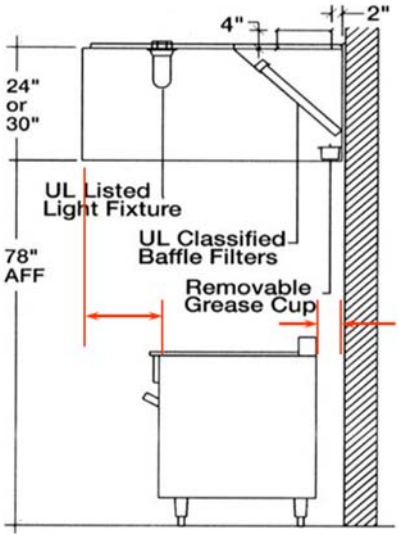
Where applicable, the following best-design practices should be incorporated within the exhaust system design and specifications to ensure that capture and containment performance of the hood is satisfactorily at the reduced exhaust rate:

1. Incorporate partial side panels or end walls.





2. Maximize overhang and minimize clearance between appliance and rear wall.



3. Positioning heavy duty equipment (e.g., broilers) in middle of the hood and light duty (e.g., ovens, kettles) at the end of the cook line.
4. Specifying walk-mounted canopy hoods instead of single-island canopies.
5. Specifying back-shelf (i.e., proximity hoods) over short-order equipment such as griddles and fryers.

6. Low-velocity introduction of makeup air near hoods (e.g., no 4-way diffusers in kitchens).
7. Maximize transfer air (detailed within 17.2.3.).
8. Incorporate demand ventilation controls (detailed within 17.2.4.).

17.2.2 – Maximize transfer air/minimize dedicated makeup air *(to be completed)*

17.2.3 – Demand Ventilation Controls for Exhaust Hoods *(to be completed)*

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