SPECIFICATIONS

HVAC REPLACEMENT
FAA-TRI-701374

June 7, 2012

TRI-CITIES AIR TRAFFIC CONTROL TOWER
BLOUNTVILLE, TENNESSEE

Design by:
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TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS
01 00 00 GENERAL PARAGRAPHS
01 10 00 SUMMARY OF WORK
01 10 12 CONSTRUCTION ADMINISTRATION FORMS
01 10 15 ACRONYMS AND DEFINITIONS
01 14 00 CONDITIONS AFFECTING WORK
01 18 00 EXISTING UTILITIES
01 25 00 SUBSTITUTION PROCEDURES
01 31 19 PROJECT MEETINGS
01 33 00 SUBMITTAL PROCEDURES
01 40 00 CONTRACTOR QUALITY CONTROL
01 42 00 REFERENCES
01 50 00 TEMPORARY FACILITIES AND CONTROLS
01 52 16 SAFETY REQUIREMENTS
01 56 23 BARRIERS AND ENCLOSURES
01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS
01 58 00 CONSTRUCTION IDENTIFICATION SIGNS
01 58 13 POSTING OF NOTICES
01 71 33 PROTECTION OF WORK AND PROPERTY
01 74 13 CONSTRUCTION CLEANING
01 74 23 FINAL CLEANING
01 77 00 CLOSEOUT PROCEDURES
01 78 23 OPERATION AND MAINTENANCE DATA
01 78 36 WARRANTIES AND GUARANTEES
01 78 39 PROJECT RECORD DOCUMENTS

DIVISION 02 - EXISTING CONDITIONS
02 01 00 INTERIM LIFE SAFETY MEASURES FOR FACILITIES UNDER CONSTRUCTION
02 03 00 GENERAL REQUIREMENTS FOR DEMOLITION AND RENOVATION
02 82 15 ENVIRONMENTAL AIR MOINTORING
02 82 33 REMOVAL AND DISPOSAL OF ASBESTOS CONTAINING MATERIALS
02 83 33 REMOVAL AND DISPOSAL OF PAINT WITH LEAD

DIVISION 03 - CONCRETE
03 30 00 CAST-IN-PLACE CONCRETE

DIVISION 04 – MASONRY (NOT USED)

DIVISION 05 – METALS
05 50 00 METAL FABRICATIONS

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES (NOT USED)

DIVISION 07 - THERMAL AND MOISTURE PROTECTION (NOT USED)

DIVISION 08 – OPENINGS (NOT USED)

DIVISION 09 – FINISHES (NOT USED)

DIVISION 10 – SPECIALTIES (NOT USED)

DIVISION 11 – EQUIPMENT (NOT USED)

DIVISION 12 – FURNISHINGS (NOT USED)

DIVISION 13 - SPECIAL CONSTRUCTION (NOT USED)

DIVISION 14 - CONVEYING EQUIPMENT (NOT USED)

DIVISION 21 - FIRE SUPPRESSION (NOT USED)

DIVISION 22 – PLUMBING (NOT USED)

DIVISION 23 - HEATING VENTILATING AND AIR CONDITIONING

23 05 00 COMMON WORK RESULTS FOR HVAC
23 05 13 COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
23 05 19 METERS AND GAGES FOR HVAC PIPING
23 05 23 GENERAL-DUTY VALVES FOR HVAC PIPING
23 05 29 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
23 05 33 HEAT TRACING FOR HVAC PIPING
23 05 48 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT
23 05 53 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
23 05 93 TESTING, ADJUSTING, AND BALANCING
23 07 00 HVAC INSULATION
23 09 23 INSTRUMENTATION AND CONTROLS FOR HVAC
23 21 13 HYDRONIC PIPING
23 21 23 HYDRONIC PUMPS
23 23 00 REFRIGERANT PIPING
23 25 00 HVAC WATER TREATMENT
23 31 13 METAL DUCTS
23 33 00 AIR DUCT ACCESSORIES
23 52 30 COMMERCIAL ELECTRIC BOILERS
23 64 23 SCROLL WATER CHILLERS
23 73 13 MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS
23 81 26 SPLIT-SYSTEM AIR-CONDITIONERS

DIVISION 26 - ELECTRICAL

26 05 00 COMMON WORK RESULTS FOR ELECTRICAL

26 05 19 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
26 05 29 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
26 05 33 RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS
26 05 53 IDENTIFICATION FOR ELECTRICAL SYSTEMS
26 28 16 ENCLOSED SWITCHES AND CIRCUIT BREAKERS
26 29 13 ENCLOSED CONTROLLERS

DIVISION 27 – COMMUNICATIONS (NOT USED)

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY (NOT USED)

DIVISION 31 – EARTHWORK (NOT USED)

DIVISION 32 - EXTERIOR IMPROVEMENTS (NOT USED)

DIVISION 33 – UTILITIES (NOT USED)

APPENDICES
APPENDIX 1 – FAA PRE-CONSTRUCTION AND MAINTENANCE PROJECT SAFETY AND HEALTH CHECKLIST

APPENDIX 2 – ELECTRICAL WORK, INTERIOR

APPENDIX 3 – ELECTRICAL POWER POLICY IMPLEMENTATION AT NATIONAL AIRSPACE SYSTEM FACILITIES

APPENDIX 4 – ASBESTOS SURVEY INVENTORY

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SECTION 01 00 00- GENERAL PARAGRAPHS

PART 1 - GENERAL

1.1 PRE BID SITE VISIT

A. The offerer is expected to carefully examine the areas of the proposed work, to see first hand the extent of the work involved. The submission of a proposal will be considered prima facie evidence that the offerer has made such examination and is satisfied as to the conditions to be encountered in performing the work. It is the obligation of the offerer to make their own interpretation of the site subsurface data included in the appendix as to the nature and extent of the work, including materials to be excavated. For access to the site, contact the Contracting Officer indicated in the solicitation.

1.2 TIME FOR COMPLETION

A. The work shall be completed within the time period defined in the General Contract.

1.3 ACTUAL DAMAGES

A. Contractor and his sureties shall be liable for any damages to the Government resulting from his refusal or failure to complete the work within the time fixed in the contract or any extensions thereof, pursuant to the clause of this contract entitled, "AMS Clause 3.10.6-6, Default (Fixed price Construction)."

1.4 PLANS, SPECIFICATIONS, AND OTHER CONTRACT DOCUMENTS

A. The requirements of AMS Clause 3.2.2.3-33, Order of precedence and AMS Clause 3.2.2.3-60, Specifications, Drawings, and Material Submittals shall apply.

B. Plans showing general outlines and details necessary for a comprehensive understanding of the work form a part of the Contract Documents. The total number and the titles of the drawings constituting the Plans are given in the index of the plans. All work under the Contract shall be performed in all respects in compliance with the requirements of the Contract Documents.

C. Contractor shall perform Work only in accordance with drawings marked "Issued for Construction" (IFC), which may be issued after commencement of work on this Contract. Such IFC drawings may be revised from time to time by Change Notice and upon issuance become a part of the Contract, superseding or supplementing the original contract drawings.

D. The Contract Documents provide for a complete work, and may have been prepared in divisions of various crafts, trades and other categories of work. The Contractor is responsible

for the performance of all work under the Contract regardless of any such divisions, and shall ensure that all of the work is performed and completed.

E. The FAA will provide the Contractor with one bound and one unbound copy of the construction plans and specifications marked "Issued for Construction" for the Contractor's use during the execution of the Contract. The Contractor may reproduce these documents for its use during the performance of the work under this Contract.

F. The Contractor shall maintain at the Site at all times at least one (1) copy of Plans, Technical Specifications and all other Contract Documents, together with at least one (1) complete set of approved Shop Drawings and approved samples.

G. The Contractor shall make available at the job site one copy of each referenced standard (or as directed by the COR, for the Contractor's and the FAA's use during the time that work is covered by the standard.

H. The Contract, Plans, Specifications, and all referenced standards cited are essential parts of the Contract requirements. A requirement occurring in one is as binding as though occurring in all. They are intended to be complementary and to describe and provide for a complete work.

I. In the event of any conflicts ambiguities, or discrepancies among the Contract Documents, the precedence in resolving such conflicts, ambiguities, or discrepancies shall be as follows:

1. The Schedule of Bid Items (excluding the specifications)
2. Representations and other instructions
3. Contract Clauses
4. Contract modifications
5. Addenda
6. Special Provisions shall govern over General Conditions, Division 1, and Technical Specifications.
7. General Conditions shall govern over Division 1, Technical Specifications, and Plans.
8. Division 1 shall govern over Technical Specifications and Plans.
9. Technical Specifications shall govern over Plans and over Standard Specifications and over standards for testing and materials. Drawings take precedence over specifications as to quantity and location. Specifications take precedence over Drawings as to quality of materials and workmanship.
10. Plans shall govern over Standard Specifications and over standards for testing and materials.
11. On the Plans, calculated or figured dimensions shall govern over scaled dimensions.
12. Subject to the foregoing provisions of this paragraph, the more stringent requirements shall apply in the event any conflicts cannot be resolved by applying the order of precedence.

J. The Contractor shall not take advantage of any apparent error, omission, discrepancy, or ambiguity on the Plans or Specifications. If any error, omission, discrepancy, or ambiguity is found by the Contractor in the Plans or Technical Specifications, the Contractor shall refer the same to the Contracting Officer (CO) prior to beginning work on affected task(s), for interpretation and decision, and such decision shall be final.

K. The CO shall have the right to correct apparent errors or omissions in the Plans and Technical Specifications and to make such interpretations as he may deem necessary for the proper fulfillment of the Contract Documents. During the course of the work, should any conflicts, ambiguities, or discrepancies be found that are not addressed or any discrepancies between the Plans and the Technical Specifications to which the Contractor has failed to call attention before submitting the offer, then the CO will interpret the intent of the Plans and Technical Specifications and the Contractor hereby agrees to abide by the CO's interpretation and agrees to carry out the work in accordance with the decision of the CO. In such event the Contractor will be held to have included in the offer the most expensive material and/or method of construction.

L. When a material, article, or equipment is designated by a brand name, and more than one brand name is listed, it will be understood that the design is based on one of the brand name listed products. The contractor will be responsible for all coordination necessary to accommodate the material, article, or equipment actually being provided without additional cost to the government.

M. The organization of the contract Documents into divisions, sections and articles, and the arrangement of Drawings does not restrict or limit the Contractor in dividing the Work among Subcontractors or in establishing the extent of work to be performed by any trade.

N. Product and Reference Standards:

1. When descriptive catalog designations including manufacturer's name, product brand name, or model number are referred to in the Contract Documents, such designations shall be considered as being those found in industry publications of current issue on the date of the first advertisement for offers.
2. When standards of the Federal Government, State Department of Transportation, Standards Organization such as ASTM, AASHTO, AWS, or ANSI, trade societies, or trade associations are referred in the Contract Documents by specific date of issue, these shall be considered a part of this Contract. When such references do not bear a date of issue, the current published edition on the date of the first advertisement for offers shall be considered as part of the Contract.
3. Where in the Contract Documents an item is identified by a particular manufacturer's name, model or other code it shall be interpreted to include other manufacturers' product of like and equal quality whether the words "or equal" are included or not.
4. Wherever a particular manufacturer's product is required, to the exclusion of all others, appropriate language is included in the Contract Documents.
5. Wherever the terms, "as directed", "ordered", "permitted", "designate", "as approved", "approved equal", "or equal", "acceptable" and other words of similar meaning which authorize an exercise of judgement are used in the Contract Documents, such judgment shall be vested only in the Architect/Engineer and/or the FAA.

1.5 CONFORMITY WITH PLANS AND SPECIFICATIONS

A. No deviation from the Plans, Technical Specifications and other Contract Documents shall be

permitted without the prior written approval of the RE.

1.6 SUPERVISION AND CONSTRUCTION PROCEDURES

A. At all times during performance of this contract, and until the work is completed and accepted, the Contractor shall directly superintend the work or assign and have on the worksite a competent superintendent who is satisfactory to the CO and has the authority to act for the Contractor.

B. The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences, and procedures and for coordinating all portions of the Work under the Contract including coordination of the duties of all trades, unless the Contract Documents give other specific instructions concerning these matters.

C. The Contractor shall control its operations and those of its Subcontractors and Suppliers to assure the least inconvenience to the traveling public. Under all circumstances, safety shall be the most important consideration.

D. Contractor shall lay out all work well enough in advance to avoid conflicts or interferences with other work in progress so that in case of interference the layout may be altered to suit the conditions, prior to the installation of any work and without additional cost to the FAA. The contractor shall be responsible to coordinate all work and take all action as required to avoid conflicts between trades. Unless specifically noted otherwise, establish the exact location of equipment based on the actual dimensions of equipment furnished. Mechanical and electrical work shall be coordinated so that work may proceed according to the following sequence to avoid conflict:

1. Air handling unit placement
2. Gravity Pipes (drains, sewer, storm)
3. Duct routing
4. Cable tray placement
5. Light fixture location
6. Pressure pipe routing
7. Conduit routing

1.7 CORRESPONDENCE

A. Contract correspondence shall be directed to the CO with a copy to the RE. Submittals will be sent direct to the RE with a copy of the transmittal letter to the CO.

1.8 LIST OF SUBCONTRACTORS

A. The Contractor shall, within 10 calendar days after award, furnish to the CO with a copy to the RE, a list of subcontractors showing the type of work each will perform. If all subcontracts have not been awarded when the initial list is submitted, the Contractor shall update the list.

1.9 PRECONSTRUCTION CONFERENCE

A. The CO will arrange a conference at a location, mutually agreeable to the CO and the Contractor as soon as practicable after award of a contract. It will be mandatory that the Contractor or his designated representative attends.

1.10 WORK NOT INCLUDED

A. Items noted on the drawings, details, or schedules as "N.I.C." (Not in Contract) are not included in this contract.

1.11 REQUIRED INSURANCE

A. Contractor to Maintain Insurance Coverage.

1. The Contractor shall at its sole expense, procure and maintain in effect at all times during the performance of the Work insurance coverage with insurers and under forms of policies satisfactory to the FAA, and with limits not less than those set forth in this article.
2. Minimum Financial Security Requirements. All insurance companies providing insurance required by this Contract must meet certain minimum financial security requirements. These requirements conform to the rating published by A.M. Best & Co. and a current Best's Key Rating Guide-Property-Casualty. All companies providing insurance under this Contract must:

   a. Have a current Best's Rating not less than A- and current;
   b. Have a current Best's Financial Size Category not less than Class IX and,
   c. Authorized by the State Insurance Commissioner pursuant to a valid and current Certificate of Authority to conduct and transact Surety business in the State of construction.

3. Written Notification. If the issuing company does not meet these minimum requirements, or for any other reason shall be or become unsatisfactory to FAA, written notification shall be provided by the FAA, and the Contractor shall promptly obtain a new policy issued by an insurer acceptable to FAA.
4. Certificates of Insurance. Contractor shall deliver to FAA at the time of execution of these Contract certificates of insurance as evidence that policies providing such coverage and limits of insurance are in full force and effect. Certificates shall be issued in the form provided by FAA or if none is provided, in a form acceptable to FAA. The policy will provide that advance written notice will be given to FAA thirty (30) days prior to cancellation for other than non-payment, termination or material alteration of said policies of insurance. Termination for non-payment shall require ten (10) days notice. Certificates shall identify on their face the project name, applicable contract number, notice of termination requirements and additional insured.

5. Standard Coverage

a. Workers' Compensation Statutory as required by any applicable law or regulation.
b. If there is an exposure of injury to Contractor's employees under the U.S. Longshoremen's and Harbor Workers' Compensation Act, the Jones Act or under laws, regulations or statutes applicable to maritime employees, coverage shall be included for such injuries or claims.
c. Employer's Liability of not less than: Five Hundred Thousand Dollars ($ 500,000) each accident.

6. General Liability Insurance Coverage. Contractor shall carry Commercial General Liability Insurance covering all operations by or on behalf of Contractor providing insurance for bodily injury liability and property damage liability for the limits of liability indicated below and including coverage for:

a. Premises and Operations;
b. Products and Completed Operations;
c. Contractual Liability insuring the obligations assumed by Contractor in this Contract;
d. Broad form Property Damage (including Completed Operations);
e. Explosion, Collapse and Underground Hazards; and
f. Personal Injury Liability;
g. The Commercial General Liability insurance shall be the Occurrence Coverage Form.
h. Policy Limits. For Contractor's Commercial General Liability Insurance, the limits of liability for bodily injury, property damage, and personal injury shall be not less than:

1) $2,000,000 Combined single limit for Bodily Injury and Property Damage each occurrence;
2) $2,000,000 Personal Injury Limit each occurrence;
3) $4,000,000 Products-Completed Operations Annual Aggregate Limit and;
4) $4,000,000 General Annual Aggregate Limit (other than Products-Completed Operations).

7. Endorsement. If the policy does not have an endorsement providing the General Annual Aggregate limits as indicated above Contractor shall provide an endorsement entitled "Amendment of Limits of Insurance for the _____ Airport ATCT Project". Such endorsement shall provide for a Products-Completed Operations Annual Aggregate Limit of not less than two million dollars ($2,000,000) and a General Annual Aggregate Limit of not less than two million dollars ($2,000,000). The required limits may be satisfied by a combination of a primary policy and an excess or umbrella policy.
8. Automobile Liability Insurance including coverage for the operation of any vehicle to include, but not limited to, owned, hired and non-owned.
9. The combined single limit for Bodily Injury and Property Damage Liability shall be not less than ten million dollars ($10,000,000) for any one accident or loss. The required limits may be satisfied by a combination of a primary policy and an excess or umbrella policy.
10. Contractor's Automobile Liability Insurance shall include coverage for Automobile Contractual Liability.

B. Related Obligations.

1. No Limitations. The requirements contained herein as to types and limits, as well as FAA's approval of insurance coverage to be maintained by Contractor, are not intended to and shall not in any manner limit or qualify the liabilities and obligations assumed by Contractor under this Contract.
2. Insurance Certificates. The Certificates of Insurance must provide clear evidence that Contractor's Insurance Policies contain the minimum limits of coverage and the special provisions prescribed in this clause.
3. Authorization and Licensing of Agent. Each and every agent acting as authorized representative on behalf of a company affording coverage under this Contract shall warrant when signing the Acord Certificate Insurance that specific authorization has been granted by the company for the agent to bind coverage as required and to execute the Acord Certificate of Insurance as evidence of such coverage. FAA's coverage requirements may be broader than the original policies, and these requirements have been conveyed to the companies for these terms and conditions. In addition, each and every agent shall warrant when signing the Acord Certificate of Insurance that the agent is licensed to do Surety business in the State with the State Insurance Commissioner and that the company or companies are currently in good standing in the State.
4. Use of Facilities. Contractor agrees that it will not use the facilities for any purpose which might void any policy of insurance concerning the Work or render any loss under any policy uncollectible.

C. FAA Furnished Insurance.

1. FAA is not maintaining any insurance on behalf of Contractor covering against loss or damage to the Work or to any other property of Contractor. In the event Contractor maintains insurance against physical loss or damage to Contractor's construction equipment and tools, such insurance shall include an insurer's waiver of rights of subrogation in favor of FAA.

D. Notifications.

1. In accordance with the submittal requirements outlined above, Contractor shall deliver the original and two (2) copies of the Certificate(s) of Insurance required by this clause and all subsequent notices of cancellation, termination and alteration of such policies to the CO with a copy to the RE.

E. Certificate of Insurance.

1. The scope of coverage shall be shown on the certificate of insurance as "All operations of the Named Insured".

1.12 SECURITY REQUIREMENTS

A. Personnel List: Contractor shall provide the Resident Engineer with a list of Contractor's personnel who will require access to the site. The list shall be kept current during project work.

The Contractor shall provide all personnel with readily identifiable numbered badges during the period their access to the site is required. Badges shall be in accordance with Airport Requirements and shall be worn on outer clothes at all times when on airport property and at work in the site.

B. Security Investigation: Contractor's site superintendent shall submit to an FAA security background check and obtain an official FAA contractor ID badge. Other Contractor personnel may be subject to security investigation by FAA. Upon request by the Resident Engineer, the Contractor shall promptly complete all security forms provided by the Resident Engineer.

C. Communication: The Contractor shall request through the Resident Engineer, a meeting with the Airport Manager and Control Tower personnel to discuss planned Contractor activities in the controlled airport operation area.

D. Right to Search: Current procedures at FAA facilities located within airport boundaries include the "right to search". If in the judgment of the authorized security guard a cause to search a vehicle or the person of personnel exists, such search will be made.

E. Airport Requirements: Contractor must also meet all the Airport's security requirements for work at the airport.

1.13 CHANGED CONDITIONS

A. Wherever changed conditions as defined in Contract Clause entitled, "Changes and Changed Conditions" are encountered, and wherever conditions exposed during the course of the work necessitate a change from quantities indicated or specified as either estimated quantities or as a basis for offers, whether or not provision for a change in price for such variation is specified, the CO must be notified in writing and written directions to do so must be obtained before quantities stated in the contract documents are exceeded.

1.14 EXISTING WORK

A. The disassembling, disconnecting, cutting, removal, or altering in any way of existing work shall be carried on in such a manner as to prevent injury or damage to all portions of existing work, whether they are to remain in place, be re-used in the new work, or be salvaged and stored.

B. All portions of existing work which have been cut, damaged, or altered in any way during construction operations shall be repaired or replaced in kind in an approved manner to match existing or adjoining work. All work of this nature shall be performed by the Contractor at his expense and shall be as directed. Existing work shall, at the completion of all operations, be left in a condition as good as existed before the new work started.

1.15 MATERIALS AND EQUIPMENT TO BE SALVAGED

A. Except where specifically specified otherwise herein, or designated on the drawings, all

existing materials and equipment which are required to be removed or disconnected to perform the work but are not indicated or specified for use in the new work, shall become the property of the Contractor and shall be disposed of properly. The Government may elect to salvage any or all materials removed by the Contractor by giving prior notice and pricing up materials at job site.

1.16 PAYMENTS TO CONTRACTOR

A. The obligation of the Government to make any of the payments required under any of the provisions of this contract shall, in the discretion of the CO be subject to 1) reasonable deductions on account of defects in material or workmanship, and 2) any claims which the Government may have against the Contractor under or in connection with this contract. Any overpayments to the Contractor shall, unless otherwise adjusted, be repaid to the Government upon demand.

1.17 PARTIAL OCCUPANCY OR USE

A. The FAA may occupy or use any completed or partially completed portion of the Work at any stage and, if the FAA chooses such partial occupancy, the Contractor and FAA shall designate by an agreement the conditions of such partial occupancy. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the FAA and Contractor have accepted in writing the responsibilities assigned to each of them by the RE for payments, retainage if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. Consent of the Contractor to partial occupancy or use by the FAA shall not be unreasonably withheld.

1.18 UNCOVERING AND CORRECTION OF WORK

A. Uncovering Work

1. If any portion of the Work is covered contrary to the RE's request or to requirements specifically expressed in the Contract Documents, it must, if required in writing by the RE be uncovered for his observation and be recovered (if corrections are not required) or be corrected, if applicable, at the Contractor's expense without change in the Contract Time.
2. If a portion of the Work has been covered which the RE or any applicable governmental authority has not specifically requested to observe prior to its being covered, the RE may request to see such Work and it shall be uncovered by the Contractor. If such work is in accordance with the Contract Documents, costs of uncovering and restoration shall, by appropriate Change Order, be charged to the FAA. If such Work is not in accordance with the Contract Documents, the Contractor shall pay such costs unless the condition was caused by the FAA or a separate contractor in which event the FAA shall be responsible for payment of such costs.

B. Correction Of Work

1. The Contractor shall promptly correct Work rejected by the RE or any governmental authority that fails to conform to the requirements of the Contract Documents, whether observed before or after Substantial Completion and whether or not fabricated, installed or completed. The Contractor shall bear all costs of correcting such rejected Work, including additional testing and inspections and compensation for the RE's services and expenses incurred by the FAA.
2. If, within two years after the date of Substantial Completion of the Work or designated portion thereof, or after the date for commencement of warranties established above, or by terms of an applicable special warranty required by the Contract Documents, any of the work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of written notice from the FAA to do so unless the FAA has previously given the Contractor a written acceptance of that specific condition. This period of two years shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual performance of the Work. This obligation shall survive acceptance of the Work under the Contract and termination of the Contract. The FAA shall give such notice within a reasonable amount of time after discovery of the condition.
3. The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the FAA.
4. If the Contractor fails to correct nonconforming Work within a reasonable time, the FAA may correct it in accordance with General Provisions. If the Contractor does not proceed with correction of such nonconforming Work within a reasonable time fixed by written notice from the RE, the FAA may correct or remove such nonconforming work and all costs for such corrections or removals shall be assessed against the Contractor.
5. The Contractor shall bear the cost of correcting destroyed or damaged Work, whether completed or partially completed, of the FAA or separate contractors caused by the Contractor's performing correction or removal of Work which is not in accordance with the requirements of the Contract Documents.
6. Nothing contained herein shall be construed to establish a period of limitation with respect to other obligations that the Contractor might have under the Contract Documents. Establishment of the time period of two years as described above relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability and damages with respect to the Contractor's obligations other than specifically to correct the Work.

C. Acceptance Of Nonconforming Work

1. If the FAA prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the FAA may do so instead of requiring its removal or correction. If the FAA accepts the Work under such circumstances, the Total Contract Price will be reduced in an equitable manner as determined by the Contracting Officer, whether or not final payment has been made.

D. Terms and Conditions" and "Contract Clauses"

1. Wherever a reference to a clause of the General Provisions or General Conditions occurs in the technical section of the specifications, it shall be taken to mean the "Terms and Conditions" and "Contract Clauses" having the same title as the referenced General Provisions or General Conditions clause.

1.19 UNDERGROUND UTILITIES

A. Utilities Encountered - Efforts have been taken to locate all the underground utilities and cables on the contract drawings; however, unforeseen utilities and underground cables may be encountered. Actual cable locations shall be verified in the field by the Contractor by hand digging a minimum of five (5') on each side of the cable. FAA owned cable will be marked by the FAA prior to the start of work by the Contractor.

1.20 LOCATION OF SERVICES

A. The FAA does not guarantee the accuracy or the completeness of the location information relating to existing utility services, facilities, or structures that may be shown on the plans of encountered in the work. Any inaccuracy or omission in such information shall not relieve Contractor of its responsibility to protect such existing features from damage or unscheduled interruption of service.

1.21 COOPERATE WITH OTHER ENTITIES

A. Cooperate with the FAA and other public or private utility services, or a utility service of another government agency that may be authorized by the FAA to construct, reconstruct, or maintain such utility services or facilities during the progress of the work. Control operations to prevent the unscheduled interruption of such utility services and facilities.

1.22 NOTICE TO FAA/OPERATORS

A. Prior to commencing the work in the general vicinity of an existing utility service or facility, Contractor shall notify each FAA/operator in writing of activities that might affect its interests. If, in Contractor's opinion, the FAA/operator's assistance is needed to locate the utility service or facility or the presence of a representative of the FAA/operator is desirable to observe the work, such advice should be included in the notification. Furnish a copy of such written notices to RE.

1.23 EXCAVATION METHODS

A. Where the outside limits of an underground utility service have been located and staked on the ground, Contractor shall use excavation methods acceptable to the RE as may be required to

insure protection from damage due to Contractor's operations.

1.24 DAMAGE TO SERVICES

A. Should Contractor damage or interrupt the operation of a utility service or facility by accident or otherwise, it shall immediately notify in writing the FAA/operator, appropriate public safety authorities, and the RE and shall take all reasonable measures to prevent further damage or interruption of service. Cooperate with the utility service or facility FAA and the RE continuously until such damage has been repaired and service restored.

1.25 FAILURE TO PROTECT PROPERTY

A. Contractor shall not be entitled to any extension of time or compensation on account of Contractor's failure to protect all facilities, equipment, materials and other property as described herein. All costs in connection with any Improvements or restoration necessary or required by reason of unauthorized obstruction, damage, or use shall be borne by Contractor.

1.26 UTILITY CONTRACTOR LICENSING REQUIREMENTS

A. Contractor shall comply with all state and local requirements for construction of utilities.

1.27 ASBESTOS AND LEAD FREE CERTIFICATION

A. FAA policy is to construct all new facilities without asbestos or lead containing products. The Contractor shall provide a letter on his company's standard letter head stating that to the best of his knowledge no product or material used on this project contains asbestos or lead. The statement shall include the name of the project and the contract number and shall be signed by an officer of the company. The statement shall be furnished within 10 calendar days of the Substantial Completion date. Submission of this statement is a condition for final payment under the contract.

B. Verification: If the FAA suspects the presence of asbestos or lead, tests shall be performed on the material or product at the FAA's expense. If it is determined that the product or material does contain asbestos or lead, then the contractor shall remove the product or material and replace at his own expense including the expense of the testing and any retesting that may be necessary.

C. Non – Compliance: If the Contractor fails to provide the above statement, then the FAA shall have a complete building survey performed by a qualified testing firm and the costs deducted from the contractor's final payment.

1.28 MATERIAL SAFETY DATA SHEETS (MSDS):

A. The Contractor shall submit to the Resident Engineer Material Safety Data Sheets (MSDS) for all materials and/or products utilized during the course of the project accomplishment. During

the course of the project, both the Resident Engineer and the Contractor shall routinely check products utilized on-site to ensure only products which have had MSDS submitted are utilized. Copies of all MSDS shall be turned over to the local FAA office for their records.

1.29 INITIAL SUBMITTALS

A. The following submittals are required to have FAA approval prior to Notice to Proceed.

1.	Section 01 00 00	LIST OF SUBCONTRACTORS, CERTIFICATE OF INSURANCE
2.	Section 01 32 00	CONSTRUCTION SCHEDULE
3.	Section 01 32 00.10	EARNED VALUE MANAGEMENT
4.	Section 01 32 33	PRE-CONSTRUCTION VIDEO
5.	Section 01 40 00	CONTRACTOR QUALITY CONTROL
6.	Section 01 52 13	FAA FIELD REPRESENTATIVE'S OFFICE
7.	Section 01 52 16	SAFETY PLANS
8.	Section 01 57 13	EROSION CONTROL PLAN
9.	Section 01 71 33	STORM PROTECTION PLAN

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION 01 00 00

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SECTION 01 10 00 - SUMMARY OF WORK

PART 1 - GENERAL

1.1 WORK COVERED BY CONTRACT DOCUMENTS

A. Work of this Contract comprises the replacement of the HVAC systems for the ATCT including the air cooled chiller, boiler, pumps and air handling units, and the AFSFO building including the condensing units and the air handling units. Electrical and general construction is included to support the HVAC replacement.

1.2 CONTRACT METHOD

A. Construct the Work under a single lump sum contract, subject to the provisions of Earned Value Management.

1.3 WORK SEQUENCE

A. Construction Work stages shall be defined by the Contractor. The following sequence is provided as General Guidance Only. Additional phasing may be necessary due to site availability restrictions. Portions of Stages may be simultaneous.

B. Stage Action

1. Provide temporary HVAC for critical areas defined by FAA.
2. Complete demolition
3. Construct new HVAC and controls work
4. Remove temporary systems

1.4 CONTRACTOR USE OF PREMISES

A. The FAA shall have the right of unlimited access to the premises.

B. Other agencies may be constructing other improvements during a portion or all of this construction. Contractor shall coordinate with other agencies contractors.

C. Coordinate use of premises in accordance with the site availability shown on the plans and as directed by the RE.

D. Assume full responsibility for protection and safekeeping of project materials under this Contract.

E. Obtain and pay for use of additional storage or work areas needed for operations under this Contract.

F. Parking is not allowed along existing roads or within portions of the site except as designated by the RE.

1.5 ACCESS TO SITE

A. Contractor's access to site shall be as shown on the plans or as directed by the RE. The Contractor shall not permit any unauthorized construction personnel or traffic on the site. The Contractor shall be responsible for traffic control to and from the various construction areas on the site. Directional signing at the access gate and along the delivery route to the storage area or work site shall be as directed by the RE. The Contractor will not be allowed to close any traffic lanes nor will the Contractor be allowed to impede the flow of airport traffic.

1.6 MATERIALS DELIVERY TO THE SITE

A. All material orders for delivery to the site shall use as a delivery address the address of the new tower. Delivery trucks shall not pass in front of the terminal.

B. Contractor shall prepare, and submit to the RE for approval, a delivery plan for all types of delivery. The plan shall define the procedures that will be used to accommodate delivery traffic for all types of deliveries (e.g. concrete/asphalt, steel, precast, earth/aggregate, tractor trailer, city delivery truck) and any staging areas that will be used. Normal flow of traffic, into and out of the airport, shall not be impeded. Deliveries shall be suspended at the direction of the RE.

C. Delivery for continuous concrete pours, such as tower foundations and concrete pavement, shall be coordinated with the RE at least two weeks in advance of anticipated dates. It may be necessary to schedule such work for only weekends depending on the seasonal air traffic volume.

D. The Contractor is responsible for immediate clean-up of any debris deposited along the access road as a result of his/her construction traffic.

1.7 CONSTRUCTION AREA LIMITS

A. The limits of construction material storage areas, equipment storage areas, parking areas, and other areas as required by the Contractor shall be as shown on the plans or as approved by the RE. Should Contractor find it necessary or advantageous to use any additional offsite area for any purpose whatsoever, Contractor shall, at its expense, provide and make its own arrangements for the use of such additional offsite areas.

B. Erect and maintain fencing, marking, and/or warning devices suitable for both day and night use to delineate the perimeter of all such areas.

C. When the Work requires Contractor to conduct operations within areas adjacent to active airport, the Work shall be coordinated with the FAA through the RE.

D. Employee Parking. Parking will not be allowed along public right of way or the entrance/exit road. In the event adequate space is not available for parking on the project site the Contractor shall arrange for off-site parking and provide bus transportation of employees to and from the site. No

other areas will be made available for Contractor use for parking, staging, trailers, or storage.

1.8 PERMITS AND FEES

A. Contractor is responsible for applying for utility services, obtaining required permits, and payment for any associated fees. Compliance is required with the conditions of all permits that have been issued. All fees must be paid by the Contractor.

B. Contractor is responsible for paying all charges associated with the construction of the project. This includes permits and inspection fees. This allocation of financial responsibility applies to all utilities.

1.9 BUILDING PERMIT APPLICATIONS

A. The contractor shall submit the Construction plans and specifications to the City for review and comment, and pay all fees associated with the review.

1.10 CERTIFICATE OF OCCUPANCY

A. Contractor will not be required to obtain a Certificate of Occupancy from the City.

1.11 SUBMITTALS

A. Delivery Plan as per section 1.6.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION 01 10 00

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SECTION 01 10 12 - CONSTRUCTION ADMINISTRATION FORMS

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. The following listed forms are hereby made a part of the Construction Documents.

PART 2 - PRODUCT

2.1 INDEX OF CONSTRUCTION ADMINISTRATION FORMS FOR CONTRACTOR

Airspace Form 7460.1
RFI Standard Form
Submittal Approval Form
FAA Life Safety System Inspection and Test Report
FAA Pre-Construction and Maintenance Project Safety and Health Checklist
FAA Fire Alarm System Certificate of Completion
Certificate of Substantial Completion (CoSC)
Substantial Completion Acceptance (SCA)
Partial Occupancy/Use Agreement (POUA)
Job Memorandum (JM)

PART 3 - EXECUTION

A. During the administration of the Contract, the Contractor will be required to complete various construction administration forms as a part of the Management System. These forms are identified above and will be issued at the Pre-Construction Conference. These forms may be revised during the construction period and the Contractor will be required to comply with any such revisions.

END OF SECTION 01 10 12

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U.S. Department of Transportation
Federal Aviation Administration

Failure To Provide All Requested Information May Delay Processing of Your Notice

Notice of Proposed Construction or Alteration

FOR FAA USE ONLY
Aeronautical Study Number
- - -

1. Sponsor *(person, company, etc. proposing this action) :*
Attn. of: _____
Name: _____
Address: _____
_____
City: _____ State: _____ Zip: _____
Telephone: _____ Fax: _____

2. Sponsor's Representative *(if other than #1) :*
Attn. of: _____
Name: _____
Address: _____
_____
City: _____ State: _____ Zip: _____
Telephone: _____ Fax: _____

3. Notice of: ☐ New Construction ☐ Alteration ☐ Existing

4. Duration: ☐ Permanent ☐ Temporary (months, days)

5. Work Schedule: Beginning _____ End _____

6. Type: ☐ Antenna Tower ☐ Crane ☐ Building ☐ Power Line ☐ Landfill ☐ Water Tank ☐ Other _____

7. Marking/Painting and/or Lighting Preferred:
☐ Red Lights and Paint ☐ Dual - Red and Medium Intensity White
☐ White - Medium Intensity ☐ Dual - Red and High Intensity White
☐ White - High Intensity ☐ Other _____

8. FCC Antenna Structure Registration Number *(if applicable):*
_____

9. Latitude: _____° _____' _____. _____"

10. Longitude: _____° _____' _____. _____"

11. Datum: ☐ NAD 83 ☐ NAD 27 ☐ Other _____

12. Nearest: City: _____ State: _____

13. Nearest Public-use (not private-use) or Military Airport or Heliport:
_____

14. Distance from #13. to Structure: _____

15. Direction from #13. to Structure: _____

16. Site Elevation *(AMSL):* _____ **ft.**

17. Total Structure Height *(AGL):* _____ **ft.**

18. Overall height (#16. + #17.) *(AMSL):* _____ **ft.**

19. Previous FAA Aeronautical Study Number (if applicable):
_____ - OE

20. Description of Location: (Attach a USGS 7.5 minute Quadrangle Map with the precise site marked and any certified survey.)

21. Complete Description of Proposal:

Frequency/Power (kW)	

Notice is required by 14 Code of Federal Regulations, part 77 pursuant to 49 U.S.C., Section 44718. Persons who knowingly and willingly violate the notice requirements of part 77 are subject to a civil penalty of $1,000 per day until the notice is received, pursuant to 49 U.S.C., section 46301 (a).

I hereby certify that all of the above statements made by me are true, complete, and correct to the best of my knowledge. In addition, I agree to mark and/or light the structure in accordance with established marking and lighting standards as necessary.

Date	Typed or Printed name and Title of Person Filing Notice	Signature

Please Type or Print on This Form

Form Approved OMB No. 2120-0001

FAA Form 7460-1 (2-99) Supercedes Previous Edition

NSN: 0052-00-012-0008

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Federal Aviation Administration

Request For Information No. 000

Title: _____

From:	**Project:**		**To:**
Contractor	**JOB TITLE**		
Contractor address	**Job Location**		
	Contract:		**Phone:**
Phone:			**Fax:**
Fax:			**RE:**
Contact:			
Drawing or Spec:	**Date Started:**	**Priority: Normal**	Potential Cost Impact? ☐ Yes ☐ No
	Date Required:		Potential Schedule Impact? ☐ Yes ☐ No
Attachments? No	**Date Completed:**		If yes to either, explain below.

Question (Include Potential Impacts):

Response:

By: , FAA

Date:

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APPROVAL OR DISAPPROVAL OF CONTRACTOR'S MATERIALS OR SHOP DRAWINGS	DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION	
1. TO: Contractor Address Tel: Fax: ATTN:	2. DATE CONTRACTOR'S SUBMITTAL RECEIVED:	3. DATE SUBMITTAL RETURNED:
	4. GOV'T TRANS. NO.	5. CONTRACTOR'S TRANS. NO.
	6. PROJECT NAME	
	7. CONTRACT NUMBER	

8. TRANSMITTAL REFERENCE TO CONTRACT DRAWINGS and/or SHOP DRAWINGS

9. TRANSMITTAL REFERENCE TO CONTRACT DRAWINGS AND PARAGRAPH NUMBER and/or CHANGE ORDER NUMBER

10. FACTS:

Gentlemen: We are returning herewith the following Submittal Data:

A. ITEM NO.	B. NO. COPIES	C. NAME OF SUPPLIER	D. TYPE OF MATERIAL OR EQUIPMENT	E. APPROVAL		F.	
				AS SUBMITTED	AS NOTED*	NOT APPROVED †	REVISE AND RESUBMIT
				☐	☐	☐	☐
				☐	☐	☐	☐
				☐	☐	☐	☐
				☐	☐	☐	☐
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				☐	☐	☐	☐
				☐	☐	☐	☐
				☐	☐	☐	☐

G. REMARKS

H. STIPULATIONS

*Data marked "Approved as Noted" is satisfactory, contingent upon contractor acceptance of corrections and/or notations, and if accepted does not require re-submittal.
†Data marked "Not Approved" does not meet job requirements, and contractor must re-submit on proper basis.
Approval of Data does not obviate Contractor Responsibility for correct take-off or installation clearance.

Carbon Copies Transmitted To:

____ ____
____ ____

Sincerely,

_____
Resident Engineer

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FAA Life Safety System Inspection & Test Report

PART 1 FIRE SYSTEM LOCATION, NOTIFICATION OF TEST & VISUAL INSPECTION

PROTECTED PROPERTY:

_____

_____

_____

PERSON RESPONSIBLE: _____ TITLE: _____
PHONE: _____ FAX: _____

Check each box that applies to the fire system being tested.

☐ STANDARD ATCT
☐ NON-STANDARD ATCT
☐ SMO
☐ SSC
☐ AFSS
☐ PROPERTY FAA OWNED
☐ PROPERTY FAA LEASED
☐ ARSR SITE
☐ SITE OCCUPIED
☐ SITE UNOCCUPIED
OTHER _____

NOTIFICATION PRIOR TO FIRE SYSTEM TESTING:

Notify the following Individuals and/or Office of the fire system test.

☐ FIRE DEPARTMENT
☐ A. F. MANAGER
☐ TERMINAL MANAGEMENT
☐ CENTRAL STATION
☐ SMO SAFETY OFFICER
☐ AIR TRAFFIC MANGER
☐ BUILDING OCCUPANTS
☐ REGION SAFETY MANAGER
☐ AIRPORT MANAGEMENT
OTHER

VISUAL INSPECTION OF SYSTEM PRIOR TO TESTING:

Visually inspect the following Prior to Testing.

☐ CONTROL PANEL(S)
☐ PANEL SWITCHES
☐ PRESSURIZATION FAN(S)
☐ BATTERY CHARGER TEST
☐ ELEVATOR EQUIPMENT
☐ DACT
☐ REMOTE DETECTOR INDICATOR
☐ SYSTEM MODIFICATIONS
☐ PANEL LIGHTS
☐ SYSTEM BATTERIES
☐ LOAD VOLTAGE
☐ HVAC SYSTEM(S)
☐ AUDIO DEVICES
☐ SUPPRESSION SYSTEM(S)
☐ SYSTEM RECORDS
☐ EMERGENCY GEN.
☐ PULL STATIONS
☐ POWER SUPPLIES
☐ SMOKE DETECTORS
☐ STROBES
☐ REMOTE ANNUNCIATOR
☐ PRINTER
☐ RECORD DRAWINGS
☐ OPERATORS MANUAL
OTHER _____

Make notations below in the comment section for items which are deficient and noted during the visual inspection. Additional space is available for notation of deficiencies in each section below.

WARNING:

IF THIS SYSTEM PROVIDES DETECTION AND/OR CONTROL FOR AUTOMATIC SUPPRESSION, THE AGENT RELEASE PORTION OF THE SUPPRESSION SYSTEM(S) *MUST* BE *DISABLED* PRIOR TO TESTING *ANY* SYSTEM INITIATING DEVICES TO PREVENT INADVERTENT AGENT RELEASE!

THIS FACILITIES HVAC SHUTDOWN, ELEVATOR RECALL AND PRESSURIZATION FAN SYSTEMS MUST BE TESTED ANNUALLY, TO INSURE PROPER OPERATION. AVOID UNNECESSARY CYCLING OF THESE SYSTEMS AND DISABLE THE CONTROLLING RELAYS OR ACTIVATE THE PREPROGRAMMED BY-PASS SWITCH AFTER INITIAL TESTING AND VERIFICATION OF EACH.

PART 2 FIRE SYSTEM PANEL DATA & SERVICE INFORMATION

LOCATION OF THE FIRE ALARM PANEL/FIRE COMMAND CENTER:

SYSTEM MANUFACTURER

MODEL NO.: DATE SYS. COMMISSIONED:

SERVICE COMPANY: PHONE: FAX:

ADDRESS:

CONTACT: SERVICE CONTRACT: □ YES NO

NICET CERT. NO.: NICET LEVEL: STATE LICENSE NO.:

DATE SERVICE STARTED: DATE SERVICE DEFAULTS:

DATE OF LAST SYSTEM SERVICE: DATE OF LAST SYSTEM TEST:

DOES THE PANEL APPEAR TO BE OPERATING PROPERLY (NORMAL CONDITION)	☐ YES	☐ NO
IS THE FIRE PANEL A POWER LIMITED SYSTEM	☐ YES	☐ NO
ARE ALL CIRCUITS SUPERVISED	☐ YES	☐ NO
IS A SYSTEM SMOKE DETECTOR PROVIDED TO PROTECT THE PANEL	☐ YES	☐ NO
IS ADEQUATE BATTERY BACK-UP PROVIDED AS PER NFPA 72	☐ YES	☐ NO
IS SURGE SUPPRESSION PROVIDED AT THE AC CIRCUIT BREAKER	☐ YES	☐ NO
IS THE 110 VOLT CIRCUIT PERMANENTLY LABELED "FIRE ALARM"	☐ YES	☐ NO
IS AN EMERGENCY GENERATOR PROVIDING BACK-UP POWER	☐ YES	☐ NO
IS THERE MORE THAN ONE SYSTEM PANEL INSTALLED	☐ YES	☐ NO

PANEL POWER SUPPLY, PRIMARY (MAIN), NOMINAL VOLTAGE _____, AMPS _____

OVERCURRENT PROTECTION, TYPE_____, AMPS _____, LOCATION _____

POWER DISCONNECT MEANS _____, LOCATION _____, LOCKOUT _____

SECONDARY (STANDBY) POWER _____ STORAGE BATTERY, AMP-HOUR RATING _____

CALCULATED CAPACITY TO OPERATE SYSTEM, IN HOURS: 4 _____ 24 _____ 60 _____

BATTERY TYPE:

☐ DRY CELL ☐ NICKEL CADMIUM ☐ SEALED LEAD ACID ☐ LEAD ACID ☐ OTHER _____

ENGINE GENERATOR DEDICATED TO THE FIRE ALARM SYSTEM POWER CIRCUIT ☐ YES ☐ NO

TRANSIENT SUPPRESION:

120V CIRCUIT DEVICE TYPE:	QTY.	LOCATION:
INITIATION CIRCUIT TYPE:	QTY.	LOCATION:
AUDIO CIRCUIT TYPE:	QTY.	LOCATION:
VISUAL CIRCUIT TYPE:	QTY.	LOCATION:
SIGNALING LINE CIRCUIT TYPE:	QTY.	LOCATION:
OTHER:		

A transient suppression device (listed for operation with the system) is required for each circuit that exits or enters a building. The device shall be mounted in a junction box at the point of exit and entry. Label each circuit being protected.

PART 1 AND 2 DEFICIENCIES NOTED AND/OR COMMENTS:

NOTE: The comment portions of this form are required to have an entry. If a deficiency does not exist then the Technician shall enter "A deficiency has not been noted." If more than one alarm panel exists, complete this form for each.

PART 3 DIGITAL ALARM COMMUNICATOR & MONITORING COMPANY

IS THIS FIRE ALARM SYSTEM MONITORED VIA A DACT ☐ YES ☐ NO
IS THE DACT A DUAL CHANNEL ☐ YES ☐ NO

IS THE SPRINKLER OR SUPPRESSION SYSTEM (IF EXISTING) MONITORED: ☐ YES ☐ NO
IS THE DACT A FOUR CHANNEL, DUAL LINE DACT (REQUIRED FOR SPRINKLER) ☐ YES ☐ NO
IS THE DACT POWER FROM THE CONTROL PANEL ☐ YES ☐ NO
IS THE POWER SUPERVISED ☐ YES ☐ NO
IS THERE A DEDICATED PRIMARY PHONE LINE ☐ YES ☐ NO
IS THERE A SECONDARY PHONE LINE ☐ YES ☐ NO

DACT MANUFACTURER: _____ MODEL NO.: _____
NAME OF CENTRAL STATION: _____ POINT OF CONTACT: _____
ADDRESS:_____

ACCOUNT # _____ PHONE: _____ FAX: _____
DATE CONTRACT STARTED: _____ DATE CONTRACT DEFAULTS: _____
LIST NAME AND PHONE NO. OF EACH PERSON(S) TO BE CONTACTED BY THE CENTRAL STATION:

_____
_____
_____

NOTED DACT DEFICIENCIES AND/OR COMMENTS:

_____
_____
_____
_____

NOTE: The comment portions of this form are required to have an entry. If a deficiency does not exist then the Technician shall enter "A deficiency has not been noted.

PART 4 INITIATION DEVICES AND INITIATING. OR SIGNALING CIRCUIT TYPE

Initiating devices, are those system(s) devices which *initiate* an alarm or supervisory condition. An Initiating Device Circuit (IDC) is a *hard-wired* (non-addressable) circuit(s), which employees initiating (non-addressable) devices, to send an alarm condition to the fire panel. A Signaling Line Circuit (SLC) is a circuit(s) which employees *addressable* initiating devices (for the purpose of this section). A fire system configuration may consist of both *hard-wired* and *addressable* circuits. Additional information is available to complete this section, in the NFPA 72, Chapter 3, Table 3-5, for IDC hardwired circuits and Table 3-6 for SLC addressable signaling line circuits. Check those boxes below that apply to the initiating devices and circuits. PART 6 of this report is for panel to panel communications and/or LCD/Printer communications. In filling out the device chart below wire class should be either "Class A" or "Class B". If the system is hardwired then the Style shall be *Style D* for Class A or *Style A* for Class B, see Table 3-5. If the system is addressable the style shall be *Style 6* for Class A or *Style 4* for Class B, see Table 3-6. These are the acceptable minimum standards of Class and Style wire configurations for the FAA.

ADDRESSABLE SYSTEM, **SIGNALING LINE CIRCUIT (SLC):**

☐ ADDRESSABLE ☐ STYLE 6 (CLASS A) ☐ STYLE 4 (CLASS B)
TOTAL QTY. OF ADDRESSABLE CIRCUITS _____ EACH CIRCUIT CAPACITY (MAX) _____
QTY. OF SPARE ADDRESSABLE POINTS _____ ON CIRCUIT(S) _____
PANEL CAPACITY FOR ADDITIONAL MODULES _____

ADDRESSABLE SYSTEM SOFTWARE:

REVISION NUMBER: _____ REVISION DATE: _____

FAA Life Safety System Inspection & Test Report

ALARM INITIATING, SUPERVISORY & CONTROL DEVICE INFORMATION:

Information of the fire alarm Circuits, Class and Style is noted below. For additional guidance regarding the characteristics of each circuit noted, refer to 3-6 for SLC in NFPA 72.

SYSTEM POINT OR DEVICE TYPE	**QUANTITY OF DEVICE TYPE:**	**WIRE CLASS:** (A or B)	**WIRE STYLE:** (4 or 6)	**CIRCUIT NUMBER:**
ADDRESSABLE SYSTEM:				
MANUAL STATIONS	____	_____	_____	_____
IONIZATION DETECTORS	____	_____	_____	_____
PHOTOELECTRIC DETECTORS	____	_____	_____	_____
ION DUCT DETECTORS	____	_____	_____	_____
PHOTO DUCT DETECTORS	____	_____	_____	_____
FIXED TEMP HEAT DETECTORS	____	_____	_____	_____
R OF R HEAT DETECTORS	____	_____	_____	_____
RATE COMPENSATED DETECTORS	____	_____	_____	_____
MONITOR OR CONTROL MODULE FOR:	____	_____	_____	_____
FIXED TEMP HEAT DETECTOR	____	_____	_____	_____
BEAM DETECTORS	____	_____	_____	_____
UV/IR DETECTORS	____	_____	_____	_____
COMBINATION DETECTOR	____	_____	_____	_____
WATERFLOW ALARM SWITCH	_____	_____	_____	_____
WATER SUPERVISORY SWITCH	____	_____	_____	_____
POST INDICATOR VALVE	____	_____	_____	_____
WATER SYSTEM AIR PRESSURE	____	_____	_____	_____
SUPPRESSION PANEL ALARM	____	_____	_____	_____
SUPPRESSION PANEL TROUBLE	____	_____	_____	_____
SUPPRESSION PANEL RELEASE	____	_____	_____	_____
SUPPRESSION PRESSURE SWITCH	____	_____	_____	_____
SUPPRESSION SUPERVISORY	____	_____	_____	_____
SECURITY CONTACT	____	_____	_____	_____
STAIRWELL PRESSURIZATION FAN ON	____	_____	_____	_____
STAIRWELL PRESSURIZATION FAN OFF	____	_____	_____	_____
STAIRWELL PRESSURIZATION MANUAL	____	_____	_____	_____
EMERGENCY GENERATOR ON	____	_____	_____	_____
EMERGENCY GENERATOR OFF	____	_____	_____	_____
ELEVATOR RECALL (PRIMARY)	____	_____	_____	_____
ELEVATOR RECALL (SECONDARY)	____	_____	_____	_____
FIRE PUMP POWER	____	_____	_____	_____
FIRE PUMP TROUBLE	____	_____	_____	_____
FIRE PUMP AUTO.	____	_____	_____	_____
FIRE PUMP RUNNING	____	_____	_____	_____
FIRE PUMP OFF	____	_____	_____	_____
FIE PUMP PHASE REFFERSAL	____	_____	_____	_____
OTHER ALARM_____	____	_____	_____	_____
OTHER TROUBLE_____	____	_____	_____	_____
OTHER SUPERVISORY _____	____	_____	_____	_____
OTHER _____	____	_____	_____	_____

HARDWIRED SYSTEM, INITIATING DEVICE AND SUPERVISORY CIRCUIT (IDC):

☐ HARDWIRED ☐ CLASS A, STYLE _____ ☐ CLASS B, STYLE _____

TOTAL QTY. OF HARDWIRED CIRCUITS _____ QTY. OF SPARE CIRCUITS _____

PANEL CAPACITY FOR ADDITIONAL ZONE MODULES_____

ALARM INITIATING & SUPERVISORY DEVICE INFORMATION:

Information of the fire alarm Circuits, Class and Style is noted below. For additional guidance regarding the characteristics of each circuit noted, refer to Table 3-5 for IDC in NFPA 72.

SYSTEM POINT OR DEVICE TYPE TYPE:	QUANTITY OF DEVICE (AorB)	WIRE CLASS: (Letter)	WIRE STYLE: NUMBER:	CIRCUIT OR ZONE
HARDWIRED SYSTEM:				
MANUAL STATIONS	_____	_____	_____	_____
IONIZATION DETECTORS	_____	_____	_____	_____
PHOTOELECTRIC DETECTORS	_____	_____	_____	_____
ION DUCT DETECTORS	_____	_____	_____	_____
PHOTO DUCT DETECTORS	_____	_____	_____	_____
FIXED TEMP HEAT DETECTORS	_____	_____	_____	_____
R OF R HEAT DETECTORS	_____	_____	_____	_____
RATE COMPENSATED DETECTORS	_____	_____	_____	_____
FIXED TEMP HEAT DETECTOR	_____	_____	_____	_____
BEAM DETECTORS	_____	_____	_____	_____
UV/IR DETECTORS	_____	_____	_____	_____
COMBINATION DETECTOR	_____	_____	_____	_____
WATERFLOW ALARM SWITCH	_____	_____	_____	_____
WATER SUPERVISORY SWITCH	_____	_____	_____	_____
POST INDICATOR VALVE	_____	_____	_____	_____
WATER SYSTEM AIR PRESSURE	_____	_____	_____	_____
SUPPRESSION PANEL ALARM	_____	_____	_____	_____
SUPPRESSION PANEL TROUBLE	_____	_____	_____	_____
SUPPRESSION PANEL RELEASE	_____	_____	_____	_____
SUPPRESSION PRESSURE SWITCH	_____	_____	_____	_____
SUPPRESSION SUPERVISORY	_____	_____	_____	_____
SECURITY CONTACT	_____	_____	_____	_____
STAIRWELL PRESSURIZATION FAN ON	_____	_____	_____	_____
STAIRWELL PRESSURIZATION FAN OFF	_____	_____	_____	_____
STAIRWELL PRESSURIZATION MANUAL	_____	_____	_____	_____
EMERGENCY GENERATOR ON	_____	_____	_____	_____
EMERGENCY GENERATOR OFF	_____	_____	_____	_____
ELEVATOR RECALL (PRIMARY)	_____	_____	_____	_____
ELEVATOR RECALL (SECONDARY)	_____	_____	_____	_____
FIRE PUMP POWER	_____	_____	_____	_____
FIRE PUMP TROUBLE	_____	_____	_____	_____
FIRE PUMP AUTO	_____	_____	_____	_____
FIRE PUMP RUNNING	_____	_____	_____	_____
FIRE PUMP OFF	_____	_____	_____	_____
FIE PUMP PHASE REFFERSAL	_____	_____	_____	_____
OTHERALARM_____	_____	_____	_____	_____
OTHER TROUBLE_____	_____	_____	_____	_____
OTHER SUPERVISORY_____	_____	_____	_____	_____
OTHER_____	_____	_____	_____	_____

NOTED SIGNALING DEVICE CIRCUIT (SLC), INITIATING DEVICE CIRCUIT (IDC) AND INITIATING DEVICE OR SUPERVISORY DEVICE DEFICIENCIES AND COMMENTS:

_____

_____

_____

_____

NOTE:The comment portions of this form are required to have an entry. If a deficiency does not exist then the Technician shall enter “A deficiency has not been noted”.

PART 5 NOTIFICATION APPLIANCE CIRCUIT (NAC)

Notification Appliance Circuits (NAC) are those system circuits that employ notification appliance device(s) which provides both *audio* and *visual* notification, in the event of a fire. Chapter 3-7 of the NFPA 72, shall provide additional information in regards to circuit performance capabilities. Refer to Table 3-7.1 for NAC Class and Style configurations. Other documents that effect the fire system audio/visual devices are as follows:

1. ANSI S3.41, *American National Standard Audible Emergency Evacuation Signal,* which requires that the fire alarm signals be *distinctive* in sound from other signals and not to be used for any other purpose. See NFPA 72, 3-7.2

2. The use of the three-pulse temporal pattern fire alarm evacuation signal has been adopted by both the American National Standard, ANSI S3.41 (as referenced above) and International Standard, ISO 8201, *Audible Emergency Evacuation Signal*. Information regarding performance, location, and mounting of Notification Appliance(s) is available in NFPA 72, Chapter 6. For control and power supplies refer to Chapter 1 and Chapter 3.

VISUAL STROBE DEVICES:

Strobes shall be UL *labeled* and the label shall indicate compliance with UL 1971, *Signaling Applications for the Hearing Impaired.* Further details are available in the NFPA 72, Chapter 6-4, Table 6.1, regarding strobe flash rate and intensity. Spacing information, for strobe placement in room, is available in the NFPA 72 Paragraph 6-4.1, Tables 6-4.1 (a), 6-4. l(b), and Figures 6-4.4.1 and 6-4.4.1 (a). Spacing information for strobe placement in corridors is available in Chapter 6-4.2, Table 6-4.4.2 and 6-4.4.3, also Figures A-6-4.4.1(b), A-6-4.4.1(c), A-6-4.4.1(d) and A-6-4.4.2.

STROBE CIRCUIT NUMBER	**STROBE CIRCUIT CLASS:** (A or B)	**STROBE CIRCUIT STYLE:** (Y or Z)	**IS CIRCUIT SUPERVISED AS REQUIRED PER NFPA 72:**	**QTY. OF STROBES PER CIRCUIT:**	**POWER** (AMPS) **REQUIRED TO DRIVE CIRCUIT:**
# 1					
# 2	_____	_____	_____	_____	_____
# 3	_____	_____	_____	_____	_____
# 4	_____	_____	_____	_____	_____
# 5	_____	_____	_____	_____	_____
# 6	_____	_____	_____	_____	_____
# 7	_____	_____	_____	_____	_____
# 8	_____	_____	_____	_____	_____
# 9	_____	_____	_____	_____	_____
# 10	_____	_____	_____	_____	_____
# 11	_____	_____	_____	_____	_____
# 12	_____	_____	_____	_____	_____
# 13	_____	_____	_____	_____	_____
# 14	_____	_____	_____	_____	_____
# 15	_____	_____	_____	_____	_____
# 16	_____	_____	_____	_____	_____
# 17	_____	_____	_____	_____	_____
# 18	_____	_____	_____	_____	_____
# 19	_____	_____	_____	_____	_____
# 20	_____	_____	_____	_____	_____
# 21	_____	_____	_____	_____	_____
# 22	_____	_____	_____	_____	_____
# 23	_____	_____	_____	_____	_____
# 24	_____	_____	_____	_____	_____
# 25	_____	_____	_____	_____	_____
# 26	_____	_____	_____	_____	_____
# 27	_____	_____	_____	_____	_____
# 28	_____	_____	_____	_____	_____
# 29	_____	_____	_____	_____	_____
# 30	_____	_____	_____	_____	_____

TOTAL POWER (IN AMPS) CONSUMED BY THE VISUAL CIRCUIT(S) _____

POWER (IN AMPS) AVAILABLE AT THE CONTROL PANEL FOR THE CIRCUIT(S) _____

IS ADEQUATE BATTERY BACK-UP PROVIDED FOR THE CIRCUITS LISTED ☐ YES ☐ NO

ARE THE CIRCUITS LISTED POWERED BY ONE FIRE CONTROL PANEL ☐ YES ☐ NO

ARE ADDITIONAL PANELS EMPLOYED TO PROVIDE CIRCUIT POWER ☐ YES ☐ NO

ARE THE ADDITIONAL PANELS SUPERVISED BY THE MAIN PANEL ☐ YES ☐ NO

ARE THE ADDITIONAL PANELS PROTECTED WITH A SYSTEM DETECTOR ☐ YES ☐ NO

ARE THE ADDITIONAL PANELS EQUIPPED WITH BATTERY BACK-UP ☐ YES ☐ NO

IS ADEQUATE BATTERY BACK-UP PROVIDED FOR THE PANELS ☐ YES ☐ NO

ARE THE ADDITIONAL PANELS EQUIPPED WITH SURGE SUPPRESSION	☐ YES	☐ NO
ARE STROBES INSTALLED THROUGHOUT THE FACILITY*	☐ YES	☐ NO
ARE STROBES INSTALLED IN ONLY PART OF THE FACILITY	☐ YES	☐ NO
ARE THE STROBES INCANDESCENT (FLASHLIGHT TYPE BULB)	☐ YES	☐ NO
ARE THE STROBES XENON TYPE (ELONGATED TYPE BULB)	☐ YES	☐ NO
ARE THE STROBES COMPLIANT WITH UL 1971 (LABELED)	☐ YES	☐ NO

* Strobe placement shall comply with the above referenced sections of the NFPA 72 as applicable.
For additional circuits fill out another page 8 of this form and attach.

NOTED VISUAL APPLIANCE AND/OR NOTIFICATION APPLIANCE CIRCUIT DEFICIENCIES AND COMMENTS:

NOTE: The comment portions of this form are required to have an entry. If a deficiency does not exist then the Technician shall enter "A deficiency has not been noted.

AUDIO DEVICES AND CIRCUITS:

Tower Cabs, TRACON Rooms and Traffic Control Rooms which must remain in operation during the investigation period of a reported fire, shall not be required to meet the dBA levels of Audio notification noted in NFPA 72, Chapter 6-3.1.1. Chimes and/or Visual devices shall be employed in those areas. Notification Appliance Circuits in the noted areas, shall be programmed to be silenced, while the visual signals in the remainder of the facility continue. Visual notification circuits in the remainder of the facility shall continue to signal an alarm, until the Fire Alarm Control Panel, is clear of all fire conditions. Any subsequent Alarm from a fire initiation device shall resound the audio and visual devices.

For areas of general occupancy, Audible signals shall have a sound level of not less than 75 dBA at a distance of 10 feet from the audio device. The sound level of the audio device shall be 15 dBA above the average ambient sound level or 5 dBA above the maximum sound level having a duration of at least 60 seconds (whichever is greater), measured 5 feet from above the floor in the occupiable area. The sound level of an audio device shall not exceed 110 dBA. Refer to NFPA 72, Chapter 6-3.7 and 6-3.7.1 for audio device location.

AUDIO CIRCUIT NUMBER	**AUDIO CIRCUIT CLASS:** (A or B)	**AUDIO CIRCUIT STYLE:** (Y or Z)	**IS CIRCUIT SUPERVISED AS REQUIRED PER NFPA 72:**	**QTY. OF DEVICES PER CIRCUIT:**	**POWER** (AMPS) **REQUIRED TO DRIVE CIRCUIT:**
# 1	_____	_____	_____	_____	_____
# 2	_____	_____	_____	_____	_____
# 3	_____	_____	_____	_____	_____
# 4	_____	_____	_____	_____	_____
# 5	_____	_____	_____	_____	_____
# 6	_____	_____	_____	_____	_____
# 7	_____	_____	_____	_____	_____
# 8	_____	_____	_____	_____	_____
# 9	_____	_____	_____	_____	_____
# 10	_____	_____	_____	_____	_____
# 11	_____	_____	_____	_____	_____
# 12	_____	_____	_____	_____	_____
# 13	_____	_____	_____	_____	_____
# 14	_____	_____	_____	_____	_____
# 15	_____	_____	_____	_____	_____
# 16	_____	_____	_____	_____	_____
# 17	_____	_____	_____	_____	_____
# 18	_____	_____	_____	_____	_____
# 19	_____	_____	_____	_____	_____
# 20	_____	_____	_____	_____	_____
# 21	_____	_____	_____	_____	_____
# 22	_____	_____	_____	_____	_____
# 23	_____	_____	_____	_____	_____
# 24	_____	_____	_____	_____	_____
# 25	_____	_____	_____	_____	_____
# 26	_____	_____	_____	_____	_____
# 27	_____	_____	_____	_____	_____
# 28	_____	_____	_____	_____	_____
# 29	_____	_____	_____	_____	_____
# 30	_____	_____	_____	_____	_____

TOTAL POWER (IN AMPS) CONSUMED BY THE AUDIO CIRCUIT(S)	_____	
POWER (IN AMPS) AVAILABLE AT THE CONTROL PANEL FOR THE CIRCUIT(S)	_____	
IS ADEQUATE BATTERY BACK-UP PROVIDED FOR THE CIRCUITS LISTED	☐ YES	☐ NO
ARE THE CIRCUITS LISTED POWERED BY ONE FIRE CONTROL PANEL	☐ YES	☐ NO
ARE ADDITIONAL PANELS EMPLOYED TO PROVIDE CIRCUIT POWER	☐ YES	☐ NO
ARE THE ADDITIONAL PANELS SUPERVISED BY THE MAIN PANEL	☐ YES	☐ NO
ARE THE ADDITIONAL PANELS PROTECTED WITH A SYSTEM DETECTOR	☐ YES	☐ NO
ARE THE ADDITIONAL PANELS EQUIPPED WITH BATTERY BACK-UP	☐ YES	☐ NO
IS ADEQUATE BATTERY BACK-UP PROVIDED FOR THE THOSE PANELS	☐ YES	☐ NO
ADDITIONAL PANELS EQUIPPED WITH SURGE SUPPRESSION	☐ YES	☐ NO
ARE AUDIO DEVICES INSTALLED THROUGHOUT THE FACILITY *	☐ YES	☐ NO
ARE AUDIO DEVICES INSTALLED IN ONLY A PORTION OF THE FACILITY	☐ YES	☐ NO
ARE THE AUDIO DEVICES ALL OF THE SAME TYPE (HORN, BELLS, CHIMES, ETC)	☐ YES	☐ NO
ARE THE AUDIO DEVICES COMPLIANT WITH NFPA 72 **	☐ YES	☐ NO
ARE THERE ANY SPARE AUDIO/VISUAL CIRCUITS AVAILABLE ON THE SYSTEM	☐ YES	☐ NO

* Note the exceptions allowed for Tower Cabs, TRACON Rooms, Control Rooms, etc.
** Note the requirement for Temporal Pattern on systems installed since July 1996.

For additional circuits fill out another page 10 and 11 of this form and attach.

NOTED AUDIO APPLIANCE AND/OR NOTIFICATION APPLIANCE CIRCUIT DEFICIENCIES AND COMMENTS:

NOTE: The comment portions of this form are required to have an entry. If a deficiency does not exist then the Technician shall enter "A deficiency has not been noted.

PART 6 REMOTE ANNUNCIATION TYPE & CIRCUIT

Check those boxes that apply.

☐ ADDRESSABLE ALPHA/NUMERIC
☐ GRAPHIC ANNUNCIATOR
☐ CLASS A, STYLE 6 WIRE CONFIGURATION
☐ SERIAL PRINTER(S) QTY. _____
☐ HARDWIRED ALPHA/NUMERIC
☐ HARDWIRED DIRECTORY ANNUNCIATOR
☐ CLASS B, STYLE 4 WIRE CONFIGURATION
☐ OTHER _____

ARE THE ANNUNCIATION DEVICES SUPERVISED	☐ YES	☐ NO
ENTRY EQUIPPED WITH AN ANNUNCIATOR	☐ YES	☐ NO
ANNUNCIATORS EQUIPPED WITH AN ALARM SILENCE	☐ YES	☐ NO
ANNUNCIATORS EQUIPPED WITH A SYSTEM RESET SWITCH	☐ YES	☐ NO

ADDRESSABLE SYSTEM ANNUNCIATORS EQUIPPED WITH ACKNOWLEDGE ☐ YES ☐ NO

NOTED REMOTE ANNUNCIATOR DEFICIENCIES AND COMMENTS:

NOTE: The comment portions of this form are required to have an entry. If a deficiency does not exist then the Technician shall enter "A deficiency has not been noted."

PART 7 VOICE EVACUATION SYSTEM CONTROLS AND DEVICES

VOICE EVACUATION SYSTEM CONTROLS:

VOICE PANEL LOCATION: _____

PANEL MANUFACTURER: _____ MODEL NO.: _____

DOES THE PANEL APPEAR TO BE OPERATING PROPERLY (NORMAL CONDITION)	☐ YES	☐ NO
IS THE PANEL EQUIPPED WITH A MIC.	☐ YES	☐ NO
IS THE PANEL EQUIPPED WITH A FIRE PHONE SYSTEM	☐ YES	☐ NO
ARE EXTRA FIRE PHONES AVAILABLE QTY. _____	☐ YES	☐ NO
ARE ALL CIRCUITS SUPERVISED	☐ YES	☐ NO
IS A SYSTEM SMOKE DETECTOR PROTECTING THE PANEL	☐ YES	☐ NO
IS ADEQUATE BATTERY BACK-UP PROVIDED AS PER NFPA 72	☐ YES	☐ NO
IS SURGE SUPPRESSION PROVIDED AT THE 110 VOLT AC CIRCUIT	☐ YES	☐ NO
IS THE 110 VOLT CIRCUIT PERMANENTLY LABELED "FIRE ALARM"	☐ YES	☐ NO
IS THE SYSTEM EQUIPPED WITH BACK-UP AMPLIFIERS	☐ YES	☐ NO
IS THERE MORE THAN ONE VOICE SYSTEM PANEL	☐ YES	☐ NO
IS THE VOICE MESSAGE AUDIBLE	☐ YES	☐ NO
IS THE VOICE MESSAGE APPLICABLE TO THE FACILITIES NEEDS	☐ YES	☐ NO

PANEL POWER SUPPLY, PRIMARY (MAIN) , NOMINAL VOLTAGE _____, AMPS _____

OVERCURRENT PROTECTION, TYPE _____, AMPS _____, LOCATION _____

POWER DISCONNECT MEANS _____, LOCATION _____, LOCKOUT _____

SECONDARY (STANDBY) POWER_____STORAGE BATTERY, AMP-HOUR RATING _____

CALCULATED CAPACITY TO OPERATE SYSTEM, IN HOURS: 4 _____ 24 _____ 60_____

BATTERY TYPE:

☐ DRY CELL ☐ NICKEL CADMIUM ☐ SEALED LEAD ACID ☐ LEAD ACID ☐ OTHER _____

TRANSIENT SUPPRESSION:

120V CIRCUIT DEVICE TYPE: QTY. LOCATION:

AUDIO CIRCUIT TYPE: QTY. LOCATION:

Additional information regarding Voice system requirements is available in the NFPA 72, Chapter 6-8.

VOICE CIRCUIT NUMBER	**VOICE CIRCUIT CLASS:** (A or B)	**VOICE CIRCUIT STYLE:** (Y or Z)	**IS CIRCUIT SUPERVISED AS REQUIRED PER NFPA 72:**	**QTY. OF DEVICES PER CIRCUIT:**	**POWER** (WATTS) **REQUIRED TO DRIVE CIRCUIT:**
# 1	_____	_____	_____	_____	_____
# 2	_____	_____	_____	_____	_____
# 3	_____	_____	_____	_____	_____
# 4	_____	_____	_____	_____	_____
# 5	_____	_____	_____	_____	_____

# 6	_____	_____	_____	_____	_____
# 7	_____	_____	_____	_____	_____
# 8	_____	_____	_____	_____	_____
# 9	_____	_____	_____	_____	_____
# 10	_____	_____	_____	_____	_____
# 11	_____	_____	_____	_____	_____
# 12	_____	_____	_____	_____	_____
# 13	_____	_____	_____	_____	_____
# 14	_____	_____	_____	_____	_____
# 15	_____	_____	_____	_____	_____
# 16	_____	_____	_____	_____	_____
# 17	_____	_____	_____	_____	_____
# 18	_____	_____	_____	_____	_____
# 19	_____	_____	_____	_____	_____
# 20	_____	_____	_____	_____	_____
# 21	_____	_____	_____	_____	_____
# 22	_____	_____	_____	_____	_____
# 23	_____	_____	_____	_____	_____
# 24	_____	_____	_____	_____	_____
# 25	_____	_____	_____	_____	_____
# 26	_____	_____	_____	_____	_____
# 27	_____	_____	_____	_____	_____
# 28	_____	_____	_____	_____	_____
# 29	_____	_____	_____	_____	_____
# 30	_____	_____	_____	_____	_____

TOTAL POWER (IN WATTS) REQUIRED BY THE AUDIO CIRCUIT(S)	_____	
POWER (IN WATTS) AVAILABLE AT THE VOICE PANEL FOR THE CIRCUIT(S)	_____	
IS THE PANEL(S) SUPERVISED BY THE MAIN PANEL	☐ YES	☐ NO
IS ADEQUATE BATTERY BACK-UP PROVIDED FOR THE CIRCUITS LISTED	☐ YES	☐ NO
IS THE PANEL UL CROSS LISTED WITH THE FIRE CONTROL PANEL	☐ YES	☐ NO
IS THE PANEL EQUIPPED WITH MANUAL ZONE SELECTION SWITCHES	☐ YES	☐ NO
ARE ADDITIONAL PANELS EMPLOYED TO PROVIDE CIRCUIT POWER	☐ YES	☐ NO
ARE THE ADDITIONAL PANELS PROTECTED WITH A SYSTEM DETECTOR	☐ YES	☐ NO
ARE THE ADDITIONAL PANELS EQUIPPED WITH BATTERY BACK-UP	☐ YES	☐ NO
IS ADEQUATE BATTERY BACK-UP PROVIDED FOR THE THOSE PANELS	☐ YES	☐ NO
ADDITIONAL PANELS EQUIPPED WITH SURGE SUPPRESSION	☐ YES	☐ NO
ARE AUDIO DEVICES INSTALLED THROUGHOUT THE FACILITY *	☐ YES	☐ NO
ARE AUDIO DEVICES INSTALLED IN ONLY A PORTION OF THE FACILITY	☐ YES	☐ NO
ARE THE AUDIO DEVICES ALL POWER TAPPED THE SAME	☐ YES	☐ NO
ARE THERE ANY SPARE AUDIO CIRCUITS AVAILABLE ON THE SYSTEM	☐ YES	☐ NO

* Note Audio Devices are not to be installed in Tower Cabs, TRACON Rooms, Control Rooms, ETC.
For additional circuits fill out another page 13 of this form and attach.

NOTED AUDIO APPLIANCE AND/OR NOTIFICATION APPLIANCE CIRCUIT DEFICIENCIES AND COMMENTS:

_____

_____

_____

_____

_____

_____

NOTE: The comment portions of this form are required to have an entry. If a deficiency does not exist then the Technician shall enter "A deficiency has not been noted."

ADDITIONAL NOTATIONS OF THE ANNUAL FIRE SYSTEM INSPECTION AND TEST:

PART 8 ACCEPTANCE OF THE ANNUAL TEST & SIGNATURES

The Annual Inspection and Test of the above noted system(s), at the above noted FAA facility was performed as per the following: FAA ORDER, 6930.1A, Fire Prevention and Maintenance of Fire Protection Equipment, 6470.5A, Maintenance of Air Route Traffic Control Center Environmental Systems, 6480.8A, Maintenance of Airport Traffic Control Towers, 3900.19B, the Occupational Safety and Health Administration, the National Fire Protection Association, the National Fire Alarm Code, and the recommendations of the System Manufacturer. Upon completion this form shall be filed with each individual noted below and the FAA Regional Safety Office.

By Technician performing the annual test and inspection.

FAA Life Safety System Inspection & Test Report

Date: _____ Time:_____Signature:_____

NICET Cert. #: _____ Printed Name and Title:_____

Employed by: _____ Phone Number: _____

State License or other Credentials: _____

FAA Individual whom witnessed the Fire System returned to normal operation.

Date: _____ Time:_____Signature:_____

Printed Name and Title: _____

The individuals listed below, with their signatures, affirm that the Fire Life Safety System(s) noted above have been restored to an operational condition. If upon completion of this test an acceptable level of protection is in question, due to the deficiencies noted, then immediate action shall be taken to correct all the deficiencies. A retest of the defective device(s) or system operation(s) shall be required. Appropriate action shall be taken to insure the safety of the facilities individuals and operations during any system repairs and/or service. The responsible FAA Safety Individual shall provide the facilities Manager with Fire Watch training and information if required to insure a continued safe operation during the repairs and service.

By Technician performing the annual test and inspection.

Date: _____ Time:_____Signature:_____

NICET Cert. #: _____ Printed Name and Title:_____

Employed by: _____ Phone Number: _____

State License or other Credentials: _____

FAA Individual whom witnessed the Fire System returned to normal operation.

Date: _____ Time:_____Signature:_____

Printed Name and Title: _____

Authority having Jurisdiction and/or approving authority:
Name and Title: _____Phone: _____ FAX:_____

Representing: _____Signature:_____

Local Fire Department:_____ Phone:_____FAX: _____

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FAA PRE-CONSTRUCTION AND MAINTENANCE PROJECT SAFETY AND HEALTH CHECKLIST

Purpose

This checklist is intended to be used as a tool by RE/COTR's, designated facility POC's, or SSC managers who oversee construction and maintenance activities that potentially have Occupational Safety, Health, and Environmental (OSH/E) related impacts on AT/AF operations. This tool shall be used, as appropriate, during critical phases of construction and maintenance activities (e.g. the pre-construction meeting, 30-60 days prior to commencement of work, weekly/daily construction meetings, etc.). Emphasis should be placed on using this checklist as a tool to assess as well as reassess hazards as the project progresses. Specifically, this checklist is intended to:

- Promote sensitivity to potential OSH/E hazards associated with projects and stress the importance of not disrupting NAS operations
- Assist in identifying and validating potential project hazards and associated risks
- Assist in preventing safety and health incidents/accidents and facility shutdowns
- Ensure appropriate contractor measures and controls are in place to address potential project hazards
- Facilitate discussion with the contractor regarding plans to prevent/minimize potential incidents/accidents
- Enhance coordination between OSH/E professionals, project personnel and contractors
- Facilitate review of critical FAA OSH/E procedures with contractors
- Raise OSH/E awareness

- This checklist relies on the training and professional judgment of the user. OSH/E personnel should be consulted as needed.
- A facility POC with a thorough understanding of facility procedures and equipment considerations should participate in the site walk-through.

NOTE: For small procurements (e.g. credit card purchases) and internal FAA projects (e.g. field maintenance party projects), without specifications, immediately contact the designated OSH/E professional for assistance in completing this checklist.

1 Project Summary Information

Fill in the requested site-specific information.

Project Name, Description and Location: _____
Project/Activity/Task (detail): _____
Planned Start: _____
Expected Completion Date: _____
ANI/Contractor Contact: Name: _____ Phone: _____
OSH/E Contact: Name: _____ Phone: _____
Facility AF POC: Name: _____ Phone: _____

2 Facility Procedures

Review site specific FAA procedures and considerations with the contractor. For example, discuss when or how during the project, emergency plans will be used/required. After the procedures have been reviewed, perform a site walk-through with the contractor.

Facility Procedures	Reviewed?			Notes
	Yes	N/A	No	
Asbestos Contingency Plan	☐	☐	☐	
Critical Power Systems Awareness	☐	☐	☐	
Lock Out/Tag Out	☐	☐	☐	
Work Permits (e.g. Asbestos, Lead)	☐	☐	☐	
Emergency Plans (e.g. Occupant Emergency Plan)	☐	☐	☐	
Impacts to Fire Alarm and Suppression Systems	☐	☐	☐	
Site Walk-Through with Facility POC & Contractor(s)	☐	☐	☐	
Hazard Communications (e.g. MSDS's)	☐	☐	☐	
Other (e.g. Access/Security/Communications Equip.)	☐	☐	☐	

2 Project Hazard/Risk Analysis

Review site specific FAA procedures and considerations with the contractor. For example, discuss when or how during the project, emergency plans will be used/required. After the procedures have been reviewed, perform a site walk-through with the contractor.

Potential Project Hazards *(Consider Sensitive AT/AF Operations)*	of Potential Risk sure/Release/Incident			Notes
	High	Low	N/A	
Hazardous Substances and Env Controls				
Asbestos (e.g. Tiles & Insulation)	☐	☐	☐	
Chemical, Gas, Fumes, Dust, Radiation	☐	☐	☐	
Indoor Air	☐	☐	☐	
Ventilation System	☐	☐	☐	
Lead-based Paint	☐	☐	☐	
Electrical Power Systems	☐	☐	☐	
Pressurized Equipment Systems	☐	☐	☐	
Work at Heights (>6 feet)	☐	☐	☐	
Other (e.g. Confined Space)	☐	☐	☐	

4 Site Safety and Health

After reviewing the potential hazards and risks in block 3, ensure that the contractor has identified measures and controls to address applicable site safety and health risks (e.g. through discussions, available site safety plans, or other applicable documents). In your judgment, if the contractor has appropriate measures to address the potential project hazards (see block 3), check the appropriate YES boxes below. If a potential project hazard has been identified in block 3 and no associated measures or controls are evident, then check the appropriate NO boxes below. If a NO box is checked, use the closeout date box to indicate when appropriate measures or controls have been incorporated into the contractor's site safety and health approach.

Program Elements	Yes	N/A	No	Closeout Date	Notes
Hazardous Substances & Environmental Controls					
Asbestos	☐	☐	☐		
Chemicals (e.g. Introduced to site) Provide MSDS	☐	☐	☐		
Gas	☐	☐	☐		
Fumes	☐	☐	☐		
Lead Paint/Other Coatings	☐	☐	☐		
Radiation and Electric Fields	☐	☐	☐		
Ventilation and Exhaust Systems	☐	☐	☐		
Electrical Power Systems	☐	☐	☐		
Procedures for Critical Power Systems Coordination	☐	☐	☐		
Provisions for GFCI	☐	☐	☐		
Control of Hazardous Energy (lockout/tagout) (e.g. electrical, mechanical, hydraulic, thermal, radiation)	☐	☐	☐		
Pressurized Equipment and Systems	☐	☐	☐		
Work at Heights (>6 feet)	☐	☐	☐		
Safe Access and Fall Protection	☐	☐	☐		
Work Platforms	☐	☐	☐		
Floor and Wall Holes and Openings	☐	☐	☐		
Personal Protective and Safety Equipment	☐	☐	☐		
Fire Prevention	☐	☐	☐		
Accident Prevention	☐	☐	☐		
Excavations (New Construction or Tie in)	☐	☐	☐		
Welding and Cutting	☐	☐	☐		
Demolition of Existing Facility in Whole or Part	☐	☐	☐		
Medical and First Aid Requirements	☐	☐	☐		
Hand and Power Tools	☐	☐	☐		
Material Handling, Storage, and Disposal	☐	☐	☐		
Rigging	☐	☐	☐		
Machinery and Mechanized Equipment (e.g. Equipment & Operator Certifications)	☐	☐	☐		
Sanitation	☐	☐	☐		
Lighting	☐	☐	☐		
Concrete & Masonry Construction & Steel Erection	☐	☐	☐		
Hazardous, Toxic, Radioactive Waste Activities	☐	☐	☐		
Other (e.g. Noise)	☐	☐	☐		

5 Review Information

The appropriate FAA point of contact and the contractor shall sign below to document discussion of the items on this form.

Reviewed By:	**Date**
FAA POC: See Addendum	
Contractor: See Addendum	

Incident Prevention and Hazard Control Methods Discussed? ☐ **Yes** ☐ **No**

This block indicates routing of this checklist for project coordination.

This form has been forwarded to:	**Name**	**Date**
SECM, OSH/E Contact:	**See Addendum**	
AF Facility Manager:	**See Addendum**	
AT Facility Manager:	**See Addendum**	
Other:	**See Addendum**	

Notes (e.g. provide further explanation of potential hazards, locations, etc. below and attach additional sheets if necessary.)

ANI Risk Mitigation Addendum — Communicate Your Activities

Review the project construction or installation activities with emphasis on potential risks to unscheduled interruptions with the site AF POC. Provide plans to mitigate each of those risks and to restore operations should an unscheduled interruption occur. Have the AF POC and the AF site manager sign the check sheet indicating approval of the plans and fax to the ANI platform manager for approval BEFORE beginning work. Ensure that the AF POC coordinates with air traffic to keep them aware of installation activities. ***Items marked with an asterisk require daily coordination with AF.*.**

Elements	Risk Yes	Risk No	Mitigation and Restoration Plan
Engineering Package			
Review of risk mitigation procedures and cut-over plans	☐	☐	
Airport Access and On-Airport Driving			
Badging	☐	☐	
Airport driver training	☐	☐	
Communication with ATCT	☐	☐	
Properly marked vehicle	☐	☐	
Access to Electrical Power			
* Essential power panels, risk of opening panel, installing conduit, manipulating wiring, etc.	☐	☐	**Site tech shall supervise any work in power panels and energize/de-energize circuits.**
* Critical power panels, risk of opening panel, installing conduit, manipulating wiring, etc.	☐	☐	**Site tech shall supervise any work in power panels and energize/de-energize circuits.**
Cable raceways	☐	☐	
Demarcs, Junction Boxes, Racks and Buried Cable			
Proper identification of cables and terminations	☐	☐	
Proximity of critical operational circuits	☐	☐	
* Coordination of digging activities	☐	☐	
Backup Systems			
Checkout of backup systems that may be required after unscheduled interruption (including diverse routes).	☐	☐	
Checkout of operational systems prior to modifications	☐	☐	
Access to Signal Cable Raceways			
Identify affected cable trays	☐	☐	
ATCT shaft	☐	☐	
* Operational consoles	☐	☐	
Removing unused cable	☐	☐	
Equipment Releases			
Schedule	☐	☐	
Coordination with AF/AT	☐	☐	
Log entries	☐	☐	**Review maint log entries ensuring purpose for release is included.**
* Removal from service	☐	☐	**Will ask site technician to remove equipment from service.**
Work Outside of Normal Duty Hours			
Schedule of activities	☐	☐	
Coordination of OPS overtime handoff if required	☐	☐	
Unscheduled Interruptions			
Restoration	☐	☐	
Return to service	☐	☐	**Site tech must return to service and make log entries.**
Notifications	☐	☐	**Site AF manager and platform manager shall be notified ASAP.**
Contractors			
Badging	☐	☐	
Oversight	☐	☐	**ANI/TSSC shall provide continuous oversight of all contractors.**
Parking	☐	☐	

AF Site POC:

_____ **Date** _____

AF Site Manager:

_____ **Date** _____

ANI Site POC:

_____ **Date** _____

ANI Platform Manager:

_____ **Date** _____

Copies provided to Site AT, AFSMO (for SECM and OSH/E contact), and ANI Operations Liaison

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FAA Fire Alarm System Certificate of Completion

PROTECTED PROPERTY:

ADDRESS: _____

_____

_____

FAA CONTACT: _____

TELEPHONE: (____) _____FAX: (____) _____

SYSTEM INSTALLER:

ADDRESS: _____

_____

_____

REPRESENTATIVE:_____NICET CERT.#: _____

TELEPHONE: (____) _____FAX: (____)_____

SYSTEM SUPPLIER:

ADDRESS: _____

_____

_____

REPRESENTATIVE: _____

TELEPHONE: (____) _____FAX: (____)_____

SERVICE ORGANIZATION:

ADDRESS: _____

_____

_____

REPRESENTATIVE:_____NICET CERT.#: _____

TELEPHONE: (____) _____FAX: (____)_____

Location of AS BUILT Drawings: _____

Location of OWNER'S MANUAL: _____

Location of TEST REPORTS: _____

DIRECTION:

FAA Fire Alarm System Certificate of Completion

Parts 1 and 3 through 9 of this Certification shall be completed after the system is installed and the installation wiring has been checked. Part 2 shall be completed after the operational acceptance tests (FAA, Life Safety System Inspection & Test Report) have been completed and approved by the FAA Safety Office. A preliminary copy of this certificate shall be given to the FAA Project Engineer and to the authority having jurisdiction who will witness operational acceptance tests.

PART 1. CERTIFICATION OF SYSTEM INSTALLATION

The system was installed and inspected by:
Name & Title:_____ Company:_____ on _____ and found to comply with the installation requirements of the FAA project drawings, specifications, and the installation requirements of the NFPA Codes and Standards Referenced, to include all associated appendix sections. The Technician or Electrician, who's signature appears below shall initial each of the following designated spaces below. The initials certify that the required documents have been complied with.

NFPA 72 National Fire Alarm Code

_____ Chapter 1-5 Fundamentals

_____Chapter 1-6 System Interfaces

_____Chapter 1-7 Documentation

_____Chapter 3 Protected Premises Fire Alarm Systems

_____Chapter 4 -3 Proprietary Supervising Station Systems

_____Chapter 4-5.1, 4-5.2. 4-5.3.2 Digital Alarm Communicator Systems

_____Chapter 5 Initiating Devices

_____Chapter 6 Notification Appliances for Fire Alarm Systems

_____Chapter 7 Inspection, Testing and Maintenance

_____Article 760 of NFPA 70, National Electrical Code

_____Chapter 4 and Chapter 5 of NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems

_____ Manufacturer's Guidelines Recommendations and Instructions

_____FAA Project Specifications, Drawings, Written Instructions and Change Orders

PART 2. CERTIFICATION OF SYSTEM OPERATION

FAA Fire Alarm System Certificate of Completion

All operational features and functions of this system were inspected and tested by:

Name & Title: _____Company: _____ on _____and found to comply with the installation requirements of the FAA project drawings, specifications written instructions, change orders, and the installation requirements of the NFPA Codes and Standards Referenced, to include associated appendix. The system was found to be operating properly in accordance with the requirements of NFPA 72 National Fire Alarm Code. The Technician who's signature appears below shall initial each of the following designated spaces below. The initials certify that the required documents have been complied with:

NFPA 72 National Fire Alarm Code

_____Chapter 1 Fundamentals of Fire Alarm Systems

_____Chapter 3 Protected Premises Fire Alarm Systems

_____Chapter 4-3 Proprietary Supervising Station Systems

_____Chapter 4-5.3.2 Digital Alarm Communicator Systems

_____ Chapter 5 Initiating Devices

_____ Chapter 6 Notification Appliances for Fire Alarm Systems

_____ Chapter 7 Inspection. Testing, and Maintenance

_____ Article 760 of NFPA 70, National Electrical Code

_____ Chapter 4 and Chapter 5 of NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems

_____ Manufacturer's Guidelines Recommendations and Instructions

_____ FAA Project Specifications, Drawings, Written Instructions and Change Orders

Configuration of Control Panel Jumper(s):

Is the Control Panel equipped with a Jumper that is capable of disabling detection of Ground Fault conditions YES ____ NO_____

Provide a description of the location and the position required for detecting system ground faults:

_____

_____

Is the Control Panel equipped with other field configured Jumpers YES _____ NO _____

Note each Jumper and it's current configuration below:

_____

_____

_____

_____

Note: Contractor may provide a panel schematic diagram with highlighted jumpers) configuration(s) noted in lieu of the above.

PART 3. DACT SYSTEM SERVICE

Enter location(s) of off premise monitoring station:

FAA Fire Alarm System Certificate of Completion

Central Station Name: _____

Address: _____

_____

_____

Central Station Supervisor:

Name: _____ Title: _____

Account #: _____ Phone: (___) _____ FAX: (__) _____

Part 4. ALARM INITIATING DEVICE CIRCUITS

See NFPA 72 Chapter 3-5 Table 3-5 Performance of Initiating Device Circuits (IDC):

	Device Qty	Building Location	Class/Style
Crt. # 1	_____	_____	_____
Crt. #2	_____	_____	_____
Crt. #3	_____	_____	_____
Crt. #4	_____	_____	_____
Crt. #5	_____	_____	_____
Crt. #6	_____	_____	_____
Crt. #7	_____	_____	_____
Crt. #8	_____	_____	_____
Crt. #9	_____	_____	_____
Crt. #10	_____	_____	_____
Crt. # 11	_____	_____	_____

Types and quantities of alarm/supervisory initiating devices installed. Check type devices installed, indicate circuit # and quantity of devices:

Qty.		**Circuit #(s)**
____	Manual Stations	_____
____	Photo Smoke Detectors	_____

____ Ion Smoke Detectors _____

____ Fixed Temp Heat Detectors _____

____ R of R Heat Detectors _____

____ Rate Comp. Heat Detectors _____

____ Photo Duct Detectors _____

____ Ion Duct Detectors _____

____ Sprinkler Water Flow Switches _____

____ Sprinkler Tamper Switches _____

____ Sprinkler PIV Switch _____

____ Water System Air Pressure _____

____ Suppression Panel Alarm _____

____ Suppression Panel Trouble _____

____ Suppression Panel Agent Release _____

____ Supplemental Fire Panel Alarm _____

____ Supplemental Fire Panel Trouble _____

____ Beam Detectors (Xmtr/Rcvr Pair) _____

____ Flame Detectors _____

____ Kitchen Hood Extinguishing System _____

____ Security Contact _____

____ Fire Pump _____

____ Engine Generator _____

____ Other _____ _____

Part 5. ALARM NOTIFICATION APPLIANCES AND C1RCTUTS

Quantity of Notification Appliance Circuits (NAC) connected to system and type of Evacuation Signal:

1 /_____/_____/_____/_____ 5 /_____/_____/_____/_____ 9 /_____/_____/_____/_____

2 /_____/_____/_____/_____ 6 /_____/_____/_____/_____ 10 /_____/_____/_____/_____

3 /_____/_____/_____/_____ 7 /_____/_____/_____/_____ 11 /_____/_____/_____/_____

4 /_____/_____/_____/_____ 8 /_____/_____/_____/_____ 12 /_____/_____/_____/_____

Number/Quantity of Devices/Class/Style/Amps or Watts (see Table 3-7.1 NFPA 72).

General Alarm ____ Temporal Code _____ Voice Evac_____ Fire Phone _____ Other_____

Audible Devices:
Note type and list quantities of alarm indicating appliances (Circuit #/Qty)

____ Bells, 6" ____ 10" ____for notification of Sprinkler System flow on NAC # ___/____, ___/____

____ Horns, Electronic___ Vibrating ___ on NAC#___/___, ___/___, ___/___, ___/___, ___/___

____ Chimes, Electronic __ Mechanical____on NAC # ___/___, ___/___, ___/___, ___/___

____ Mini-Horns on NAC # ___/___, ___/___, ___/___, ___/___, ___/___, ___/___, ___/___, ___/___

____ Other _____ on NAC # _/___, _/___, _/___, _/___, _/___, _/___

Speakers:

____ .25 Watt Speakers on NAC# ___/___, ___/___, ___/___, ___/___, ___/___, ___/___, ___/___, ___/___

____ .5 Wan Speakers on NAC# ___/___, ___/___, ___/___, ___/___, ___/___, ___/___, ___/___, ___/___

____ .75 Watt Speakers on NAC# ___/___, ___/___, ___/___, ___/___, ___/___, ___/___, ___/___, ___/___

____ 1.0 Watt Speakers on NAC# ___/___, ___/___, ___/___, ___/___, ___/___, ___/___, ___/___, ___/___

____ 1.5 Watt Speaker on NAC# ___/___, ___/___, ___/___, ___/___, ___/___, ___/___, ___/___, ___/___

____ 2.0 Watt Speakers on NAC# ___/___, ___/___, ___/___, ___/___, ___/___, ___/___, ___/___, ___/___

____ ____Watt Speaker on NAC# ___/___, ___/___, ___/___, ___/___, ___/___, ___/___, ___/___, ___/___

_____ tone for Pre-Alert

_____ tone for Evacuation

_____ tone for All Clear

_____ tone for_____

Strobes:

____ Visual Lights on NAC# ___/___, ___/___, ___/___, ___/___, ___/___, ___/___, ___/___, ___/___

____ Incandescent Red Lense on NAC# ___/___, ___/___, ___/___, ___/___, ___/___, ___/___, ___/___

____ Xenon Strobe (ADA) _____ Candela on NAC # ____ ____ Candela on NAC #_____

____ Candela on NAC #_____ , ____ Candela on NAC # _____ , ____ Candela on NAC #_____

Check the appropriate circuit configuration.

__ Audible/Visual Circuits Combined ____ Audible Circuits Separate ___ Visual Circuits Separate

__ Audible Devices turn off upon Alarm Silence Only ___ Visual Devices turn off upon System RESET

Part 6. SIGNALING LINE CIRCUITS AND DEVICES

See NFPA 72 Table 3-6 Performance of Signaling Line Circuits (SLC), note Device Quantity, Circuit Capacity and Class/Style (Class A or B Style 0.5, 1, 2a, 3, 3.5,4,4.5, 5a, 6a, or 7a) of circuit.

SLC#1	_____/_____	_____	_____
	Qty/Capacity	Building Location	Class/Style
SLC#2	_____/_____	_____	_____
	Qty/Capacity	Building Location	Class/Style

FAA Fire Alarm System Certificate of Completion

	Qty/Capacity	Building Location	Class/Style
SLC#3	_____/_____	_____	_____
SLC#4	_____/_____	_____	_____
SLC#5	_____/_____	_____	_____
SLC#6	_____/_____	_____	_____
SLC#7	_____/_____	_____	_____
SLC#8	_____/_____	_____	_____
SLC#9	_____/_____	_____	_____
SLC#10	_____/_____	_____	_____

Types and quantities of addressable initiating-'supervisory devices installed . Check type devices installed, indicate circuit # and quantity of devices:

Qty.		Circuit # (s)
_____	Manual Stations	_____
_____	Photo Smoke Detectors	_____
_____	Ion Smoke Detectors	_____
_____	Fixed Temp Heat Detectors	_____
_____	R of R Heat Detectors	_____
_____	Rate Comp. Heat Detectors	_____
_____	Photo Duct Detectors	_____
_____	Ion Duct Detectors	_____
_____	Sprinkler Water Flow Switches	_____
_____	Sprinkler Tamper Switches	_____
_____	Sprinkler PIV Switch	_____
_____	Water System Air Pressure	_____
_____	Suppression Panel Alarm	_____
_____	Suppression Panel Trouble	_____
_____	Suppression Panel Agent Release	_____
_____	Supplemental Fire Panel Alarm	_____
_____	Supplemental Fire Panel Trouble	_____
_____	Beam Detectors (Xmtr/Rcvr Pair)	_____

_____Flame Detectors _____

_____Kitchen Hood Extinguishing System _____

_____Security Contact _____

_____Fire Pump _____

_____Engine Generator _____

_____Other _____ _____

Part 7. SYSTEM POWER SUPPLIES

Primary (Main) Power Supply

Nominal Voltage _____, _____ Amps

Overcurrent Protection

Type: _____ Amps:_____

Location:

_____

_____

Secondary (Standby) Power Supply:

____ Storage Battery' _____ AH (Amp-Hr Rating) Battery Type: _____

Calculated capacity-to operate system: ____ Hour Standby _____Minutes Alarm

____ Fire Alarm System provided back-up power from Engine-driven generator.

Location of fuel storage: _____ Fuel Tank Capacity:_____

Emergency or Standby System used as backup to Primary Power Supply, instead of using a Secondary Power Supply:

____ Emergency System described in NFPA 70, Article 700.

____ Legally Required Standby System described in NFPA 70, Article 701.

____ Optional Standby System described in NFPA 70, Article 702, which also meets the performance requirements of Article 700 or 701.

PART 8. SYSTEM DEVIATIONS FROM THE REFERENCED STANDARDS:

____ None ____ As Follows (describe fully)

_____

_____

_____

_____

_____

PART 9. CERTIFICATION SIGNATURES

The individual(s) and/or contractor(s) signatures below, with their signatures, affirm that the Fire Life Safety System(s) noted herein have been installed to an operational condition that meets or exceeds the codes and standards noted. If upon completion of this certification an acceptable level of protection is in question, due to deficiencies noted, then immediate action shall be taken to correct all the deficiencies. A re-certification of the system(s) installation and/or operation(s) shall be required at no added cost to the FAA. Appropriate action shall be taken to insure the safety of the facilities individuals and operations during any system repair(s) and/or service. The FAA Safety Individual at the CAI shall provide the AF Manager with Fire Watch information to insure a continued safe facility operation during the repairs and service. Any costs incurred as a result of providing a fire watch shall be the contractors responsibility and may be deducted from monies due under the contract. This form shall be accompanied with the required "FAA Life Safety System Inspection & Test Report" for completion of a CAI.

System Installation Contractor:

(Signature-Title)	(NICET Certification)	(Date)
(Organization)		(Phone and FAX)
(Print Name and Title of FAA Test Witness)		(Phone and FAX)
(AHJ Witness)		(Phone and FAX)

System Commission Contractor:

(Signature-Title)	(NICET Certification)	(Date)
(Organization)		(Phone and FAX)
(Print Name and Title of FAA Test Witness)		(Phone and FAX)
(AHJ Witness)		(Phone and FAX)

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U.S. Department
of Transportation

**Federal Aviation
Administration**

ΓLANTA TERMINAL ENGINEERING CENTER

P.O. Box 20636
Atlanta, Georgia 30320-0631

CERTIFICATE OF SUBSTANTIAL COMPLETION (CoSC)

TO: **FEDERAL AVIATION ADMINISTRATION**

DATE OF SUBSTANTIAL COMPLETION: _____

PROJECT OR SPECIFIED PART SHALL INCLUDE: _____

PROJECT TITLE: _____

CONTRACT NO. _____

LOCATION: _____

CONTRACTOR: _____

NTP DATE: _____

The Work performed under this Contract has been inspected by authorized representatives of the FAA and Contractor and the Project (or specified part of the Project, as indicated above) is hereby declared to be substantially completed on the above date.

DEFINITION OF SUBSTANTIAL COMPLETION
The date of substantial completion of a project or specified area of a project is defined by the Contract Documents, General Conditions

A tentative list of items to be completed or corrected is appended hereto. This list may not be exhaustive, and the failure to include an item on it does not alter the responsibility of the Contractor to complete all the Work in accordance with the Contract Documents.

The Contractor accepts the above Certificate of Substantial Completion and agrees to complete and correct the items on the tentative list within the time indicated.

CONTRACTOR (Typed) _____ AUTHORIZED REPRESENTATIVE (Signature) _____ DATE

FAA RESIDENT ENGINEER (Typed) _____ FAA RESIDENT ENGINEER (Signature) _____ DATE

OWNER – FEDERAL AVIATION ADMINISTRATION
The applicable FAA AT, SSC, and SMO concurs with Substantial Completion for the purposes of maintenance and operations of the completed Work.

FAA AIR TRAFFIC REPRESENTATIVE (Typed) _____ FAA AIR TRAFFIC REPRESENTATIVE (Signature) _____ DATE

FAA SSC REPRESENTATIVE (Typed) _____ FAA SSC REPRESENTATIVE (Signature) _____ DATE

FAA SMO REPRESENTATIVE (Typed) _____ FAA SMO REPRESENTATIVE (Signature) _____ DATE

REMARKS: _____

Attached: Substantial Completion Acceptance Form (Copy)
Punchlist Dated _____
Certificate of Occupancy Dated _____ (As Required)

cc: FAA Contracting Officer
FAA Project Engineer

Construction Form 007 (9/8/99)

CERTIFICATE OF SUBSTANTIAL COMPLETION (CoSC) *(Continued)*

CONTRACT NO. _____

Concurrent with the issuance of this Certificate, the areas of responsibilities are assigned as follows:

SECURITY: _____

MAINTENANCE: _____

OPERATIONS (CLEANING/HOUSEKEEPING): _____

UTILITIES: _____

PROTECTION OF THE WORK: _____

INSURANCE: _____

HEAT: _____

COMPLETE RECORD DOCUMENTS (DATE): _____

COMPLETE O&M MANUALS (DATE): _____

DATE REQUIRED FOR COMPLETION OF CORRECTIONS TO THOSE ITEMS CONTAINED IN THE ATTACHED PUNCHLIST: _____

U.S. Department
of Transportation

**Federal Aviation
Administration**

ΓLANTA TERMINAL ENGINEERING CENTER

P.O. Box 20636
Atlanta, Georgia 30320-0631

SUBSTANTIAL COMPLETION ACCEPTANCE (SCA)

(72 Hours Notice of Inspection is Required)

PROJECT: _____
(Number & Description)

PART I - NOTICE OF INSPECTION:
The Contractor has requested a substantial completion inspection for referenced project and has submitted the attached punchlist. This inspection is scheduled for:

_____ at _____
DATE TIME

All parties will meet at _____ at the above date and time. Please ensure authorized representatives from the following are present:

Contractor: _____

FAA Resident Engineer: _____

FAA Air Traffic: _____

FAA SSC: _____

FAA SMO: _____

FAA ASO-470: _____

Others: _____

PART II – SIGNATURES OF ACCEPTANCE OF SUBSTANTIAL COMPLETION:
The following parties concur referenced project, at the above date and time of inspection, is substantially complete contingent upon concurrence of the punchlist.

Contractor: _____

FAA Resident Engineer:_____

FAA Air Traffic:_____

FAA SSC: _____

FAA ASO-470: _____

Others: _____

SUBSTANTIAL COMPLETION ACCEPTANCE (SCA) *(Continued)*

PROJECT: _____
(Number & Description)

PART III - PUNCHLIST REVIEW/ACCEPTANCE:

The following parties concur the attached punchlist dated _____ is a comprehensive punchlist to the best of their knowledge and is the substantial completion punchlist.

Contractor: _____

FAA Resident Engineer:_____

FAA Air Traffic:_____

FAA SSC: _____

FAA ASO-470: _____

Others: _____

PART IV - FINAL ACCEPTANCE:

The following parties concur all punchlist items for referenced project were completed on _____.

Contractor: _____

FAA Resident Engineer:_____

FAA Air Traffic:_____

FAA SSC: _____

FAA ASO-470: _____

Others: _____

Part IV must be completed prior to processing the Contractor's final Pay Application. **The OAR is to attach proof of FAA/TnDOT final inspections, as required.**

A copy of this form is to be attached to the Certificate of Substantial Completion at the time of issuance with Parts I through III completed.

cc: FAA Contracting Officer
FAA Project Engineer

U.S. Department
of Transportation

**Federal Aviation
Administration**

ΓLANTA TERMINAL ENGINEERING CENTER

P.O. Box 20636
Atlanta, Georgia 30320-0631

PARTIAL OCCUPANCY / USE AGREEMENT (POUA)

TO: **FEDERAL AVIATION ADMINISTRATION**

DATE OF PARTIAL OCCUPANCY/USE: _____

_____

PROJECT OR SPECIFIED PART SHALL INCLUDE:

_____

_____

_____

PROJECT TITLE : _____

CONTRACT NO: _____

LOCATION: _____

CONTRACTOR: _____

NTP DATE: _____

The Work performed under this Contract has been inspected by authorized representatives of the FAA and Contractor and the Project (or specified part of the Project, as indicated above) is hereby declared to be acceptable for Partial Occupancy/Use on the above date.

DEFINITION OF PARTIAL OCCUPANCY/USE

The date of Partial Occupancy/Use of a project or specified area of a project is defined by the Contract Documents, General Conditions

A tentative list of items to be completed or corrected is appended hereto. This list may not be exhaustive, and the failure to include an item on it does not alter the responsibility of the Contractor to complete all the Work in accordance with the Contract Documents.

The Contractor accepts the above Partial Occupancy/Use Agreement and agrees to complete and correct the items on the tentative list within the time indicated.

_____ _____

CONTRACTOR (Typed) AUTHORIZED REPRESENTATIVE (Signature) DATE

_____ _____

FAA RESIDENT ENGINEER (Typed) FAA RESIDENT ENGINEER (Signature) DATE

OWNER – FEDERAL AVIATION ADMINISTRATION

The applicable FAA AT, SSC, and SMO concurs with Partial Occupancy / Use for the purposes of maintenance and operations of the completed Work.

_____ _____

FAA AIR TRAFFIC REPRESENTATIVE (Typed) FAA AIR TRAFFIC REPRESENTATIVE (Signature) DATE

_____ _____

FAA SSC REPRESENTATIVE (Typed) FAA SSC REPRESENTATIVE (Signature)DATE

_____ _____

FAA SMO REPRESENTATIVE (Typed) FAA SMO REPRESENTATIVE (Signature) DATE

REMARKS: _____

Attached: Punchlist Dated _____
Certificate of Occupancy Dated _____ (As Required)

cc: FAA Contracting Officer
FAA Project Engineer

Construction Form 009 (9/8/99)

PARTIAL OCCUPANCY/USE AGREEMENT (POUA) *(Continued)*

CONTRACT NO. _____

Concurrent with the issuance of this Agreement, the areas of responsibilities are assigned as follows:

SECURITY: _____

MAINTENANCE: _____

OPERATIONS(CLEANING/HOUSEKEEPING): _____

UTILITIES: _____

PROTECTION OF THE WORK: _____

INSURANCE: _____

HEAT: _____

COMPLETE RECORD DOCUMENTS (DATE): _____
(Status)

WARRANTY STARTS (DATE): _____

COMPLETE O&M MANUALS (DATE): _____
(Status)

DATE REQUIRED FOR COMPLETION OF CORRECTIONS TO THOSE ITEMS CONTAINED IN THE ATTACHED PUNCHLIST: _____

U.S. Department
of Transportation
**Federal Aviation
Administration**

ΓLANTA TERMINAL ENGINEERING CENTER

P.O. Box 20636
Atlanta, Georgia 30320-0631
-6505

JOB MEMORANDUM (JM)

JM No.:_____ Date:_____ Sheet ___ of___ _

To: _____

Project: _____ **(B.P._____)**

Field inspection has indicated that the following work is not being performed in accordance with the Contract Documents. The Contractor is requested to provide his proposed Contractor Corrective Action (CCA) no later than _____.

Reference: Sheet No.: _____ Specification No.: _____ Other: _____
Subject:_____
_

Description of Discrepancy:
_____
_____
_____
_____
_____
_____
Resident Engineer_____

CONTRACTOR'S CORRECTIVE ACTION (CCA)

CCA No.: _____ Date:_____ _____
To: **FEDERAL AVIATION ADMINISTRATION – RESIDENT ENGINEER**
The following action has been taken_____
_____
_____
_____
_____
_____
_____
_____
_____
Contractor _____

FAA's
Response:_____

_____
cc: FAA Contracting Officer, FAA Project Engineer, A/E

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SECTION 01 10 15 - ACRONYMS AND DEFINITIONS

PART 1 - GENERAL

1.1 ACRONYMS AND DEFINITIONS

A. When in the Special Provisions, this specification, drawings, specifications, or documents pertaining to this contract, the following terms are used; the intent and meaning shall be as specified herein.

1. AMS - Acquisition Management System
2. AMSL - Above Mean Sea Level
3. AOA - Air Operations Area
4. ARCHITECT - Architectural Engineering Firm of Record
5. ATCT - Airport Traffic Control Tower
6. CAI - Contractors Acceptance Inspection or Substantial Completion
7. CFM - Contractor-Furnished Material
8. CO - FAA Contracting Officer
9. Contr. - Contractor
10. COR/COTR - Contracting Officer's Technical Representative also referred to as Resident Engineer (RE)
11. DESIGNER - Architectural Engineering Firm of Record
12. ENGINEER - Architectural Engineering Firm of Record
13. FAA - Federal Aviation Administration (Owner)
14. FAA Field Representative – RE
15. GFE - Government-Furnished Equipment
16. GFM - Government-Furnished Material
17. GOVERNMENT - FAA
18. IAW - In Accordance With
19. MSL - Mean Sea Level
20. NEC - National Electric Code
21. NTP - Notice to Proceed
22. OSHA - Occupational Safety and Health Administration
23. Owner - FAA
24. RE - FAA Resident Engineer (Fulltime Onsite Representative of the FAA and is also referred to as the COR/COTR).
25. RWY - Runway
26. Sponsor - Airport Owner or Airport Authority
27. Substantial Completion - CAI
28. TWY - Taxiway
29. U/L or UL - Underwriters Laboratories

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION 01 10 15

Note: See Standard Drawings “Abbreviations-Sheet 1” and “Abbreviations-Sheet 2” for additional information.

SECTION 01 14 00 - CONDITIONS AFFECTING WORK

PART 1 – GENERAL

1.1 WORK SCHEDULE

A. Normal working hours are 0700 to 1600, Monday through Friday (except U.S. Federal holidays). Contractor requests to work outside normal working hours require RE approval. However, the RE has full discretion to approve or disapprove, or withdraw approval of, requests. If the contractor desires to work outside normal hours (including Saturdays, Sundays, and holidays), he shall submit his written request to the RE at least 48 hours in advance. Some typical constraints on working outside normal working hours are:

1. The Contractor's request must be made at least two days in advance (e.g., request received by close of business Wednesday for work on following Saturday). Prior to submitting the request, the Contractor must coordinate as needed (such as utility outages) and have all required people and materials for the work that will be performed.
2. A Contractor with quality or safety problems (as determined by the RE) will be restricted to normal working hours.
3. A Contractor who fails to correct deficiencies within a reasonable time (as determined by the RE) will be restricted to normal working hours or may be allowed to work outside normal working hours only to correct those deficiencies.
4. The Contractor shall schedule his work to cause the least amount of interference to normal activities.

1.2 FAA OPERATIONS

A. The FAA has established moratorium dates for construction activity at critical Air Traffic Control facilities. The intent is to minimize impact on the ability of FAA to perform its operational activities during peak air travel dates. Moratorium dates are typically scheduled over the Thanksgiving Holiday and the Christmas/New Year Holiday. Exact dates will be provided at the preconstruction conference.

B. All construction activity during moratorium periods must be approved in advance by the FAA. Submit items of work to be performed during moratorium dates no later than forty-five (45) days prior to the moratorium dates. Activities that have, in the sole opinion of the FAA, potential to negatively impact FAA operations will not be approved. A written waiver will be provided by FAA to the Contractor outlining the allowable work items. No additional time or cost will be allowed for such denial.

1.3 AIRPORT OPERATIONS

A. RESTRICTIONS TO ACCESS - Access to work areas may be restricted from time to time by necessity of airport operations. Contractor acknowledges that it has taken into account and provided in its planning, scheduling and pricing for disruptions including but not limited to, restricted access

to portions of the site that will not be immediately available, delivery time limitations, and moratorium dates.

B. OBSTRUCTION (OB) LIGHTS - Temporary obstruction lights shall be mounted on the highest point of the crane as soon as the crane boom exceeds 100 feet. The new tower shall have obstruction lights mounted on the highest point on the tower when the tower exceeds 100 feet.

C. AIR SPACING THE CRANE(S) - The Contractor shall be responsible to airspace the maximum height of his crane by submitting FAA Form 7460 – 1 Notice of proposed Construction or Alteration. Erection of the crane will not be permitted without approval of the form. No claim for delay will be allowed for failure to submit the form in a timely manner. Allow a minimum of sixty (60) days for processing. This form is attached in specification section "Construction Administration Forms".

D. ILLUMINATION (INTERIOR) - When any work is performed at night or where daylight is obscured, Contractor shall, at its expense, provide artificial light sufficient to permit work to be carried on efficiently, satisfactorily, and safely, and to permit thorough inspection. During such time periods the access to the place of work shall also be clearly illuminated. All wiring for electric light and power shall be installed and maintained in a safe manner and meet all applicable codes and standards.

E. ILLUMINATION (EXTERIOR) – Ground level lights will be permitted to facilitate construction activity upon approval of the RE. Location and direction of illumination will be subject to acceptance by Air Traffic Control, which shall have final authority concerning this matter. Remove and/or reposition lights as required without additional cost to the FAA.

1.4 UTILITY SERVICE

A. GENERAL - Permission to interrupt any utility service shall be requested in writing a minimum of 15 calendar days prior to the desired date of interruption. No utility service shall be interrupted without written approval of the RE.

SECTION 2 - PRODUCTS

NOT USED

SECTION 3 - EXECUTION

NOT USED

END OF SECTION 01 14 00

SECTION 01 18 00 - EXISTING UTILITIES

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. Before performing any utility modifications, utility shutdowns or any hot work on existing utility within a building, the Contractor shall contact the FAA, the Airport Authority, and all concerned utilities.

PART 2 - PRODUCTS

NOT USED

PART 3 – EXECUTION

A. Prior to performing any excavation or digging, the Contractor shall give 48 hours notice to each owner of the underground utility facilities.

B. There is a rebuttable presumption of negligence on the part of the Contractor, if the Contractor fails to call the underground utility owner and receive authorization before digging, or if the Contractor calls but fails to wait the required 48 hours.

C. During the 48 hour period, the underground utility owner shall go to the site and flag its facility.

D. Violation of the above can be cause for civil fines and criminal offenses.

END OF SECTION 01 18 00

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SECTION 01 25 00-SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 DEFINITION

A. Any product or material that is submitted that is not the exact make and model number of the design basis shall be considered a substitution. This includes products that are from the same manufacturer, but are different models. If the design basis is discontinued or obsolete, any product replacement is also considered a substitution. All substitutions shall follow the substitution procedures listed herein.

1.2 SUBSTITUTION PROCEDURE

A. Submission of request for substitution shall constitute a representation by the Contractor that he:

1. Has investigated the proposed product and determined that it is equal to or better than the specified product. Absence of an explicit comparison of any characteristic of the proposed product to the specified product shall constitute a representation that the proposed product is equal to or better than the specified product with regard to that characteristic.

2. Will provide the same warranty for the proposed product as for the specified product.

3. Will coordinate the installation and make other changes which may be required for the work to be complete in all respects, including:

   a. Redesign.

   b. Additional components and capacity required by other work affected by the change.

4. Waives all claims for additional costs and time extensions which subsequently may become apparent and which are caused by the change.

5. Will reimburse the Government for additional costs for evaluation of the substitution request, redesign if required, and reapproval by authorities having jurisdiction if required.

B. Substitutions will not be considered when acceptance would require substantial revision of the contract documents.

C. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals without separate written request.

D. Substitution requests will not be considered when submitted directly by subcontractor or supplier.

E. Substitution Request Procedure: Submit written request with complete data substantiating compliance of the proposed product with the requirements of the contract documents.

1. Submit request to the Resident Engineer.

2. Submit 3 copies of each request and accompanying data.

3. Submit all requests on a standard form provided.

4. Only one request for substitution will be considered for each product.

F. Data Required with Substitution Request: Provide at least the following data:

1. Identify product by specification section and paragraph number.

2. Manufacturer's name and address, trade name and model number of product (if applicable), and name of fabricator or supplier (if applicable).

3. Complete product data.

4. A list of other projects on which the proposed product has been used, with project name, and the design professional's name.

5. An itemized comparison of the proposed product to the specified product.

6. Net amount of change to the contract sum.

7. List of maintenance services and replacement materials available.

8. Statement of the effect of the substitution on the construction schedule.

9. Description of changes that will be required in other work or products if the substitute product is approved.

G. The Resident Engineer will determine acceptability of the proposed substitution.

H. When the proposed substitution is not accepted, provide the product (or one of the products, as the case may be) specified.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 01 25 00

PRODUCT SUBSTITUTION REQUEST FORM

Note: This form to be used by General Contractor only. Requests by others will be returned with no response.

Project:
Location:_____

Government:_____

Date: _____

We hereby submit for your consideration the following substitution instead of the item specified or shown on the Drawings:

Section Number: Paragraph Specified item
_____

Proposed Substitution:
_____

_____

Attach complete product data, drawings and descriptions of products, with fabrication and installation details. Provide laboratory tests if applicable.

Provide sample, if applicable. Indicate if sample will be provided under separate cover.

Include complete information on changes to Drawings and/or Specifications that proposed substitution will require for its proper installation.

Fill in blanks below: *(Include attachments if space is insufficient. Failure to provide information will void submittal)*

A. Reason(s) for proposed substitution: *(check all that apply)*
_____ 1. Request is equivalent to product/material/assembly specified. *(Note: Attach technical documentation)*
_____ 2. Specified product or method cannot be provided within the Contract time. *(Note: This request will not be considered if the product or method cannot be provided as a result of the Contractor's failure to pursue the Work promptly, or to coordinate the various activities properly, of if the Contractor fails to place timely orders)*
_____ 3. Specified product or method cannot receive necessary approval by authority having jurisdiction, and Contractor certifies that the requested substitution can be approved. *(Note:Attach approval documentation)*
_____ 4. A substantial advantage is offered the Government, in terms of cost, time, energy conservation or other considerations of merit, after deducting redesign and evaluation costs of other work by the Government or separate contractors and similar considerations.
_____ 5. Specified product or method cannot be provided in a manner which is compatible with other materials of the Work, and the Contractor certifies that the substitution will overcome the incompatibility.
_____ 6. Specified product cannot be properly coordinated with other materials in the Work, and the Contractor certifies that the proposed substitution can be properly coordinated.

_____ 7. Specified product or method cannot receive a warranty as required by Contract Documents, and Contractor certifies that the proposed substitution can receive required warranty.

B. Does the substitution affect dimensions or details shown on Drawings:
_____ No

_____ Yes *(Note: Attach marked up prints of drawings showing changes required)*

C. What effect does the substitution have on other trades?

_____

_____

D. Compare significant qualities of proposed substitution with those of work or product originally specified or shown on drawings. Include elements such as size, weight, durability, performance, visual effect, etc.

_____

_____

E. Coordinate information. Include all changes required in other elements of the work in order to accommodate the substitution, including work performed by Government or separate contractors.

_____

_____

F. State effect substitution will have on the work schedule in comparison to the schedule which would prevail without the proposed substitution. State the effect of the proposed substitution on Contract Time.

_____

_____

G. Provide complete cost information, including a proposal of any net change in the Contract Amount.

_____

_____

H. Manufacturer's warranties of the proposed substitution and specified items are:
_____ Same

_____ Different *(Note: Explain on attachment)*

The undersigned Contractor certifies its opinion that, after thorough evaluation, the proposed substitution will result in work that in every significant respect will be equivalent to or superior to the work required by the original Contract Documents and that it will perform adequately in the application indicated. Rights to additional payment or time because of failure of the substitution to perform adequately are hereby waived.

The undersigned hereby agrees to pay in full for any changes to design, including detailing and engineering costs caused by the requested substitution.
Submitted by: *(Note: Submittal void and will be discarded if unsigned or if signed by entity other than Contractor)*

Signature: _____
(Contractor's authorized representative)

_____
(Title)

Firm Name: _____

Date: _____

For use by Resident Engineer:

_____ Accepted **_____ Accepted as Noted**

_____ Not Accepted **_____ Received too late**

By: _____ Date: _____
(Resident Engineer)

By: _____ Date: _____
(Resident Engineer)

Remarks:

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SECTION 01 31 19 - PROJECT MEETINGS

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. Contractor participation in pre-construction conferences.

B. Contractor administration of progress meetings and pre-installation conferences.

1.2 PRE-CONSTRUCTION CONFERENCES

A. The FAA will hold a pre-construction conference.

1.3 PROGRESS MEETINGS

A. Schedule and administer Project meetings throughout progress of the work at weekly intervals as well as any called meeting.

B. Attendance: Job superintendents, major subcontractors and suppliers; and RE as appropriate to agenda topics for each meeting.

C. Agenda will include review of Work progress, status of progress schedule and adjustments thereto, delivery schedules, submittals, maintenance of quality standards, pending changes and substitutions and other items affecting progress or work.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION 01 31 19

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SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Submittals listed or specified in this Contract shall conform to the provisions of this section, unless explicitly stated otherwise.

1.2 REFERENCES

NOT USED

1.3 DEFINITIONS

A. Submittal Definition: Shop drawings, product data, samples, administrative and closeout submittals, and additional data presented for review and approval. Contract clauses referring to material, workmanship specifications and drawings for construction shall apply to all submittals.

B. Types of Submittals

1. Shop Drawings. As used in this Section, drawings, schedules, diagrams, and other data prepared specifically for this contract, by the Contractor or through the Contractor by way of a subcontractor, manufacturer, supplier, distributor, or other lower tier contractor, to illustrate a portion of the work.
2. Product Data. Preprinted material such as illustrations, standard schedules, performance charts, instructions, brochures, diagrams, manufacturer's descriptive literature, catalog data, and other data to illustrate a portion of the work, but not prepared exclusively for this Contract. Information such as mix design, material characteristics, and similar data is included herein.
3. Samples. Physical examples of products, materials, equipment, assemblies, or workmanship, physically identical to a portion of the work, illustrating a portion of the work or establishing standards for evaluating the appearance of the finished work or both.
4. Administrative and Closeout Submittals. Submittals of data for which reviews and approval will be to ensure that the administrative requirements of the project are adequately met but not to ensure directly that the work is in accordance with the design concept and in compliance with the contract documents.

C. Approving Authority: Contracting Officer's Representative (COR) or Resident Engineer (RE).

D. Work: As used in this Section, the construction required by the contract documents, including labor necessary to produce the construction and materials, products, equipment, and systems incorporated or to be incorporated in such construction and including materials, products, equipment, and systems produced both on-and off-site.

1.4 SUBMITTALS

A. Submit the following in accordance with the requirements of this section.

1. Submittal status log: List each submittal. Include for each submittal the specification section number; description of item for which the submittal is required; and the Contractor's scheduled date for the submittal. Submit the log within 15 days after notice to proceed. Indicate required approval date to maintain project schedule.

1.5 PROCEDURES FOR SUBMITTALS

A. Limits and Constraints Regarding Submittals

1. Submittals shall be complete for each portion of the work; components of the work interrelated as a system shall be submitted at the same time.
2. When submittal acceptability is dependent on conditions, items, or materials included in separate subsequent submittals, the submittal will be returned without review.
3. Submittals of information not required as a submittal, or covering work for which the submittals have been returned as “No Exceptions Taken” will be returned without review.
4. Approval of a separate material, product, or component does not imply approval of assembly in which the item functions.
5. The work shall conform to approved submittals, except contractor shall conform to the contract requirements and resubmit the submittal if a previously approved submittal has an error or omission.
6. When submitting for approval material which is other than that cited in the contract, submit the necessary scale drawings, wiring and control diagrams, cuts or entire catalogs, pamphlets, descriptive literature, and performance and test data of both the material specified and the material he wishes to substitute in the number of copies of each as required under the contract.

B. Scheduling of Submittals

1. Coordinate preparation and processing of submittals with performance of the work so that work will not be delayed by submittal processing. Coordinate and sequence different categories of submittals for same work, and for interfacing units of work, so that one will not be delayed for coordination with another.
2. Except as specified otherwise, allow a review period, beginning with receipt by the approval authority, that includes at least 20 working days.

C. Substitutions: Substitutions from contract requirements require Government approval and will be considered where advantageous to the Government. Where substitutions are proposed for consideration, submit a written request, with documentation of the nature and features of the substitution and why the substitution is desirable and beneficial to the Government. The proposed substitution shall be identified separately and included along with the required submittal for the item. When a substitution is submitted for approval, the Contractor warrants the following:

1. Substitution Is Compatible: The Contract has been reviewed to establish that the substitution, when incorporated, will be compatible with other elements of the work.
2. Contractor is Responsible: The Contractor shall take action and bear the additional cost, including review costs by the Government, necessary because of the proposed substitution.

D. Resubmittal Costs: Initial submittals requiring Government approval will be reviewed at no cost to the Contractor. The cost of reviewing resubmittals, for reason of failure of the initial submittal to meet contract requirements, shall be the responsibility of the Contractor. The COR will issue a deductive contract modification to reduce the contract price by $350.00 for each resubmittal of items requiring Government review and approval. The contract completion date will not be extended due to non-compliance with submittal requirements.

E. Contractor's Responsibilities:

1. Determine and verify field measurements, materials, field construction criteria; review each submittal; and check and coordinate each submittal with requirements of the work and Contract documents.
2. Ensure that material is clearly legible. Ensure required specialty stamps are affixed and signed.
3. Stamp each sheet of each submittal with the Contractor's certificating stamp, except that data submitted in bound volume or on one sheet printed on two sides may be stamped on the front of the first sheet only. Word the submittal stamp as follows:
   "I hereby certify that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated into Contract Number _____, is in compliance with the contract drawings and specification, can be installed in the allocated spaces, and is submitted for Government approval. Certified by_____ Date _____"
4. Sign the Contractor's certification. The person signing the certification shall be one designated in writing by the Contractor as having that authority. The signature shall be in original ink. Stamped signatures are not acceptable.
5. Transmit submittals to the approving authority in orderly sequence, in accordance with the Submittal Status Log, and to prevent project delays and delays in work by the Government or separate contractors.
6. Advise the approving authority of substitution, as required by the paragraph entitled “Substitutions."
7. Correct and resubmit submittal as directed by the approving authority. Direct specific attention, in writing or on resubmitted submittal, to revisions not requested by the approving authority on previous submissions.
8. Retain a copy of approved submittals at the project site, including the Contractor's copy of approved samples.
9. Furnish additional copies of submittals if requested by the COR.
10. Ensure no work is begun until the submittals for that work have been returned with a review comment other than “Revise and Resubmit” or “Rejected”.

F. Approving Authority's Responsibilities:

1. Submittals will be reviewed for approval with reasonable promptness and only for conformance with project design concepts and compliance with the contract documents.

If a substitution is not identified as required by the paragraph entitled “Substitution ", then the approval of the submittal SHALL NOT be an approval of the substitution.

2. The checking, marking or approval of the shop drawings and/or product data by the COR shall not be construed as a complete check, but will indicate only that the general method of construction and detailing is satisfactory. Approval will not relieve the contractor of the responsibility for any error which may exist. The contractor shall be responsible for the dimensions and design of adequate connections, details, and satisfactory construction of all work.
3. Submittals will be returned with one of the following notations:

   a. Submittals marked ”As Submitted” indicate the work may proceed as presented in the submittal.
   b. Submittals marked “Not Approved” indicate the submittal has failed to meet the specification requirements and work may not proceed.
   c. Submittals marked “As Noted” indicate there are markings in the submittal that must be included to result in an acceptable submittal. Contractor may proceed with the work by accepting and incorporating the markings in the finished work unless the “Revise and Resubmit” box is checked.
   d. Submittals marked “Revise and Resubmit” must be modified and resubmitted. The revised submittal number must indicate that it is a resubmittal of a rejected submittal.

G. The transmittal sheet returning the submittal will be initialed.

1.6 FORMAT AND QUANTITY OF SUBMITTALS

A. Transmittal Form: Transmit each submittal, except sample installations and sample panels, to the office of the approving authority. Transmit submittals with a transmittal form approved by the COR and standard for the project. The transmittal form shall identify the Contractor, indicate the date of the submittal, and include information prescribed by the transmitted form and required in the paragraph entitled "Identifying Submittals." Process transmittal forms to record actions regarding sample panels and sample installations.

B. Identifying Submittals: Identify submittals, except sample panel and sample installation, with the following information permanently adhered to or noted on each separate component of each submittal and noted on the transmittal form. Mark each copy of each submittal identically, with the following:

   1. Project title and location.
   2. Construction contract number.
   3. The Section number and paragraph number of the Section by which the submittal is required and the paragraph to which it conforms.
   4. The name, address, and telephone number of the subcontractor, supplier, manufacturer and any other second tier contractor associated with the submittal.
   5. Product identification and location in project.

C. Format and Quantity for Shop Drawings

   1. For shop drawings presented on sheets larger than 11-inches by 17 inches, submit two

printed copies and one Portable Document Format (PDF) file transmitted on 700 MB compact disks (CD) of each shop drawing prepared for this project.

2. For shop drawings presented on sheets 11-inches by 17 inches or less, submit two printed copies with each bound in a separate volume and a PDF file transmitted on 700 MB compact disks (CD) of each shop drawing prepared for this project.
3. Include on each drawing the drawing title, number, date, and revision numbers and dates, in addition to the information required in the paragraph entitled "Identifying Submittals."
4. Dimension drawings, except diagrams and schematic drawings; prepare dimensioned drawings to scale. Identify materials and products for work shown.
5. Shop drawings shall be not less than 8 1/2 by 11 inches or more than 36 by 42 inches.
6. After review, the approving authority will return a PDF file and a marked original.

D. Format and Quantity for Product Data

1. Submit two printed copies with each, bound in a separate volume and a PDF file transmitted on compact disk (CD) or diskette of each Product Data prepared for this project.
2. Present submittals for each Section as a complete, bound volume. Include a table of contents listing page and catalog item numbers for product data.
3. Indicate, by prominent notation, each product that is being submitted; indicate the Section and paragraph numbers to which it pertains.
4. Supplement product data with material prepared for the project to satisfy submittal requirements for which product data does not exist. Note that the material is developed specifically for the project.

E. Format and Quantity of Samples:

1. Furnish samples in the sizes below, unless otherwise specified or unless the manufacturer has prepackaged samples of approximately the same size as specified:

   a. Sample of equipment or device: Full size.
   b. Sample of materials less than 2 by 3 inches: Built up to 8 1/2 by 11 inches.
   c. Sample of materials exceeding 8 1/2 by 11 inches: Cut down to 8 1/2 by 11 inches and adequate to indicate color, texture, and material variations.
   d. Sample of linear devices or materials such as conduit and handrails: 10-inch length or length to be supplied, if less than 10 inches.
   e. Sample of non-solid materials such as sand and paint: Pint.
   f. Color selection samples: 2 inches by 4 inches.
   g. Sample panel: 4 feet by 4 feet.
   h. Sample Installation: 100 square feet.

2. Samples showing range of variation: Where variations are unavoidable due to the nature of the materials, submit sets of samples of not less than three units showing the extremes and middle of the range.

3. Quantity, unless otherwise specified:

   a. Submit two samples, or two sets of samples showing range of variation, of each required item. One approved sample or set of samples will be retained by the

approving authority and one will be returned to the Contractor.

b. Submit one sample panel. Include components listed in technical section or as directed.

c. Submit one sample installation, where directed.

4. Reusable samples: Incorporate returned samples into the work only if so specified or indicated. Incorporated samples shall be in undamaged condition at the time of use.

5. Recording of sample installation: Note and preserve the notation of the area constituting the sample installation but remove the notation at the final clean up of the project.

6. When a color, texture or pattern is specified in naming a particular manufacturer and style, include one sample of that manufacturer and style, for comparison.

7. Transmittal Form for samples shall identify manufacturer, model, type, color, etc. sufficient to reorder or replace.

F. Format and Quantity of Administrative and Closeout Submittals

1. Unless otherwise specified, submit administrative and closeout submittals in the format and quantities required for shop drawings.
2. Comply with section entitled “Contract Closeout Procedures”.

G. A Portable Document Format (PDF) file for each shop drawing, product data, and sample transmittals shall be uploaded to FAA’s KSN website.

1.7 PROGRESS PHOTOGRAPHIC SUBMITTALS

A. Still Photographs: Before construction operations have started at the site, the contractor shall take and provide 25 color photographs showing the existing conditions and thereafter an average of 25 views shall be taken each month until completion of the work. An electronic file of each view shall be submitted to the RE promptly after taking the views.

1. Photographs shall be made using a digital camera of at least 4 mega pixel size. All digital images shall be submitted on CD along with the monthly photographs.
2. The contractor shall notify the RE 24 hours in advance of taking any photographs.

B. Ownership of Photographs: Any and all still photographs, digital files, and video tapes taken of the construction area are the property of FAA and shall not be released to any source whatsoever without the prior written permission from the RE. This provision shall prevail for the duration of the contract and indefinitely thereafter.

C. Video Photography: Refer to Section 01 32 33 for video photography requirements.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION 01 33 00

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SECTION 01 40 00 - CONTRACTOR QUALITY CONTROL

PART 1 - GENERAL

1.1 REFERENCES

A. 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.

1.2 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

A. ASTM D 3740 Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

B. ASTM E 329 Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

1.3 SUBMITTALS

A. Contractor Quality Control Plan

B. Contractor Quality Control Personnel

C. Daily Logs

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. The Contractor is responsible for quality control and shall establish and maintain an effective quality control system. The quality control system shall consist of plans, procedures, and organization necessary to produce an end product that complies with the contract requirements. The system shall cover all construction operations, both onsite and offsite, and shall be keyed to the proposed construction sequence. The site project superintendent will be held responsible for the quality of work on the job and is subject to removal by the RE for non-compliance with the quality requirements specified in the contract. The site project superintendent in this context shall be the highest level manager responsible for the overall construction activities at the site, including quality and production. The site project superintendent shall maintain a physical presence at the site at all times, except as otherwise acceptable to the RE, and shall be responsible for all construction and construction related activities at the site. Similar requirements apply to the quality control manager.

3.2 CONTRACTOR QUALITY CONTROL (CQC) PLAN

A. Content of the CQC Plan

1. The CQC Plan shall include, as a minimum, the following to cover all construction operations, both onsite and offsite, including work by subcontractors, fabricators, suppliers, and purchasing agents:
2. A description of the quality control organization, including a chart showing lines of authority.
3. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function.
4. A copy of the letter to the CQC System Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities. Copies of these letters shall also be furnished to the Government.
5. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents. These procedures shall be in accordance with Section 01 33 00, “SUBMITTAL PROCEDURES”.
6. Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. (Laboratory facilities must be approved by the RE.)
7. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation.
8. Procedures for tracking construction deficiencies from identification through acceptable corrective action. These procedures shall establish verification that identified deficiencies have been corrected.
9. Reporting procedures, including proposed reporting formats.
10. A list of the definable features of work. A definable feature of work is a task that is separate and distinct from other tasks, has separate control requirements, and may be identified by different trades or disciplines, or it may be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there is frequently more than one definable feature under a particular section. This list will be agreed upon during the coordination meeting.

B. Acceptance of Plan: Acceptance of the Contractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Government reserves the right to require the Contractor to make changes in his CQC Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

C. Notification of Changes: After acceptance of the CQC Plan, the Contractor shall notify the RE in writing of any proposed change. Proposed changes are subject to acceptance by the RE.

3.3 COORDINATION MEETING

A. After the Preconstruction Conference, before start of construction, and prior to acceptance by the Government of the CQC Plan, the Contractor shall meet with the RE and discuss the Contractor's quality control system. The CQC Plan shall be submitted for review a minimum of 7 calendar days

prior to the Coordination Meeting. During the meeting, a mutual understanding of the system details shall be developed, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's Management and control with the FAA's Quality Assurance. Minutes of the meeting will be prepared by the Contractor and signed by both the Contractor and the RE. The minutes shall become a part of the contract file. There may be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures that may require corrective action by the Contractor.

3.4 QUALITY CONTROL ORGANIZATION

A. Personnel Requirements: The requirements for the CQC organization are a CQC System Manager and sufficient number of additional qualified personnel to ensure safety and contract compliance. QCQ Manager is required to complete the 16 hour “Construction Quality Management (CQM) for Contractors” course as offered by the Corps of Engineers. Personnel identified in the technical provisions as requiring specialized skills to assure the required work is being performed properly will also be included as part of the CQC organization. The Contractor's CQC staff shall maintain a presence at the site at all times during progress of the work and have complete authority and responsibility to take any action necessary to ensure contract compliance. The CQC staff shall be subject to acceptance by the RE. The Contractor shall provide adequate office space, filing systems and other resources as necessary to maintain an effective and fully functional CQC organization. Complete records of all letters, material submittals, shop drawing submittals, schedules and all other project documentation shall be promptly furnished to the CQC organization by the Contractor. The CQC organization shall be responsible to maintain these documents and records at the site at all times, except as otherwise acceptable to the RE.

B. CQC System Manager: The Contractor shall identify as CQC System Manager an individual within the onsite work organization who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The individual shall have a minimum of 8 years experience as a superintendent, inspector, QC Manager, project manager, project engineer or construction manager on similar size and type construction contracts which included the major trades that are part of this Contract. The CQC System Manager shall be on the site at all times during construction and shall be employed by the prime Contractor. The CQC System Manager shall be assigned no other duties. An alternate for the CQC System Manager shall be identified in the plan to serve in the event of the System Manager's absence. The requirements for the alternate shall be the same as for the designated CQC System Manager.

C. Additional CQC Personnel as required: In addition to CQC personnel specified elsewhere in this specification, the Contractor shall provide as part of the CQC organization specialized personnel to assist the CQC System Manager, as required, in the following areas: mechanical, electrical, structural, architectural, materials and fire protection. These individuals shall:

1. Be directly employed by the prime Contractor or a Quality Control sub-contractor but may not be employed by a supplier or other sub-contractor on this project
2. Be responsible to the CQC System Manager
3. Be available as required to support construction activities in their areas of responsibility
4. Have the necessary education and/or experience in accordance with the experience matrix listed herein.
5. These individuals may perform other duties but must be allowed sufficient time to perform

their assigned quality control duties as described in the Quality Control Plan.

6. All personnel are subject to FAA approval.

D. EXPERIENCE MATRIX

Area	Qualifications
1. Mechanical	US Registered Mechanical Engineer with 2 years related experience or technician with 5 years related experience. Required knowledge of HVAC TAB, HVAC DDC and HVAC commissioning.
2. Electrical	US Registered Electrical Engineer with 2 years related experience or technician with 5 years related experience.
3. Structural	US Registered Structural Engineer with 2 years related experience or technician with 5 years related experience.
4. Architectural	US Registered Architect with 2 years related experience or technician with 5 years related experience.
5. Concrete, Pavements, and Soils	Materials Technician with 5 years experience for the appropriate area.
6. Fire Protection Engineer	US Registered Fire Protection Engineer (FPE). This FPE shall have no business relationships with any subcontractors involved with this project; or with any fire protection equipment device manufacturers, suppliers or installers for any such equipment provided as part of this project.

E. Organizational Changes: When it is necessary to make changes to the CQC staff, the Contractor shall revise the CQC Plan to reflect the changes and submit the changes to the RE for acceptance.

3.5 REQUEST FOR INFORMATION (RFI's) AND SUBMITTALS

A. Submittals shall be made as specified in Section 01 33 00 "SUBMITTAL PROCEDURES". The CQC shall be responsible for reviewing all RFI's and submittals prior to submission to the FAA.

3.6 CONTROL

A. Contractor Quality Control is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. At least three phases of control shall be conducted by the CQC System Manager for each definable feature of work as follows:

B. Preparatory Phase: This phase shall be performed prior to beginning work on each definable feature of work; after all required plans/documents/materials are approved/accepted, and after copies are at the work site. This phase shall include:

1. A review of each paragraph of applicable specifications, reference codes, and standards. A copy of those sections of referenced codes and standards applicable to that portion of the work to be accomplished in the field shall be made available by the Contractor at the preparatory inspection. These copies shall be maintained in the field and available for use by Government personnel until final acceptance of the work.
2. A review of the contract drawings.
3. A check to assure that all materials and/or equipment have been tested, submitted, and approved.
4. Review of provisions that have been made to provide required control inspection and testing.
5. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract.
6. A physical examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.
7. A review of the appropriate activity hazard analysis to assure safety requirements are met.
8. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.
9. A check to ensure that the portion of the plan for the work to be performed has been accepted by the RE.
10. Discussion of the initial control phase.
11. The Government shall be notified at least 48 hours in advance of beginning the preparatory control phase. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The results of the preparatory phase actions shall be documented by separate minutes prepared by the CQC System Manager and attached to the daily CQC report. The Contractor shall instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.

C. Initial Phase: This phase shall be accomplished at the beginning of a definable feature of work. The following shall be accomplished:

1. A check of work to ensure that it is in full compliance with contract requirements. Review minutes of the preparatory meeting.
2. Verify adequacy of controls to ensure full contract compliance. Verify required control inspection and testing.
3. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.
4. Resolve all differences.
5. Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.

6. The Government shall be notified at least 24 hours in advance of beginning the initial phase. Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the daily CQC report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.
7. The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

D. Follow-up Phase: Daily checks shall be performed to assure control activities, including control testing, are providing continued compliance with contract requirements, until completion of the particular feature of work. The checks shall be made a matter of record in the CQC documentation. Final follow-up checks shall be conducted and all deficiencies corrected prior to the start of additional features of work that may be affected by the deficient work. The Contractor shall not build upon nor conceal non-conforming work.

E. Additional Preparatory and Initial Phases: Additional preparatory and initial phases shall be conducted on the same definable features of work if: the quality of on-going work is unacceptable; if there are changes in the applicable CQC staff, onsite production supervision or work crew; if work on a definable feature is resumed after a substantial period of inactivity; or if other problems develop.

3.7 TESTS

A. Testing Procedure: The Contractor shall perform specified or required tests to verify that control measures are adequate to provide a product that conforms to contract requirements. Upon request, the Contractor shall furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and/or acceptance tests when specified. The Contractor shall procure the services of an approved testing laboratory or establish an approved testing laboratory at the project site. The Contractor shall perform the following activities and record and provide the following data:

1. Verify that testing procedures comply with contract requirements.
2. Verify that facilities and testing equipment are available and comply with testing standards.
3. Check test instrument calibration data against certified standards.
4. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.
5. Results of all tests taken, both passing and failing tests, shall be recorded on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test shall be given. If approved by the RE, actual test reports may be submitted later with a reference to the test number and date taken. An information copy of tests performed by an offsite or commercial test facility shall be provided directly to the RE. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this contract.

B. Testing Laboratories

1. Capability Check: The Government reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt, and steel shall meet criteria detailed in ASTM D

3740 and ASTM E 329.

2. Capability Recheck: If the selected laboratory fails the capability check, the Contractor will be assessed a charge of $500 to reimburse the Government for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory. Such costs will be deducted from the contract amount due the Contractor.

C. Onsite Laboratory: The Government reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests, and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

D. Furnishing or Transportation of Samples for Testing: Costs incidental to the transportation of samples or materials shall be borne by the Contractor. Samples of materials for test verification and acceptance testing by the Government shall be delivered to the Resident Engineers office unless otherwise coordinated.

E. Coordination for each specific test, exact delivery location, and dates will be made through the Resident Engineer.

3.8 DOCUMENTATION

A. The Contractor shall maintain current records providing factual evidence that required quality control activities and/or tests have been performed. These records shall include the work of subcontractors and suppliers and shall be on an acceptable form that includes, as a minimum, the following information:

1. Contractor/subcontractor and their area of responsibility.
2. Operating plant/equipment with hours worked, idle, or down for repair.
3. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.
4. Test and/or control activities performed with results and references to specifications/drawings requirements. The control phase shall be identified (Preparatory, Initial, Follow-up). List of deficiencies noted, along with corrective action.
5. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.
6. Submittals and deliverables reviewed, with contract reference, by whom, and action taken.
7. Offsite surveillance activities, including actions taken.
8. Job safety evaluations stating what was checked, results, and instructions or corrective actions.
9. Instructions given/received and conflicts in plans and/or specifications.
10. Contractor's verification statement.

B. These records shall indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. The original and one copy of these records in report form shall be furnished to the Government daily within 24 hours after the date covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, one report shall be prepared and submitted for every 7 days of no work

and on the last day of a no work period. All calendar days shall be accounted for throughout the life of the contract. The first report following a day of no work shall be for that day only. Reports shall be signed and dated by the CQC System Manager. The report from the CQC System Manager shall include copies of test reports and copies of reports prepared by all subordinate quality control personnel.

3.9 NOTIFICATION OF NONCOMPLIANCE

A. The RE will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the RE 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 such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

END OF SECTION 01 40 00

SECTION 01 42 00 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey COTR's action on Contractor's submittals, applications, and requests, "approved" is limited to COTR's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by COTR. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.3 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Thomson Gale's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."

B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

AA	Aluminum Association, Inc. (The) www.aluminum.org	(703) 358-2960
AAADM	American Association of Automatic Door Manufacturers www.aaadm.com	(216) 241-7333
AABC	Associated Air Balance Council www.aabchq.com	(202) 737-0202
AAMA	American Architectural Manufacturers Association www.aamanet.org	(847) 303-5664
AASHTO	American Association of State Highway and Transportation Officials www.transportation.org	(202) 624-5800
AATCC	American Association of Textile Chemists and Colorists (The) www.aatcc.org	(919) 549-8141
ABAA	Air Barrier Association of America www.airbarrier.org	(866) 956-5888
ABMA	American Bearing Manufacturers Association www.abma-dc.org	(202) 367-1155
ACI	ACI International (American Concrete Institute) www.aci-int.org	(248) 848-3700
ACPA	American Concrete Pipe Association	(972) 506-7216

	www.concrete-pipe.org	
AEIC	Association of Edison Illuminating Companies, Inc. (The) www.aeic.org	(205) 257-2530
AF&PA	American Forest & Paper Association www.afandpa.org	(800) 878-8878 (202) 463-2700
AGA	American Gas Association www.aga.org	(202) 824-7000
AGC	Associated General Contractors of America (The) www.agc.org	(703) 548-3118
AHA	American Hardboard Association (Now part of CPA)	
AHAM	Association of Home Appliance Manufacturers www.aham.org	(202) 872-5955
AI	Asphalt Institute www.asphaltinstitute.org	(859) 288-4960
AIA	American Institute of Architects (The) www.aia.org	(800) 242-3837 (202) 626-7300
AISC	American Institute of Steel Construction www.aisc.org	(800) 644-2400 (312) 670-2400
AISI	American Iron and Steel Institute www.steel.org	(202) 452-7100
AITC	American Institute of Timber Construction www.aitc-glulam.org	(303) 792-9559
ALCA	Associated Landscape Contractors of America (Now PLANET - Professional Landcare Network)	
ALSC	American Lumber Standard Committee, Incorporated www.alsc.org	(301) 972-1700
AMCA	Air Movement and Control Association International, Inc. www.amca.org	(847) 394-0150
ANSI	American National Standards Institute www.ansi.org	(202) 293-8020
AOSA	Association of Official Seed Analysts, Inc. www.aosaseed.com	(405) 780-7372

APA	Architectural Precast Association www.archprecast.org	(239) 454-6989
APA	APA - The Engineered Wood Association www.apawood.org	(253) 565-6600
APA EWS	APA - The Engineered Wood Association; Engineered Wood Systems (See APA - The Engineered Wood Association)	
API	American Petroleum Institute www.api.org	(202) 682-8000
ARI	Air-Conditioning & Refrigeration Institute www.ari.org	(703) 524-8800
ARMA	Asphalt Roofing Manufacturers Association www.asphaltroofing.org	(202) 207-0917
ASCE	American Society of Civil Engineers www.asce.org	(800) 548-2723 (703) 295-6300
ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute (See ASCE)	
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers www.ashrae.org	(800) 527-4723 (404) 636-8400
ASME	ASME International (The American Society of Mechanical Engineers International) www.asme.org	(800) 843-2763 (973) 882-1170
ASSE	American Society of Sanitary Engineering www.asse-plumbing.org	(440) 835-3040
ASTM	ASTM International (American Society for Testing and Materials International) www.astm.org	(610) 832-9585
AWCI	AWCI International (Association of the Wall and Ceiling Industry International) www.awci.org	(703) 534-8300
AWCMA	American Window Covering Manufacturers Association (Now WCSC)	

AWI	Architectural Woodwork Institute www.awinet.org	(571) 323-3636
AWPA	American Wood-Preservers' Association www.awpa.com	(205) 733-4077
AWS	American Welding Society www.aws.org	(800) 443-9353 (305) 443-9353
AWWA	American Water Works Association www.awwa.org	(800) 926-7337 (303) 794-7711
BHMA	Builders Hardware Manufacturers Association www.buildershardware.com	(212) 297-2122
BIA	Brick Industry Association (The) www.bia.org	(703) 620-0010
BICSI	BICSI www.bicsi.org	(800) 242-7405 (813) 979-1991
BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association International) www.bifma.com	(616) 285-3963
BISSC	Baking Industry Sanitation Standards Committee www.bissc.org	(866) 342-4772
CCC	Carpet Cushion Council www.carpetcushion.org	(610) 527-3880
CDA	Copper Development Association www.copper.org	(800) 232-3282 (212) 251-7200
CEA	Canadian Electricity Association www.canelect.ca	(613) 230-9263
CFFA	Chemical Fabrics & Film Association, Inc. www.chemicalfabricsandfilm.com	(216) 241-7333
CGA	Compressed Gas Association www.cganet.com	(703) 788-2700
CIMA	Cellulose Insulation Manufacturers Association www.cellulose.org	(888) 881-2462 (937) 222-2462
CISCA	Ceilings & Interior Systems Construction Association www.cisca.org	(630) 584-1919

CISPI	Cast Iron Soil Pipe Institute www.cispi.org	(423) 892-0137
CLFMI	Chain Link Fence Manufacturers Institute www.chainlinkinfo.org	(301) 596-2583
CRRC	Cool Roof Rating Council www.coolroofs.org	(866) 465-2523 (510) 485-7175
CPA	Composite Panel Association www.pbmdf.com	(301) 670-0604
CPPA	Corrugated Polyethylene Pipe Association www.cppa-info.org	(800) 510-2772 (202) 462-9607
CRI	Carpet & Rug Institute (The) www.carpet-rug.com	(800) 882-8846 (706) 278-3176
CRSI	Concrete Reinforcing Steel Institute www.crsi.org	(847) 517-1200
CSA	Canadian Standards Association	(800) 463-6727 (416) 747-4000
CSA	CSA International (Formerly: IAS - International Approval Services) www.csa-international.org	(866) 797-4272 (416) 747-4000
CSI	Cast Stone Institute www.caststone.org	(717) 272-3744
CSI	Construction Specifications Institute (The) www.csinet.org	(800) 689-2900 (703) 684-0300
CSSB	Cedar Shake & Shingle Bureau www.cedarbureau.org	(604) 820-7700
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute) www.cti.org	(281) 583-4087
DHI	Door and Hardware Institute www.dhi.org	(703) 222-2010
EIA	Electronic Industries Alliance www.eia.org	(703) 907-7500
EIMA	EIFS Industry Members Association www.eima.com	(800) 294-3462 (770) 968-7945

EJCDC	Engineers Joint Contract Documents Committee www.ejdc.org	(703) 295-5000
EJMA	Expansion Joint Manufacturers Association, Inc. www.ejma.org	(914) 332-0040
ESD	ESD Association www.esda.org	(315) 339-6937
FIBA	Federation Internationale de Basketball (The International Basketball Federation) www.fiba.com	41 22 545 00 00
FIVB	Federation Internationale de Volleyball (The International Volleyball Federation) www.fivb.ch	41 21 345 35 35
FM Approvals	FM Approvals www.fmglobal.com	(781) 762-4300
FM Global	FM Global (Formerly: FMG - FM Global) www.fmglobal.com	(401) 275-3000
FMRC	Factory Mutual Research (Now FM Global)	
FRSA	Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc. www.floridaroof.com	(407) 671-3772
FSA	Fluid Sealing Association www.fluidsealing.com	(610) 971-4850
FSC	Forest Stewardship Council www.fsc.org	49 228 367 66 0
GA	Gypsum Association www.gypsum.org	(202) 289-5440
GANA	Glass Association of North America www.glasswebsite.com	(785) 271-0208
GRI	(Now GSI)	
GS	Green Seal www.greenseal.org	(202) 872-6400
GSI	Geosynthetic Institute	(610) 522-8440

	www.geosynthetic-institute.org	
HI	Hydraulic Institute www.pumps.org	(888) 786-7744 (973) 267-9700
HI	Hydronics Institute www.gamanet.org	(908) 464-8200
HMMA	Hollow Metal Manufacturers Association (Part of NAAMM)	
HPVA	Hardwood Plywood & Veneer Association www.hpva.org	(703) 435-2900
HPW	H. P. White Laboratory, Inc. www.hpwhite.com	(410) 838-6550
IAS	International Approval Services (Now CSA International)	
IBF	International Badminton Federation www.internationalbadminton.org	6-03-9283-7155
ICEA	Insulated Cable Engineers Association, Inc. www.icea.net	(770) 830-0369
ICRI	International Concrete Repair Institute, Inc. www.icri.org	(847) 827-0830
IEC	International Electrotechnical Commission www.iec.ch	41 22 919 02 11
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The) www.ieee.org	(212) 419-7900
IESNA	Illuminating Engineering Society of North America www.iesna.org	(212) 248-5000
IEST	Institute of Environmental Sciences and Technology www.iest.org	(847) 255-1561
IGCC	Insulating Glass Certification Council www.igcc.org	(315) 646-2234
IGMA	Insulating Glass Manufacturers Alliance www.igmaonline.org	(613) 233-1510
ILI	Indiana Limestone Institute of America, Inc. www.iliai.com	(812) 275-4426

ISO	International Organization for Standardization www.iso.ch	41 22 749 01 11
	Available from ANSI www.ansi.org	(202) 293-8020
ISSFA	International Solid Surface Fabricators Association www.issfa.net	(877) 464-7732 (702) 567-8150
ITS	Intertek Testing Service NA www.intertek.com	(972) 238-5591
ITU	International Telecommunication Union www.itu.int/home	41 22 730 51 11
KCMA	Kitchen Cabinet Manufacturers Association www.kcma.org	(703) 264-1690
LMA	Laminating Materials Association (Now part of CPA)	
LPI	Lightning Protection Institute www.lightning.org	(800) 488-6864
MBMA	Metal Building Manufacturers Association www.mbma.com	(216) 241-7333
MFMA	Maple Flooring Manufacturers Association, Inc. www.maplefloor.org	(847) 480-9138
MFMA	Metal Framing Manufacturers Association, Inc. www.metalframingmfg.org	(312) 644-6610
MH	Material Handling (Now MHIA)	
MHIA	Material Handling Industry of America www.mhia.org	(800) 345-1815 (704) 676-1190
MIA	Marble Institute of America www.marble-institute.com	(440) 250-9222
MPI	Master Painters Institute www.paintinfo.com	(888) 674-8937
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc. www.mss-hq.com	(703) 281-6613

NAAMM	National Association of Architectural Metal Manufacturers www.naamm.org	(312) 332-0405
NACE	NACE International (National Association of Corrosion Engineers International) www.nace.org	(800) 797-6623 (281) 228-6200
NADCA	National Air Duct Cleaners Association www.nadca.com	(202) 737-2926
NAGWS	National Association for Girls and Women in Sport www.aahperd.org/nagws/	(800) 213-7193, ext. 453
NAIMA	North American Insulation Manufacturers Association www.naima.org	(703) 684-0084
NBGQA	National Building Granite Quarries Association, Inc. www.nbgqa.com	(800) 557-2848
NCAA	National Collegiate Athletic Association (The) www.ncaa.org	(317) 917-6222
NCMA	National Concrete Masonry Association www.ncma.org	(703) 713-1900
NCPI	National Clay Pipe Institute www.ncpi.org	(262) 248-9094
NCTA	National Cable & Telecommunications Association www.ncta.com	(202) 775-3550
NEBB	National Environmental Balancing Bureau www.nebb.org	(301) 977-3698
NECA	National Electrical Contractors Association www.necanet.org	(301) 657-3110
NeLMA	Northeastern Lumber Manufacturers' Association www.nelma.org	(207) 829-6901
NEMA	National Electrical Manufacturers Association www.nema.org	(703) 841-3200
NETA	InterNational Electrical Testing Association www.netaworld.org	(888) 300-6382 (303) 697-8441
NFHS	National Federation of State High School Associations	(317) 972-6900

	www.nfhs.org	
NFPA	NFPA (National Fire Protection Association) www.nfpa.org	(800) 344-3555 (617) 770-3000
NFRC	National Fenestration Rating Council www.nfrc.org	(301) 589-1776
NGA	National Glass Association www.glass.org	(866) 342-5642 (703) 442-4890
NHLA	National Hardwood Lumber Association www.natlhardwood.org	(800) 933-0318 (901) 377-1818
NLGA	National Lumber Grades Authority www.nlga.org	(604) 524-2393
NOFMA	NOFMA: The Wood Flooring Manufacturers Association (Formerly: National Oak Flooring Manufacturers Association) www.nofma.com	(901) 526-5016
NRCA	National Roofing Contractors Association www.nrca.net	(800) 323-9545 (847) 299-9070
NRMCA	National Ready Mixed Concrete Association www.nrmca.org	(888) 846-7622 (301) 587-1400
NSF	NSF International (National Sanitation Foundation International) www.nsf.org	(800) 673-6275 (734) 769-8010
NSSGA	National Stone, Sand & Gravel Association www.nssga.org	(800) 342-1415 (703) 525-8788
NTMA	National Terrazzo & Mosaic Association, Inc. (The) www.ntma.com	(800) 323-9736 (540) 751-0930
NTRMA	National Tile Roofing Manufacturers Association (Now TRI)	
NWWDA	National Wood Window and Door Association (Now WDMA)	
OPL	Omega Point Laboratories, Inc. (Now ITS)	
PCI	Precast/Prestressed Concrete Institute www.pci.org	(312) 786-0300

PDCA	Painting & Decorating Contractors of America www.pdca.com	(800) 332-7322 (314) 514-7322
PDI	Plumbing & Drainage Institute www.pdionline.org	(800) 589-8956 (978) 557-0720
PGI	PVC Geomembrane Institute http://pgi-tp.ce.uiuc.edu	(217) 333-3929
PLANET	Professional Landcare Network (Formerly: ACLA - Associated Landscape Contractors of America) www.landcarenetwork.org	(800) 395-2522 (703) 736-9666
PTI	Post-Tensioning Institute www.post-tensioning.org	(602) 870-7540
RCSC	Research Council on Structural Connections www.boltcouncil.org	
RFCI	Resilient Floor Covering Institute www.rfci.com	(301) 340-8580
RIS	Redwood Inspection Service www.calredwood.org	(888) 225-7339 (415) 382-0662
SAE	SAE International www.sae.org	(877) 606-7323 (724) 776-4841
SDI	Steel Deck Institute www.sdi.org	(847) 458-4647
SDI	Steel Door Institute www.steeldoor.org	(440) 899-0010
SEFA	Scientific Equipment and Furniture Association www.sefalabs.com	(516) 294-5424
SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers (See ASCE)	
SGCC	Safety Glazing Certification Council www.sgcc.org	(315) 646-2234
SIA	Security Industry Association www.siaonline.org	(703) 683-2075
SIGMA	Sealed Insulating Glass Manufacturers Association	

	(Now IGMA)	
SJI	Steel Joist Institute www.steeljoist.org	(843) 626-1995
SMA	Screen Manufacturers Association www.smacentral.org	(561) 533-0991
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association www.smacna.org	(703) 803-2980
SMPTE	Society of Motion Picture and Television Engineers www.smpte.org	(914) 761-1100
SPFA	Spray Polyurethane Foam Alliance (Formerly: SPI/SPFD - The Society of the Plastics Industry, Inc.; Spray Polyurethane Foam Division) www.sprayfoam.org	(800) 523-6154
SPIB	Southern Pine Inspection Bureau (The) www.spib.org	(850) 434-2611
SPRI	Single Ply Roofing Industry www.spri.org	(781) 647-7026
SSINA	Specialty Steel Industry of North America www.ssina.com	(800) 982-0355 (202) 342-8630
SSPC	SSPC: The Society for Protective Coatings www.sspc.org	(877) 281-7772 (412) 281-2331
STI	Steel Tank Institute www.steeltank.com	(847) 438-8265
SWI	Steel Window Institute www.steelwindows.com	(216) 241-7333
SWRI	Sealant, Waterproofing, & Restoration Institute www.swrionline.org	(816) 472-7974
TCA	Tile Council of America, Inc. www.tileusa.com	(864) 646-8453
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance www.tiaonline.org	(703) 907-7700
TMS	The Masonry Society www.masonrysociety.org	(303) 939-9700

TPI	Truss Plate Institute, Inc. www.tpinst.org	(703) 683-1010
TPI	Turfgrass Producers International www.turfgrasssod.org	(800) 405-8873 (847) 649-5555
TRI	Tile Roofing Institute www.tileroofing.org	(312) 670-4177
UL	Underwriters Laboratories Inc. www.ul.com	(877) 854-3577 (847) 272-8800
UNI	Uni-Bell PVC Pipe Association www.uni-bell.org	(972) 243-3902
USAV	USA Volleyball www.usavolleyball.org	(888) 786-5539 (719) 228-6800
USGBC	U.S. Green Building Council www.usgbc.org	(202) 828-7422
USITT	United States Institute for Theatre Technology, Inc. www.usitt.org	(800) 938-7488 (315) 463-6463
WASTEC	Waste Equipment Technology Association www.wastec.org	(800) 424-2869 (202) 244-4700
WCLIB	West Coast Lumber Inspection Bureau www.wclib.org	(800) 283-1486 (503) 639-0651
WCMA	Window Covering Manufacturers Association (Now WCSC)	
WCSC	Window Covering Safety Council (Formerly: WCMA - Window Covering Manufacturers Association) www.windowcoverings.org	(800) 506-4636 (212) 297-2109
WDMA	Window & Door Manufacturers Association (Formerly: NWWDA - National Wood Window and Door Association) www.wdma.com	(800) 223-2301 (847) 299-5200
WI	Woodwork Institute (Formerly: WIC - Woodwork Institute of California) www.wicnet.org	(916) 372-9943
WIC	Woodwork Institute of California (Now WI)	

WMMPA	Wood Moulding & Millwork Producers Association www.wmmpa.com	(800) 550-7889 (530) 661-9591
WSRCA	Western States Roofing Contractors Association www.wsrca.com	(800) 725-0333 (650) 570-5441
WWPA	Western Wood Products Association www.wwpa.org	(503) 224-3930

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

BOCA	BOCA International, Inc. (See ICC)	
IAPMO	International Association of Plumbing and Mechanical Officials www.iapmo.org	(909) 472-4100
ICBO	International Conference of Building Officials (See ICC)	
ICBO ES	ICBO Evaluation Service, Inc. (See ICC-ES)	
ICC	International Code Council www.iccsafe.org	(888) 422-7233 (703) 931-4533
ICC-ES	ICC Evaluation Service, Inc. www.icc-es.org	(800) 423-6587 (562) 699-0543
SBCCI	Southern Building Code Congress International, Inc. (See ICC)	
UBC	Uniform Building Code (See ICC)	

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

CE	Army Corps of Engineers www.usace.army.mil	
CPSC	Consumer Product Safety Commission www.cpsc.gov	(800) 638-2772 (301) 504-7923

DOC	Department of Commerce www.commerce.gov	(202) 482-2000
DOD	Department of Defense http://.dodssp.daps.dla.mil	(215) 697-6257
DOE	Department of Energy www.energy.gov	(202) 586-9220
EPA	Environmental Protection Agency www.epa.gov	(202) 272-0167
FAA	Federal Aviation Administration www.faa.gov	(866) 835-5322
FCC	Federal Communications Commission www.fcc.gov	(888) 225-5322
FDA	Food and Drug Administration www.fda.gov	(888) 463-6332
GSA	General Services Administration www.gsa.gov	(800) 488-3111
HUD	Department of Housing and Urban Development www.hud.gov	(202) 708-1112
LBL	Lawrence Berkeley National Laboratory www.lbl.gov	(510) 486-4000
NCHRP	National Cooperative Highway Research Program (See TRB)	
NIST	National Institute of Standards and Technology www.nist.gov	(301) 975-6478
OSHA	Occupational Safety & Health Administration www.osha.gov	(800) 321-6742 (202) 693-1999
PBS	Public Building Service (See GSA)	
PHS	Office of Public Health and Science www.osophs.dhhs.gov/ophs	(202) 690-7694
RUS	Rural Utilities Service (See USDA)	(202) 720-9540
SD	State Department	(202) 647-4000

	www.state.gov	
TRB	Transportation Research Board http://gulliver.trb.org	(202) 334-2934
USDA	Department of Agriculture www.usda.gov	(202) 720-2791
USPS	Postal Service www.usps.com	(202) 268-2000

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

ADAAG	Americans with Disabilities Act (ADA) Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities Available from Access Board www.access-board.gov	(800) 872-2253 (202) 272-0080
CFR	Code of Federal Regulations Available from Government Printing Office www.gpoaccess.gov/cfr/index.html	(866) 512-1800 (202) 512-1800
DOD	Department of Defense Military Specifications and Standards Available from Department of Defense Single Stock Point http://dodssp.daps.dla.mil	(215) 697-2664
DSCC	Defense Supply Center Columbus (See FS)	
FED-STD	Federal Standard (See FS)	
FS	Federal Specification Available from Department of Defense Single Stock Point http://dodssp.daps.dla.mil	(215) 697-2664
	Available from Defense Standardization Program www.dps.dla.mil	
	Available from General Services Administration www.gsa.gov	(202) 619-8925
	Available from National Institute of Building Sciences www.wbdg.org/ccb	(202) 289-7800
FTMS	Federal Test Method Standard (See FS)	

MIL	(See MILSPEC)	
MIL-STD	(See MILSPEC)	
MILSPEC	Military Specification and Standards Available from Department of Defense Single Stock Point http://dodssp.daps.dla.mil	(215) 697-2664
UFAS	Uniform Federal Accessibility Standards Available from Access Board www.access-board.gov	(800) 872-2253 (202) 272-0080

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION 01 42 00

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes requirements for temporary utilities, support facilities (storage sheds), and security and protection of temporary facilities.

1.2 DEFINITIONS

A. Permanent Enclosure: As determined by COTR, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

B. Sanitary Facilities: Temporary Sanitary Facilities shall comply with the requirements of the State and County health standards. Enclosed portable self-contained units or temporary water closets and urinals, secluded from public view.

1.3 USE CHARGES

A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to: FAA's construction forces, testing agencies, and authorities having jurisdiction.

1.4 SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

1.5 QUALITY ASSURANCE

A. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.6 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before FAA's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pavement: Comply with Paving Sections of specification.

B. Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts with galvanized barbed-wire top strand.

C. Portable Chain-Link Fencing: Minimum 2-inch, 9-gage, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top and bottom rails. Provide bases for supporting posts.

D. Electrical & lighting materials, devices & equipment: Adequate to the purpose; standard fixtures & devices, meeting UL and NEC requirements for temporary service installations.

E. Pipe materials, connections and fittings: Adequate to the purpose.

F. Drinking Water Dispensers: Standard products.

2.2 TEMPORARY FACILITIES

A. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

B. Storm Tie Downs: All temporary storage sheds to be located on the site for a period exceeding thirty (30) days shall be provided with storm tie downs. The tie downs shall conform to local standards and at a minimum shall meet the local requirements for anchoring of mobile homes. During such periods of time as are designated by the National Weather Service as being a severe weather warning, all temporary sheds and offices shall be anchored or removed from the site.

C. Storage sheds, substantial and watertight, shall be used to store all materials subject to damage by weather. Storage sheds shall have floors raised at least six (6) inches above the ground on heavy joists or sleepers. Contractor and subcontractors shall provide such temporary storage as, in the opinion of the RE, may be necessary to fully protect all stored materials, equipment, apparatus, etc., during the progress of the work.

D. Temporary Offices and Storage Sheds: Contractor and each major subcontractor shall provide their office and storage sheds on the premises, maintain same, and remove same upon completion.

1. All storage sheds shall comply with applicable codes and shall be located as approved by RE.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Adequate to the purpose.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

2.4 TOILET FACILITIES

A. Enclosed portable self-contained units or temporary water closets and urinals, designed either for chemical neutralization or for holding in a temporary tank for pumping by a legally permitted sewage transport company.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

C. Contractor shall provide and pay for all temporary facilities as necessary for the proper and expeditious execution of the work. Contractor shall provide all labor, materials, equipment and appurtenances necessary for the complete installation, operation and maintenance of all temporary facilities. Contractor shall pay costs of all utilities consumed. All work under this Section shall comply with applicable laws, rules, regulations, codes, ordinances and orders of all federal, state and local authorities having jurisdiction for the safety of persons, materials and property. Contractor shall remove all such temporary installations and connections when no longer necessary for the project work.

3.2 UPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet of building lines. Comply with NFPA 241.
2. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to FAA.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas in same location as permanent roads and paved areas. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.

1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to specifications.
3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course.
5. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

C. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

D. Parking: Provide temporary parking areas for construction personnel.

E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

F. Project Identification and Temporary Signs: Provide Project identification and other signs as indicated on Drawings. Install signs where indicated to inform public and individuals seeking entrance to Project. Unauthorized signs are not permitted.

1. Provide temporary, directional signs for construction personnel and visitors.
2. Maintain and touchup signs so they are legible at all times.

G. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction.

H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

I. Temporary Elevator Use: Refer to Division 14 Sections for temporary use of new elevators.

J. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

K. Temporary Use of Permanent Stairs: Cover finished, permanent stairs with protective covering of plywood or similar material so finishes will be undamaged at time of acceptance.

3.3 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

B. Temporary Erosion, Sedimentation and Pollution Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to adjacent properties, storm sewer systems, and waterways, in accordance with the National Pollutant Discharge Elimination System (NPDES) Permit and additional authorities having jurisdiction.

1. Inspect, repair, monitor and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established in accordance with NPDES Permit requirements.

C. Stormwater Control: Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

D. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

E. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Obtain extended warranty for FAA. Perform control operations lawfully, using environmentally safe materials.

F. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.

1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel**.** Provide FAA with one set of keys.

G. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.

H. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

I. Covered Walkway: (If shown on Drawings) Erect structurally adequate, protective, covered walkway for passage of individuals along adjacent public street(s). Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction.

1. Construct covered walkways using scaffold or shoring framing.
2. Provide wood-plank overhead decking, protective plywood enclosure walls, handrails, barricades, warning signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.
3. Extend back wall beyond the structure to complete enclosure fence.
4. Paint and maintain in a manner approved by FAA and COTR.

J. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.

K. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by FAA from fumes and noise.

1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant plywood on construction operations side.
2. Construct dustproof partitions with 2 layers of 3-mil polyethylene sheet on each side. Cover floor with 2 layers of 3-mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant plywood.

   a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches between doors. Maintain water-dampened foot mats in vestibule.

3. Insulate partitions to provide noise protection to occupied areas.
4. Seal joints and perimeter. Equip partitions with dustproof doors and security locks.
5. Protect air-handling equipment.
6. Weather strip openings.
7. Provide walk-off mats at each entrance through temporary partition.

L. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.

1. Prohibit smoking in hazardous fire-exposure areas.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.4 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

2. The Contractor and each subcontractor shall be responsible for cleaning and maintaining all temporary offices and storage sheds in proper condition acceptable to the RE. All exposed surfaces on the outside and inside of field offices and temporary toilet enclosures and outside of storage sheds shall be painted and maintained with exterior enamel paint. Colors are subject to approval by the RE. All temporary facilities shall be maintained by the Contractor and shall be kept in usable condition at all times until completion of the work and/or their removal is authorized by the RE.

3. Maintain lighting. Promptly replace worn or defective parts and non-working bulbs.

4. Maintain temporary water system: Maintain system to provide continuous service with adequate pressure to outlets. Maintain connections, pipes, fittings, and fixtures and conserve use of all utilities. Failure to stop leaks or other waste of water will be cause for revocation of permit for the use of said water from the airport system.

5. Maintain temporary toilet facilities: Clean facilities and surrounding areas daily. Provide toilet paper, paper towels and soap in suitable dispensers.

6. Maintain erosion, sedimentation, and pollution control measures throughout the project life cycle. Inspect erosion, sedimentation, and pollution control measures once per week and following each rain event. Any deficiencies shall be reported to the RE and promptly corrected within 48-hours.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. FAA reserves right to take possession of Project identification signs.

2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. Remove temporary erosion, sedimentation and pollution control measures upon final stabilization of site.
4. Remove temporary lighting material and equipment when permanent system is operational.
5. Remove temporary toilet facilities when permanent facilities are available for use, but no later than Substantial Completion.
6. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified. in Section 01 77 00 "Closeout Procedures."

END OF SECTION 01 50 00

SECTION 01 52 16 - SAFETY REQUIREMENTS

PART 1 - GENERAL

1.1 REFERENCES

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

1. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

a.	ANSI A10.14	Construction and Demolition Operations – Requirements for Safety Belts, Harnesses, Lanyards and Lifelines for Construction and Demolition Use
b.	ANSI Z359.1	Safety Requirements for Personal Fall Arrest Systems

2. CODE OF FEDERAL REGULATIONS (CFR)

a.	29 CFR 1910.94	Ventilation
b.	29 CFR 1910.120	Hazardous Waste Operations and Emergency Response
c.	29 CFR 1926.65	Hazardous Waste Operations and Emergency Response
d.	29 CFR 1926.502(f)	Warning Line Systems
e.	29 CFR 1926.1200	Hazard Communication Standard (MSDS)

3. CORPS OF ENGINEERS (COE)

a.	COE EM-385-1-1	Safety and Health Requirements Manual

4. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

a.	NFPA 70	National Electrical Code
b.	NFPA 241	Safeguarding Construction, Alteration, and Demolition Operations

1.2 DEFINITIONS

A. Certified Safety Professional. A safety manager, safety specialist, or safety engineer that has passed the CSP exam administered by the Board of Certified Safety Professionals.

B. Confined Space. A space which by design has limited openings for entry and exit, unfavorable natural ventilation which could contain or produce dangerous air contaminants, and which is not intended for continuous employee occupancy, engulfment or any other recognized safety or health hazard. Confined spaces include, but are not limited to storage tanks, process vessels, pits, silos, vats, degreasers, reaction vessels, boilers, ventilation and exhaust ducts, sewers, tunnels, underground utility vaults, and pipelines.

C. Multi-employer work site (MEWS). The prime contractor is the “controlling authority” for all work

site safety and health of the subcontractors.

D. Recordable Occupational Injuries or Illness. An occupational injury or illnesses which result in serious injuries, lost workday cases, non-fatal cases or significant mishaps.

E. Serious Injuries & Fatalities. Regardless of the time between the injury and death or the length of the illness; hospitalization of three or more employees; or property damage in excess of $200,000.

F. Lost Workday Cases. Injuries, other than fatalities, that result in lost workdays.

G. Non-Fatal Cases. Cases without lost workdays which result in transfer to another job or termination of employment, or require medical treatment (other than first aid) or involve property damage in excess of $10,000 but less than $200,000 or involve: loss of consciousness or restriction of work or motion. This category also includes any diagnosed occupational illnesses which are reported to the employer but are not classified as facilities or lost workday cases.

H. Safety Officer. The superintendent or other qualified or competent person who is responsible for the on-site safety required for the project. The contractor quality control person cannot be the safety officer, even though the QC has safety inspection responsibilities as part of the QC duties.

I. Significant Contractor Mishap. A contractor mishap which involves falls of 4 feet or more, electrical mishaps, confined space mishaps, diving mishaps, equipment mishaps, and fire mishaps which result in a lost time injury, or property damage of $10,000 or more, but less than $200,000; or when fire department or emergency medical treatment (EMT) assistance is required.

J. Medical Treatment. Treatment administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment provided by a physician or registered personnel.

K. First aid. An on-time treatment, and follow-up visit for the purpose of observation, of minor scratches, cuts, burns, splinters, and so forth, which do not ordinarily require medical care, even though provided by a physician or registered professional personnel.

L. Lost Workdays. The number of days (consecutive or not) after, but not including, the day of injury or illness during which the employee would have worked but could not do so; that is, could not perform all or part of his normal assignment during all or any part of the workday or shift; because of the occupational injury or illness.

1.3 SUBMITTALS

A. Statements

1. Accident Prevention Plan (APP): Submit at least 30 calendar days prior to start of work at the job site, follow Appendix A of COE EM-385-1-1, make APP site specific.
2. Activity Hazard Analysis (AHA): Submit the AHA for the preparatory phase as a part of the APP. Submit subsequent AHA for each major phase of work at least 30 calendar days prior to the start of that phase. Format subsequent AHA as amendments to the APP.

B. Records

1. Daily Confined Space Entry Permit. Submit one copy of each permit attached to each Daily Production Report.
2. Reports. Submit reports as their incidence occurs, in accordance with the requirements of the paragraph entitled, "Reports".

1.4 QUALITY ASSURANCE

A. Qualifications

1. Qualifications of Safety Officer:

   a. Ability to manage the on-site contractor safety program through appropriate management controls.
   b. Ability to identify hazards and have the capability to expend resources necessary to abate the hazards.
   c. Must have worked on similar types of projects that are equal to or exceed the scope of the project assigned with the same responsibilities.

2. Qualifications of Qualified Person, Confined Space Entry. The qualified person shall be capable (by education and specialized training) of anticipating, recognizing, and evaluating employee exposure to hazardous substances or other unsafe conditions in a necessary control and protective action to ensure worker safety.

B. Meetings

1. Preconstruction Conference: The safety officer shall attend the preconstruction conference to discuss work procedures and safety.
2. Weekly Safety Meetings: Hold weekly. Provide minutes showing contract title, signatures of attendees and a list of topics discussed.

1.5 ACCIDENT PREVENTION PLAN (APP)

A. Prepare the APP in accordance with the required and advisory provisions of COE EM-385-1-1 including appendix A, "Minimum Basic Outline for Preparation of Accident Prevention Plan," and as modified herein. Include the associated AHA and other specific plans, programs and procedures listed on Pages A-3 and A-4 of COE EM-385-1-1, some of which are called out below.

B. Contents of the Accident Prevention Plan:

1. Name and safety related qualifications of safety officer (including training and any certifications).
2. Qualifications of competent and of qualified persons.
3. Identify the individual who will complete exposure data (hours worked); accident investigations, reports and logs; and immediate notification of accidents to include subcontractors.
4. Emergency response plan. Conform to COE EM-385-1-1, paragraph 01.E and include a map denoting the route to the nearest emergency care facility with emergency phone numbers.

Contractor may be required to demonstrate emergency response.

5. Confined Space Entry Plan. Identify the qualified person's name and qualifications, training, and experience. Delineate the qualified person's authority to direct work stoppage in the event of hazardous conditions. Include procedure for rescue by contractor personnel and the coordination with emergency responders. (If there is no confined space work, include a statement that no confined space work exists and none will be created.)
6. Hazardous Material Use. Provisions to deal with hazardous materials, pursuant to the Contract Clause "FAR 52.223-3, Hazardous Material Identification and Material Safety Data." And the following:

    a. Inventory of hazardous materials to be introduced to the site with estimated quantities.
    b. Plan for protecting personnel and property during the transport, storage and use of the materials.
    c. Emergency procedures for spill response and disposal, including a site map with approximate quantities on site at any given time. The site map will be attached to the inventory, showing where the hazardous substances are stored.
    d. Material Safety Data Sheets for inventoried materials not required in other section of this specification.
    e. Labeling system to identify contents on all containers on-site.
    f. Plan for communicating high health hazards to employees and adjacent occupants.

7. Hazardous Energy Control Plan. For hazardous energy sources, comply with COE EM-385-1-1, paragraph 12.A.07.
8. Critical Lift Procedures. Weight handling critical lift plans will be prepared and signed in accordance with COE EM-385-1-1, paragraph 16.c.18.
9. Alcohol and Drug Abuse Plan

    a. Describe plan for testing with pre-employment screening in accordance with the DFAR Clause subpart 252.223-7004, "Drug Free Work Force".
    b. Description of the on-site prevention program.

10. Fall Protection Plan. The plan shall be site specific and protect all workers at elevations above 6 feet.
11. Silica Exposure Reduction. The plan shall include specific procedures to prevent employee silica inhalation exposures.

1.6 ACTIVITY HAZARD ANALYSIS (AHA)

A. Prepare for each phase of the work. As a minimum, define activity being performed, sequence of work, specific hazards anticipated, control measures to eliminate or reduce each hazard to acceptable levels, training requirements for all involved, and the competent person in charge of that phase of work. For work with fall hazards, including fall hazards associated with scaffold erection and removal, identify the appropriate fall arrest systems. For work with materials handling equipment, address safeguarding measures related to materials handling equipment. For work requiring excavations, include excavation safeguarding requirements. The appropriate AHA shall be reviewed and attendance documented by Contractor at the preparatory, initial, and follow-up phases of Quality Control inspection.

1.7 DRUG PREVENTION PROGRAM

A. Conduct a proactive drug and alcohol use prevention program for all workers, prime and subcontractor, on the site. Ensure that no employees either use illegal drugs or consume alcohol during work hours. Ensure no employees under the influence of drugs or alcohol during work hours. After accidents, collect blood, urine or saliva specimens and test injured employee influence. A copy of the test shall be made available to the RE upon request.

1.8 FALL HAZARD PREVENTION PROGRAM

A. Scaffolds: Delineate the fall protection requirements necessary during the erection and dismantling operation of scaffolds used on the project in the fall protection plan and activity hazard analysis for the phase of work.

B. Training: Institute a fall protection program. As part of the Fall Protection Program, contractor shall provide training for each employee who might be exposed to fall hazards.

1.9 DUTIES OF THE SAFETY OFFICER

A. Ensure construction hazards are identified and corrected.

B. Maintain applicable safety reference material on the job site.

C. Maintain a log of safety inspections performed.

D. Attend the pre-construction conference.

E. Generate and approve agenda for safety meetings.

1.10 DISPLAY OF SAFETY INFORMATION

A. Display the following information in clear view of the on-site construction personnel:

1. Map denoting the route to the nearest emergency care facility with emergency phone numbers.
2. AHA
3. Confined space entry permit.

1.11 SITE SAFETY REFERENCE MATERIALS

A. Maintain safety-related references applicable to the project, including those listed in the article “References”. Maintain applicable equipment manufacturers’ manuals.

1.12 HIGH HAZARD WORK AND LONG DURATION

A. Work under this contract is potentially hazardous. Pursuant to contract clause “FAR 52.236-13, Accident Prevention, Alternate I,” submit in writing additional proposals for effecting accident prevention under hazardous conditions. Meet in conference with RE to discuss and develop mutual

understanding relative to the administration of the overall safety program.

1.13 EMERGENCY MEDICAL TREATMENT

A. Contractors shall arrange for their own emergency medical treatment. FAA has no responsibility to provide.

1.14 REPORTS

A. Reporting Reports: For OSHA recordable accidents, the prime contractor will conduct a suitable investigation, complete the Contractor Significant Incident Report (CSIR) form and provide to the RE within 5 calendar days of the accident.

B. Notification: Notify RE, within 4 hours, of any accident meeting the definition of OSHA recordable occupational injury or illness. Information shall include Contractor name; contract title; type of contract; name of activity, installation or location where mishap occurred; date and time of mishap; names of personnel injured; extent of property damage, if any; and brief description of mishap (to include type of construction equipment used, participants, etc). In addition to OSHA reporting requirements, initial notification shall be made of any accident involving significant mishaps.

C. Monthly Exposure Report: Monthly exposure reporting, to the RE is required to be attached to the monthly billing request. This report is a compilation of employee-hours worked each month for all site workers, both prime and subcontractor.

D. OSHA Citations and Violations: Provide the RE with a copy of each OSHA citation, OSHA report and Contractor response. Correct violations and citations promptly and provide written corrective actions to the RE.

PART 2 - PRODUCTS

2.1 FALL PROTECTION ANCHORAGE

A. Fall protection anchorages, used by contractors to protect their people, will be left in place and so identified for continued customer use.

2.2 CONFINED SPACE SIGNAGE

A. Provide permanent signs integral to or securely attached to access covers for new confined spaces. Signs working: “DANGER—PERMIT REQUIRED CONFINED SPACE – DO NOT ENTER –“ on bold letters a minimum of one inch in height and constructed to be clearly legible with all paint removed. The signal work “DANGER” and shall be red and readable from 5 feet.

PART 3 - EXECUTION

3.1 CONSTRUCTION

A. Comply with COE EM-385-1-1, NFPA 241, the accident prevention plan, the activity hazard analysis and other related submittals and activity fire and safety regulations.

B. Hazardous Material Exclusions: Not withstanding any other hazardous material used in this contract, radioactive materials or instruments capable of producing ionizing/non-ionizing radiation as well as materials which contain asbestos, mercury or polychlorinated biphenyls, di-isocynates, lead-based paint are prohibited. Exceptions to the use of any of the above excluded materials may be considered by RE upon written request by Contractor.

C. Unforeseen Hazardous Material: If material that may be hazardous to human health upon disturbance during construction operations is encountered, stop that portion of work and notify the RE immediately. Within 14 calendar days the RE will determine if the material is hazardous. If material is not hazardous or poses no danger, the RE will direct the Contractor to proceed without change. If material is hazardous and handling of the material is necessary to accomplish the work, the RE will issue a modification pursuant to "FAR 52.243-4, Changes" and "FAR 52.236-2, Differing Site Conditions".

3.2 PRE-OUTAGE COORDINATION MEETING

A. Contractors are required to apply for utility outages a minimum of 15 days in advance. As a minimum, the request should include the location of the outage, utilities being effected, duration of outage and any necessary sketches. Once approved and prior to beginning work on the utility system requiring shut down, the Contractor shall attend a pre-outage coordination meeting with the RE to review the scope of work and the lock out/tag out procedures for work protection.

3.3 PERSONNEL PROTECTION

A. Hazardous Noise: Provide hazardous noise signs, and hearing protection, wherever equipment and work procedures produce sound-pressure levels greater than 85 dBA steady state or 140 dBA impulse, regardless of the duration of the exposure.

B. Fall Protection: Enforce use of the fall protection device named for each activity in the AHA all times when an employee is on a surface 6 feet or more above lower levels. Personal fall arrest systems are required when working from an articulating or extendible boom, scissor lifts, swing stages, or suspended platform. Fall protection must comply with ANSI A10.14.

1. Personal Fall Arrest Device: Equipment, subsystems and components shall meet ANSI Z359.1, Personal Fall Arrest Systems. Only a full-body harness with a shock absorbing lanyard is an acceptable personal fall arrest device. Body belts may only be used as positioning devices only such as for steel reinforcing assembly. Body belts are not authorized as a personal fall arrest device. Harnesses must have upper middle back "D" rings for proper body suspension during a fall. Lanyard must be fitted with a double locking snap hook attachment. Webbing, straps, and ropes must be of synthetic fiber or wire rope.
2. Fall Protection for Roofs:

   a. For work within 6 feet of an edge, on low pitched roofs, personnel shall be protected by use of personal fall arrest systems, guardrails, safety nets. Safety monitoring system is not adequate fall protection and is not authorized.

b. For work greater than 6 feet from an edge, warning lines shall be erected and installed in accordance with 29 CFR 1926.502(f).

3. Safety Nets: Safety nets shall be provided in unguarded workplaces more than 25 feet above surface.

C. Scaffolding: Employees shall be provided with a safe means of access to the work area on the scaffold. Climbing on any scaffold braces or supports not specifically designed for access is prohibited. Contractor shall ensure that scaffold erection is performed by employees that are qualified. Do not use scaffold without the capability of supporting at least four times the maximum intended load or without appropriate fall protection as delineated in the accepted fall protection plan. Minimum platform size shall be based on the platform not being greater in height than four times the dimension of the smallest width dimension for rolling scaffold. Some Baker type scaffolding has been found not to meet these requirements. Stationary scaffolds must be attached to structural building components to safeguard against tipping forward or backward. The first tie-in shall be at the height equal to 4 times the width of the scaffold base.

D. Use of Material Handling Equipment

1. Material handling equipment such as forklifts shall not be modified with work platform attachments for supporting employees unless specifically delineated in the manufacturers printed operating instructions. Crane supported work platforms shall only be used in extreme conditions if the Contractor proves that using any other access to the work location would provide a greater hazard to the workers.
2. Cranes must be equipped with Load Indicating Devices, anti-two blocks devices, load, boom angle moment indicating indicators.

E. Excavations: The competent person for excavation shall be on site when work is being performed in excavation, and shall inspect excavations prior to entry by workers. Individual must evaluate for all hazards, including atmospheric, necessary to correct hazards promptly.

F. Conduct of Electrical Work: Underground electrical spaces must be certified safe for entry before entering to conduct work. Cable intended to be cut must be positively identified and de-energized prior to performing each cut. Perform all high voltage cutting remotely. When racking in or live switching of circuit breakers, no additional person other than the switch operator will be allowed in the space during the actual operation. Plan so that work near energized parts is minimized to the fullest extent possible. Use of electrical outages clear of any energized electrical sources is the preferred method. When working in energized substations, only qualified electrical workers shall be permitted to enter. When work requires Contractor to work near energized circuits as defined by the NFPA 70, high voltage personnel must use personnel protective equipment that includes, as a minimum, electrical hard hat, safety shoes, insulating gloves with leather protective sleeves, fire retarding shirts, coveralls, face shields, and safety glasses. Insulating blankets, hearing protection, and switching suits may be required, depending on the specific job and as delineated in the Contractor AHA.

G. Work in Manholes: Contractor shall provide mechanical ventilation for all work accomplished in manholes, unless other hazards are present like friable asbestos.

H. Work in Confined Spaces: Comply with the requirements in Section 06.I of COE EM-385-1-1. Any

potential for a hazard in the confined space requires a permit system to be used.

1. Entry Procedures. Prohibit entry into a confined space by personnel for any purpose, including hot work, until the qualified person has conducted appropriate tests to ensure the confined or enclosed space is safe for the work intended and that all potential hazards are controlled or eliminated and documented. (See Section 06.I.05 of COE EM-385-1-1 for entry procedures.) All hazards pertaining to the space shall be reviewed with each employee during review of the AHA.
2. Forced air ventilation is required for all confined space entry operations and the minimum air exchange requirements must be maintained.
3. Ensure the use of rescue and retrieval devices in confined spaces greater than 5 feet in depth. Conform to Sections 06.I.09, 06.I.10 and 06.I.11 of COE EM-385-11.
4. Include training information for employees who will be involved as entrant attendants for the work. Conform to Section 06.I.06 of COE EM-385-1-1.
5. Entry Permit. Use ENGFORM 5044-R or other form with the same minimum information for the Daily Confined Space Entry Permit, completed by the qualified person. Post the permit in a conspicuous place close to the confined space entrance.

I. Crystalline Silica: Grinding, abrasive blasting, and foundry operations of construction materials containing crystalline silica, shall comply with OSHA regulations, such as 29 CFR 1910.94, and COE EM-385-1-1, (Appendix C). The Contractor shall develop and implement effective exposure control and elimination procedures to include dust control systems, engineering controls, and establishment of work area boundaries, as well as medical surveillance, training, air monitoring, and personal protective equipment.

3.4 ACCIDENT SCENE PRESERVATION

A. For serious accidents, ensure the accident site is secured and evidence is protected remaining undisturbed until released by the RE. After release is issued, promptly replace used, damaged, or worn equipment.

END OF SECTION 01 52 16

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SECTION 01 56 23 - BARRIERS AND ENCLOSURES

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. Barriers

B. Protected Walkways

C. Security Fencing

D. Tree and Plant Protection.

E. Weather Closures

F. Partition and Ceiling Enclosures

G. Maintenance

H. Removal

I. Site Restoration

PART 2 - PRODUCTS

2.1 MATERIALS

A. May be new or used as may be dictated by all governing codes, adequate to the purpose, which will not create hazardous conditions.

PART 3 - EXECUTION

3.1 MARKING FOR HAZARDS

A. Furnish, erect, and maintain all barricades, warning signs and markings for hazards necessary to protect the public and the work. When used during periods of darkness, such barricades, warning signs and hazard markings shall be suitably illuminated.

B. Furnish, erect, and maintain markings and associated lighting of open trenches, excavations, temporary stock piles, and parked construction equipment that may be hazardous to the operation of emergency fire-rescue or maintenance vehicles on the airport in reasonable conformance to FAA Advisory Circular 150/5370-2C, Operational Safety on Airports during Construction. Identify each motorized vehicle or piece of construction equipment in reasonable conformance to FAA Advisory Circular 150-5370-2C.

3.2 BARRIERS AND PROTECTED WALKWAYS

A. Provide to prevent public entry, to protect existing trees and plants, and to protect existing facilities and adjacent properties from damage.

B. Provide fence enclosing construction area of height and type required to maintain site security.

3.3 TREE AND PLANT PROTECTION

A. Preserve and protect existing trees and plants designated to remain.

B. Consult with the RE, remove agreed-on roots and branches which interfere with construction. Employ qualified tree surgeon to remove and to treat cuts. If required by governing ordinances, consult with FAA prior to removing any trees.

C. Protect areas with drip lines from traffic, parking, storage, dumping, chemically injurious materials and liquids, ponding and continuous running water.

D. Provide barriers around drip lines, with access for maintenance.

E. Replace trees and plants damaged by construction work with material of comparable or greater value.

3.4 WEATHER CLOSURES - AS NEEDED

A. Provide temporary roofing and weathertight insulated closures of openings in exterior surfaces to maintain specified working conditions to protect products and finished work from inclement weather.

3.5 PARTITIONS AND CEILING ENCLOSURES

A. Temporary construction of this type is not anticipated.

3.6 MAINTENANCE

A. Maintain during progress of work. Repaint painted surfaces as directed by the RE.

B. Relocate and extend during successive stages of construction.

3.7 REMOVAL

A. Remove temporary materials, equipment and construction at Final Acceptance. Repair or replace damage caused by installation or use of barricades and enclosures. Remove fence post setting.

3.8 SITE RESTORATION

A. Restore site and existing facilities to remain but damaged during construction to specified condition.

END OF SECTION 01 56 23

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SECTION 01 57 19 - TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 - GENERAL

1.1 REFERENCES

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

1. CODE OF FEDERAL REGULATIONS (CFR)

a.	29 CFR 1910	Occupational Safety and Health Standards
b.	40 CFR 122.26	EPA National Pollutant Discharge Elimination System Permit Regulations
c.	40 CFR 241	Guidelines for Disposal of Solid Waste
d.	40 CFR 243	Guidelines for the Storage and Collection of Residential, Commercial, and Institutional Solid Waste
e.	40 CFR 258	Subtitle D Landfill Requirements
f.	40 CFR 261	Identification and Listing of Hazardous Waste
g.	40 CFR 262	Generators of Hazardous Waste
h.	40 CFR 263	Transporters of Hazardous Waste
i.	40 CFR 264	Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
j.	40 CFR 265	Interim Status Standard for Owners and Operators of Hazardous Waste Management Facilities
k.	40 CFR 266	Management of Specific Hazardous Waste and Specific Types of Hazardous Waste Management Facilities
l.	40 CFR 268	Land Disposal Restrictions
m.	40 CFR 279	Used Oil Regulations
n.	40 CFR 300	National Oil and Hazardous Substances Pollution Contingency Plan
o.	40 CFR 372 SUBPART D	EPA Toxic Chemical Release Reporting Regulations
p.	49 CFR 173	Shipments and Packaging's

2. ENVIRONMENTAL PROTECTION AGENCY (EPA)

a.	EPA 832-R-92-005	Storm Water Management for Construction Activities

1.2 DEFINITIONS

A. Sediment: Soil and other debris that has eroded and has been transported by runoff water or wind.

B. Solid Waste: Garbage, refuse, debris, sludge or other discharged material (except hazardous waste as defined in paragraph entitled "Hazardous Waste" or hazardous debris as defined in paragraph entitled "Hazardous Debris"), including solid, liquid, semisolid, or contained gaseous materials resulting from domestic, industrial, commercial, mining, or agricultural operations. Material not

regulated as solid waste are: nuclear source or byproduct materials regulated under the Federal Atomic Energy Act of 1954 as amended; suspended or dissolved materials in domestic sewage effluent or irrigation return flows, or other regulated point source discharges; regulated air emissions; and fluids or wastes associated with natural gas or crude oil exploration or production.

C. Green waste: The vegetative matter from landscaping, land clearing and grubbing, including, but not limited to, grass bushes, scrubs, small trees and saplings, tree stumps and plant roots. Marketable trees, grasses and plants that are indicated to remain, be re-located, or be re-used are not included.

D. Surplus soil: Existing soil that is in excess of what is required for this work, including aggregates intended, but not used, for on-site mixing of concrete, mortars and paving. Contaminated soil meeting the definition of hazardous material or hazardous waste is not included.

E. Inert construction and demolition debris: Broken or removed concrete, masonry, and rock asphalt paving; ceramics; roofing paper and shingles. All in accordance with state requirements.

F. Wood: Dimension and non-dimension lumber, plywood, chipboard, hardboard. Treated and/or painted wood that meets the definition of lead contaminated or lead based contaminated paint is not included.

G. Scrap metal: Scrap and excess ferrous and non-ferrous metals such as reinforcing steel, structural shapes, pipe and wire that are recovered or collected and disposed of as scrap. Scrap metal meeting the definition of hazardous material or hazardous waste is not included.

H. Paint cans: Metal cans that are empty of paints, solvents, thinners and adhesives. If permitted by the paint can label, a thin dry film may remain in the can.

I. Recyclables: Materials, equipment and assemblies such as doors, windows, door and window frames, plumbing fixtures, glazing and mirrors that are recovered and sold as recyclable. Metal meeting the definition of lead contaminated or lead based paint contaminated must be disposed in accordance with state requirements.

J. Debris: Non-hazardous solid material generated during the construction, demolition, or renovation of a structure which exceeds 2.5 inch particle size that is: a manufactured object; plant or animal matter; or natural geologic material (e.g., cobbles and boulders). A mixture of debris and other material such as soil or sludge is also subject to regulation as debris if the mixture is comprised primarily of debris by volume, based on visual inspection.

K. Hazardous Debris: As defined in paragraph entitled “Debris” of this section, debris that contains listed hazardous waste (either on the debris surface, or in its interstices, such as pore structure) per 40 CFR 261; or debris that exhibits a characteristic of hazardous waste per 40 CFR 261.

L. Chemical Wastes: This includes salts, acids, alkalies, herbicides, pesticides, and organic chemicals.

M. Garbage: Refuse and scraps resulting from preparation, cooking, dispensing, and consumption of food.

N. Hazardous Waste: Hazardous waste as defined in 40 CFR 261 or as defined by applicable state and

local regulations.

O. Oily Waste: Petroleum products and bituminous materials.

P. Class I Ozone Depleting Substance (ODS)

1. Class I ODS is defined in Section 602(a) of The Clean Air Act and includes the following chemicals:

Chlorofluorocarbon-11 (CFC-11)	Chlorofluorocarbon-213 (CFC-213)
Chlorofluorocarbon-12 (CFC-12)	Chlorofluorocarbon-214 (CFC-214)
Chlorofluorocarbon-13 (CFC-13)	Chlorofluorocarbon-215 (CFC-215)
Chlorofluorocarbon-111 (CFC-111)	Chlorofluorocarbon-216 (CFC-216)
Chlorofluorocarbon-112 (CFC-112)	Chlorofluorocarbon-217 (CFC-217)
Chlorofluorocarbon-113 (CFC-113)	Halon-1211
Chlorofluorocarbon-114 (CFC-114)	Halon-1301
Chlorofluorocarbon-115 (CFC-115)	Halon=2402
Chlorofluorocarbon-211 (CFC-211)	Carbon tetrachloride
Chlorofluorocarbon-212 (CFC-212)	Methyl chloroform

1.3 SUBMITTALS

A. Statements

1. Environmental Protection Plan (see Section 1.6 for detailed requirements).
2. Dirt and Dust Control Plan

a. Dirt and Dust Control Plan: Submit truck and material haul routes along with a plan for controlling dirt, debris, and dust on base roadways. As a minimum, identify in the plan the subcontractor and equipment for cleaning along the haul route and measures to reduce dirt, dust, and debris from roadways.

B. Field Test Reports

1. Laboratory Analysis

a. Submit a copy of a laboratory analysis of solid waste and debris with the potential of becoming classified as a hazardous waste (i.e., abrasive/sand blasting debris, etc.). Waste stream determinations are required at the point of generation and must sufficiently document whether the waste will be a solid waste, hazardous waste, or Resource Conservation and Recovery Act (RCRA) exempt waste. Determinations must use EPA approved methods and provide written rational for whether the waste is classified as hazardous or non-hazardous. The Contractor shall bear the cost of the waste stream determinations, and the RE reserves the right to request waste stream determinations on questionable waste streams.

C. Records

1. Some of the records listed below are also required as part of other submittals. For the

"Records" submittal, maintain on-site a separate three-ring Environmental Records binder and submit at the completion of the project. Make separate parts to the binder corresponding to each of the applicable sub items listed below.

a. Preconstruction survey
b. Solid waste disposal permit
c. Waste determination documentation
d. Disposal documentation for hazardous and regulated waste
e. Regulatory notification
f. Erosion and sediment control inspection reports
g. Solid waste disposal report

2. Preconstruction Survey: Perform a preconstruction survey of the project site with the RE and take photographs showing existing environmental conditions in and adjacent to the site. Submit a report for the record.
3. Solid Waste Disposal Permit: Submit one copy of a permit or license showing such agency's approval of the disposal plan before transporting wastes off Government property.
4. Waste Determination Documentation: The Contractor shall complete a Waste Determination form (provided at the pre-construction conference) for all contractor derived wastes to be generated. The waste determination must be based upon either a constituent listing from the manufacturer used in conjunction with consideration of the process by which the waste was generated, EPA approved analytical data, or laboratory analysis (Material Safety Data Sheets (MSDS) by themselves are not adequate). All support documentation must be attached to the Waste Determination form. As a minimum, a Waste Determination form must be provided for the following wastes (this listing is not all inclusive): oil and latex based painting and caulking products, solvents, adhesives, aerosols, petroleum products, and all containers of the original materials.
5. Disposal Documentation for Hazardous and Regulated Waste: Submit a copy of the applicable EPA and state permit(s), manifest(s), or license(s) for transportation, treatment, storage, and disposal of hazardous and regulated waste by permitted facilities.
6. Regulatory Notification: The Contractor is responsible for all regulatory notification requirements in accordance with Federal, state and local regulations. The Contractor shall forward copies to the RE prior to commencement of work activities. Typically, regulatory notifications must be provided for the following (this listing is not all inclusive): demolition, renovation, NPDES defined site work, remediation of controlled substances (asbestos, hazardous waste, lead paint).
7. Solid Waste Disposal Report: Monthly the Contractor shall submit a solid waste disposal report to the RE. For each waste, the report shall state the classification (using the definitions provided in this section), amount, location, and name of the business receiving the solid waste. The Contractor shall include copies of the waste handling facilities' weight tickets, receipts, bills of sale, and other sales documentation. In lieu of sales documentation, the Contractor may submit a statement indicating the disposal location for the solid waste which is signed by an officer of the Contractor firm authorized to legally obligate or bind the firm. The sales documentation or Contractor certification shall include the receiver's tax identification number and business, EPA or state registration number, along with the receiver's delivery and business address and telephone numbers. For each solid waste retained by the Contractor for his own use, the Contractor shall submit on the solid waste disposal report the information previously described. Prices paid or received shall not be reported to the RE unless required by other provisions or specifications of this Contract or

public law.

1.4 CLASS I ODS PROHIBITION

A. Class I ODS as defined and identified herein shall not be used in the performance of this contract, nor be provided as part of the equipment. This prohibition shall be considered to prevail over any other provision, specification, drawing, or referenced documents.

1.5 ENVIRONMENTAL PROTECTION REQUIREMENTS

A. 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 Federal, state, and local regulations pertaining to the environment, including water, air, solid waste, hazardous waste and substances, oily substances, and noise pollution.

B. Licenses and Permits: Obtain licenses and permits pursuant to the “Permits and Responsibilities” FAR Clause.

C. Contractor Liabilities for Environmental Protection: The Contractor is advised that this project and the facility are subject to federal, state, and local regulatory agency inspections to review compliance with environmental laws and regulations. The Contractor shall fully cooperate with any representative from and federal, state and local regulatory agency who may visit the job site and shall provide immediate notification to the RE, who shall accompany them on any subsequent site inspections. The Contractor shall complete, maintain and make available to the RE, station, or regulatory agency personnel all documentation relating to environmental compliance under applicable federal, state and local laws and regulations. The Contractor shall immediately notify the RE if a Notice of Violation (NOV) is issued to the Contractor.

D. The Contractor shall be responsible for all damages to persons or property resulting form Contractor fault or negligence as well as for the payment of any civil fines or penalties which may be assessed by any federal, state or local regulatory agency as a result of the Contractor’s or any subcontractor’s violation of any applicable federal, state, or local environmental law or regulation. Should a Notice of Violation (NOV), Notice of Noncompliance (NON), Notice of Deficiency (NOD), or similar regulatory agency notice be issued to the FAA or FAA as facility owner/operator on account of the actions or inactions of the Contractor or one of its subcontractors in the performance of work under this contract, the Contractor shall fully cooperate with the FAA and/or FAA in defending against regulatory assessment of any civil fines or penalties arising out of such actions or inactions.

1.6 ENVIRONMENTAL PROTECTION PLAN

A. The Environmental Protection Plan shall be submitted in the following format and shall, at a minimum, address the following elements (also refer to paragraph entitled “Protection of Natural Resources” in this section):

1. Description of the Environmental Protection Plan

a. General overview and purpose
b. General site information

2. Protection of Natural Resources

a. Land resources
b. Tree protection
c. Replacement of damaged landscape features
d. Temporary construction
e. Fish and wildlife resources
f. Wetland areas

3. Storm Water Management and Control

a. Ground cover
b. Erodible soils
c. Temporary measures

1) Mechanical retardation and control of runoff
2) Vegetation and mulch

B. Prevention of Releases to the Environment

1. Procedures to prevent releases to the environment
2. Notifications in the event of a release to the environment

C. Protection of the Environment from Waste (Hazardous Waste Management Section)

1. Control and disposal of solid and sanitary waste

2. Control and disposal of hazardous waste (Hazardous Waste Management Section) This item shall consist of the management procedures for all hazardous waste to be generated. As a minimum, include the following:

a. Procedures to be employed to ensure a written waste determination is made for appropriate wastes which are to be generated;
b. Sampling/analysis plan;
c. Methods of hazardous waste accumulation/storage (i.e., in tanks and/or containers);
d. Management procedures for storage, labeling, transportation, and disposal of waste (treatment of waste is not allowed unless specifically noted);
e. Management procedures and regulatory documentation ensuring disposal of hazardous waste complies with Land Disposal Restrictions (40 CFR 268);
f. Management procedures for recyclable hazardous materials such as lead-acid batteries, used oil, and the like;
g. Used oil management procedures in accordance with 40 CFR 279;
h. Pollution prevention/hazardous waste minimization procedures;
i. Plans for the disposal of hazardous waste by permitted facilities;
j. Procedures to be employed to ensure all required employee training records are maintained.

D. Environmental Protection Plan Review: Fourteen days after the environmental protection meeting, submit the proposed Environmental Protection Plan for further discussion, review, and approval. Commencement of work shall not begin until the environmental protection plan has been approved.

1.7 UNFORESEEN HAZARDOUS OR REGULATED MATERIAL

A. If material that is not indicated in the contract documents is encountered that may be dangerous to human health upon disturbance during construction operations, stop that portion of work and notify the RE immediately. Intent is to identify materials such as PCB, lead paint, mercury, petroleum products, and friable and nonfriable asbestos. Within 14 calendar days the FAA will determine if the material is hazardous. If the material is not hazardous or poses no danger, the FAA will direct the Contractor to proceed without change. If the material is hazardous and handling of the material is necessary to accomplish the work, the FAA will issue a modification pursuant of "FAR 52.243-4, Changes" and "FAR 52.236-2, Differing Site Conditions".

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.1 PROTECTION OF NATURAL RESOURCES

A. Preserve the natural resources within the project boundaries and outside the limits of permanent work. Restore to an equivalent or improved condition upon completion of work. Confine construction activities to within the limits of the work indicated or specified.

1. Land Resources: Except in areas to be cleared, do not remove, cut, deface, injure, or destroy trees or shrubs without the RE's permission. Do not fasten or attach ropes, cables, or guys to existing nearby trees for anchorages unless authorized by the RE. Where such use of attached ropes, cables, or guys is authorized, the Contractor shall be responsible for any resultant damage.

a. Protection of Trees: Protect existing trees which are to remain and which may be injured, bruised, defaced, or other wise damaged by construction operations. Remove displaced rocks from uncleared areas. By approved excavation, remove trees with 30 percent or more of their root systems destroyed.

b. Replacement: Remove trees and other landscape features scarred or damaged by equipment operations, and replace with equivalent, undamaged trees and landscape features. Obtain RE's approval before replacement.

2. Water Resources

a. Oily and Hazardous Substances: Prevent oily or other hazardous substances from entering the ground, drainage areas, or local bodies of water. For oil, fuel oil, or other hazardous substance spills, verbally notify the RE immediately. Surround all temporary fuel oil or petroleum storage tanks with a temporary earth beam of sufficient

size and strength to contain the contents of the tanks in the event of leakage or spillage.

3. Fish and Wildlife Resources: Do not disturb fish and wildlife. Do not alter water flows or otherwise significantly disturb the native habitat adjacent to the project and critical to the survival of fish and wildlife, except as indicated or specified.

3.2 HISTORICAL AND ARCHAEOLOGICAL RESOURCES

A. Carefully protect in-place and report immediately to the RE historical and archaeological items or human skeletal remains discovered in the course of work. Stop work in the immediate area of the discovery until directed by the RE to resume work. The FAA retains ownership and control over historical and archaeological resources.

3.3 EROSION AND SEDIMENT CONTROL MEASURES

A. Burnoff: Burnoff of the ground cover is not permitted.

B. Protection of Erodible Soils: Immediately finish the earthwork brought to a final grade, as indicated or specified. Immediately protect the side slopes and back slopes upon completion of rough grading. Plan and conduct earthwork to minimize the duration of exposure of unprotected soils.

C. Temporary Protection of Erodible Soils: Use the following methods to prevent erosion and control sedimentation:

1. Mechanical Retardation and Control of Runoff: Mechanically retard and control the rate of runoff from the construction site. This includes construction of diversion ditches, benches, berms, and use of silt fences and straw bales to retard and divert runoff to protected drainage courses.
2. Sediment Basins: Trap sediment in temporary sediment basins. Select a basin size to accommodate the runoff of a local 2-year storm. Pump dry and remove the accumulated sediment, after each storm. Use a paved weir or vertical overflow pipe for overflow. Remove collected sediment from the site. Institute effluent quality monitoring programs.
3. Vegetation and Mulch: Provide temporary protection on sides and back slopes as soon as rough grading is completed or sufficient soil is exposed to require erosion protection. Protect slopes by accelerated growth of permanent vegetation, temporary vegetation, mulching, or netting. Stabilize slopes by hydroseeding, anchoring mulch in place, covering with anchored netting, sodding, or such combination of these and other methods necessary for effective erosion control.

3.4 CONTROL AND DISPOSAL OF SOLID WASTES

A. Pick up solid wastes, and place in covered containers which are regularly emptied. Do not prepare or cook food on the project site. Prevent contamination of the site or other areas when handling and disposing of wastes. At project completion, leave the areas clean. Recycling is encouraged and can be coordinated with the RE and the activity recycling coordinator. Remove all solid waste (including non-hazardous debris) from FAA property and dispose off-site at an approved landfill. Solid waste disposal off-site must comply with most stringent local state, and federal requirements including 40 CFR 241, 40 CFR 243, and 40 CFR 258.

B. Dumpsters: Equip dumpsters with a secure cover. Keep cover closed at all times, except when being loaded with trash and debris. Locate dumpsters behind the construction fence or out of the public view. Empty site dumpsters at least once a week or as needed to keep the site free of debris and trash. If necessary, provide 55 gallon trash containers to collect debris in the construction site area. Locate the trash containers behind the construction fence or out of the public view. Empty trash containers at least once a day. For large demolitions, large dumpsters without lids are acceptable but should not have debris higher than the sides before emptying.

3.5 CONTROL AND DISPOSAL OF HAZARDOUS WASTES

A. Hazardous Waste/Debris Management: The Contractor shall identify all construction activities that will generate hazardous waste/debris. The Contractor must provide a documented waste determination for all resultant waste streams. Hazardous waste/debris shall be identified, labeled, handled, stored, and disposed of in accordance with all Federal, State and local regulations including 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 40 CFR 265, 40 CFR 266, and 40 CFR 268. Hazardous waste shall also be managed in accordance with the approved Hazardous Waste Management Section of the Environmental Protection Plan. Store hazardous wastes in approved containers in accordance with 49 CFR 173. Hazardous waste generated within the confines of the facilities shall be identified as being generated by the Contractor. Prior to removal of any hazardous waste from FAA property, all hazardous waste manifests must be signed by the Contractor and a copy given to the RE. No hazardous waste shall be brought onto FAA's property. Provide to the RE a copy of waste determination documentation for any solid waste streams that have any potential to be hazardous waste or contain any chemical constituents listed in 40 CFR 372-SUBPART D. For hazardous wastes spills, verbally notify the RE immediately.

1. Regulated Waste Storage/Satellite Accumulation/90 Day Storage Areas: If the work requires the temporary storage/collection of regulated or hazardous wastes, the Contractor may request the establishment of a Regulated Waste Storage Area, a Satellite Accumulation Area, or a 90 Day Storage Area at the point of generation. The Contractor must submit a request in writing to the RE providing the following information:

Contract Number	_____	Contractor	_____
Haz/Waste or Regulated Waste POC	_____	Phone Number	_____
Type of Waste	_____	Source of Waste	_____
Emergency POC	_____	Phone Number	
Location of the Site	_____		

(Attach Site Plan to the Request)

2. Attach a waste determination form. Allow ten working days for processing this request.

B. Pollution Prevention/Hazardous Waste Minimization: The Contractor shall actively pursue minimizing the use of hazardous materials and the generation of hazardous waste while on-base. The Hazardous Waste Management Section of the Environmental Protection Plan shall include the

Contractor's procedures for pollution prevention/hazardous waste minimization. The Contractor shall describe the types of the hazardous materials expected to be used in the construction when requesting information.

C. Hazardous Material Control: The Contractor shall include hazardous material control procedures in the Safety Plan. The procedures shall address and ensure the proper handling of hazardous materials, including the appropriate transportation requirements. The Contractor shall submit a MSDS and estimated quantities to be used for each hazardous material to the RE prior to bringing the material on base. Typical materials requiring MSDS and quantity reporting include, but are not limited to, oil and latex based painting and caulking products, solvents, adhesives, aerosol, and petroleum products. At the end of the project, the Contractor shall provide the RE with the maximum quantity of each material that was present at the site at any one time, the dates the material was present, the amount of each material that was used during the project, and how the material was used. The Contractor shall also ensure that hazardous materials are utilized in a manner that will minimize the amount of hazardous waste that is generated. The Contractor shall ensure that all containers of hazardous materials have NFPA labels or their equivalent. Copies of the MSDS for hazardous materials shall be kept on site at all times and provided to the RE at the end of the project. The Contractor shall certify that all hazardous materials removed from the site are hazardous materials and do not meet the definition of hazardous waste per 40 CFR 261.

D. Petroleum Products: Conduct the fueling and lubricating of equipment and motor vehicles in a manner that protects against spills and evaporation. All used oil generated on the site shall be managed in accordance with 40 CFR 279. The Contractor shall determine if any used oil generated while on-site exhibits a characteristic of hazardous waste. In addition, used oil containing 1000 parts per million of solvents will be considered a hazardous waste and disposed of at Contractor's expense. Used oil mixed with a hazardous waste will also be considered a hazardous waste. All hazardous waste will be managed in accordance with the paragraph entitled Hazardous Waste/Debris Management of this section and shall be managed in accordance with the approved Environmental Protection Plan.

E. Spills of Oil and Hazardous Materials: Take precautions to prevent spills of oil and hazardous material. In the event of a spill, immediately notify the RE. Spill response shall be in accordance with 40 CFR 300 and applicable State Regulations.

3.6 DUST CONTROL

A. Keep dust down at all times, including during nonworking periods. Sprinkle or treat, with dust suppressants, the soil at the site, haul roads, and other areas disturbed by operations. Dry power brooming will not be permitted. Instead, use vacuuming, wet mopping, wet sweeping, or wet power brooming. Air blowing will be permitted only for cleaning nonparticulate debris such as steel reinforcing bars. Only wet cutting will be permitted for cutting concrete blocks, concrete, and bituminous concrete. Do not unnecessarily shake bags of cement, concrete mortar, or plaster.

3.7 ABRASIVE BLASTING

A. Blasting Operations

1. The use of silica sand is prohibited in sandblasting.

2. Provide tarpaulin drop cloths and windscreens to enclose abrasive blasting operations to confine and collect dust, abrasive, agent, paint chips, and other debris.

B. Disposal Requirements: Submit analytical results of the debris generated from abrasive blasting operations per paragraph entitled Laboratory Analysis of this section. Hazardous waste generated from blasting operations shall be managed in accordance with paragraph entitled "Hazardous Waste\Debris Management" of this section and with the approved HWMP. Disposal of non-hazardous abrasive blasting debris shall be in accordance with paragraph entitled, "Control and Disposal of Solid Wastes".

END OF SECTION 07 57 19

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SECTION 01 58 00 - CONSTRUCTION IDENTIFICATION SIGNS

PART 1 - GENERAL

1.1 REQUIREMENT INCLUDED

A. Furnish, erect and remove a construction identification sign(s) in accordance with the contract drawings and as directed by the RE.

PART 2 - PRODUCTS

A. Sign Face: In accordance with the contract drawings. All edge sealed.

B. Supports: In accordance with the contract drawings.

C. Paint: Background and lettering - Exterior grade, latex, gloss paint. Colors as indicated on drawings.

PART 3 - EXECUTION

A. Install where shown; minimum post embedment in accordance with the contract drawings.

B. At final completion, remove sign and foundation. Restore site to original or proposed condition.

END OF SECTION 01 58 00

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SECTION 01 58 13 - POSTING OF NOTICES

PART 1 - GENERAL

1.1 SCHEDULE OF WAGE RATES AND BENEFITS

A. The Contractor, and each subcontractor under him, shall post in a conspicuous place on the site (1) the schedule of the specified overall hourly rate for each applicable classification; (2) the amount of liquidated damages for any failure to pay such rates; and (3) the name and address of the responsible official in County or the U.S. Department of Labor (whichever is applicable) to whom complaints should be given.

B. Copy of this Notice will be provided to the Contractor by the FAA.

1.2 NON-DISCRIMINATION CLAUSE

A. In accordance with AMS Clause No. 3.6.2-9 Equal Opportunity, the Contractor shall post the non-discrimination clause as required by Executive Order 11246.

B. The following is a statement of the required clause: Equal Employment Opportunity is the Law--Discrimination is Prohibited by the Civil Rights Act of 1964 and by Executive Order No. 11246. Title VII of the Civil Rights Act of 1964--Administered by: The Equal Employment Opportunity Commission. Prohibits discrimination because of Race, Color, Religion, Sex, or National Origin by Employers with 25 or more employees, by Labor Organizations with a hiring hall of 25 or more members, by Employment Agencies, and by Joint Labor-Management Committees for Apprenticeship or Training. Any person who believes he or she has been discriminated against should contact: The Equal Employment Opportunity Commission. 2401 E Street, NW, Washington, DC 20506.

C. EXECUTIVE ORDER NO. 11246--Administered by: The Office of Federal Contract Compliance Programs prohibits discrimination because of Race, Color, Religion, Sex, or National Origin, and requires affirmative action to ensure equality of opportunity in all aspects of employment by all Federal Government Contractors and Subcontractors, and by Contractors Performing Work Under a Federal Assisted Construction Contract, regardless of the number of employees in either case. Any person who believes he or she has been discriminated against should contact: The Office of Federal Contract Compliance Programs, U.S. Department of Labor, Washington, DC 20210.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION 01 58 13

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SECTION 01 71 33 - PROTECTION OF WORK AND PROPERTY

PART 1 - GENERAL

1.1 REQUIREMENT INCLUDED

A. Protection of products after installation.

B. Protection of existing property and landscape.

C. Storm Protection Plan.

1.2 SUBMITTALS

A. Contractor shall submit a Storm Protection Plan to the RE for approval within 15 calendar days after notice to proceed.

B. Storm Protection Plan shall include, as a minimum, the following:

1. Storm Plan objectives.
2. Methods to attain protection objectives.
3. Responsibility of key personnel for the Contractor.
4. Time frame required to secure the site.
5. Time frame required to lower and/or secure crane(s).
6. Disaster and emergency programs.
7. Lists of key personnel to be contacted in time of emergency.

PART 2 - PRODUCT

NOT USED

PART 3 - EXECUTION

3.1 PROTECTION AFTER INSTALLATION

A. Protect installed products and control traffic in immediate area to prevent damage from subsequent operations.

B. Provide protective coverings at walls, projections, corners and jambs, sills and soffits of openings in and adjacent to traffic areas.

C. Cover walls and floors of elevator cabs and jambs of cab doors with 3/4 inch plywood, when elevators are used by construction personnel.

D. Protect finished floors and stairs from dirt, wear and damage:

1. Secure heavy sheet goods or similar protective materials in place, in areas subject to foot traffic.
2. Lay planking or similar rigid materials in place, in areas subject to movement of heavy objects.
3. Lay planking or similar rigid materials in place, in areas where storage of products will occur.

E. Protect waterproofed and roofed surfaces:

1. Restrict use of surfaces from traffic of any kind and from storage of products.
2. When an activity is mandatory, obtain recommendations for protection of surfaces from manufacturer. Install protection and remove on completion of activity. Restrict use of adjacent unprotected areas.

F. Restrict traffic of any kind across planted lawn and landscape areas.

3.2 PROTECTION AND RESTORATION OF PROPERTY AND LANDSCAPE

A. The Contractor shall be responsible for the preservation of all public and private property, and shall protect carefully from disturbance or damage all land monuments and property markers until the RE has witnessed or otherwise referenced their location and shall not move them until directed.

B. The Contractor shall be responsible for all damage or injury to property of any character, during the prosecution of the work, resulting from any act, omission, neglect, or misconduct in its manner or method of executing the work, or at any time due to defective work or materials, and said responsibility will not be released until the work is completed and accepted.

C. When or where any direct or indirect damage or injury is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work, or in consequence of the nonexecution thereof by the Contractor, the Contractor shall restore, at its own expense, such property to a condition similar or equal to that existing before such damage or injury was done, by repairing, or otherwise restoring as may be directed, or it shall make good such damage or injury in an acceptable manner, at no additional cost to the government.

3.3 STORM PROTECTION PLAN

A. The Contractor shall take all precautions as necessary to prevent damage to the facility and shall be responsible for damage to the facility resulting from any act, omission, neglect, or misconduct in the execution of the approved Storm Protection Plan.

B. In the event of a severe storm warning or as directed by the RE, the Contractor shall:

1. Secure outside equipment and materials and place materials subject to possible damage in protected locations.
2. Check surrounding area, including roof, for loose material, equipment, debris, and other objects that could be blown away or against existing facilities.

3. Secure crane(s).
4. Ensure that temporary erosion controls are adequate.
5. After the storm, the Contractor may be directed by the RE to assist in the restoration of the existing facility. Any restoration shall take precedence over the construction contract. Any additional costs will be claimed under the “changes” clause of the contract.

END OF SECTION 01 71 33

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SECTION 01 74 13 - CONSTRUCTION CLEANING

PART 1 - GENERAL

1.1 REQUIREMENT INCLUDED

A. Cleaning and disposal of waste materials, debris and rubbish during construction.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Provide covered containers for deposit of waste materials, debris and rubbish.

PART 3 - EXECUTION

3.1 CLEANING

A. Maintain areas under Contractor's control free of waste materials, scraps, surplus material, debris and rubbish. Maintain site in a clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums attics, crawl spaces and other closed or remote spaces, prior to closing the space.

C. Clean interior areas daily to provide suitable conditions for work and to prevent fire or accidents.

D. Use power brooms to clean paved areas as needed and immediately prior to opening any paved area to aircraft or vehicular traffic.

E. All combustible waste materials shall be removed from buildings at the end of each working day.

F. Broom clean interior areas prior to start of surface finishing and continue cleaning on a daily basis.

G. Control cleaning operations so that dust and other particulates will not adhere to wet or newly-coated surfaces.

H. Responsibility for construction cleaning shall not be delegated to subcontractors performing construction work under this Contract.

3.2 DISPOSAL

A. Remove waste materials, debris and rubbish from site bi-weekly and legally dispose of off-site in an authorized disposal area.

3.3 CONTRACTOR'S FAILURE TO CLEAN

A. If the Contractor fails to maintain levels of cleanliness in work areas, satisfactory to the RE, then the FAA shall have the right to cause such areas to be cleaned by others. The costs to the FAA for such cleaning, plus 25% for administration, shall be the obligation of the Contractor and shall be deducted from any money due the Contractor hereunder.

END OF SECTION 01 74 13

SECTION 01 74 23 - FINAL CLEANING

PART 1 - GENERAL

1.1 REQUIREMENT INCLUDED

A. Final cleaning of project.

1.2 SUMMARY

A. This section includes administrative and procedural requirements, protections of construction in progress, and for final cleaning at Substantial Completion.

B. Environmental Requirements: Conduct cleaning and waste-disposal operations in compliance with local laws and ordinances. Comply fully with federal and local environmental and antipollution regulations.

C. Do not dispose of volatile wastes, such as mineral spirits, oil, or paint thinner, in storm or sanitary drains.

D. Burning or burying of debris, rubbish, or other waste material on the premises is not permitted.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by the manufacturer or fabricator of the material to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Provide final-cleaning operations. Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit of work to the condition expected from a commercial building cleaning and maintenance program. Comply with manufacturer’s instructions.

B. Cleaning Operations: Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for the entire Project or a portion of the Project.

1. Clean the Project Site, yard and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and foreign substances.
2. Sweep paved areas broom clean. Rake grounds that are neither planted nor paved to a

smooth, even-textured surface.

3. Broom and mop clean concrete floors in unoccupied spaces.
4. Remove petrochemical spills, stains, and other foreign deposits.
5. Remove tools, construction equipment, machinery, and surplus material from the site.
6. Vacuum clean carpet and similar soft surfaces, removing debris and excess nap. Shampoo, if required.
7. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
8. Remove marks, stains, fingerprints, and other soils or other dirt from painted, decorated, and natural finished woodwork and other work.
9. Clean cabinet work removing stains, paint, dirt and dust.
10. Remove spots, plaster, soil and paint from ceramic tile, marble, and other finished materials, and wash or wipe clean.
11. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
12. Clean flooring materials thoroughly; comply with materials manufacturer's instructions and recommendations.
13. Remove labels that are not permanent labels.
14. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
15. Clean food-service equipment to a sanitary condition, ready and acceptable for its intended use.
16. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
17. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
18. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs and defective and noisy starters in fluorescent and mercury vapor fixtures.
19. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
20. Clean ductwork, blowers, and coils of units that were operated during construction.
21. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
22. Leave the Project clean and ready for occupancy.

C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid the Project of rodents, insects and other pests. Comply with regulations of local authorities.

D. Removal of Protection: Remove temporary protection and facilities installed during construction to protect previously completed installations during the remainder of the construction period.

E. Compliances: Comply with governing regulations and safety standards for cleaning operations. Remove waste materials from the site and dispose of lawfully.

1. Where extra materials of value remain after completion of associated work, they become the

FAA's property. Dispose of these materials as directed by the FAA.

2. The Contractor shall not dispose of debris or waste materials on the FAA's property without the prior written approval of the FAA.

END OF SECTION 01 74 23

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SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
   1. Inspection procedures.
   2. Punch list.
   3. Warranties.

1.2 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.

   1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
   2. Advise FAA of pending insurance changeover requirements.
   3. Obtain and submit releases permitting FAA unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
   4. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.
   5. Deliver tools, spare parts, extra materials, and similar items to location designated by FAA. Label with manufacturer's name and model number where applicable.
   6. Make final changeover of permanent locks and deliver keys to FAA. Advise FAA's personnel of changeover in security provisions.
   7. Complete startup testing of systems.
   8. Submit test/adjust/balance records.
   9. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
   10. Advise FAA of changeover in utilities.
   11. Submit changeover information related to FAA's occupancy, use, operation, and maintenance.
   12. Complete final cleaning requirements, including touchup painting.
   13. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion, also referred to as the Contractor Acceptance Inspection (CAI). On receipt of request, COTR will either schedule the inspection within 14 days or notify Contractor of unfulfilled requirements. COTR will prepare the Certificate of Substantial Completion after the inspection or will notify Contractor of items, either on Contractor's list or additional items identified by COTR, that must be completed or corrected before certificate will be issued. COTR will also provide a punch list that will form the basis of requirements for the Final Completion.

1.3 FINAL COMPLETION

A. Preliminary Procedures: Contractor should request final inspection prior to contract completion date. Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a Final Application for Payment.
2. Submit certified copy of COTR's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by COTR. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit a letter from the airport certifying that work areas located on the airport were left in a satisfactory condition.
5. Perform a final cleaning in accordance with Section 01 74 23 “FINAL CLEANING”.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, COTR will either proceed with inspection or notify Contractor of unfulfilled requirements. COTR will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1.4 WARRANTIES

A. Submit warranties in accordance with Section 01 78 36 “WARRANTIES AND GUARANTEES”. Warranty period shall begin on date of Substantial Completion as listed in Certificate of Substantial Completion.

B. Partial Occupancy: Submit properly executed warranties within fifteen (15) days of completion of designated portions of the Work that are completed and occupied or used by FAA during construction period by separate agreement with Contractor.

C. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION 01 77 00

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. Preparation and submittal of operation and maintenance data.

1.2 REFERENCES

A. The current issues of the publication listed below forms a part of this specification to the extent referenced. The publication is referred to in the text by the basic designation only.

B. DEFENSE LOGISTICS AGENCY (DLA)

1. DLA H 4-1 Federal Supply Code for Manufacturers (FSCM); United States and Canada - Name to Code, June 1982

1.3 SUBMISSION OF OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance (O&M) data which is specifically applicable to this contract and a complete and concise depiction of the provided equipment or product. Data containing extraneous information to be sorted through to find applicable instructions will not be accepted. Present information in sufficient detail to clearly explain user O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal. Submit in accordance with Section 01 33 00, "SUBMITTAL PROCEDURES."

B. Quantity: Submit five copies of the manufacturers' information specified herein for the components, assemblies, subassemblies, attachments, and accessories. The items for which O&M data is required are listed in the technical sections which specify that particular item.

Provide Portable Document Format (PDF) file on 700+ MB compact disk or other approved portable electronic media for each manual. PDF file shall contain Table of Contents and Bookmarks to match manual. PDF shall also be uploaded to FAA’s KSN website.

C. Package Content and Format: For each product, system, or piece of equipment requiring submission of O&M data, submit the package required in the individual technical section. Labels shall be on paper in color(s) specified with black print, and shall clearly denote the following:

FEDERAL AVIATION ADMINISTRATION
AIRPORT DESCRIPTOR
ATCT FACILITY
(Manual Title)
(Date)

D. Package content shall be as required in the paragraph entitled "Schedule of Operations and

Maintenance Data Packages," with the following general requirements:

1. First page shall be a Cover Page, identifying:

FEDERAL AVIATION ADMINISTRATION
AIRPORT DESCRIPTOR
ATCT FACILITY
(Manual Title)
(Date)

2. Second page shall be a Table of Contents indicating the contents of the binder(s).
3. The third page shall list the Names, Addresses, Contracts, and Phone Numbers for the following:

    a. FAA Project Engineer
    b. Designer(s)
    c. General Contractor
    d. Subcontractors
    e. Sub-subcontractors
    f. Suppliers

4. The remaining portions of the manual shall be separated by each major division of work as identified by the Contract Documents.

    a. PROJECT INFORMATION
    b. Within each major division of work, each section shall be individually identified by a typed index/tab. For each specification requirement, submit the following information in the order outlined below:

        1) Copies of all warranties/guarantees, as specifically required by the specification section, and Letters of Certification. Original warranties/guarantees shall be included in the appropriate section of the closeout manual(s).
        2) Copies of the “Approved” Shop Drawing/Submittals/Equipment Manufacturer’s Schematics. Oversized drawings shall be folded and inserted in clear vinyl pockets or, for large sets of drawings, provide an insert page stipulating that the drawings are provided separately. All copies shall be stamped with the appropriate review stamp, marked, signed, and dated.
        3) Test Reports
        4) Operating and Maintenance Instructions, including but not limited to:

            a) Manufacturer’s Recommended Care and Cleaning
            b) Installation Instructions
            c) Parts Lists
            d) Lubrication Checklists
            e) Equipment Supplier Lists
            f) Special Instructions
            g) Preventive Maintenance Instructions.

5. Service and Maintenance Contracts: Include Name, address and phone number and contact of

Manufacturer's authorized Repair Company.

6. Completed FAA Turnover Forms:

   a. See 3.1 for list of forms.

7. Copies of electrical panel schedules and directories.

E. Changes to Submittals: Manufacturer-originated changes or revisions to submitted data shall be furnished by the Contractor if a component of an item is so affected subsequent to acceptance of the O&M data. Changes, additions, or revisions required by the Contracting Officer for final acceptance of submitted data, shall be submitted by the Contractor within 30 calendar days of the notification of this change requirement.

1.4 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

A. Operating Instructions: Include specific instructions, procedures, and illustrations for the following phases of operation:

1. Safety Precautions: List personnel hazards and equipment or product safety precautions for all operating conditions.
2. Operator Prestart: Include requirements to set up and prepare each system for use.
3. Startup, Shutdown, and Post shutdown Procedures: Include a control sequence for each of these operations.
4. Normal Operations: Include control diagrams with data to explain operation and control of systems and specific equipment.
5. Emergency Operations: Include emergency procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include emergency shutdown instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance on emergency operations of all utility systems including valve locations and portions of systems controlled.
6. Operator Service Requirements: Include instructions for services to be performed by the operator such as lubrication, adjustments, and inspection.
7. Environmental Conditions: Include a list of environmental conditions (temperature, humidity, and other relevant data) which are best suited for each product or piece of equipment and describe conditions under which equipment should not be allowed to run.

B. Preventive Maintenance: Include the following information for preventive and scheduled maintenance to minimize corrective maintenance and repair.

1. Lubrication Data: Include lubrication data, other than instructions for lubrication in accordance with paragraph entitled "Operator Service Requirements":

   a. A table showing recommended lubricants for specific temperature ranges and applications;
   b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities; and
   c. A lubrication schedule showing service interval frequency.

2. Preventive Maintenance Plan and Schedule: Include manufacturer's schedule for routine preventive maintenance, inspections, tests and adjustments required to ensure proper and economical operation and to minimize corrective maintenance and repair. Provide manufacturer's projection of preventive maintenance man-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft.

C. Corrective Maintenance: Include manufacturer's recommendations on procedures and instructions for correcting problems and making repairs.

1. Troubleshooting Guides and Diagnostic Techniques: Include step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.
2. Wiring Diagrams and Control Diagrams: Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation numbering.
3. Maintenance and Repair Procedures: Include instructions and list tools required to restore product or equipment to proper condition or operating standards.
4. Removal and Replacement Instructions: Include step-by-step procedures and list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Instructions shall include a combination of text and illustrations.
5. Spare Parts and Supply Lists: Include lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead time to obtain.
6. Corrective Maintenance Man-Hours: Include manufacturer's projection of corrective maintenance man-hours including craft requirements by type of craft. Corrective maintenance that requires participation of the equipment manufacturer shall be identified and tabulated separately.

D. Appendices: Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following:

1. Parts Identification: Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number which will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies.

a. Manufacturer's standard commercial practice: The parts data may cover more than one model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as a master parts catalog, in accordance with the manufacturer's standard commercial practice.

b. Other than manufacturer's standard commercial practice: End item manufacturer may add a cross-reference to implement components' assemblies and parts requirements when implementation in manual form varies significantly from the style, format, and method of manufacturer's standard commercial practice. Use the format in the following example:

End Item Manufacturer's -Alphanumeric Sequence-	-	Actual Manufacturer's Name and FSCM-	-	Actual Manufacturer Part No.-
100001		John Doe & Co.		00000 2000002

c. List FSCM in accordance with DLA H 4-1.

2. Warranty Information: List and explain the various warranties and include the servicing and technical precautions prescribed by the manufacturers or contract documents to keep warranties in force.
3. Personnel Training Requirements: Provide information available from the manufacturers to use in training designated personnel to operate and maintain the equipment and systems properly.
4. Testing Equipment and Special Tool Information: Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.
5. Contractor Information: Provide a list that includes the name, address, and telephone number of the General Contractor and each subcontractor installing the product or equipment. Include local representatives and service organizations most convenient to the project site. Provide the name, address, and telephone number of the product or equipment manufacturers.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.1 ATTACHMENTS

A. The following forms have been included in this Section. See Division 26 for additional Electrical forms.

1. Exhibit A: Project Information
2. Exhibit B: Performance Verification and Demonstration to Owner
3. Exhibit C: Voltage and Amperage Readings
4. Exhibit D: Motor Test Information
5. Exhibit E: Check-Out Memo
6. Exhibit F: D-C High Voltage Cable Test Report

7. Exhibit G: Ground Test Information
8. Exhibit H: Spare Parts Certification Memo
9. Exhibit I: Conductor Insulation Resistance Test Memo
10. Example: Description Sheet – Cover
11. Example: Description Sheet – Spline

END OF SECTION 01 78 23

EXHIBIT A
PROJECT INFORMATION

Contractor shall fill in the blanks below and insert in the Operating and Maintenance Manuals.
Submit one (1) sheet for each major division of Work.

Project Name: _____

Specification Division Number & Name: _____

Subcontractor: _____

Contact: _____ Phone: _____

Date Project Bid: _____

Project Start Date: _____

Days allowed for Construction: _____

Target Completion: _____

Substantial Completion Certification Date: _____

	Date Submitted	Date Provided
Close-out Documentation Manual:	_____	_____
Operating and Maintenance Manuals:	_____	_____
Owner Performance Verification and Demonstrations:	_____	_____
Manufacturer's Performance Verification Memos:	_____	_____
Manufacturer's Test Data:	_____	_____
Record Documents:	_____	_____

EXHIBIT B
PERFORMANCE VERIFICATION AND DEMONSTRATION TO OWNER

This form verifies that the FAA has been given a demonstration of the proper operation on the equipment or systems noted below.

Project Name:_____
Specification Division Number & Name:_____

Equipment/Systems Demonstrated: _____

Along with a complete demonstration of the equipment/system, these items have been reviewed at this demonstration and shall be included in the Operating and Maintenance Manuals, under the appropriate specification section:

1) Written operating instructions.
2) Test data and performance verification information as required by the installer and/or manufacturer.
3) Maintenance information published by manufacturer's representative.
4) Check-out Memo signed by manufacturer's representative.
5) Printed warranties by manufacturer of equipment.
6) Explanation of the warranty/guarantee on the system.
7) Prints showing actual "As-Built" conditions.

_____ _____
(Name of General Contractor) (Signature, Title, Date)

_____ _____
(Name of Subcontractor) (Signature, Title, Date)

A demonstration of the system/equipment in operation and of the maintenance procedures has been successfully completed.

FEDERAL AVIATION ADMINISTRATION

_____
(Signature, Date)

EXHIBIT C
VOLTAGE AND AMPERAGE READINGS

Project Name: _____

Switchgear/Panelboard: _____

Full Load Amperage Readings: Date: _____ Time: _____

Phase A: _____
Phase B: _____
Phase C: _____
Neutral: _____
Ground: _____

Full Load Voltage Readings: Date: _____ Time: _____

Phase:	A to N	A to B
	B to N	A to C
	C to N	B to C

Contractor's Representative: _____
_____ Date

Engineer's Representative: _____
_____ Date

FAA's Authorized Representative: _____
_____ Date

EXHIBIT D
MOTOR TEST INFORMATION

Project Name:_____

Description of Motor: _____

Checked By:_____ Date Checked:_____

a) Name and Identifying Mark of Motor (Indicate at existing):_____
b) Manufacturer:_____

c) Model Number:_____

d) Serial Number:_____

e) RPM:_____

f) Frame Size:_____

g) Code Letter:_____

h) Horsepower:_____

i) Nameplate, Voltage and Phase:_____

j) Nameplate Amps:_____

k) Actual Voltage:_____

l) Actual Amps:_____

m) Starter Manufacturer:_____

n) Starter Size:_____

o) Heater Size, Catalog No. and Amp Rating:__

p) Manufacturer of Dual-Element Fuse:_____

q) Amp Rating of Fuse:_____

r) Power Factor:_____

Contractor's Representative:_____
Date

Signature of Checker:_____
Date

FAA's Authorized Representative:_____
Date

EXHIBIT E
CHECK-OUT MEMO

This form shall be completed and a copy provided to the FAA at the FAA's Performance Verification and Demonstration meeting. A copy shall also be included in the specification section of the Operating and Maintenance Manual for the equipment checked.

Project Name:_____
Type of Equipment Checked: _____

Equipment Number: _____

Name of Equipment Manufacturer: _____

Signature below by the Manufacturer's authorized representative signifies that the equipment has been satisfactorily tested and checked out on the job by the manufacturer.

1. The attached Test Data and Performance Verification information was used to evaluate the equipment installation and operation.

2. The equipment is properly installed, has been tested by the manufacturer's authorized representative, and is operating satisfactorily in accordance with all requirements, except for items noted below.*

3. Written operating and maintenance information has been presented to the Contractor, and gone over with him in detail.

4. Sufficient copies of all applicable operating and maintenance information, part lists, lubrication checklists, and warranties have been furnished to the contractor for insertion in the Operating and Maintenance Manuals.

Manufacturer's Representative:_____
(Print or Type Name and Title)

_____
(Print or Type Address and Phone Number)

Signature of Manufacturer's Representative: _____
Date Checked

Witnessed By: _____
(Signature and Title of Contractor's Representative)

*Exceptions Noted at Time of Check-Out: (Use additional pages if necessary)

EXHIBIT F
D-C HIGH VOLTAGE CABLE TEST REPORT

Project Name: _____
Location: _____

Description:_____
Rated Voltage:_____

TEST DATA

Set Leakage at Test Voltage_____ma Variac_____

Pri. Voltage_____ Sphere Gap_____Inches

Duct Temp._____ Ambient Temp._____Weather_____
Cable Status_____1 hour prior tests.

TEST RESULTS

Phase or conductor	A	B	C	Remarks
Starting Time				
0				
15 sec.				
30 sec.				
45 sec.				
1 min.				
2 min.				
3 min.				
4 min.				
5 min.				

Final Test voltage:_____ Time Finish: _____

KV DC After 1 Min.: Test Procedure_____ No. Terminals_____
Joints_____
Witnessed By: _____
Performed By: _____

EXHIBIT G
GROUND TEST INFORMATION

Project Name: _____

Ground Type: _____

Test By: _____

Date of Test: _____

Ground Location: _____

Ground Type (rod, water pipe, etc.) _____

Prior to Connection to System: Ground: _____ (OHMS)

After Connection to System: Ground: _____ (OHMS)

Weather conditions (Wet/Dry)_____ Soil conditions (Wet/Dry):_____

Contractor's Representative: _____
Date

Engineer's Representative: _____
Date

FAA's Representative: _____
Date

EXHIBIT H
SPARE PARTS CERTIFICATION MEMO

This form shall be completed and a copy provided to the Owner at the Owner's Performance Verification and Demonstration meeting. A copy shall also be included in the specifications section of each Operations and Maintenance Manual for the equipment checked.

Name of Project:_____

Type of Spare Parts:_____

Specification Reference:_____

Quantity of Spare Parts:_____

Signature below by the Contractor and subcontractor signifies that the spare parts required by the drawings and/or specifications have been turned over to the FAA. Signature by the FAA acknowledges receipt of the same spare parts.

Name of General Contractor:_____

Authorized Signature and Title:_____

Date:_____

Name of RE:_____

Authorized Signature and Title:_____

Date:_____

EXHIBIT I
CONDUCTOR INSULATION RESISTANCE TEST MEMO

NAME OF PROJECT:_____

Conductor Location From:_____ To:_____

Size of Conductor_____

Insulation Type_____ Insulation Voltage Rating___
Date of Test_____ Time of Test_____
Weather Conditions_____
Test Voltage (DC)_____ Range _____
Megger Instrument/Serial Number _____
Testing Methodology _____

INSULATION RESISTANCE MEASUREMENT
(Acceptable Measurement not to be less than one (1) Megohm)

Phase A to Ground_____
Phase B to Ground_____
Phase C to Ground_____
Neutral to Ground_____
Isolated Ground to Ground_____
Name of General Contractor:_____

Authorized Signature and Title:_____
Date

Name of Consulting Engineer:_____

Authorized Signature and Title:_____
Date

Name of RE:_____

Authorized Signature and Title:_____
Date

EXAMPLE – Cover Sheet

FEDERAL AVIATION ADMINISTRATION

AIRPORT DESCRIPTOR

ATCT FACILITY

OPERATION AND MAINTENANCE BROCHURES

EXAMPLE – Spline

FAA

AIRPORT DESCRIPTOR

ATCT FACILITY

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L
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OPERATING
AND
MAINTENANCE
MANUAL

FAA

AIRPORT DESCRIPTOR

ATCT FACILITY

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OPERATING
AND
MAINTENANCE
MANUAL

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SECTION 01 78 36 - WARRANTIES AND GUARANTEES

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. Preparation and submittal of warranties and guarantees.

1.2 FORM OF WARRANTY

A. Bind in commercial quality 8 ½ x 11 inch three-ring side binders, with hardback, cleanable, plastic covers.

B. Label cover of each binder with typed or printed title `WARRANTIES AND GUARANTEES', with Contract No. and Project Title; name, address and telephone number of Contractor.

C. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified and the name of the product or work item.

D. Separate each warranty or guaranty with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheet as necessary. List subcontractor, supplier and manufacturer, with name, address and telephone number of responsible principal.

1.3 PREPARATION OF WARRANTY

A. Obtain warranties and guarantees, executed in duplicate by responsible subcontractors, suppliers and manufacturers, within ten (10) days after completion of the applicable item of work. Date of beginning of time of warranty will be the date of Substantial Completion.

B. Warranties and guarantees shall be made out in the name of, and accrue to the benefit of the Federal Aviation Administration.

1.4 TIME OF WARRANTY

A. Provide warranties prior to final acceptance.

B. For items of work when acceptance is delayed beyond date of Substantial Completion, submit within ten (10) days after acceptance, listing the date of acceptance as the beginning of the warranty or guaranty period.

1.5 EQUIPMENT WARRANTY TAGS AND GUARANTEE LOCAL REPRESENTATIVES

A. The Contractor shall furnish with each guarantee, the name address, and telephone number of the

guarantor, the name, address, and telephone number of the guarantor's representative nearest to the site, who, upon request of the FAA representative, will honor the guarantee during the guaranty period and will provide the service prescribed by the terms of the guarantee. At the time of installation, the Contractor shall tag each item of warranted equipment with a durable, oil and water resistant tag approved by the RE. Tag shall be attached with copper wire and sprayed with a clear silicone, waterproof coating. Leave the date of acceptance and inspectors signature blank until project is accepted for Substantial Completion. Tag shall show the following information:

B. Equipment warranty tags

1. Type of Equipment
2. Accepted Date
3. Warranted Until
4. Under Contract Number
5. Inspector's Signature

1.6 QUANTITY

A. Provide three (3) complete copies of warranties and guarantees.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION 01 78 36

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. This section describes the requirements for the creation and maintenance of “As Built Drawings;” referred to herein as Record Documents.

B. Maintenance of Record Documents.

C. Submittal of Record Documents.

1.2 MAINTENANCE OF DOCUMENTS AND SAMPLES

A. Store Record Documents in Field Office apart from documents used for construction. Provide files, racks and secure storage for Record Documents.

B. Maintain Record Documents in clean, dry and legible conditions. Do not use Record Documents for construction purposes.

C. Keep Record Documents and Samples available for inspection by FAA.

1.3 AS-BUILT INFORMATION

A. Record information on a set of full size drawings, provided by FAA.

B. Provide felt tip marking pens, maintaining separate colors for each major system, for recording information.

C. Record information concurrently with construction progress. Do not conceal any work until required information is recorded.

D. Contract Drawings and approved Shop Drawings: Legibly mark each item to record actual construction, including:

1. Measured depths of elements of foundation in relation to finish grade or first floor datum.
2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of construction.
4. Field changes of dimensions and details.
5. Changes made by Addenda, Change Order(s) (if any) and Work Order(s) (if any).
6. Details not on original Contract Drawings.
7. References to related Shop Drawings and Modifications.

E. Specifications: Legibly mark each item to record actual construction, including changes made by Addenda and Change Order.

F. Other Documents: Maintain manufacturer's certification, inspection certifications, field test records, and training documents required by individual Specification Sections.

1.4 SUBMITTALS

A. At Substantial Completion, deliver Record Documents and samples under provision of Section 01 77 00, “CLOSEOUT PROCEDURES”.

B. Provide Portable Document Format (PDF) file of all record drawings on 700+ MB compact disk or other approved electronic media and upload PDF to FAA’s KSN website.

C. Provide CAD-produced drawing (MicroStation) drawing(s) of all underground utilities including location, elevation, and size of all pipes, conduits, manholes, drainage structures, ductbanks, etc. Provide .dgn and .pdf files of same.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION 01 78 39

SECTION 02 01 00 – INTERIM LIFE SAFETY MEASURES FOR FACILITIES UNDER CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY OF WORK

A. During construction activities, it is likely temporary hazards may be posed due to the work being conducted in the facility. Interim Life Safety Measures (ILSM) are actions that must be taken to compensate for the temporary hazards. This document addressed administrative actions which must be taken to ensure the current level of life safety is maintained at all times and occupants are not subjected to hazardous conditions for even short periods of time.

B. Implementation and Enforcement: Implementation and enforcement of ILSM is the responsibility of all occupants within the building, including employees and construction personnel. However, primary identification of hazards and the actions taken to compensate for temporary hazards are the responsibility of the Contractor. All ILSM are subject to approval by the Resident Engineer.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.1 PRE-CONSTRUCTION MEETING

A. Prior to commencement of construction, conduct a meeting to inform all Tower and Base Building occupants (employees and construction personnel) of the project scope and duration. This should include, at a minimum, the following:

1. An overview of the construction project.
2. A preliminary schedule for the construction.
3. Discussion of affected fire protection and life safety systems including, active and passive features.
4. Discussions of the effect on daily and emergency operations.
5. Handout of written policies for ILSM for all employees and construction personnel.
6. Demonstration of signs, messages, etc., to be used to identify hazardous conditions and the corresponding ILSM.
7. List of contacts for reporting hazardous conditions.
8. Discussion of anticipated hazards throughout the project and the ILSM for each.

3.2 ACTIVE AND PASSIVE FIRE PROTECTION AND LIFE SAFETY FEATURES

A. Due to the criticality of FAA facilities, most facilities are provided with a number of active and passive fire protection and life safety features. If any of these features are compromised in any way, ILSM shall be instituted immediately. These features include:

1. Fire-resistive construction.
2. Stair ventilation system (stair pressurization or vented vestibule).
3. Fire detection and alarm system.
4. Exit signage.
5. HVAC shutdown.
6. Unlocking security doors.

3.3 SITUATIONS COMPROMISING LIFE SAFETY

A. General concepts of situations which compromise the level of life safety as required by the applicable codes and standards include:

1. Blocked or obstructed exits.
2. Obstructed access for emergency vehicles and personnel.
3. Fire protection system malfunctioning or out of service.
4. Storage of additional combustibles or flammable liquids.
5. Temporary sources of ignition due to construction activities (cutting, welding, etc.).
6. Temporary penetrations in fire-rated walls and partitions (including missing doors).

B. Single Means of Egress: All work shall be conducted in such a way as to not obstruct or compromise the single means of egress from the ATCT.

3.4 SMOKING

A. Smoking shall not be permitted in areas under construction at any time in FAA facilities.

3.5 NOTIFICATION SIGNAGE

A. The Contractor shall provide appropriate signage, in locations approved by the Resident Engineer, to notify occupants of current activities and ILSM in effect at the facility. The signage shall be verified prior to each construction shift and employee shift. The signage shall indicate the present hazards and the safety measure provided to compensate for the hazards.

3.6 QUALITY CONTROL

A. During construction, the following practices shall be adhered to in addition to those required for specific hazards discussed below:

1. Construction personnel shall check all doors opening into stairs to ensure door hardware is functioning properly. This includes a visual inspection of all doors to ensure the construction has not been compromised and checking all door hardware including latching hardware and self-closing devices to verify proper operation. Any deficient components shall be repaired or replaced immediately.
2. The temporary use of wood chocks or other objects to prop open fire-rated doors shall be permitted as necessary for construction work. At the completion of work for the day, the construction supervisor shall verify all propped doors have been returned to the closed position.
3. The construction supervisor shall inspect the job site a minimum of twice per week to verify all life safety features are present and operational and have not been damaged by construction, including:

    a. Exit signage.
    b. Exits are free of storage or obstructions.
    c. Exit stairs, including treads, landings, handrails, headroom.
    d. Exit illumination.
    e. Emergency lighting (battery-operated).
    f. Evacuation route maps (ensure these are installed and readily visible).

4. If the fire alarm system is not provided with offsite monitoring, provide a telephone with a direct line to the fire department for notification in case of a fire. The Resident Engineer shall approve the location of the telephone.
5. Inform the fire department of construction activities in the facility and provide them a copy of written ILSM policies. The Contractor shall regularly update the fire department on the status of construction and ILSM (minimum of once every two weeks).

3.7 OPERATIONAL FIRE ALARM SYSTEM

A. If the facility fire alarm system is not operational, is malfunctioning, or is in a trouble condition due to construction activities, the Contractor shall provide, at a minimum, the following additional ILSM.

B. Inform Fire Department: Inform the fire department of the problems with the facility fire alarm system and inform them of the ILSM being taken to compensate for the deficient system.

C. Trouble Signals: Ensure trouble signals at the main fire alarm control panel and the Cab and TRACON annunciator panels remain functional until the system is returned to proper function. Trouble signals at either panel shall not be bypassed.

D. Magnetic Door Hold-Open Devices: Test magnetic door holders to ensure these devices still operate via the fire alarm system. If door holders do not work, all door holders shall be disabled and shall not be returned to use until the fire alarm system is returned to normal.

E. Facility Inspections: Construction supervisors shall inspect all areas prior to each shift to ensure all active and passive fire protection features are still operational including all

fire doors are in closed position and are not propped open, and the sprinkler system is still functional (i.e. valves are in the open position), if applicable.

F. Fire Alarm Inoperable at End of Shift: If the fire alarm system is not operational at the end of the construction shift, provide a temporary, manual switch in the Cab to activate the stair ventilation system (ATCT's only).

3.8 TEMPORARY IGNITION SOURCES

A. When construction activities involve the use of temporary ignition sources ("hot works"), i.e. welding, cutting, plumbers torch, etc., the Contractor shall provide, at a minimum, the following ILSM. (Note: Additional measures may be required by the Resident Engineer for specific situations.)

1. Inform construction supervisor of hazardous operations.
2. Keep a log of all hot work activities.
3. Provide the appropriate type fire extinguisher to the personnel performing the work (all construction personnel shall be trained in the proper use of fire extinguishers prior to the commencement of work).
4. Disable any fire alarm initiating devices or zones that may be susceptible to a false alarm during the operation. Notify the Resident Engineer prior to disabling fire alarm devices.
5. Return all fire alarm devices to normal operation at the completion of work. At the end of the shift, all fire alarm devices shall be returned to operational condition regardless of the status of the work.

3.9 STORAGE OF COMBUSTIBLES

A. When construction activities involve the storage of an unusual amount of combustibles and/or combustible liquids within the facility, the Contractor shall provide, at a minimum, the following ILSM. (NOTE: The Specification addressed Contractor storage spaces and other limitations. Additional measures may be required by the Resident Engineer for specific situations.)

1. Submit a written request to the Resident Engineer requesting permission to store materials within the facility. The request shall indicate the proposed location, types and quantities of combustibles, MSDS sheets (if applicable), approximate duration of storage and proposed ILSM. The Resident Engineer will provide a copy of all requests to the FAA Safety and Environmental Compliance Manager.
2. Provide additional fire extinguishers appropriate for the anticipated hazard.
3. Ensure proper cleaning techniques are utilized in the storage area at the end of each shift. This includes cleaning all dust and waste materials, replacing lids on liquids, cleaning all spills, returning all flammable and combustible liquids to a flammable liquids storage locker.
4. Check throughout the storage area daily for exposed ignition sources. Any exposed ignition sources shall be repaired or removed from the storage area.

3.10 STAIR VENTILATION SYSTEM

A. Conduct a meeting to inform all air traffic personnel upon restoring the stair ventilation system to normal operation.

END OF SECTION 02 01 00

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SECTION 02 03 00 – GENERAL REQUIREMENTS FOR DEMOLITION AND RENOVATION

PART 1 - GENERAL

1.1 REFERENCES

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

B. AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

1. AHRI Guideline K (2005) Guideline for Containers for Recovered Non-Flammable Fluorocarbon Refrigerants

C. AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

1. AASHTO M 145 (1991; R 2004) Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
2. AASHTO T 180 (2001; R 2004) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and an 457-mm (18-in) Drop

D. AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

1. ASSE/SAFE A10.6 (2006) Safety Requirements for Demolition Operations

E. CARPET AND RUG INSTITUTE (CRI)

1. CRI (2009) CRI Carpet Installation Standard

F. U.S. ARMY CORPS OF ENGINEERS (USACE)

1. EM 385-1-1 (2008) Safety and Health Requirements Manual

G. U.S. DEPARTMENT OF DEFENSE (DOD)

1. DOD 4000.25-1-M (2006; Notice 1) Requisitioning and Issue Procedures

H. U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

1. FAA AC 70/7460-1 (Rev K) Obstruction Marking and Lighting

I. U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

1. 40 CFR 61 National Emission Standards for Hazardous Air Pollutants
2. 40 CFR 82 Protection of Stratospheric Ozone
3. 49 CFR 173.301 Shipment of Compressed Gases in Cylinders and Spherical Pressure Vessels

1.2 GENERAL REQUIREMENTS

A. This Section specifies administrative and procedural requirements for demolition and renovation. Refer to other Sections for specific work requirements and limitations applicable to individual parts of the work. Requirements of this Section apply to all disciplines. Refer to specific Sections for other requirements and limitations applicable to the work.

B. Do not begin demolition until authorization is received from the COTR/RE. Do not allow accumulations inside or outside the building. The work includes demolition and removal of resulting rubbish and debris. Remove rubbish and debris from Government property daily, unless otherwise directed. Store materials that cannot be removed daily in areas specified by the COTR/RE. In the interest of occupational safety and health, perform the work in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections.

C. Protection of Existing Property: Before beginning any demolition work, the Contractor shall carefully survey the site and examine the drawings and specification to determine the extent of the work. The Contractor shall take all necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain in property of the Government, and any damaged items shall be repaired or replaced as approved by the COTR/RE at no additional cost to the Government. The Contractor shall carefully coordinate the work of this section with all other work and shall construct and maintain shoring, bracing and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work preformed under this contract.

D. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would reduce their load-carrying capacity or load-deflection ratio.

E. Operational and Safety Limitations: Do not cut and patch operating elements or safety related components in a manner that would result in reducing their capacity to perform as intended, or result in increased maintenance, or decreased operational life or safety.

F. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces, in a manner that would, in the COTR/RE’s opinion, reduce the building’s aesthetic qualities or result in visual evidence of cutting and patching. Remove and replace work cut and patched in a visually unsatisfactory manner.

1.3 SUBMITTALS

A. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

1. Demolition Plan

1.4 REGULATORY AND SAFETY REQUIREMENTS

A. Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the "Contract Clauses," conform to the safety requirements contained in ASSE/SAFE A10.6.

B. Notifications:

1. General Requirements: Furnish timely notification of demolition projects to the COTR/RE in writing 10 working days prior to the commencement of work in accordance with 40 CFR 61, Subpart M.

1.5 DUST AND DEBRIS CONTROL

A. Prevent the spread of dust and debris to occupied portions of the building and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution. Vacuum and dust the work area daily.

1.6 PROTECTION

A. Traffic Control Signs:

1. Where pedestrian, driver or aircraft safety is endangered in the area of removal work, use traffic barricades with flashing lights. Notify the COTR/RE prior to beginning such work.
2. Contractor must provide a minimum of 2 aviation red or high intensity white obstruction lights on temporary structures (including cranes) over 100 feet 30 meter above ground level. Light construction and installation must comply with FAA AC 70/7460-1. Lights must be operational during periods of reduced visibility, darkness, and as directed by the COTR/RE. Maintain the temporary services during the period of construction and remove only after permanent services have been installed and tested and are in operation.

B. Items to Remain in Place: Take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government. Repair or replace damaged items as approved by the COTR/RE. Coordinate the work of this section with all other work indicated. Construct and maintain shoring, bracing, and supports as required. Ensure that structural elements are not overloaded. Increase structural supports or add new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition work. Repairs, reinforcement, or structural replacement require approval by the COTR/RE prior to performing such work.

C. Existing Construction Limits and Protection: Do not disturb existing construction beyond the extent indicated or necessary for installation of new construction. Provide temporary shoring and bracing for support of building components to prevent settlement or other movement. Provide protective measures to control accumulation and migration of dust and dirt in all work areas. Remove snow, dust, dirt, and debris from work areas daily.

D. Weather Protection: For portions of the building to remain, protect building interior and materials and equipment from the weather at all times. Where removal of existing roofing is necessary to accomplish work, have materials and workmen ready to provide adequate and temporary covering of exposed areas.

E. Trees: Protect trees within the project site which might be damaged during demolition, and which are indicated to be left in place. Replace any tree designated to remain that is damaged during the work under this contract with like-kind or as approved by the COTR/RE.

F. Utility Service: Maintain existing utilities indicated to stay in service and protect against damage during demolition and operations. Coordinate with COTR/RE for shutdown utilities.

G. Facilities: Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated on drawings, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities. Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, must remain standing without additional bracing, shoring, or lateral support until demolished or deconstructed, unless directed otherwise by the COTR/RE. Ensure that no elements determined to be unstable are left unsupported and place and secure bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

H. Protection of Personnel: Before, during and after the demolition work the Contractor shall continuously evaluate the condition of the structure being demolished or deconstructed and take immediate action to protect all personnel working in and around the project site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.7 BURNING

A. The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.8 RELOCATIONS

A. Perform the removal and reinstallation of relocated items as indicated on drawings with workmen skilled in the trades involved. Items to be relocated which are damaged by the Contractor shall be repaired or replaced with new undamaged items as approved by the COTR/RE.

1.9 REQUIRED DATA

A. Prepare a Demolition Plan. Include in the plan procedures for careful removal and disposition of materials to be reused, coordination with other work in progress, a disconnection schedule of utility services, a detailed description of methods and equipment to be used for each operation and of the sequence of operations. Include statements affirming Contractor inspection of the existing roof deck and its suitability to perform as a safe working platform or if inspection reveals a safety hazard to workers, state provisions for securing the safety of the workers throughout the performance of the work. Provide procedures for safe conduct of the work in accordance with EM 385-1-1. Plan shall be approved by COTR/RE prior to work beginning.

1.10 ENVIRONMENTAL PROTECTION

A. Comply with the Environmental Protection Agency requirements specified.

1.11 USE OF EXPLOSIVES

A. Use of explosives will not be permitted.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Use materials that are identical to existing materials. If identical materials are not available or cannot be used where exposed surfaces are involved, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect. Use materials whose installed performance will equal or surpass that of existing materials .

PART 3 - EXECUTION

3.1 INSPECTION

A. Prior to Cutting Existing Surfaces: Examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. Take corrective action before proceeding, if unsafe or unsatisfactory conditions are encountered.

B. Prior to Proceeding: Meet at the site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

3.2 PREPARATION

A. Provide temporary support of work to be cut. Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas. Take all precautions necessary to avoid cutting existing pipe, conduit or ductwork serving the building, but scheduled to be removed or relocated until provisions have been made to bypass them.

3.3 EXISTING FACILITIES TO BE REMOVED

A. GENERAL

1. Existing construction scheduled to be removed for reuse shall be disassembled. Dismantled and removed materials are to be separated, set aside, and prepared as specified, and stored or delivered to a collection point for reuse.
2. Existing Structures:

a. Remove existing structures indicated to be removed to top of foundation walls. Break up basement slabs to permit drainage. Remove sidewalks, curbs, gutters and street light bases as indicated on drawings.
b. Interior walls, other than retaining walls and partitions, shall be removed to top of concrete slab on ground.
c. Demolish structures in a systematic manner from the top of the structure to the ground. Complete demolition work above each level before the supporting members on the lower level are disturbed. Demolish concrete and masonry walls in small sections. Remove structural framing members and lower to ground by means of derricks, platforms hoists, or other suitable methods as approved by the COTR/RE.

d. Locate demolition equipment throughout the structure and remove materials so as to not impose excessive loads to supporting walls, floors, or framing.

3. Cutting and Patching:

a. Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.
b. Cutting: Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition. Cut existing construction using methods least likely to damage elements to be retained or adjoining construction. Where possible review proposed procedures with the original installer; comply with original installer's recommendations. In general, where cutting is required use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

1) Avoid Marring Existing Surfaces: To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
2) Concrete and Masonry Surfaces: Cut through concrete and masonry using a cutting machine such as carborundum saw or diamond core drill.
3) Utility Services: Bypass utility services such as pipe or conduit before cutting, where services are shown or required to be removed, relocated or abandoned. Remove pipe or conduit in walls or partitions that are noted to be removed, unless noted by Resident Engineer to be cut-off. Cap, valve, or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after bypassing and cutting. Use approved firestopping methods in all fire-rated walls, floors or ceilings.

c. Patch: Patch with durable seams that are as invisible as possible. Comply with specified tolerances. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
d. Finish Restoration: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
e. Finish Restoration in More than One Area: Where removal of walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space to provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
f. Smooth Painted Surfaces: Where patching occurs in a smooth painted surface, extend final paint coat over entire area containing the patch, after the patched area has received primer and second coat.
g. Existing Ceilings: Patch, repair or re-hang existing ceilings as necessary to provide an even plane surface of uniform appearance.

4. Items with Unique/Regulated Disposal Requirements: Remove and dispose of items with unique or regulated disposal requirements in the manner dictated by law or in the most environmentally responsible manner.

B. CIVIL

1. Utilities and Related Equipment:

   a. General Requirements: Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by the COTR/RE. Do not interrupt existing utilities serving facilities occupied and used by the Government except when approved in writing and then only after temporary utility services have been approved and provided. Do not begin demolition work until all utility disconnections have been made. Shut off and cap utilities for future use, as indicated on drawings.
   b. Disconnecting Existing Utilities: Remove existing utilities as indicated on drawings and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the COTR/RE. When utility lines are encountered that are not indicated on drawings on the drawings, the COTR/RE shall be notified prior to further work in that area. Remove meters and related equipment and deliver to a location in accordance with instructions of the COTR/RE.

2. Paving and Slabs: Remove or sawcut concrete paving and slabs as indicated on drawings to a depth of 3-6 inches below existing adjacent grade.

C. ARCHITECTURAL

1. Roofing: Remove existing roof system and associated components in their entirety down to existing roof deck. Remove roofing system and insulation without damaging the roof deck. Sequence work to minimize building exposure between demolition and new roof materials installation.

   a. Temporary Roofing: Install temporary roofing and flashing as necessary to maintain a watertight condition throughout the course of the work. Remove temporary work prior to installation of permanent roof system materials unless approved otherwise by the COTR/RE. If the existing deck or support structure is deteriorated where indicated, such that ability to support foot traffic and construction loads is unknown. Make provisions for worker safety during demolition, and installation of new materials.
   b. Reroofing: When removing the existing roofing system from the roof deck, remove only as much roofing as can be recovered by the end of the work day, unless approved otherwise by the COTR/RE. Do not attempt to open the roof covering system in threatening weather. Reseal all openings prior to suspension of work the same day.

2. Carpentry: Remove and reinstall windows, doors, frames, and cabinets, and similar items as whole units, complete with trim and accessories as indicated on drawings. Do not remove hardware attached to units, except for door closers unless noted otherwise in drawings. Brace the open end of door frames to prevent damage.
3. Carpet: Remove existing carpet in accordance with manufacturer recommendations. Remove adhesive according to recommendations of the Carpet and Rug Institute (CRI). Adhesive removal solvents shall comply with CRI 104.
4. Acoustic Ceiling Tile: Remove and store ceiling tiles to be reused if indicated on drawings.

5. Locksets on Swinging Doors: The Contractor shall remove all locksets from all swinging doors indicated on drawings to be removed and disposed. Deliver the locksets and related items to a designated location for receipt by the COTR/RE after removal.

D. STRUCTURAL

1. Masonry: Sawcut and remove masonry so as to prevent damage to surfaces to remain and to facilitate the installation of new work. Where new masonry adjoins existing, the new work shall abut or tie into the existing construction as specified for the new work. Provide square, straight edges and corners where existing masonry adjoins new work and other locations.
2. Concrete: Saw concrete along straight lines to a depth of a minimum 2 inch. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Break out the remainder of the concrete provided that the broken area is concealed in the finished work, and the remaining concrete is sound. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete.
3. Structural Steel: Dismantle structural steel at field connections and in a manner that will prevent bending or damage. Flame-cutting torches are permitted when other methods of dismantling are not practical. Any structural steel to be reuse shall be stored off the ground and protected from the weather.
4. Miscellaneous Metal: When shop-fabricated items such as access doors and frames, steel gratings, metal ladders, metal railings, metal windows and similar items and light-gage and cold-formed metal framing, metal toilet partitions, toilet accessories and similar items will be reused, removed them as whole units and shall be store and protected from weather.

E. MECHANICAL

1. Air Conditioning Equipment: Remove air conditioning, refrigeration, and other equipment containing refrigerants without releasing chlorofluorocarbon refrigerants to the atmosphere in accordance with the Clean Air Act Amendment of 1990. Recover all refrigerants prior to removing air conditioning, refrigeration, and other equipment containing refrigerants and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS)."
2. Cylinders and Canisters: Remove all fire suppression system cylinders and canisters and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS)."
3. Mechanical Equipment and Fixtures: Disconnect mechanical hardware at the nearest connection to existing services to remain, unless otherwise noted. Mechanical equipment and fixtures must be disconnected at fittings. Remove service valves attached to the unit. Do not remove equipment until approved.
4. Piping: Disconnect piping at unions, flanges and valves, and fittings as required to reduce the pipe into straight lengths. If the piping that remains can become pressurized due to upstream valve failure, end caps, blind flanges, or other types of plugs or fittings with a pressure gage and bleed valve shall be attached to the open end of the pipe to ensure positive leak control. Carefully dismantle piping that previously contained gas, gasoline, oil, or other dangerous fluids, with precautions taken to prevent injury to persons and property.

F. ELECTRICAL

1. Electrical Equipment and Fixtures: Disconnect primary, secondary, control, communication, and signal circuits at the point of attachment to their distribution system.

    a. Fixtures: Remove electrical fixtures as indicated on drawings.
    b. Electrical Devices: Remove switches, switchgear, transformers, conductors including wire and nonmetallic sheathed and flexible armored cable, regulators, meters, instruments, plates, circuit breakers, panelboards, outlet boxes, and similar items as indicated on drawings.
    c. Wiring Ducts or Troughs: Dismantle plug-in ducts and wiring troughs into unit lengths. Remove plug-in or disconnecting devices from the busway as indicated on drawings.
    d. Conduit and Miscellaneous Items: Remove conduit except where embedded in concrete or masonry as indicated on drawings. Consider corroded, bent, or damaged conduit as scrap metal. Sort straight and undamaged lengths of conduit according to size and type. Classify supports, knobs, tubes, cleats, and straps as debris to be removed and disposed.

3.4 DISPOSITION OF MATERIAL

A. Title to Materials: All materials and equipment removed shall become the property of the Contractor and shall be removed from Government property.

B. Reuse of Materials and Equipment: Remove and store materials and equipment indicated to be reused to prevent damage, and reinstall as the work progresses.

C. Disposal of Ozone Depleting Substance (ODS): Class I and Class II ODS are defined in Section, 602(a) and (b), of The Clean Air Act. Prevent discharge of Class I and Class II ODS to the atmosphere. Place recovered ODS in cylinders meeting AHRI Guideline K suitable for the type ODS (filled to no more than 80 percent capacity) and provide appropriate labeling. Recovered ODS shall be removed from Government property and disposed of in accordance with 40 CFR 82. Products, equipment and appliances containing ODS in a sealed, self-contained system (e.g. residential refrigerators and window air conditioners) shall be disposed of in accordance with 40 CFR 82.

    1. Special Instructions: No more than one type of ODS is permitted in each container. A warning/hazardous label shall be applied to the containers in accordance with Department of Transportation regulations. All cylinders including but not limited to fire extinguishers, spheres, or canisters containing an ODS shall have a tag with the following information:

        a. Activity name and unit identification code.
        b. Activity point of contact and phone number.
        c. Type of ODS and pounds of ODS contained.
        d. Date of shipment.

    2. Fire Suppression Containers: Deactivate fire suppression system cylinders and canisters with electrical charges or initiators prior to shipment. Also, safety caps must be used to cover exposed actuation mechanisms and discharge ports on these special cylinders.

D. Transportation Guidance: Ship all ODS containers in accordance with MIL-STD-129, DLA 4145.25 (also referenced one of the following: Army Regulation 700-68, Naval Supply

Instruction 4440.128C, Marine Corps Order 10330.2C, and Air Force Regulation 67-12), 49 CFR 173.301, and DOD 4000.25-1-M.

3.5 DISPOSAL OF REMOVED MATERIALS

A. Regulation of Removed Materials: Dispose of debris, rubbish, scrap, and other materials resulting from removal operations with all applicable federal, state and local regulations as contractually specified.

B. Burning on Government Property: Burning of materials removed from demolished structures will not be permitted on Government property.

C. Removal to Spoil Areas on Government Property: Transport noncombustible materials removed from demolition structures to designated spoil areas on Government property.

D. Removal from Government Property: Transport waste materials removed from demolished structures, from Government property for legal disposal. Dispose of waste soil as directed.

END OF SECTION 02 03 00

SECTION 02 82 15 – ENVIRONMENTAL AIR MONITORING

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish all labor, material and equipment, and perform all work required to provide air monitoring services to support asbestos containing materials (ACM) activities as specified herein. Where conflicts exist between the contents of this specification and applicable regulations, the most stringent requirement(s) shall apply.

1.2 REFERENCE

A. 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. The current version of referenced publications at the time of the bid shall be used. Where conflicts exist between documents, the most stringent requirements shall apply.

B. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

1. ANSI Z9.2 (2006), Fundamentals Governing the Design and Operation of Local Exhaust Systems
2. ANSI Z87.1 (2003), Occupational and Educational Eye and Face Protection.
3. ANSI Z88.6 (2006), Respiratory Protection.

C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. ASTM E 1368 (1997), Visual Inspection of Asbestos Abatement Projects
2. ASTM D 2986-95A, Evaluation of Air Assay Media by the Monodisperse DOP (Dioctyl Phthalate) Smoke Test

D. UNITED STATES OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION

1. 29 CFR 1910, Occupational Safety and Health Standards
2. 29 CFR 1926, Safety and Health Regulations for Construction

E. COMPRESSED GAS ASSOCIATION (CGA)

1. GA G-7 (1990), Compressed Air for Human Respiration
2. CGA G-7.1 (1997), Commodity Specification for Air

F. ENVIRONMENTAL PROTECTION AGENCY (EPA)

1. EPA 340/1-90-018 (1990), Asbestos/NESHAP Regulated Asbestos Containing Materials Guidance
2. EPA 340/1-90-019 (1990), Asbestos/NESHAP Adequately Wet Guidance
3. EPA 560/5-85-024 (1985), Guidance for Controlling Asbestos-Containing Materials in Buildings

4. EPA 600/4-85-049 (1985), Measuring Airborne Asbestos Following an Abatement Action
5. 40 CFR 61, National Emission Standards for Hazardous Air Pollutants
6. 40 CFR 763, Asbestos Hazard Emergency Response Act, Asbestos School Hazard Abatement Reauthorization Act

G. NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

1. NIOSH Pub No. 94-113 (1994), NIOSH Manual of Analytical Methods, 4th Edition with First Supplement

H. UNDERWRITERS LABORATORIES (UL)

1. UL 586 (1990), High-Efficiency Particulate Air Filter Units

I. ASHRAE

1. SPC 52.2P, Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size

J. FEDERAL AVIATION ADMINISTRATION (FAA)

1. Asbestos Control Program (ACP)

1.3 DEFINITIONS

A. Adequately Wet: A term as defined in 40 CFR 61, Subpart M and EPA 340/1-90-019 that means to sufficiently mix or penetrate with liquid to prevent the release of particulates. If visible emissions are observed coming from asbestos-containing material (ACM), then that material has not been adequately wetted. However, the absence of visible emissions is not sufficient evidence of being adequately wetted.

B. Asbestos Containing Material: Any material containing more than one percent asbestos. For purposes of these specifications, ACM includes presumed asbestos-containing material (PACM) as defined by 29 CFR 1926.1101.

C. Asbestos Regulated Work Area: An area established to demarcate areas where Class I, II, and III asbestos work is conducted, and any adjoining area where debris and waste from such asbestos work accumulates; and a work area where the airborne concentration of asbestos fibers exceeds, or has a possibility to exceed, the permissible exposure limit.

D. Certified Industrial Hygienist (CIH): An Industrial Hygienist certified in the comprehensive practice of industrial hygiene by the American Board of Industrial Hygiene.

E. Class I Asbestos Work: Activities involving the removal of thermal system insulation (TSI) and surfacing ACM.

F. Class II Asbestos Work: Activities involving the removal of ACM that is not thermal system insulation or surfacing material. This includes, but is not limited to, the removal of asbestos-containing wallboard, floor tile and sheeting, roofing and siding shingles, and construction

mastic. Certain “incidental” roofing materials such as mastic, flashing and cements when they are still intact are excluded from Class II asbestos work.

G. Class III Asbestos Work: Repair and maintenance operations where ACM, including TSI and surfacing ACM, is likely to be disturbed. Operations may include drilling, abrading, or cutting a hole, cable pulling, and crawling through tunnels or attics and spaces above the ceiling where ACM or asbestos-containing debris may be disturbed. Removal of small amounts of ACM that would fit into a single glove bag or disposal bag may be classified as a Class III job.

H. Class IV Asbestos Work: Maintenance and custodial construction activities during which employees contact but do not disturb ACM and activities to clean up dust, waste and debris resulting from Class I, II, and III activities. This may include dusting surfaces where ACM waste and debris and accompanying dust exists and cleaning up loose ACM debris from TSI or surfacing ACM following construction.

I. Disturbance: Activities that disrupt the matrix of ACM, crumble or pulverize ACM, or generate visible debris from ACM.

J. Friable ACM: A term as defined in 40 CFR 61, Subpart M and EPA 340/1-90-018 that means any material containing more than 1 percent asbestos as determined using the method specified in 40 CFR 763, Appendix A, Subpart F, Section 1, Polarized Light Microscopy (PLM), that when dry, can be crumbled, pulverized, or reduced to powder by hand pressure.

K. High Efficiency Particulate Air (HEPA) filter: A filter capable of trapping and retaining at least 99.97 percent of all mono-dispersed particles of 0.3 micrometers or greater in diameter.

L. Industrial Hygienist: A professional qualified by education, training, and experience to anticipate, recognize, evaluate, and develop controls for occupational health hazards.

M. Permissible Exposure Limits: OSHA PELs are worker exposure limits regulating the amount or concentration of a substance in air that shall not be exceeded. (1) An airborne concentration of asbestos of 0.1 fibers per cubic centimeter of air (f/cc) as an eight- (8) hour time weighted average (TWA). (2) An airborne concentration of asbestos of 1.0 f/cc as averaged over a sampling period of thirty (30) minutes (Excursion Limit).

N. Time-Weighted Average (TWA): The TWA is an 8-hour time weighted average of airborne concentration of fibers (longer than 5 micrometers) per cubic centimeter of air that represents the employee's 8-hour workday as determined by Appendix A of 29 CFR 1926.1101.

1.4 GENERAL REQUIREMENTS

A. This specification shall be used in conjunction with the Asbestos Abatement Specification.

B. The Environmental Monitoring Services Contractor (hereafter referred to as the Environmental Contractor) shall be completely independent from the Abatement Contractor and shall not be an employee of the Abatement Contractor or be an employee or principal of a firm recognized by Federal, state, or local regulations that would constitute a business relationship that would not be considered independent of the Abatement Contractor Scope of Work.

C. The Environmental Contractor shall provide all labor, material, and equipment necessary to accomplish the following:

1. Provide professional services to review and comment on the Abatement Contractor's Asbestos Abatement Plan.
2. If previously untested building components suspected to contain asbestos are observed and located in areas impacted by the abatement work, the Environmental Contractor shall notify the COTR/RE who will have the option presuming the material contains asbestos or directing the Environmental Contractor to collect bulk samples of the material. Analysis of bulk samples shall be performed using polarized light microscopy as specified by 40 CFR Part 763, Subpart E, Appendix C.
3. Develop two air monitoring plans for the asbestos abatement project. One will address area air monitoring inside of the regulated area and in FAA occupied areas outside the regulated area. The other plan will address personal air monitoring for FAA personnel outside the regulated work area. (See Attachments 1 and 2 for Air Monitoring Plans)
4. Conduct asbestos briefings for FAA employees during various phases of the abatement project.
5. Provide 24-hour air monitoring services and accomplish on-site analysis by Phase Contrast Microscopy (PCM) of samples to quantify fiber concentrations.
6. Provide analysis of air samples by an accredited laboratory Proficiency Analytical Testing (PAT) and/or American Industrial Hygiene Association (AIHA) and National Voluntary Laboratory Accreditation Program (NVLAP) utilizing Transmission Electron Microscopy (TEM) to quantify the airborne asbestos fiber concentration.
7. Provide services to measure and record pressure differentials 24 hours per day.
8. Provide professional services to accomplish full-time site inspection of asbestos removal activities, including daily written reports of such activities.
9. Attend and participate in on-site meetings, such as the preconstruction meeting, as required throughout the project.
10. Provide a "Final Report" to document that abatement activities were performed in compliance with Federal, state, local requirements and the asbestos abatement contract specifications.
11. Provide 24-hour pressure differential alarm monitoring.
12. Provide consultation pertaining to representative personal air monitoring by a CIH in the event the Facility Asbestos Abatement Contingency Plan is implemented.
13. Maintain daily activity logs, which shall be provided to the COTR/RE and SECM within 24 hours of request.

D. FAA Furnished Equipment: No Government Furnished Materials will be provided.

E. Coordination: All Coordination between the Environmental Contractor and both the Abatement Contractor and the facility, shall be exclusively through the COTR/RE unless otherwise directed in writing by the Contracting Officer (CO) (See Attachment 2).

F. Schedule of Work:

1. Baseline samples will be collected 30 days prior to abatement. No activities will be allowed to proceed if baseline samples analyzed by PCM indicate fiber concentrations greater than 0.025 f/cc. If the results are greater than 0.025 f/cc, re-sampling and establishment of a new baseline will take place following re-cleaning by the abatement

contractor. If baseline concentrations less than 0.025 f/cc cannot be achieved, the COTR/RE will obtain justification for approval by the FAA headquarters' CIH.

2. Set-up work: All set-up work (e.g. enclosure construction, pre-cleaning) by the Abatement Contractor shall take place during off-hours between 9:00PM and 5:00AM. During abatement, all asbestos abatement shall take place after all enclosures have been erected and between the hours of 9:00PM and 5:00AM.
3. Analysis: Approximately one (1) additional hour will be necessary to complete analysis of end of abatement shift samples and the daily log report.
4. Around the clock monitoring: Approximately one (1) additional hour prior to the work shift will be necessary to complete analysis of off-work shift samples. Results shall be turned over to the COTR/RE prior to commencement of daily abatement activities.
5. Weekend/holiday: Samples will be collected and analyzed on-site in maximum of 12 hour cycles.

G. Safe Working Condition: All FAA and OSHA safety regulations must be observed and enforced at all times during the project to protect both FAA and Contractor employees from injury or illness.

H. Facility Security Requirements: The facility is under security at all times. All critical areas are controlled by means of a personal identification system. All personnel entering the facility will require a visitor badge, which must be worn while on the premises. Further instructions regarding security requirements will be furnished at the time the badges are issued. All Contractors and their employees will be required to sign site entry/exit log on a daily basis.

I. Housekeeping: The Environmental Contractor shall keep the working area in a clean and proper condition. All rubbish and waste resulting from execution of the Environmental Contractor's work shall be removed at the end of each shift. Asbestos contaminated sampling waste shall be disposed of properly and will be combined with the waste generated by the Abatement Contractor.

J. Cleanup: Upon completion of the work, the Environmental Contractor shall remove his/her equipment, and unused supplies and materials.

1.5 SUMMARY OF WORK

The Environmental Contractor shall coordinate all activities with Specification 02 08 14, 1.9 (D).

1.6 REQUIREMENTS

A. Medical Surveillance Examinations: Medical requirements shall conform to 29 CFR 1926.1101.

B. Exposure Data: The Environmental Contractor shall maintain complete and accurate employee exposure data on file at the work site as required by 29 CFR 1910.1020 and 29 CFR 1926.1101.

C. Certification, Accreditation and Training:

1. Certification: All work under this contract shall be performed under the direction of an individual certified in the comprehensive practice of industrial hygiene by the American Board of Industrial Hygiene.
2. Accreditation: The independent laboratory and Environmental Contractor on-site analysts shall meet the requirements of the American Industrial Hygiene Association (AIHA), the Asbestos Analyst Registry (AAR), Proficiency Analytical Testing (PAT) Program, and the National Institute of Standards and Technology (NIST) National Voluntary Laboratory Accreditation Program (NVLAP) as applicable for the type of analysis performed.
3. Training: All persons executing the duties under this contract shall have completed appropriate EPA Model Accreditation Program (MAP) training and required annual refresher courses as appropriate for the duties that will be performed under this contract.

    a. The Environmental Contractor's CIH shall have completed an EPA MAP Asbestos Project Designer Training course.
    b. The Environmental Contractor's designated on-site oversight person shall meet the requirements of a Competent Person as outlined in 29 CFR 1926.1101. This person shall be licensed in the state and possess current EPA MAP certification as a Project Monitor or Contractor/Supervisor.
    c. PCM air sample analysts shall have completed NIOSH 582 or equivalent training.
    d. Personnel who collect bulk samples of suspect ACM shall have completed an EPA MAP Asbestos Inspector Training course.

4. Related Work Experience:

    a. The Environmental Contractor's CIH shall possess at least 3 years of experience in the asbestos abatement field.
    b. The Environmental Contractor's designated on-site oversight person shall possess at least 2 years of experience in the asbestos abatement field.

D. Respiratory Protection Program: The Environmental Contractor's CIH shall establish in writing, and implement a respiratory protection program in accordance with 29 CFR 1926.1101, 29 CFR 1910.134, ANSI Z88.2, CGA G-7 and CGA G-7.1.

E. Hazard Communication Program: A written hazard communication program shall be established and implemented in accordance with 29 CFR Section 1926.59.

F. Permits, Licenses and Notifications: Pay for and obtain all required licenses and permits.

G. Insurance: The Contractor shall purchase and maintain the following insurance coverage, with the stated minimum limits:

Type of Coverage	**Minimum Limit**
General Liability	$1 million per occurrence
Contractual Liability	$1 million per occurrence
Automobile Liability	$1 million per occurrence for bodily injury $50,000 per occurrence for property damage
Property Damage Liability	$1 million per occurrence
Worker's Compensation	$1 million per occurrence

Pollution Liability $1 million per occurrence

H. The policies evidencing required insurance shall be written on a comprehensive form of policy listing the FAA as the certificate holder. The policies shall also contain an endorsement to the effect that any cancellation or any material change adversely affecting the FAA's interest shall not be effective for such period as the laws of the State allow or until 30 days after the insurer or the Contractor gives written notice to the CO, whichever period is longer. Each policy shall include a provision that the FAA will be notified at least 30 days in advance of the effective date of any reduction in coverage or cancellation.

I. Materials and Equipment:

1. General: Unless otherwise stated herein, the Environmental Contractor shall provide all materials and equipment necessary to perform the work. This may include, but not be limited to: electrical cords, ground fault circuit interrupters, first aid kits, logbooks, log forms, markers with indelible ink, etc.
2. Air Monitoring: Air monitoring equipment furnished shall include, but not be limited to, high and low volume pumps, calibration equipment, chemical agents, quick fix and slides, and microscope with accessories.

J. Air Monitoring: Upon approval of the Abatement Contractor's Asbestos Abatement Plan, the Environmental Contractor shall prepare two Air Monitoring Plans for the performance of all work required under this contract. The Area Air Monitoring Plan will include, at a minimum, the specifics of the 24 hours per day/7 days per week area air sampling plan, baseline sampling, and clearance sampling. The Personal Air Monitoring Plan shall address the implementation of the Facility Asbestos Abatement Contingency Plan at any time during the abatement project.

K. Pressure Differential Recordings:

1. The Environmental Contractor shall furnish all equipment and personnel necessary to provide continuous, 24 hour/day, pressure differential monitoring in order to insure the Abatement Contractor's conformity with the requirements of the abatement contract. The Environmental Contractor's differential monitoring equipment will be calibrated and certified to the manufacturer's specification prior to the start of work. It shall be the Environmental Contractor's responsibility to routinely check their monitors at the beginning and end of each working day and twice per day during the removal activity. Pressure differential shall be remotely monitored with a 60-second time delay during removal activity. The COTR/RE must be notified should pressure differentials be less than 0.02 inches of water or above 0.05 inches of water. Pressure differentials greater than 0.05 inches of water must be approved by the COTR/RE and Environmental Contractor's CIH. At no time shall pressure differential exceed 0.1 inches of water. Recordings shall be documented in the Daily Log.

2. Equipment: The monitors provided shall possess the following minimum features:

a. High and low limit alarm set points
b. Audible and visual alarm system
c. Alarm delay feature
d. LCD display showing inches of water column
e. Strip Chart Recorder (must include date and time)

f. + 1 % accuracy

L. Rental Equipment:

If rental equipment is to be used, written notification shall be provided by the Environmental Contractor to the rental agency concerning the intended use of the equipment, the possibility of asbestos contamination of the equipment, and the steps that will be taken to decontaminate such equipment. A written acceptance of the terms of the Environmental Contractor's notification shall be obtained from the rental agency.

1.7 SUBMITTALS

Comply with section 01 33 00-Submittal Procedures.

1.8 MEDICAL EXAMINATIONS

A. Provide the physician's written opinions documenting completion of most recent medical examinations that verify the ability of the Environmental Contractor's employee's to work under the anticipated site conditions. This information must be provided to the COTR/RE at least 30 days prior to the start of work.

B. Exposure Data: There are no submittals required for exposure data.

C. Certification, Accreditation and Training:

1. Certification. Provide proof of current certification of the Certified Industrial Hygienist who will direct all work under this contract to the COTR/RE. The CIH shall be an accredited Asbestos Project Designer.

2. Accreditation:

a. Provide proof of successful participation in the last four (4) PAT program rounds by the parent lab of persons who will be performing the air monitoring services and fiber analysis to the COTR/RE with the bid package.
b. The Environmental Contractor and independent laboratory shall provide proof of accreditation that all laboratories and onsite analysts meet the AIHA, the Asbestos Analyst Registry (AAR), PAT Program, NVLAP, and NIOSH 582 or equivalent with the bid package. Lack of such evidence will indicate failure to meet the requirements of this specification.

3. Training:

a. Provide proof of current EPA training of all Environmental Contractor personnel executing the duties established by this contract to the COTR/RE at least 30 days prior to the start of work.
b. Provide proof that the oversight person meets the requirements of a "Competent Person" as outlined in 29 CFR 1926.1101 paragraph (b); has at least three years related experience, and is licensed in the state or possesses current EPA accreditation as a Contractor/Supervisor or project manager under AHERA..

4. Related Work Experience for CIH and Industrial Hygienists/Industrial Hygiene Technicians. Submit resumes documenting work experience as required by paragraph 1.5.C to the COTR/RE.

D. Respiratory Protection Program: Provide a copy of the Environmental Contractor's Respiratory Protection Program and documentation of respirator fit-tests to the COTR/RE at least [30] days prior to the start of work.

E. Hazard Communication Program: Provide a copy of the Environmental Contractor's Hazard Communication Plan and MSDS's for all hazardous chemicals to be used onsite to the COTR/RE at least 30 days prior to the start of work.

F. Site Specific Hazards: Provide a Site Safety Plan to address the hazards provided in paragraph 1.5.F to the COTR/RE at least 30 days prior to the start of work.

G. Permits, Licenses and Notifications: Provide necessary Federal, State, regional and local licenses, as required to perform environmental monitoring services to the COTR/RE at least 30 days prior to the start of work.

H. Insurance: Provide original certificates of insurance to the COTR/RE.

I. Materials and Equipment:

1. General: Provide a list of all equipment to be brought on site along with manufacturer's specifications to the COTR/RE at least 30 days prior to the start of work.
2. Air Monitoring Equipment: Provide a list of all air monitoring equipment to be brought on site along with manufacturer's specifications to the COTR/RE at least 30 days prior to the start of work.

J. Air Monitoring:

1. Area and Personal Air Monitoring Plans: Upon approval of the Abatement Contractor's Asbestos Abatement Plan, the Environmental Contractor shall submit 5 copies of the Air Monitoring Plan for the performance of all work required under this section to the COTR/RE at least 10 days prior to the start of work.
2. Air Monitoring Results: Typically, verbal air sampling results will be provided to the COTR within 1 hour from the time of analysis and written results will be provided within 24 hours. Results exceeding the specified stop work levels must be reported verbally within one hour of analysis with written results posted the next day. Final clearance air monitoring results shall be submitted within 2 days of collection of the samples.

K. Pressure Differential Recordings: Copies of strip chart recordings shall be provided to the COTR/RE daily.

L. Rental Equipment: A copy of the written acceptance of the terms of the Environmental Contractor's notification to the rental agency shall be submitted to the COTR/RE at least [10] days prior to the start of work.

PART 2 – PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 INSPECTIONS

A. Preliminary: The Environmental Contractor shall thoroughly inspect the area where abatement will be performed prior to the start of work. The purpose of this preliminary inspection shall be to develop air-monitoring strategies and review the feasibility of the Abatement Contractor's Asbestos Abatement Plan with respect to actual site conditions.

B. Daily: The Environmental Contractor shall conduct daily inspections of the Abatement Contractor's activities inside and outside of the asbestos regulated work area during each phase of abatement work. Such inspections shall be performed at least two times per shift inside of the asbestos regulated work area. Pre-cleaning, set-up work, abatement work practices, barrier/enclosure integrity, operation of negative air filtration units, and any other activities that may impact the intent of the asbestos abatement specifications or the Asbestos Abatement Plan shall be assessed. Smoke testing of enclosures shall be performed and documented prior to the start of abatement work. If activities or situations are observed that do not conform to the intent of the asbestos abatement specifications and/or Federal, State, or local regulations, the Environmental Contractor shall immediately notify the COTR/RE that corrective action is required.

C. Final Inspection: Upon completion of abatement work and initial cleaning by the Abatement Contractor, the Environmental Contractor and COTR/RE shall conduct a visual inspection of the asbestos regulated work area in preparation for a final cleaning. Following approval of the initial cleaning by the COTR/RE, the Abatement Contractor will perform a final cleaning of the work area. After final cleaning has been completed, the Environmental Contractor and COTR/RE shall conduct a final visual inspection of the cleaned asbestos regulated work area and complete the Final Cleaning and Visual Inspection form as specified by ASTM E 1368.

3.2 REVIEW OF ASBESTOS ABATEMENT PLAN

A. Services required in this contract include the review of the Abatement Contractor's Asbestos Abatement Plan by the Environmental Contractor's CIH. The Environmental Contractor shall review the Plan and provide a written approval or disapproval signed by a CIH. When the Environmental Contractor disapproves the Plan, the reviewer shall reference the appropriate regulation or specification section under which the Plan fails to comply and recommend amendments to the Plan.

3.3 BRIEFINGS

A. The Environmental Contractor's CIH shall conduct (4), 60-minute briefings at the Facility to inform the occupants of work places adjoining the asbestos control areas about various aspects of the project including:

1. Purpose and scope of the project.
2. Location of the work, regulated areas, and alternate routes for foot traffic and fire escape.
3. Health aspects of asbestos exposure.
4. OSHA Asbestos Standards.
5. Protective measures that will be utilized.

6. Monitoring program to determine level of airborne asbestos and differential pressures.
7. Inspection procedures to verify asbestos removal and the Abatement Contractor's compliance with safety precautions.
8. Condition/situations that warrant notification to the COTR/RE for potential work stoppage.

B. Briefings shall be scheduled 2 per day, on 2 consecutive days. They shall be conducted approximately 10 days prior to the start of any asbestos related construction activity.

C. On-site Meeting: The Environmental Contractor shall attend, and participate in on-site construction meetings such as the pre-construction meeting throughout the duration of the project. The asbestos portion of each meeting will be summarized and documented in the project log.

3.4 MONITORING NEGATIVE PRESSURE

A. The Environmental Contractor shall monitor, document, and report to the COTR/RE that the containment has been under negative pressure for a constant period of no less than 24 hours before abatement starts. If the containment is found to be unacceptable, the Environmental Contractor shall provide recommendations for corrective action to the COTR/RE.

B. The Environmental Contractor shall immediately notify the COTR/RE of any and all alarm conditions. The Environmental Contractor shall conduct inspections in the containment and perform negative pressure differential monitoring at least 2 times per shift. These inspections and pressure differential readings will be noted in the daily logbook.

C. The strip charts shall be set up in a way that they are "time traceable", i.e. while looking at a strip chart, one will be able to instantaneously determine the date and the exact time of day when a given pressure reading was recorded.

D. During off hours, the Environmental Monitoring Contractor shall verbally respond after 30 minutes of being contacted by the FAA and shall be onsite to perform an assessment not later than 60 minutes from the time of the initial page.

3.5 STOP WORK

A. If the Environmental Contractor shall immediately notify the COTR/RE of the following conditions. This will be sufficient evidence for the COTR/RE to direct the Abatement Contractor to stop work and take corrective action.

B. If air sampling and analysis conducted in accordance with these specifications and the Environmental Contractor's approved Area Air Monitoring Plan indicates airborne fiber concentrations of 0.02 f/cc above baseline or greater outside of the asbestos regulated work area.

C. If the Environmental Contractor measures pressure differentials less than 0.02 inches of water or greater than 0.05 inches of water (or other maximum limit as established by the COTR/RE and Environmental Contractor's CIH).

D. Work or conditions found to be in violation of this specification or applicable regulations. This includes, but is not limited to, puncture or collapse of containment barriers, electrical power loss, ground-fault circuit interrupter failure, equipment failure, dry removal of ACM, and visible emission from the asbestos regulated work area.

E. Any other condition that may adversely impact or disrupt flying operations or working conditions at the facility.

3.6 AIR SAMPLING

A. Sampling and analysis of airborne concentrations of asbestos fibers shall be performed in accordance with the Environmental Contractor's approved air monitoring plans and as specified herein. For area sampling during asbestos abatement work, NIOSH Pub No. 84-100 Method 7400 (PCM) with optional confirmation of results by NIOSH Pub No. 84-100 Method 7402 Transmission Electron Microscopy (TEM) shall be used. All area sampling will be conducted at a sufficient flow rate and time to collect a sample volume necessary to establish the limit of detection of the method used at 0.005 f/cc. The sampling and analytical method used for final clearance air sampling shall be the EPA TEM Method specified at 40 CFR. For personal sampling required by 29 CFR 1926.1101, NIOSH Method 7400 or equivalent shall be used for sampling and Phase Contract Microscopy (PCM) analysis. Asbestos fiber concentration confirmation of the total fiber concentration results of samples collected and analyzed by NIOSH Method 7400 may be conducted. In cases where confirmation is required, analysis shall be carried out using transmission electron microscopy in accordance with NIOSH Method 7402. When such confirmation is conducted, it shall be from the same sample filter used for the NIOSH Method 7400 PCM analysis. The Environmental Monitoring Contractor shall archive sampling cassettes for the duration of the project plus [6] months.

3.7 SAMPLING PRIOR TO ASBESTOS WORK (BASELINE SAMPLES)

A. The baseline air sampling shall be established 30 days prior to the masking and sealing operations for each abatement area site. Pre-abatement air samples shall be collected at a minimum of three locations. These locations are: Outside the building, inside the building, but outside the abatement area and inside each abatement area. One sample shall be collected for each 10,000 cubic feet (ft3) of total area in the abatement work area. One additional sample shall be collected for each 5,000 ft3 of area over 10,000 ft3. The samples shall be analyzed immediately using NIOSH Method 7400 (PCM). If any of the samples result in fiber concentration greater than 0.025 f/cc, asbestos fiber concentration shall be confirmed using NIOSH Method 7402 (TEM).

3.8 SAMPLING DURING ASBESTOS ABATEMENT WORK AND OFF-SHIFT HOURS

A. The Environmental Contractor shall provide area sampling as indicated in 29 CFR 1926.1101, state and local requirements, and in accordance with the approved air monitoring plans. Area sampling shall be conducted at least once every shift, close to the work in the containment area, outside the clean room entrance to the containment area, (outside air lock for mini and modified containment areas), inside the clean room (inside the air lock for mini and modified containment areas), outside the load-out unit exit, if used, and at an exhaust discharge point of

the local exhaust system. In areas where the construction of a containment area is not required, after initial time weighted average (TWA) airborne fiber concentrations are established, and provided the same type of work is being performed, the air sampling shall be conducted at the boundary of the asbestos regulated work area in such locations and frequency, as stated in the approved air monitoring plan.

3.9 SAMPLING AFTER FINAL CLEAN-UP (FINAL CLEARANCE SAMPLING)

A. Final Cleaning and Inspections:

1. Final clearance air monitoring shall not begin until 24 hours after completion of final cleaning. The collection of samples before adequate drying of the lockdown may result in invalid clearance sample results.
2. Prior to conducting final air clearance monitoring, the Environmental Contractor and the COTR/RE shall conduct a final visual inspection of the Abatement Contractor's final cleanup of the abated asbestos regulated work area. After COTR/RE acceptance of the final cleaning, the COTR/RE will direct the Abatement Contractor to apply the lockdown encapsulant. Final clearance air monitoring shall not begin until 24 hours after COTR/RE acceptance of lockdown encapsulant application. The Environmental Contractor will provide area sampling of airborne fibers using aggressive air sampling techniques described in 40 CFR Part 763, Appendix A to Subpart E. The collected samples shall be analyzed using Transmission Electron Microscopy (TEM) by a laboratory that participates in the National Institute of Standards and Technology (NIST) National Voluntary Laboratory Accreditation Program (NVLAP).

B. Final Clearance Criteria: The final clearance air samples shall be collected under aggressive sampling conditions as defined in 40 CFR Part 763, Appendix A to Subpart E. A minimum of 5 area air samples shall be collected inside each contiguous abatement work area. A minimum of 5 area air samples per ambient area positioned at locations representative of the air entering the abatement site shall be collected. Two (2) field blanks are to be taken by removing the cap for not more than 30 seconds and replacing it at the time of sampling before sampling is initiated at the entrance to each abatement area and at one of the ambient sites. A sealed blank is to be carried with each sample set. The work area shall be considered clean when all 5 inside samples are at or below 0.005 asbestos structures per cubic centimeter (St/cc) of air. No averaging of results shall be used. The recommended volume of air for each sample shall be 1800 liters of air. The final clearance results shall also indicate that each sample is at or below 70 structures per square millimeter (St/mm2).

C. Air Clearance Failure: The Asbestos Abatement Contractor shall repeat final cleaning procedures at no additional cost to the Government if any sample exceeds the clearance criteria in 2.9.B. Failure to meet final clearance criteria for any individual sample, will require the Asbestos Abatement Contractor to pay all cost associated with additional cleaning requirements and the cost of all additional sampling and TEM analysis. If one sample fails the final clearance criteria, the complete set of samples identified in paragraph 2.9.B shall be repeated.

END OF SECTION 02 82 15

ATTACHMENT 1: MODEL AREA AIR MONITORING PLAN

The Environmental Contractor shall conduct baseline sampling sufficient to document conditions prior to abatement in each room/area to be abated and in all perimeter areas that will be included during off-shift monitoring periods. At least one baseline sample shall be collected for each 10,000 ft3 of total area inside of each area that will be abated.

The Environmental Contractor's work hours will be from [ ]. During this time, samples will be collected as follows and the results reported to the appropriate personnel within one hour after analysis: Area sampling shall be conducted at least once every shift in the following locations: close to the work in the containment area, outside the clean room entrance to the containment area, (outside air lock for mini and modified containment areas), inside the clean room (inside the air lock for mini and modified containment areas), outside the load-out unit exit, if used, and at the exhaust discharge point of the local exhaust system. [If more than one discharge point for the local exhaust ventilation system exists, each point will be sampled on the first day of asbestos abatement work. On subsequent days, at least 25% of the discharge points will be sampled each day.] [If more than one discharge point for the local exhaust ventilation system exists, each discharge point will be sampled at least once during each day that asbestos abatement activities are conducted].

Off-shift sampling shall be conducted as follows: One hour after completion of the abatement work shift all area air pumps (minimum of eight) will be set up and allowed to run until one hour prior to the beginning of the next shift. No more than 3,000 liters of air will be collected for any off-shift samples. If sampling is to take place in a dusty area, the flow rate will be reduced by a sufficient amount to ensure that the samples do not become overloaded. Analysis of off-shift samples will be by NIOSH Method 7400 (PCM).

During periods of no Abatement Contractor work activity, for example weekends, sampling will be conducted in a maximum of 12-hour cycles. For example the Environmental Contractor will arrive on-site at 0600 and place samples. Twelve hours later, at 1800, the Environmental Contractor will return to collect the samples and place new samples to be collected at 0600 the following day. The shift will be 1800 to 2000 and 0600 to 0800 on these days.

Clearance sampling shall be conducted in accordance with EPA Publication 560/5-85-024. A minimum of five samples will be collected inside of the abatement area and five samples collected outside of the abatement area following Class I and II projects and analyzed using the EPA TEM method specified in 40 CFR Part 763. Decontamination of the abated asbestos regulated work area is considered complete when the arithmetic mean concentration of the minimum of 5 inside samples is less than or equal to 70 structures per square millimeter (70 S/mm2). When the arithmetic mean is greater than 70 S/mm2, the 3 blank samples shall be analyzed. If the three blank samples are greater than 70 S/mm2, re-sampling is required. If less than 70 S/mm2, the five outside samples shall be analyzed and a Z-test analysis performed. When the Z-test results are less than 1.65, the decontamination can be considered complete. If the Z-test results are more than 1.65, the abatement is incomplete and re-cleaning is required.][A minimum of 5 samples will be collected inside the abatement area. If the work area is larger than 10,000 ft3, one additional sample will be collected for every 5,000 ft3. For instance, a 12,000 ft3 work area would require 6 samples and a 26,000 ft3 work area would require 9 samples. Decontamination of the abated asbestos regulated work area will be considered complete when each of the 5 samples is analyzed as containing less than 0.01 fibers per cubic centimeters of air using NIOSH Method 7400 (PCM).

WEEKDAY/ CONTRACTOR'S WORK DAY SCHEDULE

START TIME	LOCATION	FLOW RATE (liters/minute)	STOP TIME	VOLUME (liters)	RESULTS REPORTED
2000	A	10.0	2200	1200	2300
2000	B	9.0	2300	1620	0000
2000	C	8.0	0000	1920	0100
2000	D	7.0	0100	2100	0200
2000	E	6.0	0200	2160	0300
2000	F	5.0	0300	2100	0400
2000	G	4.0	0400	1920	0500
2000	H	3.0	0500	1620	0600
2200	A	4.0	0600	1920	0700
2300	B	5.0	0600	2100	0700
0000	C	6.0	0600	2160	0700
0100	D	7.0	0600	2100	0700
0200	E	8.0	0600	1920	0800
0300	F	9.0	0600	1620	0800
0400	G	10.0	0600	1200	0800
0500	H	3.0	2000	2700	2100
0600	A	3.0	2000	2520	2100
0600	B	3.0	2000	2520	2100
0600	C	3.0	2000	2520	2100
0600	D	3.0	2000	2520	2100
0600	E	3.0	2000	2520	2200
0600	F	3.0	2000	2520	2200
0600	G	3.0	2000	2520	2200

WEEKEND/ NON-CONTRACTOR WORK DAYS

START TIME	LOCATION	FLOW RATE (liters/minute)	STOP TIME	VOLUME (liters)	RESULTS REPORTED
0600	A	3.0	1800	2160	2000
0600	B	3.0	1800	2160	2000
0600	C	3.0	1800	2160	2000
0600	D	3.0	1800	2160	2000
0600	E	3.0	1800	2160	2000
0600	F	3.0	1800	2160	2000
0600	G	3.0	1800	2160	2000
0600	H	3.0	1800	2160	2000
1800	A	3.0	0600	2160	0800
1800	B	3.0	0600	2160	0800
1800	C	3.0	0600	2160	0800
1800	D	3.0	0600	2160	0800
1800	E	3.0	0600	2160	0800
1800	F	3.0	0600	2160	0800
1800	G	3.0	0600	2160	0800
1800	H	3.0	0600	2160	0800

ATTACHMENT 2: MODEL PERSONAL AIR MONITORING PLAN

In the event of perimeter air sample results at or above 0.02 fibers per cubic centimeter of air (f/cc) above baseline or if it is expected that the permissible exposure limit (PEL) of 0.1 f/cc will be reached or exceeded, the Environmental Contractor will notify FAA employees occupying the affected area. The Environmental Contractor will notify the COTR/RE when fiber counts exceed 0.02 f/cc above baseline. Notification will be performed in accordance with the Facility Asbestos Abatement Contingency Plan, Figure 1 Emergency Response Flow Chart. If perimeter air sampling results exceed 0.1 f/cc, the Facility Asbestos Abatement Contingency Plan and the personal monitoring program described below will be implemented:

AREA OF THE FACILITY	NUMBER OF PERSONAL SAMPLES AS REPRESENTIVE
Control Room – STMCIC (including weather and flight data)	1 to 2
Control Room per 5 Bay Areas	1 for the Supervisor and 1 AT Controller per area of specialization
Control Room – NOM	1
Outside of the Control Room – (Auto Wing, Communication, or AF Technicians, etc.)	1 per affected area
Other Personnel	At the discretion of the IH

The first personal sample will be a 30-minute excursion sample and remaining samples may be 30-minute excursion or representative of the full shift exposure of FAA employees. The personnel chosen for monitoring will be identified based on the following criteria: 1) The personnel most at risk of exposure by their proximity to released asbestos; 2) The personnel most likely to remain in the control room the longest; 3) The personnel who are most likely to stay in one area to work; and 4) The personnel willing to volunteer for the suggested sampling.

The Environmental Contractor will be responsible for the maintenance, calibration, and proper use of personal air monitoring equipment and adhering to the National Institute for Occupational Safety and Health (NIOSH) 7400 Method or equivalent for phase contrast microscopy (PCM). Environmental Contractor PCM analysts will be listed in the American Industrial Hygiene Association's Asbestos Analytical Registry. Any transmission electron microscopy (TEM) analysis will utilize the NIOSH 7402 Method and be performed by a laboratory accredited by the American Industrial Hygiene Association.

Samples will be collected per OSHA technical field manual protocols.

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SECTION 02 82 33 - REMOVAL AND DISPOSAL OF ASBESTOS CONTAINING MATERIALS

PART 1 GENERAL

1.1 REFERENCES

The latest edition of 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 Z88.2	Respiratory Protection

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

MANUAL OF ANALYTICAL METHODS, 3RD ED., VOL. 1, PHYSICAL AND CHEMICAL ANALYSIS METHOD (P&CAM)

Method 7400	Fibers
Method 7402	Asbestos Fibers

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

29 CFR 1926.1101	Asbestos

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.145	Accident Prevention Signs and Tags

UNDERWRITERS LABORATORIES, INC. (UL) PUBLICATIONS

UL 586	High Efficiency Particulate, Air Filter

1.2 DESCRIPTION OF WORK

The work covered by this section includes possible handling of friable and nonfriable materials containing asbestos 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 any 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. The potential asbestos work will be included in the demolition of the existing ATCT. Any ACM demolition will be included in the demolition of the tower. Appendices include previous reports and building plan information. Based on included reports the previously identified ACM may already have been removed.

1.2.1 Asbestos Survey

Previous asbestos Survey's were 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 SURVEY REPORT.

1.2.2 Unidentified ACM

If ACM not identified by the ASBESTOS SURVEY REPORTS, the drawings or the specifications is encountered, the Contractor shall stop work and immediately notify the Resident Engineer. Upon direction from the Resident Engineer, the Contractor may be required to conduct sampling and testing of these suspect materials in accordance with the Industrial Hygienist's recommended procedures. Payment for this additional work will be as per the contract clauses.

1.3 DEFINITIONS

1.3.1 Action level

An airborne concentration of asbestos of 0.1 fiber (longer than 5 micrometers) per cubic centimeter (f/cc) of air calculated as an eight-(8)-hour time weighted-average (TWA).

1.3.2 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).

1.3.3 Amended Water

Water containing a wetting agent or surfactant.

1.3.4 Area Monitoring

Sampling of asbestos fiber concentrations within the regulated area and outside the regulated area which is representative of the airborne concentrations of asbestos fibers which may reach the breathing zone.

1.3.5 Asbestos

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

1.3.6 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, is undertaken.

1.3.7 Asbestos Containing Material (ACM)

Material composed of asbestos of any type and in an amount greater than 1 percent by weight, either alone or mixed with other fibrous or nonfibrous materials.

1.3.8 Asbestos Fibers

Asbestos fibers having length-to-diameter ratio of at least 3 to 1 and 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).

1.3.9 Asbestos Permissible Exposure Limit (PEL)

Exposure to an airborne concentration of asbestos fibers not to exceed 0.1 fiber per cubic centimeter of air as an eight-(8)-hour time weighted average (TWA).

1.3.10 Authorized Person

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

1.3.11 Breathing Zone

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

1.3.12 Category I Nonfriable ACM

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

1.3.13 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.

1.3.14 Certified Industrial Hygienist (CIH)

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

1.3.15 Class I Asbestos Work

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

1.3.16 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 and sheeting, roofing and siding shingles, and construction mastics.

1.3.17 Class III Asbestos Work

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

1.3.18 Clean Room

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

1.3.19 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, who 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 meet 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)).

1.3.20 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.

1.3.21 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.

1.3.22 Demolition

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

1.3.23 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 shall the amount of ACM or PACM so disturbed exceed that which can be contained in one glove bag or waste bag which shall not exceed 60 inches in length and width.

1.3.24 Employee Exposure

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

1.3.25 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).

1.3.26 Encapsulate

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

1.3.27 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.

1.3.28 Fiber

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

1.3.29 Friable Asbestos Material

Material that contains more than 1 percent asbestos by weight which can be crumbled, pulverized, or reduced to powder by hand pressure when dry.

1.3.30 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.

1.3.31 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. Shall be made of 6 mil thick plastic and shall be seamless at the bottom.

1.3.32 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 particles or larger.

1.3.33 Homogeneous Area

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

1.3.34 Intact

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

1.3.35 Negative Initial Exposure Assessment

A demonstration which complies with the criteria in this section, that employee exposure during an operation is expected to be consistently below the PEL's.

1.3.36 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 material is considered hazardous during removal and disposal procedures.

1.3.37 (PACM) Presumed Asbestos Containing Material

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

1.3.38 Personal Monitoring

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

1.3.39 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 shall be in areas related to material composition, project size, number of employees and the engineering work practice and personal protection controls required.

1.3.40 Regulated Areas

An area established to demarcate areas where Class I, II and III asbestos work is conducted, and any adjoining area where debris and waste from such asbestos work 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.

1.3.40.1 Enclosed Regulated Area

A regulated area which has been isolated by physical boundaries to prevent the spread of asbestos dust, fibers, or debris. A local exhaust system is required.

1.3.41 Regulated Asbestos-Containing Material (RACM)

(a) Friable asbestos material

(b) Category I nonfriable ACM that has become friable

(c) Category I nonfriable ACM that will become or has been subjected to sanding, grinding, cutting, or abrading; and

(d) Category II nonfriable ACM that has a high probability of becoming crumbled, pulverized, or reduced to powder by the forces acting on the material in the course of the demolition or renovation operation.

1.3.42 Thermal System Insulation (TSI)

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

1.3.43 Thermal System Insulation ACM

Thermal system insulation which contains more than 1% asbestos.

1.3.44 Time Weighted Average (TWA)

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

1.4 SUBMITTALS

The following shall be submitted in accordance with Section “SUBMITTALS” and approved by the Resident Engineer prior to commencing any work involving asbestos materials:

SD-01: Data

Local Exhaust Equipment

HEPA Vacuum Equipment

Respirators

SD-08: Statements

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 along with certification that persons counting 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.

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 is experienced in asbestos removal activities.

Prior Experience
(1) 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 shall furnish for Government approval (for himself or for his selected asbestos removal subcontractor) written demonstration of successfully completed asbestos abatement projects of similar nature and scope. A short summary of three (3) asbestos abatement projects performed shall 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 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 shall 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 shall further document that at least one on-site representative, such as a foreman or management-level person or other authorized representative, trained in the provisions of this regulation and the means of complying with them, is present. Every 2 years, the trained on-site individual shall receive refresher training in the provisions of this regulation. The required training shall 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 recordkeeping; and asbestos hazards and worker protection. Evidence that the required training has been completed shall be posted and made available for inspection by the NESHAPS-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 in which the Contractor (or employees scheduled to participated in this project) have participated or are currently involved. Include descriptions of role, issue and resolution to date.

Asbestos Plan

Submit a detailed Plan of the work procedures to be used in the removal and disposal of materials containing asbestos and include an explanation of the Initial Exposure Assessment. The Plan shall be prepared, signed, and sealed, including certification number and date, by the Contractor's Industrial Hygienist. Such Plan shall 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 shall 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 pollution. The Plan shall be approved by the Resident Engineer prior to the start of any asbestos work. Prior to beginning work, the Contractor shall meet with the Resident Engineer to discuss in detail the Asbestos Plan, including work procedures and safety precautions.

Notification Requirements

a. Initial Notification

The Contractor shall:

(1) Provide the U.S. Environmental Protection Agency (EPA) Regional NESHAPS-administering agency with the notice of intention to demolish or renovate. Copies of this form and any renotification forms shall be furnished to the Resident Engineer. Work shall not commence on any dates other than those stated in the notification without renotification of all parties. Delivery of the notice by U.S. Postal Service, commercial delivery service, or hand delivery is acceptable.

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

(3) Postmark or deliver the notice as follows:

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 material.

b. Renotification

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 NESHAPS-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 NESHAPS-administering agency of the new start date by telephone as soon as possible before the original start date, and

(b) Provide the NESHAPS-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 or removal operation or demolition operation covered by this paragraph will begin on a date earlier than the original start date, provide the NESHPAS-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 shall 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 shall 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) Description of the facility or affected part of the facility including the size (square feet and number of floors), age, and present 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 feet, surface area in square feet on other facility components, or volume in cubic feet if off the facility components. Also, estimate the approximate amount of

Category I and Category II nonfriable ACM in the affected part of the facility that will not be removed before demolition.

(7) Location and street address (including building number or name and floor or room number, if appropriate), city, county, and state, of the facility being demolished or renovated.

(8) Description of procedures to be followed in the event that unexpected RACM is found or Category II nonfriable ACM becomes crumbled, pulverized, or reduced to powder.

SD-09: Reports

Monitoring Results

Fiber counting shall be completed and results reviewed by the Industrial Hygienist within 16 hours. The Industrial Hygienist shall notify the Contractor and the Resident Engineer immediately of any exposures to fibers in excess of the acceptable limits. Submit monitoring results to the Resident Engineer within 3 working days, signed by the testing laboratory employee performing air monitoring, the employee that tested the sample, and the Industrial Hygienist.
Job Progress Report

During abatement activities, the Industrial Hygienist shall submit a weekly job progress report to the Resident Engineer detailing abatement activities. Include review of progress with respect to Asbestos Plan, milestones and schedules, major problems and actions taken, injury reports, equipment breakdown and a compilation of the week's 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 shall be signed by the Contractor, asbestos abatement subcontractor and the Industrial Hygienist.

SD-18: Records

Landfill Delivery Records

Submit written evidence that the landfill for disposal is approved for asbestos disposal by the state and local regulatory agencies. Submit copies of all waste shipment records and resulting correspondence.

1.5 TITLE TO MATERIALS

Materials resulting from demolition work, except as specified otherwise, shall become the responsibility of the Contractor and shall 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.

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 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

Institute 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 30 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.

1.10 TRAINING

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 Industrial Hygienist 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 1926.58 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.

1.11 Accreditation of Asbestos Removal Personnel

a. In order to qualify for initial accreditation as an asbestos project supervisor, a person shall meet the following requirements:

(1) Have a minimum of six (6) months experience as an asbestos project supervisor or as an asbestos worker.

(2) Have attend an approved training course for asbestos project supervision and received a passing score on the written examination for such course during the twelve (12) months prior to submitting an application.

b. In order to qualify for initial accreditation as an asbestos worker, a person shall have attended an approved training course for asbestos workers or an approved training course for asbestos project supervisors and received a passing score on the written examination for such course during the twelve(12) months prior to submitting an application.

1.12 PERMITS

Obtain necessary permits in conjunction with this project for the transportation and disposition of asbestos containing materials, and provide timely notification of such actions as may be required by Federal, State, regional, and local authorities.

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 requirement shall apply.

PART 2 PRODUCTS

2.1 EQUIPMENT AND MATERIAL USED IN REMOVAL OPERATIONS

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

2.2 RESPIRATORS

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. Provide personnel engaged in the removal or demolition of pipes, structures, or equipment covered or insulated with asbestos, or in the removal or demolition of asbestos insulation or covering, with Type C supplied air respirators. During the performance of work when removal or demolition of asbestos materials is not underway and after the TWA and ceiling limit has been established, the Contractor shall provide respirators as required in 29 CFR 1926.1101(h)

RESPIRATOR PROTECTION FOR ASBESTOS FIBERS

Airborne concentration of asbestos or condition of use	Required respirator
Not in excess of 1 f/cc (10XPEL), or otherwise as required independent of exposure	Half-mask air purifying respirator other than a disposable respirator, equipped with high efficiency filters.
Not in excess of 5 f/cc (50XPEL).	Full facepiece 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.
Not in excess of 100 f/cc (1,000XPEL), or unknown. concentration	Full facepiece supplied air respirator operated in pressure demand mode, equipped with an auxiliary positive pressure self-contained breathing apparatus.

*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.

(3) Respirator program. Establish a respirator program as required by ANSI Z88.2-80 and 29 CFR 1910.134.

2.3 SPECIAL CLOTHING

2.3.1 Protective Clothing

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

2.3.2 Work Clothing

Provide cloth work clothes to wear under the protective coveralls and foot covering.

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 1910.14(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.

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 shall 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 inch of water and accuracy within plus or minus 1.0 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 shall 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 shall 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, shall 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, shall 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 shall utilize HEPA filtration systems.

2.8.5 Water Sprayer

The water sprayer shall 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 shall be penetrating sealants and shall meet the following criteria:

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

b. Sealants selected for use by the Contractor shall be one of those demonstrating probable effective performance under the tests conducted by an independent testing laboratory and are approved by the Resident Engineer.

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

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

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

f. They shall be acceptable weathering and aging characteristics.

g. They shall be acceptable by architectural standards.

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

i. They shall 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.

Establish a respirator program as required by ANSI Z88.2 and 20 CFR 1910.135.

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 operations 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 worksuits in the equipment room using a HEPA vacuum before proceeding to a shower.

For employees performing Class I work involving less than 25 linear or 10 square feet of TSI or surfacing ACM and PACM, and for Class II and Class III work where exposures exceed a PEL, establish a equipment room or area that is adjacent to the regulated area which is covered by a impermeable drop cloth on the floor or horizontal working surface. The area must be of sufficient size as to accommodate cleaning of equipment and removing personal protective equipment. Ensure that employees enter and exit the regulated area through the equipment room or area.

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 unobstructed path to the work sites. During asbestos removal, the Contractor shall 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 Resident Engineer or his authorized representative shall be final.

3.1.6 Preparation for Removal

3.1.6.1 Movable Furnishings

Some 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. Contractor to remove any remaining items prior to start of asbestos work.

3.1.6.2 Pre-Cleaning

All wall and floor surface areas, other than those from which surface areas, other than those from which asbestos is to be removed, and all non-movable asbestos is to be removed, and all non-movable furnishings, equipment, and fixtures remaining in the work area shall 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 shall be suitably protected as approved by the Resident Engineer. Items in the work area which may require access by User during abatement shall be designated during the pre-abatement walkthrough and enclosures constructed with access flops sealed with waterproof tape.

3.1.7 Regulated Areas

All Class I, II, and III asbestos work shall be conducted within regulated areas. The regulated area shall 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 shall be provided and displayed pursuant to 29 CFR 1026.1101(k)(6). Access to regulated areas shall be limited to authorized persons. All persons entering a regulated area where employees are required to wear respirators, shall be supplied with a respirator. All asbestos work performed within regulated areas shall be supervised by a competent person.

3.1.7.1 Non-Enclosed Regulated Area Requirements

The construction of an enclosed regulated area is impractical for removal activities. Provide a 20-foot roped off perimeter around the area where asbestos handling procedures are performed and maintain other requirements for regulated areas. Also, where an enclosure is not provided, conduct personal and area monitoring of airborne fibers during the work shift at the designated limits downwind of the asbestos work area at not less than once every 4 hours. If the concentration of airborne asbestos fibers monitored

at the designated limits at any time exceeds the lesser of two times the background or the action level, evacuate personnel in adjacent areas. If adjacent areas are contaminated, clean the contaminated areas, monitor, and visually inspect the area as specified herein.

3.2 ASBESTOS ABATEMENT PROCEDURES

3.2.1 Initial Exposure Assessment

Ensure that a "competent person" conducts an exposure assessment immediately before or at the initiation of the operation to ascertain expected exposures during that operation or workplace. The assessment must be completed in time to comply with requirements which are triggered by exposure data or the lack of a "negative exposure assessment," and to provide information necessary to assure that all control systems planned are appropriate for that operation and will work properly.

An Initial Exposure Assessment shall 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 shall 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 shall 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 shall 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, shall 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 employee 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 shall be used during all Class I work, during all Class II work where the ACM is not removed in a substantially intact state, during all Class II and III work which is not performed using wet methods, during all Class II and III work where a negative exposure assessment is not produced, and during all Class III jobs where TSI or surfacing ACM or PACM is being disturbed. Provide the appropriate respirator as specified.

3.2.4 Controls and Work Practices

The following controls and work practices shall 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 collection device equipped with a HEPA filter

The following work practices and controls shall 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 shall be used for all Class I work.

a. Installation and operation of the control systems, shall 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 shall 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, Subpt. 3, or that perimeter area levels are no more than background levels representing the same area before the asbestos work began.

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

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

e. All objects within the regulated area shall be 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 Negative Pressure Enclosure (NPE) Systems

A Negative Pressure Enclosure (NPE) System shall be used where the configuration of the work area does not make the erection of the enclosure infeasible. Specifications and work practices shall be as required in 29 CFR 1926.1101(g)(5).

3.2.5.2 Glovebag Systems

Glovebag systems shall be used to remove PACM and/or ACM from straight runs of piping with the following specifications and work practices. Each glovebag shall be installed so that it completely covers the circumference of pipe or other structure where the work is to be done. Shall be smoke- tested for leaks and any leaks sealed prior to use and may be used only once and may not be moved. Shall not be used on surfaces whose temperature exceeds 150 degrees. Prior to disposal, they shall be collapsed by removing air within them using a HEPA vacuum. Before beginning the operation, loose and friable material adjacent to the glovebag/box operation shall be wrapped and sealed in two layers of six mil plastic or otherwise rendered intact.

Where system uses attached waste bag, such bag shall be connected to collection bag using hose or other material which shall withstand pressure of ACM waste and water without losing its integrity. Sliding valve or other device shall separate waste bag from hose to ensure no exposure when waste bag is disconnected.

At least two persons shall be required to perform Class I glovebag removals.

3.2.5.3 Negative Pressure Glove Bag Systems

A Negative Pressure Glove Bag System shall be used to remove ACM or PACM from piping. Attach HEPA vacuum systems or other devices to bag to prevent collapse during removal and run continually during the operation. Where a separate waste bag is used along with a collection bag and discarded after one use, the collection bag may be reused if rinsed clean with amended water before reuse.

3.2.5.4 Negative Pressure Glove Box Systems

A Negative Pressure Glove Box System shall be used to remove ACM or PACM from pipe runs. Box shall be constructed with rigid sides and made from metal or other material which can withstand the weight of the ACM and PACM and water used during removal. A negative pressure generator shall be used to create negative pressure in system. An air filtration unit shall be attached to the box. The box shall be fitted with gloved apertures. An aperture at the base of the box shall serve as a bagging outlet for waste ACM and water. A back-up generator shall be present on site. The box shall be smoke tested prior to each use. At least two persons shall perform the removal.

3.2.5.5 Water Spray Process System

A Water spray Process System shall be used for removal of ACM and PACM from cold line piping if, employees carrying out such process have completed a 40-hour separate training course in its use, in addition to training required for employees performing Class I work. Piping shall be surrounded on 3 sides by rigid framing. A 360 degree water spray, delivered through nozzles supplied by a high pressure separate water line, shall be formed around the piping. The system shall be operated by at least three persons, one of whom shall not perform removal, but shall check equipment, and ensure proper operation of the system. After removal, the ACM and PACM shall be bagged while still inside the water barrier.

3.2.5.6 Intact Asbestos Insulated Pipe Removal

When both piping and insulation are to be removed tintact, wet he insulation, then, using glovebag technique, remove 10-inch to 12-inch section of the pipe insulation and encapsulate exposed edges of the asbestos insulation to remain, remove the glovebag, cut and remove the intact insulated pipe. Long components removed intact may be wrapped in 2 layers or 6-mil polyethylene sheeting secured with tape at the ends, prior to or after cutting the pipe, for transport to the landfill. Intact insulated pipe shall be removed in manageable sections.

3.2.6 Class II Abatement Requirements

Class II asbestos work shall be performed by complying with work practices and controls designated for each type of asbestos work to be performed set out in 29 CFR1926.1101((g)(7). Class II work also may be performed using a method allowed for Class I work, except that glove bags and glove boxes are allowed if they fully enclose the Class II material to be removed.

3.2.6.1 Vinyl and Asphalt Flooring Materials

For removing vinyl and asphalt flooring materials which contain ACM or for buildings constructed prior to 1980:

a. Flooring or its backing shall not be sanded.

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

c. Resilient sheeting shall 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 shall 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 shall 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 shall be assumed to be asbestos-containing unless an industrial hygienist determines that it is asbestos-free using recognized analytical techniques.

3.2.6.2 Roofing Material Removal

a. Roofing material shall be removed in an intact state to the extent feasible.

b. Wet methods shall be used where feasible.

c. Cutting machines shall be continuously misted during use, unless a competent person determines that misting substantially decreases worker safety.

d. All loose dust left by the sawing operation must be HEPA vacuumed immediately.

e. Unwrapped or unbagged roofing material shall be immediately lowered to the ground via covered dust-tight chute, crane or hoist, or placed in an impermeable waste bag or wrapped in plastic sheeting and lowered to ground no later than the end of the work shift.

f. Upon being lowered, unwrapped material shall be transferred to a closed receptacle in such manner so as to preclude the dispersion of dust.

g. Roof level heating and ventilation air intake sources shall be isolated or the ventilation system shall be shut off.

3.2.6.3 Cementitious Asbestos-Containing Siding and Shingles or Transite Panels

a. Cutting, abrading or breaking siding, shingles, or transite panels, shall be prohibited unless the employer can demonstrate that methods less likely to result in asbestos fiber release cannot be used.

b. Each panel or shingle shall be sprayed with amended water prior to removal.

c. Unwrapped or unbagged panels or shingles shall be immediately lowered to the ground via covered dust-tight chute, crane or hoist, or placed in an impervious waste bag or wrapped in plastic sheeting and lowered to the ground no later than the end of the work shift.

d. Nails shall be cut with flat, sharp instruments.

3.2.6.4 Gaskets Containing ACM

a. If visibly deteriorated and unlikely to be removed intact, removal shall be undertaken within a glovebag.

b. The gasket shall be thoroughly wetted with amended water prior to its removal.

c. The wet gasket shall be immediately placed in a disposal container.

d. Any scraping to remove residue must be performed wet.

3.2.6.5 Transite Board Removal Method

The wallboard material shall be sprayed with a lockdown sealant in order to reduce the potential of fiber release and the fasteners and board shall be removed. After removal, the wallboard shall be wrapped in two layers of 6-mil plastic and sealed with tape. If the size of the wallboard permits, the wrapped material shall be placed in drums for disposal. The wallboard shall not be sawed, crushed or abraded at any time during removal. Clean up shall consist of HEPA vacuuming any accumulated asbestos debris and spraying of lockdown sealant on the framing to which the wallboard material was fastened.

3.2.6.6 Trowelled-On Wall Plaster Removal Method

The material is sprayed with amended water and saturated sufficiently to wet it to the substrate without causing excess dripping. Remove the saturated material in small sections. The asbestos material is sprayed repeatedly during the work process to maintain wet conditions and to minimize asbestos fiber dispersion. As it is removed, the material is placed in 6-mil plastic bags and appropriate containers for disposal.

3.2.6.7 Any other Class II Removal of ACM

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

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

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

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

3.2.7 Class III Asbestos Work

Class III work shall be performed using wet methods. To the extent feasible, work shall be performed using local exhaust ventilation. Where disturbance involves drilling, cutting, etc., use impermeable dropcloths, and shall isolate the operation using mini-enclosures or glovebag systems. Work which involves the disturbance of TSI requires respirators.

3.3 COLLECTION

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

The following types of non-friable ACM that may be found in this project are considered non-RACM and do not require special collection action:
Vinyl Asbestos Flooring
Asphalt Roofing

All notification requirements are still applicable, however, to Non-RACM.

3.3.2 Regulated Asbestos Containing Material (RACM)

Asbestos containing material shall be removed in manageable sections. Removed material should be containerized before moving to a new location for continuance of work. Surrounding areas within the 20-foot perimeter shall be periodically sprayed and maintained in a wet condition until visible material is cleaned up.

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. Clean all surfaces in the work area and other contaminated areas with water. When asbestos removal, disposal, and cleanup are complete, the Contractor shall certify, in writing, that the concentration of airborne fibers in the regulated area is less than 0.0l fibers (longer than 5 micrometers) per cubic centimeters of air. Do not remove the regulated area enclosure or roped-off perimeter and caution signs prior to the Resident Engineer's receipt of the certification. After final cleanup, remove filters on the building HVAC system and provide new filters. Dispose of filters as asbestos-contaminated waste. Reestablish HVAC, mechanical, and electrical systems in proper working order. The Resident Engineer will visually inspect the affected surfaces for residual asbestos material and accumulated dust; the Contractor shall reclean areas showing dust or residual asbestos materials. If recleaning is required, monitor the airborne fiber concentration after recleaning. Notify the Resident Engineer before unrestricted entry is permitted. The Government shall have the option to perform independent monitoring to certify the areas are safe before entry is permitted.

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 and shall also be labeled with the name of the Contractor and the location at which the waste was generated. Place bags in disposable asbestos-waste drums. Steel drums are not allowed.

Label wrapped materials that will not fit in drums in the same manner as described in para. 1. above.

3.3.2.1 Removing Material Intact

Asbestos containing material removed from the building shall not be dropped or thrown to the ground. Material should be removed as intact sections whenever possible and carefully lowered 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 shall be kept wet at all times.

3.3.2.2 Containers

Containers (drums or 6-mil polyethylene bags) shall be sealed when full. Wet material will be heavy and double bagging of waste material is usually necessary. A determination of need for single or double bags must be made early in the abatement process and approved by the Resident Engineer. Bags, if used, shall not be overfilled. They should be securely sealed to prevent accidental opening and leakage by tying tops of bags in an overhand knot or by taping in gooseneck fashion. Do not seal bags with wire or cord. Bags may be placed in drums for staging and transportation to the landfill. Bags shall 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 shall submit, in the asbestos plan, an alternate proposal for removal, containerizing, and disposal of the asbestos materials and fibers.

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 shall be placed into drums for disposal.

3.3.2.4 Asbestos Contaminated Soil

The removed soil shall be placed in 6-mil plastic bags, sealed and then placed in asbestos 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 shall 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 shall contain a series of several filters with progressively smaller pore sizes to avoid rapid clogging of the system by large particles. Disposable filters shall be treated as asbestos waste.

3.4 DISPOSAL OF ACM

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

The following types of non-friable ACM that may be found in this project are considered non-RACM and do not require special disposal action:

Vinyl Asbestos Flooring
Asphalt Roofing

All notification requirements are still applicable, however, to Non-RACM.

3.4.2 Regulated Asbestos Containing Material (RACM)

1. Once drums, bags and otherwise containerized asbestos containing materials have been removed from the work area, they shall be loaded into an enclosed truck for transportation to the designated landfill. Asbestos waste shall not be allowed to be placed in trucks with non-asbestos waste.

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

3. Drums shall 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.

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

5. Large steel dumpsters (roll-off type) 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 shall not be placed in these type dumpsters, nor shall they be used for non-asbestos waste. Bags shall be placed, not thrown, into these containers to avoid splitting.

6. Dispose of waste asbestos material at a state permitted sanitary landfill off Government property.

7. For temporary storage, store sealed impermeable bags in asbestos waste drums. An area for interim storage of asbestos waste-containing drums will be assigned by the Resident Engineer 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 shall be allowed to remain at the site overnight.

8. Procedure for hauling and disposal shall comply with 40 CFR 6l, Subpart M, 40 CFR 241, 40 CFR 257, and State, regional and local standards. Vehicles used to transport asbestos-containing waste material must be marked as follows:

Mark vehicles used to transport asbestos-containing waste material during the loading and unloading of the waste so that the signs are visible. 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.

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

10. Bags, drums and components shall be inspected as they are offloaded at the disposal site. Material in damaged containers shall be repacked in empty drums or bags as necessary.

11. Waste containers shall 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.

12. Personnel off-loading containers at the disposal site shall wear protective equipment consisting of disposable head, body and foot protection and, at a minimum, half-facepiece, air-purifying, dual cartridge respirators equipped with high efficiency particulate air (HEPA) filters. Following the removal of all

containerized waste, the truck cargo area shall be decontaminated to meet the no visible residue criteria. Polyethylene sheeting shall 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, Contractor shall supply protective clothing and respiratory protection for the duration of this operation.

13. Shipment Records

a. Maintain waste shipment records, using a form similar to that shown 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 yards).

(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, and 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 shall 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 Resident Engineer within 3 working days following delivery of asbestos containing waste material (ACWM), copies of all waste shipment records. Also within 3 working days of initiation, provide to the Resident Engineer 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.

3.4.3 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 Visual Inspection after Cleanup

Prior to the performance of final air monitoring, the Contractor and the Resident Engineer or his representative shall perform a visual inspection for asbestos dust/residue. If residue is found, additional wipedown/vacuuming shall be performed to satisfaction of the Resident Engineer.

3.5.2 Monitoring After Final Cleanup

After the removal site has passed the visual inspection, provide area monitoring of fibers (at least 3 samples per removal site) under aggressive conditions and establish the TWA of less than 0.0l fibers (longer than 5 micrometers) per cubic centimeter of air after final cleanup but before removal of the enclosure of the regulated area. Provide area monitoring and establish the TWA 2 days and 5 days after the enclosure of the regulated area is removed. Provide area monitoring and establish the TWA after final cleanup when an enclosure is not required. The fiber counts from the samples shall be less than 0.0l fibers (longer than 5 micrometers) per cubic centimeter of air or be not greater than the reference TWA, whichever is less. Should any of the final samplings indicate a higher value, the Contractor shall take appropriate actions to reclean the area and shall repeat the monitoring.

3.5.3 Sampling

Sampling under aggressive conditions shall include the following procedures:

a. Before starting the sampling pumps, direct the exhaust from forced air equipment (such as 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 slow 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.

3.5.4 Air Clearance Failure

Should clearance sampling results fail to meet the final cleanup requirements, the Contractor shall take appropriate action at no additional cost to the Government, to reclean, resample, and analyze data until final cleanup requirements are met.

3.5.5 Site Inspection

While performing asbestos removal work, the Contractor shall be subject to onsite inspection by the Resident Engineer who may be assisted by safety or health personnel. If the work is in violation of specification requirements, the Resident Engineer 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 shall be at the Contractor's expense.

3.5.6 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 shall be coated with an approved lockdown sealant to permanently bind any remaining fibers in place. Sealant shall be applied by airless sprayers and in accordance with the sealant manufacturers recommendations.

3.5.7 Sealant Tint

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

3.5.8 Reestablishment of the Work Area

Reestablishment of the work area shall only occur following the completion of clean-up procedures and after clearance air monitoring has been performed and documented to the satisfaction of the Resident Engineer.

3.5.9 Visual Inspection

The Contractor and Resident Engineer shall visually inspect the work area for any remaining visible residue. Evidence of asbestos materials will necessitate additional cleaning requirements.

3.5.10 Clearance of Work Area

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

3.5.11 Remaining Building Demolition Procedures

Contractor may proceed with remaining building demolition procedures.

END OF SECTION 02 82 33

CERTIFICATE OF WORKER'S RELEASE

DATE: _____

TO: _____
(Insert Owner's Name and Address)

RE: _____
(Insert Project Name and Address)

In consideration of my employment by _____in
(Contractor)
connection with the removal and disposal of asbestos, or other work in asbestos-contaminated work areas, and in consideration of the sum of ONE AND NO/100 ($1.00) DOLLAR and other good and valuable consideration in hand paid, at and before the sealing and delivery of these presents, the receipt, sufficiency, and adequacy of which are hereby acknowledged, the undersigned does hereby acknowledge, warrant, represent, covenant, and agree as follows:

1. I acknowledge and understand that I have been or will be employed in connection with the removal of, disposal of, or other treatment to, asbestos, or other work in asbestos-contaminated work areas, and I acknowledge that in handling asbestos and breathing asbestos dust, including, but not limited to, THE FACT THAT ASBESTOS CAN CAUSE ASBESTOSIS AND IS A KNOWN CARCINOGEN, AND CAN THEREFORE CAUSE VARIOUS TYPES OF CANCER.

2. I acknowledge and understand that ANY CONTACT WITH ASBESTOS, WHETHER IT CAN BE SEEN OR NOT, MAY CAUSE ASBESTOSIS AND VARIOUS FORMS OF CANCER, WHICH MAY NOT SHOW UP FOR MANY YEARS, AND I covenant and agree faithfully to take all precautions required of me.

3. I knowingly assume all risks in connection with potential exposure to asbestos and I do hereby release and forever discharge Owner, Architect, independent laboratory or engineers employed by the Owner or Architect, and all of their directors, officers, employees, nominees, personal representatives, affiliates, successors, and assigns from and against any and all liability whatsoever, at common law or otherwise, except any rights which the undersigned may have under the provisions of the applicable Workmen's Compensation Laws. Expect as specifically set forth herein, I hereby waive and relinquish any and all claims of every nature which I now have or may have or claim to have which are in any way, directly or indirectly related to exposure of asbestos and asbestos-containing materials.

_____	_____
Name of Worker (Must be typed)	Signature of Worker (As acknowledgement of reading this page of this two-page Certificate.)

CERTIFICATE OF WORKER'S RELEASE, Cont.

4. I hereby warrant and represent that I have not been disabled, laid-off, or compensated in damages or otherwise, because of the disease of asbestosis.

SIGNATURE_____

SOCIAL SECURITY NUMBER_____

SIGNED IN PRESENCE OF:

_____
Notary No. and Seal

(Submit one copy for each employee prior to employee staring work.)

SPECIAL ENDORSEMENT (INSURANCE)

Attached to and forming a part of Policy No. _____of the
_____ issued at is _____ Agency.
(Name of Insurance Company) (City) (State)

Date of endorsement_____for

_____
(Name of Project)

In consideration of the premium for which the policy is written and proper rate adjustment when applicable, the insurance company agrees as follows:

> The insurance company agrees that this policy shall not be cancelled, changed, allowed to lapse, or expire until 30 days after the Owner has received written notice thereof as evidenced by return receipt of registered letter or until such time as other valid and effective insurance coverage acceptable in every respect to the Owner and providing protection equal to protection called for in the policy shown below shall have been received, accepted, and acknowledged by the Owner.
>
> The insurance company acknowledges and agrees that this policy is applicable for Contractor or Subcontractor whose business is asbestos removal or asbestos abatement.
>
> Any other provisions to the contrary notwithstanding, coverage under this policy shall specifically include all operations of asbestos abatement required by the project named above.

The forgoing insurance provisions have been incorporated into the reference and are hereby made a part of Insurance Policy No. _____, this _____ day of _____, 20__.

_____
(Name of Company)

_____
(Signature of Authorized Representative)

EMPLOYEE SAFETY INSTRUCTION FORM

Employee Name: _____

Employee Address: _____

Employee Telephone No.: _____

Union Card Number: _____

Classification of Worker: _____

Have you had in the past, or present, any respiratory problems?

Yes_____No _____

Have you worked in the past with asbestos or fiberglass type materials?

Yes _____No _____

The project you will be working on involves the use of asbestos and the removal of the asbestos from the building. Asbestos is considered a health hazard.

The company is supplying all necessary safety clothing and working conditions required and necessary for your protection from asbestos hazard.

You shall be instructed at commencement of the job on the required use of safety equipment, clothing, working conditions and procedures. These must be rigidly adhered to. Smoking is not permitted in the work areas. Disregarding of safety instructions shall result in instant dismissal.

I acknowledge that safety instructions have been given to my by the company at my work commencement and I am thoroughly conversant with them and have answered the above questions truthfully.

Signed _____
Employee

Date _____

(Submit one copy for each employee prior to employee starting work.)

RESPIRATOR TRAINING CERTIFICATION

PROJECT NAME: _____

I hereby certify that I have been trained in the use of each type of respiratory protection equipment required for use on this Project. The training included the following:

1. Explanation of dangers related to misuse.

2. Instruction on putting on, fitting, testing and wearing the respirator.

3. Instruction on inspection, cleaning and maintaining the respirator.

4. Instruction on emergency situations.

I further certify that I understand the use, care and inspection of the respirator and have tested and work the unit.

Signed: _____

Date: _____

Superintendent's Signature: _____

(Submit one copy for each employee prior to employee starting work)

CERTIFICATE OF VISITOR'S RELEASE

DATE: _____

TO: _____
(Insert Project Name and Address)

In consideration of my visit(s) to the above named project in connection with the removal and disposal of asbestos, or other work in asbestos-contaminated work areas, the undersigned does hereby acknowledge, warrant, represent, covenant, and agree as follows:

1. I acknowledge and understand that I have been or will be employed in connection with the removal of, disposal of, or other treatment to, asbestos, or other work in asbestos contaminated work areas, and I acknowledge that I have been advised of and I understand the dangers inherent in handling asbestos and breathing asbestos dust, including, but not limited to, THE FACT THAT ASBESTOS CAN CAUSE ASBESTOSIS AND IS A KNOWN CARCINOGEN AND CAN, THEREFORE, CAUSE VARIOUS TYPES OF CANCER.

2. I acknowledge and understand that ANY CONTACT WITH ASBESTOS, WHETHER IT CAN BE SEEN OR NOT, MAY CAUSE ASBESTOSIS AND VARIOUS FORMS OR CANCER, WHICH MAY NOT SHOW UP FOR MANY YEARS, and I covenant and agree faithfully to take all precautions required of me.

_____
Signature of Visitor
(as acknowledgement of reading this page 1 of this two-page Certificate)

3. I knowingly assume all risks in connection with potential exposure to asbestos and I do hereby, for myself and my heirs at law, release and forever discharge Owner, Owner'sRepresentative, Architect, independent testing laboratory or engineers employed by the Owner, Owner's Representative, Architect, and all of their directors, officers, employees, nominees, personal representatives, affiliates, successor, and assigns from and against any and all liability whatsoever, at common law or otherwise, except any rights the applicable workmen's compensation laws. Except as specifically set forth herein I hereby waive and relinquish any and all claims of every nature which I now have or may have or claim to have which are in any way, directly or indirectly, related to exposure to asbestos and asbestos-containing materials.

4. I hereby warrant and represent that I have not been disabled, laid-off, or compensated in damages or otherwise, because of the disease of asbestosis.

Signature_____

Social Security Number_____

Signed in presence of:

_____
(General Superintendent)

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SECTION 02 83 33- REMOVAL AND DISPOSAL OF PAINT WITH LEAD

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z88.2	Respiratory Protection

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1926.103	Respiratory Protection
29 CFR 1926.21	Safety Training and Education
29 CFR 1926.33	Access to Employee Exposure and Medical Records
29 CFR 1926.55	Gases, Vapors, Fumes, Dusts, and Mists
29 CFR 1926.59	Hazard Communication
29 CFR 1926.62	Lead
29 CFR 1926.65	Hazardous Waste Operations and Emergency Response
40 CFR 260	Hazardous Waste Management System: General
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 263	Standards Applicable to Transporters of Hazardous Waste
40 CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 268	Land Disposal Restrictions
40 CFR 745	Lead-Based Paint Poisoning Prevention in Certain Residential Structures

49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements
49 CFR 178	Specifications for Packagings

UNDERWRITERS LABORATORIES (UL)

UL 586	Standard for High-Efficiency Particulate, Air Filter Units

1.2 DEFINITIONS

1.2.1 Abatement

"Abatement" means any set of measures designed to permanently eliminate lead-based paint hazards in accordance with standards established by appropriate Federal agencies. Such term includes:

a. The removal of lead-based paint and lead-contaminated dust, the permanent containment or encapsulation of lead-based paint, the replacement of lead-painted surfaces or fixtures, and the removal or covering of lead contaminated soil; and

b. All preparation, cleanup, disposal, and post-abatement clearance testing activities associated with such measures.

1.2.2 Action Level

Employee exposure, without regard to use of respirators, to an airborne concentration of lead of 30 micrograms per cubic meter of air averaged over an 8 hour period in a work environment.

1.2.3 Area Sampling

Sampling of lead concentrations within the lead control area and inside the physical boundaries, which is representative of the airborne lead concentrations but is not collected in the breathing zone of personnel.

1.2.4 Child Occupied Facility

A building or portion of a building constructed prior to 1978 visited regularly by the same child, 6 years of age or under, on a least two different days within any week, provided each days visit last at least 3 hours and the combined weekly visit last at least 6 hours and the combined annual visit last at least 60 hours. Child occupied facilities may include, but are not limited to FAA day-care centers.

1.2.5 Competent Person (CP)

As used in this section, refers to a person employed by the Contractor who is trained in the recognition and control of lead hazards in accordance with current federal, State, and local regulations. A Certified Industrial Hygienist (CIH) certified for comprehensive practice by the American Board of Industrial Hygiene or a Certified Safety Professional (CSP) certified by the Board of Certified Safety Professionals is required.

1.2.6 Contaminated Room

Refers to a room for removal of contaminated personal protective equipment (PPE).

1.2.7 Decontamination Shower Facility

That facility that encompasses a clean clothing storage room, and a contaminated clothing storage and disposal rooms, with a shower facility in between.

1.2.8 Deleading

Activities conducted by a person who offers to eliminate lead-based paint or lead-based paint hazards or to plan such activities in commercial buildings, bridges or other structures.

1.2.9 Eight-Hour Time Weighted Average (TWA)

Airborne concentration of lead to which an employee is exposed, averaged over an 8 hour workday as indicated in 29 CFR 1926.62.

1.2.10 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 or larger size particles.

1.2.11 Lead

Metallic lead, inorganic lead compounds, and organic lead soaps.

1.2.12 Lead-Based Paint (LBP)

Paint or other surface coating that contains lead in excess of 1.0 milligrams per centimeter squared or 0.5 percent by weight.

1.2.13 Lead-Based Paint Activities

In the case of target housing or child occupied facilities, lead-based paint activities include; a lead-based paint inspection, a risk assessment, or abatement of lead-based paint hazards.

1.2.14 Lead-Based Paint Hazard (LBP Hazard)

Any condition that causes exposure to lead from lead-contaminated dust, lead-contaminated soil, lead-based paint that is deteriorated or present in accessible surfaces, friction surfaces, or impact surfaces that would result in adverse human health effects.

1.2.15 Paint with Lead (PWL)

Any paint that contains lead as determined by the testing laboratory using a valid test method. The requirements of this section does not apply if no detectable levels of lead are found using a quantitative

method for analyzing paint using laboratory instruments with specified limits of detection (usually 0.01%). An X-Ray Fluorescence (XRF) instrument is not considered a valid test method.

1.2.16 Lead Control Area

A system [of control methods] to prevent the spread of lead dust, paint chips or debris to adjacent areas that may include temporary containment, floor or ground cover protection, physical boundaries, and warning signs to prevent unauthorized entry of personnel. HEPA filtered local exhaust equipment may be used as engineering controls to further reduce personnel exposures or building/outdoor environmental contamination.

1.2.17 Lead Permissible Exposure Limit (PEL)

Fifty micrograms per cubic meter of air as an 8 hour time weighted average as determined by 29 CFR 1926.62. If an employee is exposed for more than eight hours in a workday, the PEL shall be determined by the following formula:

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

1.2.18 Personal Sampling

Sampling of airborne 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 employees' 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 centered at the nose or mouth of an employee.

1.2.19 Physical Boundary

Area physically roped or partitioned off around an enclosed lead control area to limit unauthorized entry of personnel. As used in this section, "inside boundary" shall mean the same as "outside lead control area but inside the physical boundary."

1.3 DESCRIPTION

1.3.1 Description of Work

Due to the age of the facility to be renovated, it is assumed that LBP/PWL may be encountered. As such, any encountered LBP/PWL shall be removed/controlled.

1.3.2 Coordination with Other Work

The contractor shall coordinate with work being performed in adjacent areas. Coordination procedures shall be explained in the Removal/Control Plan and shall describe how the Contractor will prevent lead exposure to other contractors and/or Government personnel performing work unrelated to lead activities.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section “SUBMITTALS” and approved prior to commencing any work involving LBP/PWL.

SD-03: Product Data

Vacuum Filters

Respirators

SD-06: Test Reports

Sampling results

Occupational and Environmental Assessment Data Report

SD-07: Certificates

Qualifications of CP

Testing Laboratory qualifications

Notification of the Commencement of LBP Hazard Abatement
Third Party Consultant Qualifications

Lead-based paint/paint with lead removal/control plan including CP approval (signature, date, and certification number)

Rental equipment notification

Respiratory Protection Program

Hazard Communication Program

State approved hazardous waste treatment, storage, or disposal facility for lead disposal

Lead Waste Management Plan

Vacuum filters

Clearance Certification

SD-11: Closeout Submittals

Completed and signed hazardous waste manifest from treatment or disposal facility

Certification of Medical Examinations

Waste turn-in documents or weight tickets for non-hazardous wastes that are disposed of at sanitary or construction and demolition landfills

1.5 QUALITY ASSURANCE

1.5.1 Qualifications

1.5.1.1 Qualifications of CP

Submit name, address, and telephone number of the CP selected to perform responsibilities specified in paragraph entitled "Competent Person (CP) Responsibilities." Provide previous experience of the CP. Submit proper documentation that the CP is trained in accordance with Federal, State, and local laws.

1.5.1.2 Training Certification

Submit a certificate for each employee and supervisor, signed and dated by the authorized training provider meeting 40 CFR 745 (Subpart L) requirements, stating that the employee or supervisor has received the required lead training and is certified to perform or supervise deleading or lead removal.

1.5.1.3 Testing Laboratory

Submit the name, address, and telephone number of the testing laboratory selected to perform the air and wipe sampling, testing, and reporting of airborne concentrations of lead. Use a laboratory accredited under the EPA National Lead Laboratory Accreditation Program (NLLAP) by either the American Association for Laboratory Accreditation (A2LA) or the American Industrial Hygiene Association (AIHA) and that is successfully participating in the Environmental Lead Proficiency Analytical Testing (ELPAT) program to perform sample analysis. Laboratories selected to perform blood lead analysis shall be OSHA approved.

1.5.1.4 Third Party Consultant Qualifications

Submit the name, address, and telephone number of the third party consultant selected to perform the wipe sampling for determining concentrations of lead in dust or soil sampling. Submit proper documentation that the consultant is trained and certified as an inspector technician or inspector/risk assessor by the USEPA authorized State (or local) certification and accreditation program.

1.5.2 Requirements

1.5.2.1 Competent Person (CP) Responsibilities

a. Verify training meets all federal, State, and local requirements.

b. Review and approve lead-based paint/paint with lead removal/control plan for conformance to the applicable standards. Ensure work is performed in strict accordance with specifications at all times.

c. Continuously inspect lead-based paint removal/control work for conformance with the approved plan.

d. Perform air and wipe sampling.

e. Control work to prevent hazardous exposure to human beings and to the environment at all times.

f. Certify the conditions of the work as called for elsewhere in this specification.

1.5.2.2 Lead-Based Paint/Paint with Lead Removal/Control Plan (LBP/PWL R/CP)

Submit a detailed job-specific plan of the work procedures to be used in the removal/control of LBP/PWL. The plan shall include a sketch showing the location, size, and details of lead control areas, location and details of decontamination facilities, viewing ports, and mechanical ventilation system. Include a description of equipment and materials, controls and job responsibilities for each activity from which lead is emitted. Include in the plan, eating, drinking, smoking and sanitary procedures, interface of trades, sequencing of lead related work, collected waste water and paint debris disposal plan, air sampling plan, respirators, personal protective equipment, and a detailed description of the method of containment of the operation to ensure that lead is not released outside the lead control area. Include site preparation, cleanup and clearance procedures. Include occupational and environmental sampling, training, sampling methodology, frequency, duration of sampling, and qualifications of sampling personnel in the air sampling portion of the plan. Include a description of arrangements made among contractors on multi-contractor worksites to inform affected employees and to clarify responsibilities to control exposures.

1.5.2.3 Occupational and Environmental Assessment Data Report

If initial monitoring is necessary, submit occupational and environmental sampling results to the Resident Engineer within three working days of collection, signed by the testing laboratory employee performing the analysis, the employee that performed the sampling, and the CP.

In order to reduce the full implementation of 29 CFR 1926.62, the Contractor shall provide documentation. Submit a report that supports the determination to reduce full implementation of the requirements of 29 CFR 1926.62 and supporting the Lead Removal/Control Plan.

a. The initial monitoring shall represent each job classification, or if working conditions are similar to previous jobs by the same employer, provide previously collected exposure data that can be used to estimate worker exposures per 29 CFR 1926.62. The data shall represent the worker's regular daily exposure to lead for stated work.

b. Submit worker exposure data gathered during the task based trigger operations of 29 CFR 1926.62 with a complete process description. This includes manual demolition, manual scraping, manual sanding, heat gun, power tool cleaning, rivet busting, cleanup of dry expendable abrasives, abrasive blast enclosure removal, abrasive blasting, welding, cutting and torch burning where lead containing coatings are present.

c. The initial assessment shall determine the requirement for further monitoring and the need to fully implement the control and protective requirements including the lead compliance plan per 29 CFR 1926.62.

1.5.2.4 Medical Examinations

Initial medical surveillance as required by 29 CFR 1926.62 shall be made available to all employees exposed to lead at any time (1 day) above the action level. Full medical surveillance shall be made available to all employees on an annual basis who are or may be exposed to lead in excess of the action level for more than 30 days a year or as required by 29 CFR 1926.62. Adequate records shall show that employees meet the medical surveillance requirements of 29 CFR 1926.33, 29 CFR 1926.62, and 29 CFR 1926.103. Maintain complete and accurate medical records of employees for a period of at least 30 years or for the duration of employment plus 30 years, whichever is longer.

1.5.2.5 Training

Train each employee performing paint removal, disposal, and air sampling operations prior to the time of initial job assignment and annually thereafter, in accordance with 29 CFR 1926.21, 29 CFR 1926.62, and State and local regulations where appropriate.

1.5.2.6 Respiratory Protection Program

a. Provide each employee required to wear a respirator a respirator fit test at the time of initial fitting and at least annually thereafter as required by 29 CFR 1926.62.

b. Establish and implement a respiratory protection program as required by ANSI Z88.2, 29 CFR 1926.103, 29 CFR 1926.62, and 29 CFR 1926.55.

1.5.2.7 Hazard Communication Program

Establish and implement a Hazard Communication Program as required by 29 CFR 1926.59.

1.5.2.8 Lead Waste Management

The Lead Waste Management Plan shall comply with applicable requirements of federal, State, and local hazardous waste regulations and address:

a. Identification and classification of hazardous wastes associated with the work.

b. Estimated quantities of wastes to be generated and disposed of.

c. Names and qualifications of each contractor that will be transporting, storing, treating, and disposing of the wastes. Include the facility location and operator and a 24-hour point of contact. Furnish two copies of proof of State hazardous waste permit applications, permits, manifests, and EPA Identification numbers.

d. Names and qualifications (experience and training) of personnel who will be working on-site with hazardous wastes.

e. List of waste handling equipment to be used in performing the work, to include cleaning, volume reduction, and transport equipment.

f. Spill prevention, containment, and cleanup contingency measures including a health and safety plan to be implemented in accordance with 29 CFR 1926.65.

g. Work plan and schedule for waste containment, removal and disposal. Wastes shall be cleaned up and containerized daily. Proper containment of the waste includes using acceptable waste containers (e.g., 55-gallon drums) as well as proper marking/labeling of the containers.

h. Unit cost for waste disposal according to this plan.

1.5.2.9 Environmental, 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. Submit matters regarding interpretation of standards to the Resident Engineer for resolution before starting work. Where specification requirements and the referenced documents vary, the most stringent requirement shall apply.

Licensing and certification in the State where project is located is required.

1.5.3 Pre-Construction Conference

Along with the CP, meet with the Resident Engineer to discuss in detail the lead waste management plan and the lead-based paint/paint with lead removal/control plan, including work procedures and precautions for the removal plan.

1.6 EQUIPMENT

1.6.1 Respirators

Furnish appropriate respirators approved by the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services, for use in atmospheres containing lead dust. Respirators shall comply with the requirements of 29 CFR 1926.62.

1.6.2 Special Protective Clothing

Furnish personnel who will be exposed to lead-contaminated dust with proper disposable protective whole body clothing, head covering, gloves, and foot coverings as required by 29 CFR 1926.62. Furnish proper disposable plastic or rubber gloves to protect hands. Reduce the level of protection only after obtaining approval from the CP.

1.6.3 Rental Equipment Notification

If rental equipment is to be used during lead-based paint handling and disposal, notify the rental agency in writing concerning the intended use of the equipment. Furnish a copy of the written notification to the Resident Engineer.

1.6.4 Vacuum Filters

UL 586 labeled HEPA filters.

1.6.5 Equipment for Government Personnel

Furnish the Resident Engineer with two complete sets of personal protective equipment (PPE) daily, as required herein, for entry into and inspection of the paint removal work within the lead controlled area. Personal protective equipment shall include disposable whole body covering, including appropriate foot, head, and hand protection. PPE shall remain the property of the Contractor. The Government will provide respiratory protection for the Resident Engineer.

1.7 PROJECT/SITE CONDITIONS

1.7.1 Protection of Existing Work to Remain

Perform paint removal work without damage or contamination of adjacent areas. Where existing work is damaged or contaminated, restore work to its original condition or better.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Protection

3.1.1.1 Notification

a. Notify the Resident Engineer 20 days prior to the start of any paint removal work.
b. Notification of the Commencement of LBP Hazard Abatement

Submit a copy of the notification of the commencement of LBP hazard abatement to Resident Engineer.

3.1.1.2 Boundary Requirements

a. Provide physical boundaries around the lead control area by roping off the area designated in the work plan or providing curtains, portable partitions or other enclosures to ensure that lead will not escape outside the lead control area.

b. Warning Signs - Provide warning signs at approaches to lead control areas. 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.

3.1.1.3 Furnishings

The Government will partially remove furniture and equipment from the building before lead-based paint removal work begins. Coordinate with Resident Engineer as to what the Government will remove.

3.1.1.4 Heating, Ventilating and Air Conditioning (HVAC) Systems

Shut down, lock out, and isolate HVAC systems that supply, exhaust, or pass through the lead control areas. Seal intake and exhaust vents in the lead control area with 6 mil plastic sheet and tape. Seal seams in HVAC components that pass through the lead control area.

3.1.1.5 Decontamination Shower Facility

Provide clean and contaminated change rooms and shower facilities in accordance with this specification and 29 CFR 1926.62.

3.1.1.6 Eye Wash Station

Where eyes may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes shall be provided within the work area.

3.1.1.7 Mechanical Ventilation System

a. Use adequate ventilation to control personnel exposure to lead in accordance with 29 CFR 1926.62.

b. To the extent feasible, use local exhaust ventilation connected to HEPA filters or other collection systems, approved by the CP. Local exhaust ventilation systems shall be evaluated and maintained in accordance with 29 CFR 1926.62.

c. Vent local exhaust outside the building only and away from building ventilation intakes.

d. Use locally exhausted, power actuated, paint removal tools.

3.1.1.8 Personnel Protection

Personnel shall wear and use protective clothing and equipment as specified herein. Eating, smoking, or drinking or application of cosmetics is not permitted in the lead control area. No one will be permitted in the lead control area unless they have been appropriately trained and provided with protective equipment.

3.2 ERECTION

3.2.1 Lead Control Area Requirements

Establish a lead control area by situating critical barriers and physical boundaries around the area or structure where LBP/PWL removal/control operations will be performed.

3.3 APPLICATION

3.3.1 Work Procedures

Perform removal of lead-based paint in accordance with approved lead-based paint/paint with lead removal/control plan. Use procedures and equipment required to limit occupational and environmental exposure to lead when lead-based paint is removed in accordance with 29 CFR 1926.62. Dispose of removed paint chips and associated waste in compliance with Environmental Protection Agency (EPA), State, and local requirements.

3.3.2 Lead-Based Paint Removal/Control/Deleading

Provide methodology for LBP/PWL removal and processes to minimize contamination of work areas outside the control area with lead-contaminated dust or other lead-contaminated debris/waste and to ensure that unprotected personnel are not exposed to hazardous concentrations of lead. Describe this LBP/PWL removal/control process in the LBP/PWL R/CP.

3.3.2.1 Indoor Paint Removal

Perform paint removal in conjunction with demolition activities in lead control areas using enclosures, barriers, or containments. Collect residue and debris for disposal in accordance with federal, State, and local requirements.

3.3.3 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.

b. Remove protective clothing in the contaminated change room, and place them in an approved impermeable disposal bag.

c. Wash hands and face at the site, don appropriate disposable or uncontaminated reusable clothing; move to an appropriate facility; shower.

d. Change to clean clothes prior to leaving the physical boundary designated around the lead control area.

3.4 FIELD QUALITY CONTROL

3.4.1 Tests

3.4.1.1 Air and Wipe Sampling

Air sample for lead in accordance with 29 CFR 1926.62 and as specified herein. Air and wipe sampling shall be directed or performed by the CP.

a. The CP shall be on the job site directing the air and non-clearance wipe sampling and inspecting the lead-based paint removal/control work to ensure that the requirements of the contract have been satisfied during the entire lead-based paint removal operation.

b. Collect personal air samples on employees who are expected to have the greatest risk of exposure as determined by the CP. In addition, collect air 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 samples, within 72 hours after the air samples are taken.

3.4.1.2 Air Sampling During Paint Removal Work

Conduct area air sampling daily, on each shift in which lead-based paint removal operations are performed, in areas immediately adjacent to the lead control area. Sufficient area monitoring shall be conducted to ensure unprotected personnel are not exposed at or above 30 micrograms per cubic meter of air. If 30 micrograms per cubic meter of air is reached or exceeded, stop work, correct the conditions(s) causing the increased levels. Notify the Resident Engineer immediately. Determine if condition(s) require any further change in work methods. Removal work shall resume only after the CP and the Resident Engineer give approval. For outdoor operations, at least one sample on each shift shall be taken on the downwind side of the lead control area.

3.4.1.3 Testing of Removed Paint and Used Abrasive

Test removed paint and used abrasive in accordance with 40 CFR 261 for hazardous waste.

3.5 CLEANING 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. At the end of each shift and when the paint removal operation has been completed, clean the area of visible lead paint contamination by vacuuming with a HEPA filtered vacuum cleaner, wet mopping the area and wet wiping the area as indicated by the CP. Reclean areas showing dust or residual paint chips or debris. After visible dust, chips and debris is removed, wet wipe and HEPA vacuum all surfaces in the work area. If adjacent areas become contaminated at any time during the work, clean, visually inspect, and then wipe sample all contaminated areas. The CP shall then certify in writing that the area has been cleaned of lead contamination before restarting work.

3.5.1.1 Clearance Certification

The CP shall certify in writing that air samples collected outside the lead control area during paint removal operations are less than 30 micrograms per cubic meter of air; the respiratory protection used for the employees was adequate; the work procedures were performed in accordance with 29 CFR 1926.62 and 40 CFR 745; and that there were no visible accumulations of material and dust containing lead left in the work site. Do not remove the lead control area or roped off boundary and warning signs prior to the Resident Engineer's acknowledgement of receipt of the CP certification.

Certify surface wipe samples are not significantly greater than the initial surface loading determined prior to work.

Clear the lead control area in industrial facilities of all visible dust and debris.

3.5.2 Disposal

a. Collect lead-contaminated waste, scrap, debris, bags, containers, equipment, and lead-contaminated clothing that may produce airborne concentrations of lead particles. Label the containers in accordance with 29 CFR 1926.62 and 40 CFR 262. Dispose of lead-contaminated waste material at a State approved hazardous waste treatment, storage, or disposal facility off Government property.

b. Place 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. For hazardous waste, the collection drum requires marking/ labeling in accordance with 40 CFR 262 during the accumulation/ collection timeframe. The Resident Engineer 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, transport, and dispose lead or lead-contaminated material classified as hazardous 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.

d. All material, whether hazardous or non-hazardous shall be disposed in accordance with laws and provisions and Federal, State, or local regulations. Ensure waste is properly characterized. The result of each waste characterization (TCLP for RCRA materials) will dictate disposal requirements.

3.5.2.1 Disposal Documentation

Submit written evidence to demonstrate the hazardous waste treatment, storage, or disposal facility (TSD) is approved for lead disposal by the State or local regulatory agencies. Submit one copy of the completed hazardous waste manifest, signed and dated by the initial transporter in accordance with 40 CFR 262. Contractor shall provide a certificate that the waste was accepted by the disposal facility. Provide turn-in documents or weight tickets for non-hazardous waste disposal.

3.5.3 Payment for Hazardous Waste

Payment for disposal of hazardous and non-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 or non-hazardous waste delivered is returned and a copy is furnished to the Government.

END OF SECTION 02 83 33

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
   1. Concrete applications addressed in other specifications such as mechanical unit pads.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

   1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, bar arrangement, splices and laps, and supports for concrete reinforcement.

D. Samples:

   1. Vapor retarder.
   2. Mockups of slab finishes

E. Qualification Data: For Installer, manufacturer, and testing agency.

F. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

   1. Aggregates.

G. Material Certificates: For each of the following, signed by manufacturers:

   1. Cementitious materials
   2. Admixtures
   3. Form materials and form-release agents

4. Steel reinforcement and accessories
5. Curing compounds
6. Bonding agents
7. Vapor retarders
8. Repair materials

H. Floor surface flatness and levelness measurements to determine compliance with specified tolerances.

I. Field quality-control test and inspection reports.

J. Minutes of preinstallation conference.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. Testing Agency Qualifications: An independent agency, acceptable to resident engineer qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

E. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

F. Preinstallation Conference: Conduct conference at Project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete subcontractor.

2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, forms and form removal limitations, vapor-retarder installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

a. Structural 1, B-B or better; mill oiled and edge sealed.

B. Chamfer Strips: Wood, metal, PVC, or rubber strips, as indicated on the drawings.

C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

D. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

2.4 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.5 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I or III. Supplement with the following:

a. Fly Ash: ASTM C 618, Class C.

B. Silica Fume: ASTM C 1240, amorphous silica.

C. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Water: ASTM C 94/C 94M and potable.

2.6 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.7 VAPOR RETARDERS

A. Plastic Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.

1. Products:

a. Fortifiber Corporation; Moistop Ultra A.
b. Raven Industries Inc.; Vapor Block 15.
c. Reef Industries, Inc.; Griffolyn Type-65G.

B. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

2.8 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Products:

a. Axim Concrete Technologies; Cimfilm.
b. Burke by Edoco; BurkeFilm.
c. ChemMasters; Spray-Film.
d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Aquafilm.
e. Dayton Superior Corporation; Sure Film.
f. Euclid Chemical Company (The); Eucobar.
g. Kaufman Products, Inc.; Vapor Aid.
h. Lambert Corporation; Lambco Skin.
i. L&M Construction Chemicals, Inc.; E-Con.
j. MBT Protection and Repair, Div. of ChemRex; Confilm.

k. Meadows, W. R., Inc.; Sealtight Evapre.
l. Metalcrete Industries; Waterhold.
m. Nox-Crete Products Group, Kinsman Corporation; Monofilm.
n. Sika Corporation, Inc.; SikaFilm.
o. Symons Corporation, a Dayton Superior Company; Finishing Aid.
p. Unitex; Pro-Film.
q. US Mix Products Company; US Spec Monofilm ER.
r. Vexcon Chemicals, Inc.; Certi-Vex EnvioAssist.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. Products:

a. Burke by Edoco; Cureseal 1315 WB.
b. ChemMasters; Polyseal WB.
c. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Sealcure 1315 WB.
d. Euclid Chemical Company (The); Super Diamond Clear VOX.
e. Kaufman Products, Inc.; Sure Cure 25 Emulsion.
f. Lambert Corporation; UV Safe Seal.
g. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
h. Meadows, W. R., Inc.; Vocomp-30.
i. Metalcrete Industries; Metcure 30.
j. Symons Corporation, a Dayton Superior Company; Cure & Seal 31 Percent E.
k. Tamms Industries, Inc.; LusterSeal WB 300.
l. Unitex; Hydro Seal 25.
m. US Mix Products Company; US Spec Radiance UV-25.
n. Vexcon Chemicals, Inc.; Vexcon Starseal 1315.

2.9 RELATED MATERIALS

A. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

B. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.10 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.11 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 25 percent.
2. Combined Fly Ash and Pozzolan: 25 percent.
3. Silica Fume: 10 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing or plasticizing admixture in concrete, as required, for placement and workability.

2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

2.12 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Concrete Pads, and any concrete not specified below or in other specification sections. Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 3000 psi at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.50
3. Slump Limit: 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
4. Air Content: Concrete exposed to severe freezing and thawing environments shall have 7 percent air entrainment for 3/4-inch nominal maximum aggregate size. Concrete exposed to moderate freezing and thawing environments shall have 4-6 percent air entrainment for 3/4-inch nominal maximum aggregate size. Concrete exposed to mild freezing and thawing environments shall have 4 percent or less air entrainment for 3/4-inch nominal maximum aggregate size.

2.13 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.14 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK

A. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

B. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:

1. Class A, 1/8 inch for smooth-formed finished surfaces.

C. Construct forms tight enough to prevent loss of concrete mortar.

D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

E. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

F. Chamfer exterior corners and edges of permanently exposed concrete.

G. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

H. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

I. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of walls, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.

1. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by RE.

3.4 SHORES AND RESHORES

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR RETARDERS

A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches and seal with manufacturers recommended tape.

B. Bituminous Vapor Retarders: Place, protect, and repair vapor retarders according to manufacturer's written instructions.

C. Granular Course: Cover vapor retarder with fine-graded granular material, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch or minus 3/4 inch.

3.6 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.7 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 and approval by RE.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

C. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

D. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.8 FINISHING FORMED SURFACES

A. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete.

B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.9 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-foot- long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed 1/8 inch.

2. The finish surface shall produce a finished surface conforming to ASTM E1155 tolerance as follows:
   a. Minimum overall area F Flatness of FF-30 and minimum overall area F Levelness of FL-25.
   b. Minimum local area F Flatness of FF-18 and minimum local area F Levelness of FL-13.

C. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel finished floor surfaces.

3.10 MISCELLANEOUS CONCRETE ITEMS

A. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

3.11 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

D. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

   a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.12 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by RE. Remove and replace concrete that cannot be repaired and patched to RE's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by RE.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as pads, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
5. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
6. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to RE's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to RE's approval.

3.13 FIELD QUALITY CONTROL

A. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections:

1. Steel reinforcement placement.
2. Verification of use of required design mixture.
3. Concrete placement, including conveying and depositing.
4. Concrete Finish

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Compression Test Specimens: ASTM C 31/C 31M.

   a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
   b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.

5. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

   a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
   b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

6. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength

and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

8. Test results shall be reported in writing to RE, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by RE but will not be used as sole basis for approval or rejection of concrete.
10. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by RE. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by RE.
11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate dos not comply with the Contract Documents.

D. Measure floor and slab flatness and levelness according to ASTM E 1155 within 48 hours of finishing.

END OF SECTION 03 30 00

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Steel framing and supports for mechanical and electrical equipment.
   2. Steel framing and supports for applications where framing and supports are not specified in other Sections.

B. Products furnished, but not installed, under this Section:

   1. Anchor bolts, and wedge-type inserts indicated to be cast into concrete or unit masonry.

1.2 SUBMITTALS

A. Shop Drawings: Show fabrication and installation details for metal fabrications.

   1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

B. Mill Certificates: Signed by manufacturers of stainless-steel certifying that products furnished comply with requirements.

C. Welding certificates.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.3 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Welding Qualifications: Qualify procedures and personnel according to the following:

   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
   3. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.4 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.5 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.

C. Steel Tubing: ASTM A 500, cold-formed steel tubing.

D. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.

2.3 NONFERROUS METALS

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.

B. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

2.4 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening aluminum.
2. Provide stainless-steel fasteners for fastening stainless steel.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3; with hex nuts, ASTM A 563, Grade C3; and, where indicated, flat washers.

D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 1.

E. Eyebolts: ASTM A 489.

F. Machine Screws: ASME B18.6.3.

G. Lag Screws: ASME B18.2.1.

H. Plain Washers: Round, ASME B18.22.1.

I. Lock Washers: Helical, spring type, ASME B18.21.1.

J. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

K. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.6 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.7 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

C. Galvanize miscellaneous framing and supports where indicated.

D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.8 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.9 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with universal shop primer.

C. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.10 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. As-Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).

C. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with

edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:

1. Cast Aluminum: Heavy coat of bituminous paint.
2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.

1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations unless otherwise indicated.
2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 50 00

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SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. HVAC demolition.
9. Equipment installation requirements common to equipment sections.
10. Painting and finishing.
11. Concrete bases.
12. Supports and anchorages.

B. General: Work shall be performed in accordance with these specifications and good practice. No modifications to these specifications will be accepted without the expressed written approval of the COTR. It is the Contractor's responsibility to document COTR's approval of any such modifications prior to the execution of work. Requirements of these Specifications modified by any addenda, change orders, written approvals and written instructions issued by the COTR, if any, shall be as specifically identified by Section and Paragraph in those addenda, change orders, written approvals and written instructions. Approvals of submittals are subject to additional limitations described elsewhere in these Specifications. System concept drawing sheets are for information only to show potential system arrangement. Field verify information contained on these drawings and is responsible for design and installation of the system in accordance with the specifications. The bid drawings do not show all information necessary for installation of the system, but are intended to be used as a guide for the purpose of designing the systems and preparing a bid.

C. Removal of Debris and Salvage: Remove rubbish and debris resulting from work on a daily basis. Debris shall be disposed of offsite. Rubbish not removed by the Contractor will be removed by the FAA and back-charged to the Contractor. Removal of debris and rubbish from the premises shall be coordinated with the COTR.

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

1.4 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31, "Building Services Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting

electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.6 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Section 08 31 13 "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Known Acceptable Source: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:
1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.4 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Known Acceptable Source:

a. Eslon Thermoplastics.

B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Known Acceptable Source:

a. Thompson Plastics, Inc.

C. Plastic-to-Metal Transition Unions: MSS SP-107, PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

1. Known Acceptable Source:

a. NIBCO INC.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

1. Known Acceptable Source:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Eclipse, Inc.
d. Epco Sales, Inc.
e. Hart Industries, International, Inc.
f. Watts Industries, Inc.; Water Products Div.
g. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

1. Known Acceptable Source:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Epco Sales, Inc.
d. Watts Industries, Inc.; Water Products Div.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Known Acceptable Source:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. Known Acceptable Source:

a. Calpico, Inc.
b. Lochinvar Corp.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

1. Known Acceptable Source:

a. Perfection Corp.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Co., Inc.

2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Known Acceptable Source:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

2.8 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

D. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.

E. One-Piece, Floor-Plate Type: Cast-iron floor plate.

F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

A. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to FAA.

B. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type with spring clips.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type and set screw.
h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.

i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw or spring clips.
j. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
l. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

2. Existing Piping: Use the following:

a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
g. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed hinge and set screw or spring clips.
i. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
k. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Section 07 62 00 "Sheet Metal Flashing and Trim" for flashing.

1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Section 07 92 00 "Joint Sealants" for materials and installation.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Section 07 84 13 "Penetration Firestopping" for materials.

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Nonpressure Piping: Join according to ASTM D 2855.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.6 PAINTING

A. Painting of HVAC systems, equipment, and components is specified in Section 09 91 00 "Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Section 03 30 00 "Cast-in-Place Concrete."

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Section 05 50 00 "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.9 GROUTING

A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 23 05 00

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SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Comply with NEMA MG-10 Energy Management Guide For Selection and use of Polyphase Motors.

D. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: Class F.

J. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 23 05 13

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SECTION 23 05 19 - METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Thermometers.
2. Gages.
3. Test plugs.

1.2 DEFINITIONS

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated; include performance curves.

B. Shop Drawings: Schedule for thermometers gages and flowmeters indicating manufacturer's number, scale range, and location for each.

C. Product Certificates: For each type of thermometer gage and flowmeter, signed by product manufacturer.

D. Operation and Maintenance Data: For Thermometer and gages to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

A. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Palmer - Wahl Instruments Inc.
2. Trerice, H. O. Co.
3. Weiss Instruments, Inc.
4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Case: Die-cast aluminum or brass, 7 inches long.

C. Tube: Red or blue reading, organic-liquid filled, with magnifying lens. Mercury shall not be used.

D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.

E. Window: Glass.

F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

G. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.

H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.2 THERMOWELLS

A. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
2. Palmer - Wahl Instruments Inc.
3. Trerice, H. O. Co.
4. Weiss Instruments, Inc.
5. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Manufacturers: Same as manufacturer of thermometer being used.

C. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.3 PRESSURE GAGES

A. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
2. Palmer - Wahl Instruments Inc.
3. Trerice, H. O. Co.
4. Weiss Instruments, Inc.
5. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.

1. Case: Dry type, drawn steel or cast aluminum, 4-1/2-inch diameter.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Red or other dark-color metal.
7. Window: Glass.
8. Ring: Metal.
9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
10. Range for Fluids under Pressure: Two times operating pressure.

C. Pressure-Gage Fittings:

1. Valves: NPS 1/4 brass or stainless-steel needle type.
2. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.4 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Peterson Equipment Co., Inc.
2. Sisco Manufacturing Co.
3. Trerice, H. O. Co.
4. Watts Industries, Inc.; Water Products Div.

B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.

C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

D. Core Inserts: One or two self-sealing rubber valves.

1. Insert material for air, water, oil, or gas service at 20 to 200 deg F shall be CR.
2. Insert material for air or water service at minus 30 to plus 275 deg F shall be EPDM.

E. Test Kit: Furnish one test kit(s) containing one pressure gage and adaptor, two thermometer(s), and carrying case. Pressure gage, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.

1. Pressure Gage: Small bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be 0 to 200 psig.
2. Low-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial ranges shall be 25 to 125 deg F.
3. High-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial ranges shall be 0 to 220 deg F.
4. Carrying case shall have formed instrument padding.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

A. Install liquid-in-glass thermometers in the following locations:

1. Inlet and outlet of each hydronic zone.
2. Inlet and outlet of each hydronic boiler and chiller.
3. Inlet and outlet of each hydronic coil in air-handling units.
4. Outside-air, return-air, and mixed-air ducts.

B. Install dry -case-type, vapor -actuated dial thermometers at suction and discharge of each pump.

C. Provide the following temperature ranges for thermometers:

1. Heating Hot Water: 0 TO 160 deg F, with 2-degree scale divisions.
2. Chilled Water: 0 to 100 deg F, with 2-degree scale divisions.

3.2 GAGE APPLICATIONS

A. Install dry-case-type pressure gages for discharge of each pressure-reducing valve.

B. Install dry-case-type pressure gages at chilled-water inlets and outlets of chillers.

C. Install dry -case-type pressure gages at suction and discharge of each pump.

3.3 INSTALLATIONS

A. Install direct-mounting thermometers and adjust vertical and tilted positions.

B. Install remote-mounting dial thermometers on panel, with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.

C. Install thermowells with socket extending a minimum of 2 inches into fluid and in vertical position in piping tees where thermometers are indicated.

D. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.

E. Install remote-mounting pressure gages on panel.

F. Install needle-valve and snubber fitting in piping for each pressure gage for fluids (except steam).

G. Install test plugs in tees in piping.

H. Install flow indicators, in accessible positions for easy viewing, in piping systems.

3.4 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines, and equipment.

3.5 ADJUSTING

A. Calibrate meters according to manufacturer's written instructions, after installation.

B. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION 23 05 19

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SECTION 23 05 23 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.
3. Iron ball valves.
4. Iron, single-flange butterfly valves.
5. Bronze lift check valves.
6. Bronze swing check valves.
7. Iron swing check valves.
8. Iron, center-guided check valves.
9. Iron, plate-type check valves.

1.2 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.3 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.4 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to HVAC valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Handwheel: For valves other than quarter-turn types.
2. Handlever: For quarter-turn valves NPS 6 and smaller.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
2. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Solder Joint: With sockets according to ASME B16.18.
3. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRASS BALL VALVES

A. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:

1. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Hammond Valve.
   d. Jamesbury; a subsidiary of Metso Automation.
   e. Milwaukee Valve Company.
   f. NIBCO INC.
   g. Standard: MSS SP-110.
   h. SWP Rating: 150 psig.
   i. CWP Rating: 600 psig.
   j. Body Design: Two piece.
   k. Body Material: Forged brass.
   l. Ends: Threaded.
   m. Seats: PTFE or TFE.
   n. Stem: Brass.
   o. Ball: Chrome-plated brass.
   p. Port: Full.

B. Two-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:

1. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Hammond Valve.
   d. Jamesbury; a subsidiary of Metso Automation.
   e. Milwaukee Valve Company.

2. Description:

   a. Standard: MSS SP-110.
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Two piece.
   e. Body Material: Forged brass.

f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

2.3 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Conbraco Industries, Inc.; Apollo Valves.
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Hammond Valve.
   d. Milwaukee Valve Company.
   e. NIBCO INC.
   f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

   a. Standard: MSS SP-110.
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Two piece.
   e. Body Material: Bronze.
   f. Ends: Threaded.
   g. Seats: PTFE or TFE.
   h. Stem: Bronze.
   i. Ball: Chrome-plated brass.
   j. Port: Full.

B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Conbraco Industries, Inc.; Apollo Valves.
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Hammond Valve.
   d. Milwaukee Valve Company.
   e. NIBCO INC.
   f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

   a. Standard: MSS SP-110.

b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

2.4 IRON BALL VALVES

A. Class 125, Iron Ball Valves:

1. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Valve, Inc.
b. Conbraco Industries, Inc.; Apollo Valves.
c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-72.
b. CWP Rating: 200 psig.
c. Body Design: Split body.
d. Body Material: ASTM A 126, gray iron.
e. Ends: Flanged.
f. Seats: PTFE or TFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel.
i. Port: Full.

2.5 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Known Acceptable Source: Subject to compliance with requirements, available Manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Bray Controls; a division of Bray International.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. DeZurik Water Controls.
e. Hammond Valve.
f. Milwaukee Valve Company.
g. NIBCO INC.

h. Tyco Valves & Controls; a unit of Tyco Flow Control.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 150 psig.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Aluminum bronze.

B. 150 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Aluminum-Bronze Disc:

1. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Bray Controls; a division of Bray International.
b. Conbraco Industries, Inc.; Apollo Valves.
c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
d. Crane Co.; Crane Valve Group; Jenkins Valves.
e. Crane Co.; Crane Valve Group; Stockham Division.
f. DeZurik Water Controls.
g. Hammond Valve.
h. Milwaukee Valve Company.
i. NIBCO INC.
j. Tyco Valves & Controls; a unit of Tyco Flow Control.
k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 150 psig.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: NBR.
f. Stem: One- or two-piece stainless steel.
g. Disc: Aluminum bronze.

C. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Ductile-Iron Disc:

1. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Bray Controls; a division of Bray International.
b. Cooper Cameron Valves; a division of Cooper Cameron Corp.

c. Crane Co.; Crane Valve Group; Center Line.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. DeZurik Water Controls.
f. Hammond Valve.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Tyco Valves & Controls; a unit of Tyco Flow Control.
j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 150 psig.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Nickel-plated or -coated ductile iron.

D. 150 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Ductile-Iron Disc:

1. Known Acceptable source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Bray Controls; a division of Bray International.
b. Cooper Cameron Valves; a division of Cooper Cameron Corp.
c. Crane Co.; Crane Valve Group; Center Line.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. DeZurik Water Controls.
f. Hammond Valve.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Tyco Valves & Controls; a unit of Tyco Flow Control.
j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 150 psig.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: NBR.
f. Stem: One- or two-piece stainless steel.
g. Disc: Nickel-plated or -coated ductile iron.

2.6 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Bronze Disc:

1. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Division.

2. Description:

   a. Standard: MSS SP-80, Type 1.
   b. CWP Rating: 200 psig.
   c. Body Design: Vertical flow.
   d. Body Material: ASTM B 61 or ASTM B 62, bronze.
   e. Ends: Threaded.
   f. Disc: Bronze.

2.7 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Division.
   d. Hammond Valve.
   e. Milwaukee Valve Company.
   f. NIBCO INC.
   g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

   a. Standard: MSS SP-80, Type 3.
   b. CWP Rating: 200 psig.
   c. Body Design: Horizontal flow.
   d. Body Material: ASTM B 62, bronze.
   e. Ends: Threaded.
   f. Disc: Bronze.

B. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Division.
   d. Milwaukee Valve Company.
   e. NIBCO INC.

2. Description:

   a. Standard: MSS SP-80, Type 3.
   b. CWP Rating: 300 psig.
   c. Body Design: Horizontal flow.
   d. Body Material: ASTM B 62, bronze.
   e. Ends: Threaded.
   f. Disc: Bronze.

2.8 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Division.
   d. Hammond Valve.
   e. Milwaukee Valve Company.
   f. NIBCO INC.
   g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

   a. Standard: MSS SP-71, Type I.
   b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
   c. NPS 14 to NPS 24, CWP Rating: 150 psig.
   d. Body Design: Clear or full waterway.
   e. Body Material: ASTM A 126, gray iron with bolted bonnet.
   f. Ends: Flanged.
   g. Trim: Bronze.
   h. Gasket: Asbestos free.

2.9 IRON, CENTER-GUIDED CHECK VALVES

A. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

1. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Hammond Valve.
   b. Metraflex, Inc.
   c. Milwaukee Valve Company.
   d. Mueller Steam Specialty; a division of SPX Corporation.
   e. NIBCO INC.
   f. Spence Strainers International; a division of CIRCOR International.
   g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

   a. Standard: MSS SP-125.
   b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
   c. NPS 14 to NPS 24, CWP Rating: 150 psig.
   d. Body Material: ASTM A 126, gray iron.
   e. Style: Compact wafer.
   f. Seat: Bronze.

B. Class 125, Iron, Globe, Center-Guided Check Valves with Metal Seat:

1. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Hammond Valve.
   b. Metraflex, Inc.
   c. Milwaukee Valve Company.
   d. Mueller Steam Specialty; a division of SPX Corporation.
   e. NIBCO INC.
   f. Spence Strainers International; a division of CIRCOR International.
   g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

   a. Standard: MSS SP-125.
   b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
   c. NPS 14 to NPS 24, CWP Rating: 150 psig.
   d. Body Material: ASTM A 126, gray iron.
   e. Style: Globe, spring loaded.
   f. Ends: Flanged.
   g. Seat: Bronze.

C. Class 150, Iron, Globe, Center-Guided Check Valves with Metal Seat:

1. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. NPS 2-1/2 to NPS 12, CWP Rating: 300 psig.
c. NPS 14 to NPS 24, CWP Rating: 250 psig.
d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
e. Style: Globe, spring loaded.
f. Ends: Flanged.
g. Seat: Bronze.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Center-Guided Check Valves: In horizontal or vertical position, between flanges.

3. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball or butterfly valves.
2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
3. Pump-Discharge Check Valves:

   a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
   b. NPS 2-1/2 and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal -seat check valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
5. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.5 CHILLED-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 150, bronze disc.
3. Ball Valves: Two piece, full port, brass or bronze with stainless-steel trim.
4. Bronze Swing Check Valves: Class 150, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron Ball Valves, NPS 2-1/2 to NPS 10: Class 150.

3. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM or NBR seat, aluminum-bronze disc.
4. Iron, Single-Flange Butterfly Valves, NPS 14 to NPS 24: 150 CWP, EPDM or NBR seat, aluminum-bronze disc.
5. Iron Swing Check Valves: Class 125, metal seats.
6. Iron, Center-Guided Check Valves: Class 150, globe, metal seat.

3.6 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 150, bronze disc.
3. Ball Valves: Two piece, full port, brass or bronze with stainless-steel trim.
4. Bronze Swing Check Valves: Class 150, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron Ball Valves, NPS 2-1/2 to NPS 10: Class 150.
3. Iron Swing Check Valves: Class 125, metal seats.
4. Iron, Center-Guided Check Valves: Class 150, globe, metal seat.

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SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following hangers and supports for HVAC system piping and equipment:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment supports.

1.2 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Design seismic-restraint hangers and supports for piping and equipment.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Thermal-hanger shield inserts.

B. Shop Drawings: Signed and sealed by a qualified Licensed Professional Engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers. Include Product Data for components.
2. Metal framing systems. Include Product Data for components.

3. Pipe stands. Include Product Data for components.
4. Equipment supports.

C. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.3, "Structural Welding Code--Sheet Steel."
3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
4. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Known Acceptable Source: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Known Acceptable Source:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. Grinnell Corp.
3. Tolco Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Known Acceptable Source:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. Power-Strut Div.; Tyco International, Ltd.
3. Tolco Inc.
4. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Known Acceptable Source:

1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.

C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Known Acceptable Source:

a. B-Line Systems, Inc.; a division of Cooper Industries.
b. Hilti, Inc.
c. ITW Ramset/Red Head.

2.7 PIPE STAND FABRICATION

A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

2.8 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.9 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.

2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
7. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
8. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
9. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
10. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
11. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
12. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
13. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
14. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
15. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.

6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

N. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

M. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.

   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.

d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to maximum of 1 inch. Cover ends of support rods and other sharp edges with padding where sharp edges are hazard to operating personnel.

3.6 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 23 05 29

SECTION 23 05 33 - HEAT TRACING FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes heat tracing with the following electric heating cables:

1. Self-regulating, parallel resistance.

1.2 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated.

1. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.

B. Shop Drawings: For electric heating cable. Include plans, sections, details, and attachments to other work.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.

E. Warranty: Special warranty specified in this Section.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

A. Known Acceptable Source: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. BH Thermal Corporation.
2. Chromalox, Inc.; Wiegand Industrial Division; Emerson Electric Company.
3. Delta-Therm Corporation.
4. Easy Heat Inc.
5. Nelson Heat Trace.
6. Pyrotenax; a division of Tyco Thermal Controls.
7. Raychem; a division of Tyco Thermal Controls.
8. Thermon Manufacturing Co.
9. Trasor Corp.

B. Heating Element: The self-regulating heating cable shall consist of two (2) 16 AWG nickel-copper bus wires embedded in parallel in a self-regulating polymer core that varies its power output to respond to temperature all along its length, allowing the heating cable to be cut to length in the field. The heating cable shall be covered by a radiation-crosslinked, modified polyolefin dielectric jacket. To provide a ground path and to enhance the heating cable's ruggedness, the heating cable shall have a braid of tinned copper and an outer jacket of modified polyolefin, as required per section 427-23 of the NEC-1996.

C. Terminate with waterproof, factory-assembled nonheating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.

D. Electrical Insulating Jacket: Flame-retardant polyolefin.

E. Maximum Operating Temperature (Power On): 150 deg F.

F. Maximum Exposure Temperature (Power Off): 185 deg F.

G. Capacities and Characteristics:

1. Maximum Heat Output: 6 W/ft.
2. Piping Diameter: 3" NPS.
3. Number of Parallel Cables: 1.
4. Spiral Wrap Pitch: none.
5. Volts: 120 V.
6. Phase: single.
7. Hertz: 60.

2.2 CONTROLS

A. Refer to Section 23 09 23 – Instrumentation and Controls for HVAC.

2.3 ACCESSORIES

A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.

B. Warning Labels: Refer to Section 23 05 53 "Identification for HVAC Piping and Equipment."

C. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.

1. Width for Markers on Pipes with OD, Including Insulation, less than 6 Inches: 3/4 inch minimum.
2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install electric heating cable across expansion joints according to manufacturer's written recommendations using slack cable to allow movement without damage to cable.

B. Install electric heating cables after piping has been tested and before insulation is installed.

C. Install electric heating cables according to IEEE 515.1.

D. Install insulation over piping with electric cables according to Section 23 07 00 "HVAC Insulation."

E. Install warning tape on piping insulation where piping is equipped with electric heating cables.

F. Set field-adjustable switches and circuit-breaker trip ranges.

G. Protect installed heating cables, including nonheating leads, from damage.

3.3 CONNECTIONS

A. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Testing: Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.

1. Test cables for electrical continuity and insulation integrity before energizing.
2. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.

B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounting cables.

C. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 23 05 33

SECTION 23 05 48 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Restrained elastomeric isolation mounts.
3. Restrained spring isolators.
4. Housed spring mounts.
5. Elastomeric hangers.
6. Spring hangers.
7. Spring hangers with vertical-limit stops.
8. Pipe riser resilient supports.
9. Resilient pipe guides.
10. Seismic snubbers.
11. Restraining braces and cables.

1.2 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.3 PERFORMANCE REQUIREMENTS

A. Wind-Restraint Loading:

1. Site Class as Defined in the IBC: D.
2. Assigned Seismic Use Group or Building Category as Defined in ASCE 7-2005: III.

   a. Component Importance Factor: 1.5.
   b. Component Response Modification Factor: Per ASCE 7-2005 Table 13.6-1.
   c. Component Amplification Factor: Per ASCE 7-2005 Table 13.6-1.

3. Design Spectral Response Acceleration at Short Periods (0.2 Second): MCE – S_{ds} = 0.420g and 10% in 50 years - S_{ds} = 0.172g.
4. Design Spectral Response Acceleration at 1-Second Period: MCE – Sd_1 = 0.201g and 10% in 50 years – Sd_1 = 0.080g.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

   a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES or OSHPD.
   b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified Licensed Professional Engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic and wind forces required to select vibration isolators, seismic and wind restraints, and for designing vibration isolation bases.

   a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Division 23 Sections for equipment mounted outdoors.

2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.

3. Duct Supports: Refer to Division 23 Section, “Metal Ducts” for additional requirements.
4. Seismic- and Wind-Restraint Details:

   a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.
   b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
   c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Division 23 Sections for equipment mounted outdoors.
   d. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES or OSHPD, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

C. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.

D. Welding certificates.

E. Qualification Data: For Licensed Professional Engineer.

F. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Known Acceptable Source: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Kinetics Noise Control.
2. Mason Industries.
3. Vibration Mountings & Controls, Inc.

B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene.

C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

D. Restrained Mounts: All-directional mountings with seismic restraint.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

E. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Restraint: Seismic or limit stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

F. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.

1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
2. Base: Factory drilled for bolting to structure.
3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel up or down before contacting a resilient collar.

G. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

H. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

I. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

J. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.

K. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.2 SEISMIC-RESTRAINT DEVICES

A. Known Acceptable Source: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.; a division of Cooper Industries.
2. Hilti, Inc.

3. Kinetics Noise Control.
4. Mason Industries.
5. Unistrut; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES or OSHPD.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
3. Maximum 1/4-inch air gap, and minimum 1/4-inch- thick resilient cushion.

D. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

E. Restraint Cables: ASTM A 603 galvanized -steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

F. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod.

G. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

I. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

J. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

2.3 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic- and wind-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic- and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES or OSHPD.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:

1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES or OSHPD providing required submittals for component.

B. Piping Restraints:

1. Comply with requirements in MSS SP-127.

2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

C. Ductwork Restraints:

1. Refer to Section 23 31 13 “Metal Ducts” for additional requirements.

D. Install cables so they do not bend across edges of adjacent equipment or building structure.

E. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES or OSHPD providing required submittals for component.

F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

G. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

H. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

I. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 23 21 13 "Hydronic Piping" for piping flexible connections.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing person acceptable to COTR.
2. Schedule test with COTR before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain COTR's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by COTR.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust air-spring leveling mechanism.

D. Adjust active height of spring isolators.

E. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train FAA's maintenance personnel to adjust, operate, and maintain air-mounting systems.

END OF SECTION 23 05 48

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SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Stencils.
6. Valve tags.
7. Warning tags.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

C. Valve numbering scheme.

D. Valve Schedules: For each piping system to include in maintenance manuals.

1.3 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch Stainless steel, 0.025-inch Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.

2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.4 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: White Yellow.

C. Background Color: Black.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.5 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material: Fiberboard or metal.
2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.6 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch Stainless steel, 0.025-inch Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.7 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Reinforced grommet and wire or string.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Pipe Label Color Schedule: Provide colors per ANSI/ASME A13.1.

3.4 DUCT LABEL INSTALLATION

A. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue: For cold-air supply ducts.
2. Yellow: For hot-air supply ducts.
3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
4. ASME A13.1 Colors and Designs: For hazardous material exhaust.

B. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be provided instead of plastic-laminated duct labels, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.

C. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

   a. Chilled Water: 1-1/2 inches, round.
   b. Refrigerant: 1-1/2 inches, round.
   c. Hot Water: 1-1/2 inches 2 inches, round.

2. Valve-Tag Color:

   a. Chilled Water: Green.
   b. Refrigerant: Natural.
   c. Hot Water: Natural.

3. Letter Color:

   a. Chilled Water: White.
   b. Refrigerant: White.
   c. Hot Water: White.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 23 05 53

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

a. Constant-volume air systems.

2. Balancing Hydronic Piping Systems:

a. Variable-flow hydronic systems.

1.2 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An entity engaged to perform TAB Work.

1.3 SUBMITTALS

A. Qualification Data: Within 45 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 45 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 90 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. Certified TAB reports.

E. Sample report forms.

F. Instrument calibration reports, to include the following:

1. Instrument type and make.

2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.4 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC NEBB or TABB.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC NEBB or TABB.
2. TAB Technician: Employee of the TAB contractor and who is certified by AABC NEBB or TABB as a TAB technician.

B. TAB Conference: Meet with COTR and Commissioning Authority on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items:

a. The Contract Documents examination report.
b. The TAB plan.
c. Coordination and cooperation of trades and subcontractors.
d. Coordination of documentation and communication flow.

C. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard TAB contractor's forms approved by COTR and Commissioning Authority.

E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.5 PROJECT CONDITIONS

A. Full FAA Occupancy: FAA will occupy the site and existing building during entire TAB period. Cooperate with FAA during TAB operations to minimize conflicts with FAA's operations.

B. Partial FAA Occupancy: FAA may occupy completed areas of building before Substantial Completion. Cooperate with FAA during TAB operations to minimize conflicts with FAA's operations.

1.6 COORDINATION

A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums used for return, or relief air to verify that they meet the leakage class of connected ducts as specified in Section 23 31 13 "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" ASHRAE 111 NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

1. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
   1. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 23 33 00 "Air Duct Accessories."
   2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 23 07 00 "HVAC Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 23 31 13 "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

   1. Measure total airflow.

a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:

a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
b. Measure static pressure directly at the fan outlet or through the flexible connection.
c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
6. Obtain approval from COTR and Commissioning Authority for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.

a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check liquid level in expansion tank.
3. Check makeup water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.7 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.8 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.

5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.9 PROCEDURES FOR CHILLERS

A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:

1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
6. Capacity: Calculate in tons of cooling.
7. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.10 PROCEDURES FOR BOILERS

A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

3.11 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 10 percent or minus 10 percent.
2. Air Outlets and Inlets: Plus 10 percent or minus 5 percent.
3. Heating-Water Flow Rate: Plus 10 percent or minus 5 percent.
4. Cooling-Water Flow Rate: 0 to Plus 10 percent.

3.12 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems'

balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare monthly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.13 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. COTR's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.

14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches, and bore.
    i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
    j. Number, make, and size of belts.
    k. Number, type, and size of filters.

2. Motor Data:

    a. Motor make, and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches, and bore.
    f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

    a. Total air flow rate in cfm.

b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Filter static-pressure differential in inches wg.
f. Preheat-coil static-pressure differential in inches wg.
g. Cooling-coil static-pressure differential in inches wg.
h. Heating-coil static-pressure differential in inches wg.
i. Outdoor airflow in cfm.
j. Return airflow in cfm.
k. Outdoor-air damper position.
l. Return-air damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft..
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Water flow rate in gpm.
i. Water pressure differential in feet of head or psig.
j. Entering-water temperature in deg F.
k. Leaving-water temperature in deg F.
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig.
n. Refrigerant suction temperature in deg F.

G. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:

a. System identification.
b. Location.

c. Coil identification.
d. Capacity in Btu/h.
e. Number of stages.
f. Connected volts, phase, and hertz.
g. Rated amperage.
h. Air flow rate in cfm.
i. Face area in sq. ft..
j. Minimum face velocity in fpm.

2. Test Data (Indicated and Actual Values):

a. Heat output in Btu/h.
b. Air flow rate in cfm.
c. Air velocity in fpm.
d. Entering-air temperature in deg F.
e. Leaving-air temperature in deg F.
f. Voltage at each connection.
g. Amperage for each phase.

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft..
g. Indicated air flow rate in cfm.
h. Indicated velocity in fpm.
i. Actual air flow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

J. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Service.
d. Make and size.
e. Model number and serial number.
f. Water flow rate in gpm.
g. Water pressure differential in feet of head or psig.
h. Required net positive suction head in feet of head or psig.
i. Pump rpm.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig.
b. Pump shutoff pressure in feet of head or psig.
c. Actual impeller size in inches.
d. Full-open flow rate in gpm.
e. Full-open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
j. Voltage at each connection.

k. Amperage for each phase.

K. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.14 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:

a. Measure airflow of at least 10 percent of air outlets.
b. Measure water flow of at least 5 percent of terminals.
c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
d. Verify that balancing devices are marked with final balance position.
e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by COTR and Commissioning Authority.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of COTR and Commissioning Authority.
3. COTR and Commissioning Authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, FAA may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

3.15 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 23 05 93

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SECTION 23 07 00 - HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Insulation Materials:

   a. Cellular glass.
   b. Flexible elastomeric.
   c. Mineral fiber.

2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Lagging adhesives.
6. Sealants.
7. Factory-applied jackets.
8. Field-applied fabric-reinforcing mesh.
9. Field-applied cloths.
10. Field-applied jackets.
11. Tapes.
12. Securements.
13. Corner angles.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.
8. Detail field application for each equipment type.

C. Qualification Data: For qualified Installer.

D. Field quality-control reports.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.5 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.6 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

D. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Cell-U-Foam Corporation; Ultra-CUF.
b. Pittsburgh Corning Corporation; Foamglas Super K.

2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Board Insulation: ASTM C 552, Type IV.
5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
6. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
7. Factory fabricated shapes according to ASTM C 450 and ASTM C 585.

E. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Aeroflex USA Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.
c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

F. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ jor with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied ASJ or with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. CertainTeed Corp.; Commercial Board.

b. Johns Manville; 800 Series Spin-Glas.
c. Knauf Insulation; Insulation Board.
d. Owens Corning; Fiberglas 700 Series.

G. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ or FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. CertainTeed Corp.; CrimpWrap.
b. Johns Manville; MicroFlex.
c. Knauf Insulation; Pipe and Tank Insulation.
d. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Insulco, Division of MFS, Inc.; Triple I.
b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.

B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Insulco, Division of MFS, Inc.; SmoothKote.
b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
c. Rock Wool Manufacturing Company; Delta One Shot.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Cellular-Glass Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Products, Division of ITW; CP-96.
b. Foster Products Corporation, H. B. Fuller Company; 81-33.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Aeroflex USA Inc.; Aeroseal.
b. Armacell LCC; 520 Adhesive.
c. Foster Products Corporation, H. B. Fuller Company; 85-75.
d. RBX Corporation; Rubatex Contact Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.

2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Chemical Company (The); 739, Dow Silicone.
b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Products, Division of ITW; CP-35.
b. Foster Products Corporation, H. B. Fuller Company; 30-90.
c. ITW TACC, Division of Illinois Tool Works; CB-50.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Products, Division of ITW; Encacel.
b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
c. Marathon Industries, Inc.; 570.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

D. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Products, Division of ITW; CP-10.
b. Foster Products Corporation, H. B. Fuller Company; 35-00.
c. ITW TACC, Division of Illinois Tool Works; CB-05/15.

2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F.
4. Solids Content: 63 percent by volume and 73 percent by weight.
5. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Products, Division of ITW; CP-52.
    b. Foster Products Corporation, H. B. Fuller Company; 81-42.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
4. Service Temperature Range: Minus 50 to plus 180 deg F.
5. Color: White.

2.6 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Products, Division of ITW; CP-76.
    b. Foster Products Corporation, H. B. Fuller Company; 30-45.
    c. Pittsburgh Corning Corporation; Pittseal 444.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Products, Division of ITW; CP-76-8.
    b. Foster Products Corporation, H. B. Fuller Company; 95-44.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto PVC Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: Color-code jackets based on system. Color as selected by COTR.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

5. Factory-fabricated tank heads and tank side panels.

C. Metal Jacket:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Products, Division of ITW; Metal Jacketing Systems.
b. PABCO Metals Corporation; Surefit.
c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.

a. Sheet and roll stock ready for shop or field sizing or Factory cut and rolled to size.
b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper or 2.5-mil- thick Polysurlyn.
d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper or 2.5-mil- thick Polysurlyn.
e. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.

5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
   b. Compac Corp.; 104 and 105.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
   d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
   b. Compac Corp.; 130.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
   d. Venture Tape; 1506 CW NS.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
   b. Compac Corp.; 120.

c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
d. Venture Tape; 3520 CW.
e.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.9 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Childers Products; Bands.
   b. PABCO Metals Corporation; Bands.
   c. RPR Products, Inc.; Bands.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing or closed seal.

3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.

   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

      1) AGM Industries, Inc.; CWP-1.
      2) GEMCO; CD.
      3) Midwest Fasteners, Inc.; CD.
      4) Nelson Stud Welding; TPA, TPC, and TPS.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; CWP-1.
2) GEMCO; Cupped Head Weld Pin.
3) Midwest Fasteners, Inc.; Cupped Head.
4) Nelson Stud Welding; CHP.

3. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; RC-150.
2) GEMCO; R-150.
3) Midwest Fasteners, Inc.; WA-150.
4) Nelson Stud Welding; Speed Clips.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

4. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) GEMCO.
2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, galvanized steel.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. C & F Wire.
b. Childers Products.
c. PABCO Metals Corporation.

2.10 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. Color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and prepare surfaces to be insulated. Remove materials that will adversely affect insulation application.

B. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

   a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

D. Insulation Installation at Floor Penetrations:

1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Pipe: Install insulation continuously through floor penetrations.
3. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:

    a. Do not weld anchor pins to ASME-labeled pressure vessels.
    b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
    d. Do not overcompress insulation during installation.
    e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    f. Impale insulation over anchor pins and attach speed washers.
    g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches.
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

C. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch- diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from aluminum, at least 0.050 inch thick.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.6 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.7 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install Flexible Elastomeric Insulation – See below.

3.8 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.9 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

E. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Impale insulation over pins and attach speed washers.
    f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

F. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.10 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

    1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.11 FINISHES

A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

B. Do not field paint aluminum or stainless-steel jackets.

3.12 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect ductwork, randomly selected by COTR, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
2. Inspect field-insulated equipment, randomly selected by COTR, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
3. Inspect pipe, fittings, strainers, and valves, randomly selected by COTR, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.13 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in nonconditioned space.
4. Indoor, exposed return located in nonconditioned space.
5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.

B. Items Not Insulated:

1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
2. Factory-insulated flexible ducts.
3. Factory-insulated plenums and casings.
4. Flexible connectors.
5. Vibration-control devices.
6. Factory-insulated access panels and doors.

3.14 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, rectangular, supply-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.

B. Concealed, rectangular, return-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.

C. Exposed, rectangular, supply-air duct insulation shall be the following:

1. Duct Liner: 2 inches thick and 2-lb/cu. ft. nominal density.

D. Exposed, rectangular, return-air duct insulation shall be the following:

1. Duct Liner: 1 inch thick and 2-lb/cu. ft. nominal density.

E. Exposed, rectangular, outdoor-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density in double wall duct.

F. Exposed, supply-air plenum insulation shall be the following:

1. Duct Liner: 2 inches thick and 2-lb/cu. ft. nominal density.

G. Exposed, return-air plenum insulation shall be the following:

1. Duct Liner: 1 inch thick and 2-lb/cu. ft. nominal density.

3.15 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.

C. Chillers: Insulate cold surfaces on chillers, including, but not limited to, evaporator bundles, suction piping, compressor inlets, tube sheets, water boxes, and nozzles with one of the following:

1. Cellular Glass: 2 inches thick.
2. Flexible Elastomeric: 1 inch thick.

D. Chilled-water pump insulation shall be the following:

1. Cellular Glass: 3 inches thick.

E. Chilled-water buffer and expansion tank insulation shall be one of the following:

1. Cellular Glass: 2 inch thick.
2. Flexible Elastomeric: 1 inch thick.

F. Heating-hot-water buffer and expansion tank insulation shall be one of the following:

1. Cellular Glass: 1-1/2 inches thick.
2. Mineral-Fiber Board: 1 inch thick and 2-lb/cu. ft. nominal density.
3. Mineral-Fiber Pipe and Tank: 1 inch thick.

G. Chilled-water air-separator insulation shall be one of the following:

1. Cellular Glass: 2 inches thick.
2. Flexible Elastomeric: 1 inch thick.

H. Heating-hot-water air-separator insulation shall be one of the following:

1. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.
2. Mineral-Fiber Pipe and Tank: 2 inches thick.

3.16 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

3.17 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:

1. Insulation shall be the following:

a. Flexible Elastomeric: 1 inch thick for use on instrumentation, thermal wells, sensors and valve stems only.

B. Chilled Water , above 40 Deg F:

1. Insulation shall be the following:

a. Cellular Glass: 1-1/2 inches thick and PVC jacket.
b. Existing: Install PVC jacket over all exposed interior existing pipe insulation.
c. Flexible Elastomeric: 1 inch thick for use on instrumentation, thermal wells, sensors and valve stems only.

C. Heating-Hot-Water Supply and Return, 200 Deg F and below:

1. Insulation shall be the following:

a. Cellular Glass: 1-1/2 inches thick and PVC jacket.
b. Existing: Install PVC jacket over all exposed interior existing pipe insulation.

D. Refrigerant Suction and Hot-Gas Piping:

1. Insulation shall be the following:

a. Flexible Elastomeric: 1 inch thick.

E. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. Insulation shall be the following:

a. Flexible Elastomeric: 1 inch thick.

F. Hot Service Drains:

1. Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.

3.18 OUTDOOR PIPING INSULATION SCHEDULE

A. Chilled-Water Supply and Return:

1. Insulation shall be the following:

a. Cellular Glass: 2 inches thick and aluminum jacket.

B. Refrigerant Suction and Hot-Gas Piping:

1. Insulation shall be the following:

a. Flexible Elastomeric: 2 inches thick.

C. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. Insulation shall be the following:

a. Flexible Elastomeric: 2 inches thick.

3.19 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Concealed:

1. None.

D. Ducts and Plenums, Exposed:

1. None.

E. Equipment, Concealed:

1. None.

F. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:

1. Aluminum, Corrugated: 0.032 inch thick.

G. Piping, Concealed:

1. None.

H. Piping, Exposed:

1. PVC, Color-Coded by System: 20 mils thick.

3.20 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Exposed:

1. Aluminum, Corrugated : 0.032 inch thick.

END OF SECTION 23 07 00

SECTION 23 09 23 – INSTRUMENTATION AND CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 REFERENCES

A. The publications listed below form a part of this Specification to the extent referenced. The publications listed below are referenced as the latest edition published as of the date of this document. The publications are referred to within the text by the basic designation only.

1. Air Movement and Control Association International (AMCA)

   a. AMCA 500-D — Laboratory Methods of Testing Dampers for Rating

2. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

   a. ASHRAE Guideline 3 — Reducing Emission of Halogenated Refrigerants in Refrigeration and Air-Conditioning Equipment and Systems

3. ASME International (ASME)

   a. ASME B16.5 Pipe Flanges and Flanged Fittings
   b. ASME B31.1 Power Piping

4. ASTM International (ASTM)

   a. ASTM A 126 — Gray Iron Castings for Valves, Flanges, and Pipe Fittings

5. Institute of Electrical and Electronics Engineers (IEEE)

   a. IEEE C62.41 — Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits
   b. IEEE C62.45 — Surge Testing for Equipment Connected to Low-Voltage (1000v and less)AC Power Circuits

6. Manufacturers Standardization Society (MSS)

   a. MSS SP-110 — Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
   b. MSS SP-72 — Ball Valves with Flanged or Butt-Welding Ends for General Service

7. National Fire Protection Association (NFPA)

   a. NFPA 70 — National Electrical Code

b. NFPA 90A — Installation of Air Conditioning and Ventilating Systems

8. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

a. SMACNA HVAC Duct Construction Standards: HVAC Duct Construction Standards - Metal and Flexible
b. SMACNA HVAC TAB: HVAC Systems - Testing, Adjusting and Balancing

9. Underwriters Laboratories (UL)

a. UL 1449 — Transient Voltage Surge Suppressors
b. UL 506 — Specialty Transformers
c. UL 916 — Energy Management Equipment

1.2 ADDITIONAL REFERENCES

A. TIA/EIA-232 Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Exchange;

B. TIE/EIA-485 Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multi-point Systems;

C. TIA/EIA-568 Commercial Building Telecommunications Wiring Standard;

D. FCC 47 CFR Part 15, Subpart B - Unintentional Radiators; and

E. NEMA ICS-6 Enclosures for Industrial Control Systems.

1.3 GENERAL REQUIREMENTS

A. The DDC system equipment and controllers shall be i/Net as manufactured by Schneider Electric (t.a.c.). Please contact Mr. Mike Willover (407) 977-6600 for companies qualified to install i/Net systems within FAA terminal facilities. The following company's are known to be pre-approved partners for this project:

1. Future Controls, Inc.
5719 Zip Drive, Suite 1
Fort Meyers, Florida 33905
(800) 330-1303
Attn: Mr. Thomas Hansen, Jr.

2. C-Tech
116 Portland Road
Whitehouse, Tennessee 37188
(615) 672-8210
Attn: Mr. Jim Brown

3. Schneider Electric SI Branch
   2600 Perimeter Park Drive
   Suite 150
   Morrisville, NC 27560
   (919) 388-1800
   Attn. Mr. Tom Brewer

1.4 DEFINITIONS

A. Digital Controller: A control module which is microprocessor based, programmable by the user, has integral input/output within the module or on network connected modules, and performs stand-alone operations.

B. Direct Digital Control (DDC): Digital controls, as defined in this Section, performing control logic. The controller directly senses building environment and makes control decisions based on user defined, controller resident programs. The controller outputs control signals that directly operate valves, dampers, and motor controllers. No conventional control devices, pneumatic or electronic, such as receiver-controllers, thermostats, and logic units are present within or interface with a direct digital control loop. Actuators are electric or pneumatic, and the controller output is converted to the appropriate type of signal.

C. DDC System: A system made up of one or more digital controllers which communicate on a network.

D. Distributed Control: The intent of distributed control is to install the controllers near their respective controlled equipment. The control system consists of stand-alone controllers, with the total number of input and output points limited to 48 or less per controller. Failure of any single controller will not cause the loss of more then 48 control points.

E. Dynamic Control: A process that optimizes energy efficiency of HVAC systems (air handling units, chillers, pumps) and as specified by increasing and decreasing setpoints or starting and stopping equipment in response to heating and cooling needs of the facility. A requirement of dynamic control is knowing the heating/cooling demand status of the process. Therefore dynamic control requires controllers connected in a communications network.

F. Firmware: Firmware is software programmed into read only memory (ROM) and erasable programmable read only memory (EPROM) chips. Software may not be changed without physically altering the chip.

G. Hand-Held Terminal: A hand-held terminal is a manufacturer specific device connected directly to a communications port on a controller, through which the controller is accessed and, in some cases, programmed.

H. Input/Output (I/O) Points: I/O points refer to analog inputs (AI), digital inputs (DI), analog outputs (AO), and digital outputs (DO) in a digital controller. Another term for digital inputs and outputs is binary inputs and outputs. Inputs are from analog sensors (temperature, pressure, humidity, flow) and digital sensors (motor status, flow switches, switch position, and pulse output devices). Outputs operate modulating and on/off control devices.

I. I/O Expansion Unit: An I/O expansion unit provides additional point capacity to a digital controller and communicates with the stand-alone digital controller on a LAN. An I/O unit is not stand-alone because the control program does not reside in the I/O unit. An I/O expander which connects directly to a stand alone controller through a multi-line microprocessor bus is restricted to reside within 3 feet of the stand alone controller and is considered part of the stand alone controller.

J. Local Area Network (LAN)

1. A communications bus that interconnects digital controllers for peer-to-peer (see "peer-to-peer" below) communications. Different levels of LANs are possible within a single DDC system. In this case, a digital controller on a higher level LAN acts as a network controller to the controllers on the lower level LAN. The network controller, then, has at least two LAN communications ports. One port supports peer-to-peer communications with other digital controllers on the higher level LAN. The other port supports communications with the digital controllers on the lower level LAN.
2. LANs permit sharing global information. This allows building and site wide control strategies such as peak demand limiting, dynamic control strategies, coordinated response to alarm conditions, and remote monitoring and programming of digital controllers.

K. Microprocessor: A microprocessor refers to the central processing unit (CPU) that contains all registers and logic circuitry that allow digital controllers to function.

L. Output Signal Conversion: Output signal conversion refers to changing one kind of control output into a proportionally related signal appropriate for direct actuation of the controlled device. An example is converting a 4 to 20 mA or 0 to 10 VDC signal to a proportional 3 to 15 psig signal to operate a pneumatic actuator.

M. Optimum Start: Optimum start is a method of starting HVAC equipment prior to scheduled occupancy in order to have the building at setpoint when occupied. Optimum start is based on the zone temperatures, zone setpoints, and outdoor temperature.

N. Peer-to-Peer: Peer-to-peer refers to controllers connected on a communications LAN that act independently, as equals, and communicate with each other to pass information.

O. PID: PID refers to proportional, integral, and derivative control; the 3 types of action that are used in controlling modulating equipment.

P. Resolution: Refers to the number of possible states an input value or output value can take and is a function of the digital controller I/O circuitry; the A/D converter for input and the D/A converter for output. Ten bit resolution has 1024 possible states.

Q. Stand-Alone Control: Refers to the digital controller performing required climate control, and energy management functions without connection to another digital controller or computer. Requirements for stand-alone control are a time clock, a microprocessor, resident control programs, PID control, and I/O. All stand-alone controllers have a communication port and firmware for direct connection and interrogation with a laptop computer or similar hand-held device. This interrogation includes parameter changes and program downloads.

R. Terminal Control Unit (TCU): An off-the-shelf, stand-alone digital controller equipped for communication on a lower level LAN. TCUs may deviate from stand-alone only in receiving energy management and time information from a stand alone digital controller. A TCU is commonly application specific and is used for distributed control of specific HVAC subsystems. A TCU communicates with other digital controllers. Typically, a TCU communicates on a lower level LAN. Examples where TCUs are used include small air-handling units (AHUs), variable air volume (VAV) boxes, fan coil units, and heat pumps.

1.5 DDC SYSTEM DESCRIPTION

A. Provide new DDC systems including associated equipment and accessories. Manufacturer's products, including design, materials, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with ASME B31.1 and NFPA 70, except as modified herein or indicated otherwise.

B. Provide the DDC systems to maintain stable temperature control and all other conditions as indicated. The end-to-end accuracy of the system, including temperature sensor error, wiring error, A/D conversion, and display, shall be 1 degree F or less.

C. Provide a DDC system with workstation software.

D. Design Requirements

1. Control System Schematic: Provide control system schematic that includes the following:

   a. Location of each input and output device.
   b. Flow diagram of each HVAC component, for instance flow through coils, fans, dampers.
   c. Name or symbol for each component such as V-1, DM-2, and T-1 for a valve, damper motor, and temperature sensor, respectively.
   d. Setpoints.
   e. Sensor range.
   f. Actuator range.
   g. Valve and damper schedules and normal position.
   h. Switch points on input switches.
   i. Written sequence of operation for each schematic.
   j. Schedule identifying each sensor and controlled device with the following information:

      1) LAN and Software point name with send and receive address if applicable
      2) Point type (AO, AI, DO, DI)
      3) Point range
      4) Digital controller number for each point

2. Electrical Equipment Ladder Diagrams: Submit diagrams showing electrical equipment interlocks, including voltages and currents.
3. Component Wiring Diagrams: Submit a wiring diagram for each type of input device and each type of output device. Diagram shall show how the device is wired and powered; showing typical connections at the digital controller and each power supply, as

well as at the device itself. Show for all field connected devices, including, but not limited to, control relays, motor starters, electric or electronic actuators, and temperature, pressure, flow, proof, and humidity sensors and transmitters.

4. Terminal Strip Diagrams: Submit a diagram of each terminal strip, including digital controller terminal strips, terminal strip location, termination numbers and associated point names.
5. Communication Architecture Schematic: Submit a schematic showing communication networks used for all DDC system controllers, workstations, and field interface devices.

1.6 SUBMITTALS

A. Submittals shall include the following:

1. Preconstruction Submittals

   a. List of Drawings
   b. List of Symbols and Abbreviations Used on Drawings
   c. List of I/O Points
   d. Equipment Components List
   e. AC Power Table

2. Shop Drawings

   a. Control system schematic
   b. Ladder diagrams
   c. Component wiring diagrams
   d. Terminal strip diagrams
   e. Communication architecture schematic

3. Product Data

   a. DDC hardware
   b. DDC capabilities
   c. Variable Frequency Motor Drives
   d. Workstation software
   e. Input devices
   f. Output devices
   g. Surge and Transient Protection
   h. Notebook computer
   i. Hand-Held terminal
   j. Smoke detectors

4. Test Reports

   a. Field Test Plan
   b. Performance Verification Test Plan
   c. Field Tests
   d. Performance Verification Tests

5. Certificates

a. Installers Qualifications
b. Training

6. Operation and Maintenance Data

a. Controls and HVAC System Operators Manual
b. DDC Manufacturer's Hardware and Software Manuals

7. Closeout Submittals

a. Training Course Documentation
b. Service organizations
c. Installer certification

1.7 Operating environment

A. Protect components from humidity and temperature variations, dust, and other contaminants, within limits published by the manufacturer.

1.8 QUALITY ASSURANCE

A. Standard Products: Material and equipment shall be standard products of manufacturer regularly engaged in the manufacturing of such product, using similar materials, design and workmanship. The standard products shall have been in commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of similarly sized equipment and materials used under similar circumstances and sold on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products are supported by a local service organization.

B. Nameplates and Tags: Nameplates and tags bearing device unique identifiers shall be engraved or stamped. Permanently attach nameplates to HVAC control panel doors and back plates. For each field mounted piece of equipment attach a plastic or metal tag with equipment name and point identifier.

C. Verification of Dimensions: Verify all dimensions in the field, and shall advise the Contracting Officer's Technical Representative (COTR) of any discrepancy before performing work.

D. Drawings: Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Carefully investigate the mechanical, electrical, and finish conditions that could affect the work, and shall furnish all work necessary to meet such conditions.

1. List of Drawings: Provide a list of drawings.
2. List of Symbols and Abbreviations Used on Drawings: Provide an index of symbols and abbreviations used on the drawings.
3. List of I/O Points: For each input and output physically connected to a digital controller provide, on a controller by controller basis, the following:

a. Point description: for example: mixed air temperature, supply fan start/stop, etc.
b. Point type: AO, AI, DO, or DI.
c. Point range.
d. Sensor range associated with point range:
e. Software name(s) associated with point, if any.
f. Point connection terminal number.

4. Equipment Components List: Submit a listing of controllers and connected devices shown on control system schematic. List the following:

a. Control system schematic name.
b. Description.
c. Manufacturer of controller.
d. Controller's name.
e. Equipment part numbers.
f. Cv for valves.
g. For actuators:

1) Motive force (electric).
2) Normal position.
3) Nominal operating range (4 to 8 mA).

5. AC Power Table: Submit a table listing each controller and the circuit breaker number, panel box number, and physical location of each controller's source of AC power.

E. Installer’s Qualifications: The Installer performing the work shall have completed at least three DDC systems installations of a similar design and have successfully operated a similar sequence of operation for at least three years.

F. Training Course Documentation: Training course documentation including a manual for each trainee plus two additional copies and one copy of audiovisual training aids, if used. Documentation shall include an agenda, defined objectives for each lesson and detailed description of the subject matter of each lesson.

G. Service Organizations: Qualified service organization list including the names and telephone numbers of organizations qualified to service the HVAC control systems.

H. Installer Certification: Provide certification that installation of the control system is complete and meets the technical requirements of this section.

I. Controls and HVAC System Operators Manual: Provide two copies of a Control and HVAC Systems Operators Manual. Provide in a 3-ring binder with a minimum of the following seven sections. Use tabs to divide each section.

1. Description of HVAC Systems: Provide a description of the HVAC system components and control system. Include sequence of operation and a complete points list.
2. Controls Drawings: Provide drawings as specified in submittal paragraph.
3. Control Program Listings: Provide listing of all control programs, including terminal equipment controller setup pages if used.

4. Current Operating Parameters: Provide printouts of input and output setup information, (database setups). This section provides information such as point addresses, slopes and offsets for all points, database of points, etc.
5. Design Information: Include relevant design data and calculations.
6. Control Equipment Technical Data Sheets: Provide technical data sheets for all controller hardware and accessories.
7. Backup of Control Program: Provide backup copies of the control program and ACAD control drawings on CD-ROM.

J. DDC Manufacturer's Hardware and Software Manuals: Provide the following manuals.

1. Installation and Technical Manuals for all digital controller hardware.
2. Installation and Technical Manuals for workstation.
3. Operator Manuals for all digital controllers.
4. Operator Manuals for all workstation software.
5. Programming Manuals for all digital controllers.
6. Programming Manuals for workstation software.

PART 2 PRODUCTS

2.1 DDC SYSTEM

A. Provide a DDC system as a distributed control system. The system shall have stand-alone digital controllers, a communications Network, and a separate workstation computer with workstation software.

B. Provide an operator programmable system to perform closed-loop, modulating control of building equipment. Connect all digital controllers through the communication network to share common data and report to workstation computers. Provide workstation DDC software capable of programming and monitoring the digital controllers. The control system shall be capable of downloading programs between the workstation and digital controllers.

C. Provide the quantity of digital controllers indicated on the drawings to perform required climate control, energy management, and alarm functions. The quantity of controllers shall be no less than the number shown on drawings. All material used shall be currently in production.

D. Direct Digital Controllers: DDC hardware shall be UL 916 rated.

1. Distributed Control: Apply digital controllers in a distributed control manner.
2. I/O Point Limitation: Total number of I/O hardware points, including those communicated over a LAN, used by a single stand-alone digital controller, including I/O expansion units shall not exceed 48.
3. Environmental Operating Limits: Provide digital controllers that operate in environmental conditions between 32 and 120 degrees F.
4. Stand-Alone Control: Provide stand-alone digital controllers.
5. Internal Clock: Provide a clock with each stand-alone controller. Each controller shall have its clock backed up by a battery or capacitor with sufficient capacity to maintain clock operation for a minimum of 72 hours during power outage.
6. Memory:

a. Provide sufficient memory for each controller to support required control, communication, trends, alarms, and messages.
b. Memory Protection: Programs residing in memory shall be protected either by using EEPROM, flash memory, or by an uninterruptible power source (battery or uninterruptible power supply (UPS)). The backup power source shall have sufficient capacity to maintain volatile memory during an AC power failure. Where the uninterruptible power source is rechargeable (a rechargeable battery), provide sufficient back-up capacity for a minimum of seventy-two hours. The rechargeable power source shall be constantly charged while the controller is operating under normal line power. Where a non-rechargeable power source is used, provide sufficient capacity for a minimum of two years accumulated power failure. Batteries shall be replaceable without soldering.

7. Inputs: Provide input function integral to the direct digital controller. Provide input type(s) as required by the DDC design. For each type of input used on high-level controllers, provide at least one similar spare input point per controller.

a. Analog Inputs: Allowable input types are 100 ohm (or higher) platinum RTDs, thermistors, 4 to 20 mA, and 0-10 VDC. Thermistor and direct RTD inputs must have appropriate conversion curves stored in controller software or firmware. Analog to digital (A/D) conversion shall have 10-bit minimum resolution.
b. Digital Inputs: Digital inputs shall sense open/close, on/off, or other two state indications.

8. Outputs: Provide output function integral to the direct digital controller. Provide output type(s) as required by the DDC design. For each type of output used on high-level controllers, provide at least one similar spare output point per controller.

a. Analog Outputs: Provide controllers with 10 bit minimum output resolution. Output shall be 4 to 20 mA, 0 to 10 VDC, or 0 to 20 psig.
b. Digital Outputs: Provide contacts rated at a minimum of 1 ampere at 24 volts.

9. PID Control: Provide controllers with proportional integral, and derivative control capability. Terminal controllers (TCV) are not required to have the derivative component.
10. Digital Controller Networking Capabilities: The upper level digital controllers shall be capable of networking with other similar upper level controllers. Upper level controllers shall also be capable of communicating over a network between buildings.
11. Communications Ports:

a. Controller-to-Controller LAN Communications Ports: Controllers in the building DDC system shall be connected in a communications network. Controllers shall have controller to controller communication ports to both peer controllers (upper level controllers) and terminal controllers (lower level controllers). Network may consist of more than one level of local area network and one level may have multiple drops. Communications network shall permit sharing information between controllers, allowing execution of dynamic control strategies, and coordinated response to alarm conditions. Minimum baud rate for the lowest level LAN is 9600 Baud. Minimum baud rate for the highest level LAN shall be 9600 Baud. Minimum baud rate for a DDC system consisting of a single LAN is 9600 Baud.

b. On-Site Interface Ports: Provide a RS-232, RS-485, or RJ-11 communications port for each digital controller that allows direct connection of a computer or hand held terminal and through which the controller may be fully accessed. Controller access shall not be limited to access through another controller. On-site interface communication ports shall be in addition to the communications port(s) supporting controller to controller communications. Communication rate is 9600 Baud minimum. Every controller on the highest level LAN shall have a communications port supporting direct connection of a computer; a hand held terminal port is not sufficient. By connecting a computer to this port, every controller in the direct digital control system shall be accessible and programmable. The following operations shall be available: downloading and uploading control programs, modifying programs and program data base, and retrieving or accepting trend reports, status reports, messages, and alarms.

c. Remote Work Station Interface Port: Provide one additional direct connect computer port in each DDC system for permanent connection of a remote operator's work station, unless the workstation is a node on the LAN. All operations possible by directly connecting a computer to a controller at the highest level LAN shall be available through this port.

12. Modem: Provide two modems per DDC system to communicate between the digital control system and the computer workstation. Minimum modem baud rate is 56 Kbaud with v.90 communication standard.
13. Digital Controller Cabinet: Each indoor digital controller cabinet shall protect the controller from dust and be rated NEMA 1, unless specified otherwise. Each outdoor digital controller cabinet shall protect the controller from all outside conditions and be rated NEMA 4. Cabinets for high level controllers shall be hinged door, lockable, and have offset removable metal back plate.
14. Main Power Switch: Each controller on the highest level LAN or each control cabinet shall have a main external power switch for isolation of the controller from AC power. The switch shall be located in the DDC cabinet.

E. Terminal Control Units (TCUs)

1. The same company as the digital controllers shall manufacture TCUs.
2. TCUs shall automatically start-up on return of power after a failure, and previous operating parameters shall exist or shall be automatically downloaded from a digital controller on a higher level LAN.
3. TCUs do not require an internal clock if they get time information from a higher level digital controller.

F. DDC Software

1. Sequence of Control: Provide, in the digital controllers, software to execute the sequence of control. Provide one registered copy of all software used to program control sequences in all direct digital controllers and LAN controllers on the computer workstation. Provide any access keys which restrict programming language software functions or the ability to compile or prepare programming for download to controllers. Provide final copy of each program used in the system in both compiled and editable formats. Where specially programmed factory configured smart controllers are used in the system, provide minimum factory programming tools and specialized controller programs ready for

download to replacement controllers. At minimum, controllers must be capable of performing programming functions outlined in the following "Parameter Modification" article.

2. Parameter Modification: Provide software to modify control parameters. Parameter modification for all controllers (high level and low level application specific) is through the main workstation computer and with laptop computer or keypad terminal directly at each controller. Modifications accomplished without having to make changes directly in line-by-line programming. When the control program is of the line-by-line type, database parameters in the following list that take real number values require assignment of variable names so parameters can be changed without modifying programming. Alternatively, block programming languages shall provide for modification of these database parameters in fill-in-the-blank screens. Parameters of like type, including those in different high level and low level controllers, may be grouped together for a single, global change. For example, an operator may group all second floor space temperature setpoints into a group and raise the setpoint by two degrees with a single command. The following parameters shall be modifiable in this way:

    a. Setpoints
    b. Dead band limits and spans
    c. Reset schedules
    d. Switch over points
    e. PID gains and time between control output changes
    f. Time
    g. Timed local override time
    h. Occupancy schedules
    i. Holidays
    j. Alarm points, alarm limits, and alarm messages
    k. Point definition database
    l. Point enable, disable, and override
    m. Trend points, trend intervals, trend reports
    n. Analog input default values
    o. Passwords
    p. Communications parameters including network and telephone communications setups

3. Differential: Where setpoint is in response to some analog input such as temperature, pressure, or humidity, include a setpoint differential to prevent short cycling of control devices.
4. Motor and Flow Status Delay: Provide an adjustable delay between when a motor is commanded on or off and when the control program looks to the motor or flow status input for confirmation of successful command execution.
5. Run time Accumulation: Provide resettable run time accumulation for each controlled digital output.
6. Timed Local Override: Provide user definable adjustable run time for each push of a momentary contact timed local override. Pushes shall be cumulative with each push designating the same length of time. Provide a user definable limit on the number of contact closures summed, such as 6, before the contact closures are ignored. Timed local overrides are disabled during occupancy periods.
7. Time Programs: Provide programs to automatically adjust for leap years, daylight savings time, and operator time adjustments.

8. Scheduling

   a. Individual controlled equipment shall be programmable with schedule based on time of day, day of week, and day of year. Equipment may be associated into groups. Each group may be associated with a different schedule. Changing the schedule of a group shall change the schedule of all equipment in the group. Groups may be modified, created and deleted by the operator.
   b. Provide capability to view and modify schedules in a seven-day week format. When control program does not automatically compute holidays, provide capability to enter holiday schedules one full year at a time.

9. Point Override: I/O and virtual points shall accept software overrides to any possible value.
10. Alarming: I/O points, software points, and all devices with feedback shall be alarmable. The type of alarm shall be determined by the Resident Engineer (routine, priority, critical, etc.). Alarms may be enabled and disabled for every point. Alarm limits shall be adjustable on analog points. Controllers connected to an external communications device such as a printer, terminal, or computer, shall download alarm and alarm message when alarm occurs. When a computer workstation is connected to a DDC system with a LAN or modem, operator selected alarm conditions will initiate a call and report to the computer. Otherwise alarms will be stored and automatically downloaded when a communications link occurs. The following conditions shall generate alarms:

    a. Motor is commanded on or off but motor status input indicates no change
    b. Temperature, humidity, or pressure strays outside selectable limits
    c. An analog input takes a value indicating sensor failure
    d. A module is not communicating on the LAN
    e. A power outage occurs
    f. Damper or valve is commanded open or closed, but limit switch status does not change.

11. Messages: Messages shall be operator defined and assigned to alarm or status conditions. Messages shall be displayed on the workstation or printer when these conditions occur.
12. Trending: DDC system shall have the capability to trend all I/O and virtual points. Points may be associated into groups. A trend report may be set up for each group. The period between logging consecutive trend values shall range from 1 minute to 60 minutes at a minimum. The minimum number of consecutive trend values stored at one time shall be 30 per variable. When trend memory is full, the most recent data shall overwrite the oldest data. Trend data shall be capable of being uploaded to a computer. Trend data shall be available on a real time basis; trend data shall appear numerically and graphically on a connected computer's screen as the data is processed from the DDC system. Trend reports shall be capable of uploading to a computer for storage.
13. Status Display: Current status of I/O and virtual points shall be displayed on command. Points shall be associated into functional groups, such as all the I/O and virtual points associated with control of a single air-handling unit, and displayed as a group, so the status of a single mechanical system can be readily checked. A group shall be selectable from a menu of groups having meaningful names; such as AHU-4, Second Floor, Chiller System, and other such names.
14. Diagnostics: Each controller shall perform self-diagnostic routines and provide messages to an operator when errors are detected. The DDC system shall be capable of recognizing

a non-responsive module on a LAN. The remaining, responsive modules on a LAN shall not operate in a degraded mode.

15. Power Loss: During a power outage, each controller shall assume a disabled status and outputs shall go to a user definable state. Upon restoration of power, DDC system shall perform an orderly restart, with sequencing of outputs.
16. Program Transfer: Provide software for download of control programs and database from a computer to controllers and upload of same to computer from controllers. Every digital controller in the DDC system shall be capable of being downloaded and uploaded to through a single controller on the highest level LAN.
17. Password Protection: Provide at least three levels of password protection to the DDC system permitting different levels of access to the system. The lowest level allows monitoring only. The highest level allows full control of all functions, including setting new passwords.

G. Workstation: Provide a central workstation computer with installed software to provide an interface for monitoring, troubleshooting, and making adjustments to the program or operating parameters of all DDC controllers, including TCUs. The workstation shall also be capable of programming all controllers, including TCUs. DDC system shall routinely operate continuously without connection to the workstation. Information at the workstation is not required for day to day operations of the direct digital controllers.

1. Hardware: The DDC system manufacturer shall recommend all workstation computer equipment and peripherals. The workstation shall be configured to operate according to the DDC system manufacturer's specifications. Workstation hardware shall be configured to allow operation of software, uploading and downloading of programs, and creation of graphics. At a minimum the workstation hardware shall consist of:

    a. Computer; computer shall use Microsoft Windows XP, and shall not have less than Intel Pentium IV processor, running at 3.2 gigahertz speed, 60 gigabyte hard disc, 2 gigabyte RAM, 1 serial and 1 parallel port, 2 USB ports, 17-inch monitor with 1280 x 768 minimum resolution, 101 character keyboard, 48X internal CD RW/DVD ROM drive.
    b. Mouse
    c. Modem; 56 Kbaud, v.90 standard
    d. Printer; printer shall be laser output with one spare cartridge.
    e. 120-volt terminal strip UL 1449 6-outlet with surge protection.

2. Software: Workstation software shall be configured to operate according to the DDC system manufacturer's specifications. Software shall be installed in the workstation computer and permit monitoring and troubleshooting of the DDC system. Workstation software permits modification of controller parameters and control for all controllers, both high level and low level application specific. Operations shall be menu selected. Menu selections shall be made with a mouse.

    a. Menu System: Menu system shall allow an operator to select a particular function or access a particular screen through successive menu penetration.
    b. Controller Parameter Modification: The workstation software shall be an interface for performance specified in paragraph entitled "Parameter Modification" and available through direct connection of a computer to a digital controller. Parameter modification shall require only that an operator "fill in the blank" for a parameter

on a screen requesting the information in plain language. Parameter modifications shall download to the appropriate controllers at operator request.

c. Program modification: For systems using a line-by-line programming language, provide an off-line text editor, similar to a BASIC program editor, permitting modification of controller resident control programs. For systems using block programming languages provide a capability for linking blocks together to create new programs or modify existing programs. Program modifications shall download to appropriate controllers at operator request.

3. Dynamic Graphic Programming: Construct the "dynamic" graphics pages for monitoring and system control. This graphics utility shall be usable both for on-line control such as override and alarm acknowledgement, and for display of system status and alarm activity. Graphics shall support at least 16 colors and not less than 60 outputs of real time, live dynamic data per graphic. The system shall display dynamic graphic data as an animated symbol (i.e., when a damper opens, the damper on a graphic plan moves to the open position; fan status "on" shall display fan moving), and ASCII set (i.e., on-off), a decimal (i.e., 96.3F), or as an analog bar graph. Each operator workstation shall support not less than 1,000 separate graphic pages. Include three-dimensional developed graphics for each device as approved by the FAA's representative for this project. The following graphic pages shall be provided:

a. Graphics shall closely follow the style of the control drawings in representing mechanical systems, sensors, controlled devices, and point names.
b. Graphic Title: Graphics shall have an identifying title visible when the graphic is being viewed.
c. Dynamic Update: When the workstation is on-line with the control system, point data shall update dynamically on the graphic images.
d. Graphic Penetration: Provide graphic penetration when the capability exists. For systems without graphic penetration, provide menu penetration for selection of individual graphics to give the same hierarchical affect provided by graphic penetration.
e. Graphic Types: Graphic-based software shall have graphics of the building section, floor plans, and mechanical systems. Provide the following graphics:

1) Building Section Graphic: Show stacked floors in section graphic with appropriate floor name on each floor.
2) Floor Plan Graphics: Provide a single graphic for each floor, unless the graphic will contain more information than can reasonably be shown on a single graphic. Each heating or cooling zone within a floor plan shall have a zone name and its current temperature displayed within the zone outline. The ductwork and associated devices (VAVs, etc.) shall be shown for quick reference of the system layout. Show each controlled variable in the zone. Provide visual warning for each point in alarm.
3) Mechanical System Graphics: Provide three-dimensional drawings to symbolize mechanical equipment; do not use line drawings. Show controlled or sensed mechanical equipment. Each graphic shall consist of a single mechanical system; examples are a graphic for an air handling unit, a graphic for a VAV terminal unit, a graphic for a split system heat pump unit, a computer room air conditioning unit, CHW loop, HW loop, etc. These systems may be combined with prior approval. Place sensors and controlled

devices associated with mechanical equipment in their appropriate locations. Place point name and point value adjacent to sensor or controlled device. Provide visual indication of each point in alarm. Conditions, such as zone temperature, associated with the mechanical system shall be shown on the graphic. Point values shall update dynamically on the graphic.

f. Graphic Editing: Full capacity as provided by a draw software package shall be included for operator editing of graphics. Graphics may be created, deleted, modified, and text added. Provide capability to store graphic symbols in a symbol directory and incorporate these symbols into graphics. A minimum of 16 colors shall be available.

g. Dynamic Point Editing: Provide full editing capability for deleting, adding, and modifying dynamic points on graphics.

h. Trending: Trend data shall be displayed graphically, with control variable and process variable plotted as functions of time on the same chart. Graphic display of trend data shall be a capability internal to the workstation software and not a capability resulting from download of trend data into a third-party spreadsheet program such as Excel, unless such transfer is automatic and transparent to the operator, and the third-party software is included with the workstation software package. At the operator's discretion, trend data shall be plotted real time.

4. Display Graphics of the HVAC System and HVAC Status: A visual interface for the operator shall be provided and displayed on the monitor screen. The system shall support an operator definable "default" system page. The default system page shall be displayed upon system startup, operator activity time-outs, and when the system is not in use. This default system page may be any one of the standard dynamic graphic pages, or may be a custom display developed for this purpose. The graphics shall as a minimum be representative of the floor plans of the buildings, including, each room with identification; representative of the HVAC equipment and each individual component location on the floor plans; elevation views which represent the vertical relationships of the HVAC equipment located in the Tower; and indication of the operational status of each HVAC component. The graphic pages shall provide direct access to all DDC controlled points. The users shall be provided access to all controllable aspects of every component of the HVAC system directly from the graphics pages; including checking device status to manually controlling each component of every device. This includes, but is not limited to, the requirements as indicated on the point system lists and the flow diagrams on the drawings.

5. Dynamic Graphic Flow Chart Programming: Construct "dynamic" graphic flow charts of system control logic/sequences for each sequence. This flow chart utility shall be usable both for on-line control logic development (i.e., programming), and for live displays of the interactive process variables occurring throughout the sequences of operations. Flow chart elements shall consist of "icons" selected from a "toolkit". The cursor and mouse shall be used to place the icons on the graphic, and to connect the icons, or modules. Text may be inserted into the graphic to describe the control logic in sentence format. Once completed, the graphics shall be able to be printed out for permanent records.

H. Maintenance Personnel Interface Tools: Provide a notebook computer for field communication with the digital controllers. In addition to changing setpoints, and making operational changes, field personnel shall be able to download programs with the notebook computer.

1. Notebook Computer

a. Provide notebook computer, necessary software, carrying case, and direct connection cable to communicate with all digital controllers when directly connected.
b. Provide notebook computer with the following features as a minimum:

1) Pentium IV 2 gigahertz dual core with active matrix color screen
2) Internal hard disk; minimum 60 gigabytes
3) Internal battery operation; for a minimum of 3 hours of operation.
4) RAM; minimum 512 megabytes
5) 48X CD RW/DVD ROM
6) Serial interface port to communicate with the digital controller. Parallel port to communicate with a printer. Two high-speed USB ports.
7) Software: Digital control manufacturer's graphic DDC software, and all other required programs installed. Windows XP operating system installed. Include all documentation and original media.

2.2 SENSORS AND INPUT HARDWARE

A. Field Installed Temperature Sensors

1. Thermistors: Precision thermistors may be used in temperature sensing applications below 200 degrees F. Sensor accuracy over the application range shall be 0.36 degree F or less between the range of 32 to 150 degrees F. Stability error of the thermistor over 5 years shall not exceed 0.25 degree F cumulative. Sensor element and leads shall be encapsulated. Bead thermistors are not allowed. A/D conversion resolution error shall be kept to 0.1 degree F. Total error for a thermistor circuit shall not exceed 0.5 degree F, which includes sensor error and digital controller A/D conversion resolution error. Provide 18 gage twisted and shielded cable for thermistors.
2. Resistance Temperature Detectors (RTDs): Provide RTD sensors with 1000 ohm, or higher, platinum elements that are compatible with the digital controllers. Sensors shall be encapsulated in epoxy, series 300 stainless steel, anodized aluminum, or copper. Temperature sensor accuracy shall be 0.1 percent (1 ohm) of expected ohms (1000 ohms) at 32 degrees F. Temperature sensor stability error over 5 years shall not exceed 0.25 degree F cumulative. Direct connection of RTDs to digital controllers, without transmitters, is preferred provided controller supports direct connection of RTDs. When RTDs are connected directly to the controller, keep lead resistance error to 0.25 degree F or less. Total error for a RTD circuit shall not exceed 0.5 degree F, which includes sensor error, lead resistance error or 4 to 20 mA or 0 to 10 VDC transmitter error, and A/D conversion resolution error.
3. Temperature Sensor Details:

a. Room Type: Conceal element behind protective cover matched to the room interior. Room temperature sensors connected directly to application specific controllers shall have integral pushbutton, system override digital input button, and a setpoint adjustment lever. Provide a connection to allow interrogation of the digital controller.
b. Duct Averaging Type: Continuous averaging RTDs for ductwork applications shall be one foot in length for each 4 square feet of ductwork cross-sectional area with a minimum length of 6 feet. Probe type duct sensors of 1-foot length minimum are acceptable in ducts 12 feet square and less.

c. Immersion Type: Three inches total immersion for use with sensor wells, unless otherwise indicated.
d. Sensor Wells: Stainless steel material. Provide heat-sensitive transfer agent between exterior sensor surface and interior well surface.
e. Outside Air Type: Provide element on the buildings north side with sunshade to minimize solar effects. Mount element at least 3 inches from building outside wall. Sunshade shall not inhibit the flow of ambient air across the sensing element. Shade shall protect sensing element from snow, ice, and rain.

B. Transmitters: Transmitters shall have 4 to 20 mA or 0 to 10 VDC output linearly scaled to the temperature, pressure, humidity, or flow range sensed. Transmitter shall be matched to the sensor, factory calibrated, and sealed. Total error shall not exceed 0.1 percent at any point across the measured span. Supply voltage shall be 24 volts AC or DC. Transmitters shall have non-interactive offset and span adjustments. For temperature sensing, transmitter stability shall not exceed 0.05 degrees C a year.

1. Spans and Ranges: Transmitter spans or ranges shall meet the following:

a. Temperature:

1) 50 degrees F span: Room, chilled water, cooling coil discharge air, return air sensors.
2) 100 degrees F span: Outside air, mixed air sensors.

b. Pressure:

1) Negative 0.5 to positive 0.5 inches water differential range: static pressure control of rooms.
2) 0 to 5 inches water differential range: Duct static pressure.
3) 0 to 60 pounds per square inch gage differential: Water differential pressure.

c. Relative Humidity:

1) 10 to 90 percent minimum relative humidity range.

2. Relative Humidity Transmitters: Provide integral humidity transducer and transmitter. Output of relative humidity instrument shall be a 4 to 20 mA or 0 to 10 VDC signal proportional to full range of relative humidity input. Accuracy shall be 2 percent of full scale; long-term stability shall be less than 1 percent drift per year. Sensing element shall be polymer type.
3. Pressure Transmitters: Provide integral pressure transducer and transmitter. Output of pressure instrument shall be a 4 to 20 mA signal proportional to the pressure span. Accuracy shall be 1.0 percent. Linearity shall be 0.1 percent.
4. Current Transducers: Provide current transducers to monitor amperage of motors. Select current transducer for normal measured amperage to be near 50 percent of full-scale range. Current transducers shall have an accuracy of 1 percent and 4 to 20 mA or 0 to 10 VDC output signal.
5. Air Quality Sensors:

a. CO2 Sensor: Provide CO2 sensors with integral transducers where shown. Output signal shall be 4 to 20 mA or 0 to 10 VDC. Accuracy shall be plus or minus 5 percent of full scale.

6. Input Switches

a. Timed Local Override: Provide momentary contact push button override with override time set in controller software. Provide to override DDC time of day program and activate occupancy program for assigned units. Upon expiration of override time, the control system shall return to time-of-day program. Time interval for the length of operation shall be software adjustable and shall expire unless reset.
b. Hand-Off-Auto Switch: Provide hand-off-auto switch with name plate to manually switch between off, DDC (auto) and manual (hand) control. Size and wire hand-off-auto switch to switch control (120 VAC or less), not line, circuitry. Wire all safety controls to protect circuit and equipment during both hand and auto operation.
c. Insertion Freeze Protection Switch: Electric switch shall be capillary type. Provide special purpose insertion thermostats with flexible elements a minimum of 20 feet in length for coil face areas up to 40 square feet. Switch contacts shall be rated for motor starter circuit voltage being interrupted. Switch shall be equipped with auxiliary set of contacts for input of switch status to digital controller. Provide additional elements or longer elements for larger coils at the rate of 1-foot of element per 4 square feet of coil. Serpentine capillaries perpendicular to the air flow to uniformly sense the entire airflow. A freezing condition at 18-inch increments along the sensing element shall activate the thermostatic switch. Switch shall require manual reset after activation.
d. Non-Modulating, Electric, Humidistat Switch: Provide a setpoint adjustable, wall-mounted humidistat. Contacts shall be Single Pole Double Throw (SPDT) for low voltage (24 volt) applications. Adjustable setpoint range shall be 20 percent to 80 percent relative humidity. Sensing element shall be bulk polymer or thin film polymer with an accuracy of plus or minus 2 percent over the entire range. Sensing element shall be non-saturating and shall be capable of withstanding a saturated condition without permanently affecting calibration or sustaining damage. Humidistat cover shall consist of locking metal or heavy-duty plastic.

7. Electronic Airflow Measurement Stations and Transmitters

a. Station - Each station shall contain an array of velocity sensing elements and straightening vanes inside a flanged sheet metal casing. The velocity sensing elements shall be of the RTD or thermistor type. The sensing elements shall be distributed across the duct cross-section in the quantity and pattern set forth for measurements and instruments of ASHRAE Gdln3 and SMACNA HVACTAB for the traversing of ducted air flows. The resistance to airflow through the airflow measurement station shall not exceed 0.08-inch water gage at an airflow of 2,000 fpm. Station construction shall be suitable for operation at airflow of up to 5,000 fpm over a temperature range of 40 to 120 degrees F, and accuracy shall be plus or minus 3 percent over a range of 125 to 2,500 fpm scaled to air volume.
b. Each transmitter shall produce a linear, temperature compensated 4 to 20 mA or 0 to 10 VDC output corresponding to the actual air flow. The transmitter shall be a

2-wire, loop powered device. The output error of the transmitter shall not exceed 0.5 percent of the calibrated measurement.

2.3 OUTPUT HARDWARE

A. Dampers: Damper shall conform to SMACNA HVAC Duct Const Standards.

1. A single damper section shall have blades no longer than 48 inches and shall be no higher than 72 inches. Maximum damper blade width shall be 8 inches. Larger sized damper shall be made from a combination of sections.
2. Dampers shall be steel, or other materials where shown. Flat blades shall be made rigid by folding the edges. Blades shall be provided with compressible seals at points of contact. The channel frames of the dampers shall be provided with jamb seals to minimize air leakage. Dampers shall not leak in excess of 20 cfm per square foot at 4 inches water gage static pressure when closed. Seals shall be suitable for an operating temperature range of minus 40 degrees F to 200 degrees F. Dampers shall be rated at not less than 2000 fpm air velocity. All blade-operating linkages shall be within the frame so that blade-connecting devices within the same damper section will not be located directly in the air stream. Damper axles shall be 0.5-inch (minimum) plated steel rods supported in the damper frame by stainless steel or bronze bearings. Blades mounted vertically shall be supported by thrust bearings. Pressure drop through dampers shall not exceed 0.04-inch water gage at 1000 fpm in the wide-open position. Frames shall not be less than 2 inches in width. Dampers shall be tested in accordance with AMCA 500-D.
3. Direct shaft mount damper actuators shall be used for controlling the open and closed position of dampers.

B. Valves

1. Valve Assembly: Valves shall have stainless steel stems. Valves shall be ANSI Class 125 or ANSI Class 150, as required by the following pressure-temperature design criteria: 150 percent of the system operating pressure at the system operating temperature. Valve leakage rating shall be 0.01 percent of rated Cv. Class 125 copper alloy valve bodies and Class 150 steel or stainless steel valves shall conform to ASME B16.5 as a minimum. Cast iron valve components shall conform to ASTM A 126 Class B or C as a minimum.
2. Butterfly Valve Assembly: Butterfly valves shall be threaded lug type suitable for dead-end service and for modulation to the fully closed position, with noncorrosive discs, stainless steel shafts supported by bearing, and EPDM seats suitable for temperatures from minus 20 degrees F to plus 250 degrees F. Valves shall have a manual means of operation independent of the actuator.
3. Ball Valve: Full port design. Ball valves 1/2-inch and larger shall conform to MSS SP-72 or MSS SP-110 and shall be cast iron or bronze with threaded, soldered, or flanged ends. Valves 2 inches or larger shall be provided with manual gear operators with position indicators.
4. Two-Way Valves: Two-way modulating valves shall have equal percentage characteristics.
5. Three-Way Valves: Three-way valves shall have equal percentage characteristics.
6. Duct Coil and Terminal Unit Coil Valves: Provide control valves with either flare-type or solder-type ends provided for duct or terminal-unit coils. Provide flare nuts for each flare-type end valve.
7. Valves for Chilled Water, Condenser Water and Glycol Service

a. Bodies for valves 1 1/2 inches and smaller shall be brass or bronze, with threaded or union ends. Bodies for valves from 2 inches to 3 inches inclusive shall be of brass, bronze or iron. Bodies for 2-inch valves shall have threaded ends. Bodies for valves from 2 1/2 to 3 inches shall have flanged-end connections. Internal valve trim shall be brass or bronze except that valve stems may be Type 316 stainless steel. Water valves shall be sized for 3 pounds per square inch differential through the valve at rated flow, except as indicated otherwise. Select valve flow coefficient (Cv) for an actual pressure drop not less than 50 percent or greater than 125 percent of the design pressure drop at design flow.

b. Valves 4 inches and larger shall be butterfly valves.

C. Actuators

1. Electric Actuators

a. Provide direct drive electric actuators for all control applications, except where indicated otherwise. When operated at rated voltage, each actuator shall be capable of delivering torque required for continuous uniform motion and shall have end switch to limit travel, or shall withstand continuous stalling without damage. Actuators shall function properly with range of 85 to 110 percent of line voltage.

b. Provide gears manufactured from steel, copper alloy, fiber, or reinforced nylon. Provide hardened steel running shafts in sleeve bearing of copper alloy, hardened steel, nylon, or ball bearing. Provide two-position actuators of the single direction, spring return, or reversing type. Provide proportioning actuators capable of stopping at all points in the cycle and starting in either direction, from any point.

c. Provide reversing and proportioning actuators with limit switches to limit travel in either direction unless operator is stall type. Actuators shall have a simple switch for reversing direction, and a button to disengage clutch for manual adjustments. Provide reversible shaded pole, split capacitor, synchronous, or stepper type electric motors.

D. Output Switches

1. Control Relays: Shall be double pole, double throw (DPDT), UL-listed, with contacts rated to the application, indicator light, and dust proof enclosure. Light indicator is lit when coil is energized and is off when coil is not energized. Relays shall be socket type, plug into a fixed base, and replaceable without need of tools or removing wiring. Encapsulated "PAM" type relays are permissible for terminal control applications.

2.4 ELECTRICAL POWER AND DISTRIBUTION

A. For controller power provide a new, dedicated 120 VAC 60 Hz source, three wire (black, white, and green). Run green ground wire to panel ground; conduit grounds are not sufficient. The power bus is to be used, shall be connected to and powered by the essential bus.

1. Transformers: Transformers shall conform to UL 506. Power digital controllers and terminal control units (TCU's) from dedicated circuit breakers with surge protection

specified. Transformers for digital controllers serving terminal equipment on lower level LANs may be grouped to have specified surge protection sized for the number of controllers on a single transformer. Provide a fuse on the transformer secondary side. Control power shall be free of harmonics.

2. Surge Protection: Surge and transient protection consist of devices installed externally to digital controllers.
3. Power Line Surge Protection: Surge suppressors external to digital controller, shall be installed on all incoming AC power. Surge suppressor shall be rated by UL 1449, have a fault indicating light, and have clamping voltage ratings below the following levels:

    a. Unit is a transient voltage surge suppressor 120 VAC/1 phase/2 wire plus ground, hard wire individual equipment protector.
    b. Unit must react within 5 nanoseconds and automatically reset.
    c. Voltage protection threshold, line to neutral, starts at no more than 211 volts peak on the 120 VAC line.
    d. The transient voltage surge suppressor must have an independent secondary stage equal to or greater than the primary stage joule rating.
    e. The primary suppression system components must be pure Silicon Avalanche Diodes.
    f. Silicon avalanche diodes or metal oxide varistors are acceptable in the independent secondary suppression system.
    g. The Transient suppression system shall incorporate an indication light which denotes whether the primary and/or secondary transient protection components is/are functioning.
    h. All system functions of the transient suppression system must be individually fused and not short circuit the AC power line at any time.
    i. The transient suppression system shall incorporate an EMI/RFI noise filter with a minimum attenuation of 13 dB at 10 kHz to 300 MHz.
    j. The system must comply with IEEE C62.41, Class "B" requirements and be tested according to IEEE C62.45.
    k. The system shall operate at minus 20 degrees C to plus 50 degrees C.

4. Telephone and Communication Line Surge Protection: Provide transient surge protection to protect the DDC controllers and LAN related devices from surges that occur on the phone lines (modem or direct connect) and on inter-unit LAN communications. Devices shall be UL-listed.

    a. The surge protection shall be a rugged package with continuous, non-interrupting protection and not use crowbar technology. Instant automatic reset after safely eliminating transient surges, induced lightning, and other forms of transient over voltages.
    b. Unit must react within 5 nanoseconds using only solid-state silicone avalanche technology.
    c. Unit shall be installed at the proper distance as recommended by the manufacturer.

5. Controller Input/Output Protection: Controller input/output points shall surge protection with optical isolation, metal oxide varistors (MOV), or silicon avalanche devices. Fuses are not permitted for surge protection.

B. Wiring: Provide complete electric wiring for DDC system, including wiring to transformer primaries. Control circuit wiring shall not run in the same conduit as power wiring over 100

volts. Circuits operating at more than 100 volts shall be in accordance with Division 26 requirements. Circuits operating at 100 volts or less shall be defined as low voltage and shall be run in rigid or flexible conduit, metallic tubing, metal raceways or wire trays, or armored cable. Provide circuit and wiring protection as required by NFPA 70. Aluminum-sheathed cable or aluminum conduit may be used but shall not be buried in concrete. Use conduit or plenum-rated cable in HVAC plenums. HVAC plenums include the space between a drop ceiling and the architectural ceiling, within walls, and within ductwork. Protect exposed wiring from abuse and damage.

1. AC Control Wiring

   a. Control wiring for 24 V circuits shall be insulated copper 18 AWG minimum and rated for 300 VAC service.
   b. Wiring for 120 V shall be 14 AWG minimum and rated for 600 V service.

2. Analog Signal Wiring: Analog signal wiring shall be 18 AWG single or multiple twisted pair. Each cable shall be 100 percent shielded, and have 20 AWG drain wire. Each wire shall have insulation rated to 300 V AC. Cables shall have an overall aluminum-polyester or tinned-copper (cable-shield tape). Install analog signal wiring in conduit separate from AC power circuits.

2.5 FIRE PROTECTION DEVICES

A. Provide smoke detectors in return and supply air ducts on downstream side of filters in accordance with NFPA 90A, except as otherwise indicated. Provide UL-listed or FM-approved detectors for duct installation.

B. Duct Smoke Detectors: Provide in each air-handling system as indicated. Furnish and install detectors under Section 28 30 00, “FAA MASTER FIRE ALARM SYSTEM.”

2.6 VARIABLE FREQUENCY MOTOR DRIVES

A. Provide interface between DDC System and variable frequency motor drives to provide motor speed controls as specified. Coordinate interface type with the drives provided.

B. Refer to Section 26 29 23, “VARIABLE-FREQUENCY MOTOR CONTROLLERS.”

PART 3 EXECUTION

3.1 INSTALLATION

A. Perform installation under supervision of competent technicians regularly employed in the installation of DDC systems.

B. Wiring Criteria

1. Input/output identification: Permanently label each field wire, cable at each end with unique descriptive identification.
2. Rigid or flexible conduit shall be terminated at all sensors, panels, troughs, and output devices.

3. Surge Protection: Install surge protection per manufacturer's specification.
4. Grounding: Ground controllers and cabinets to a good earth ground. Ground controller to a ground in accordance with Division 26 requirements. Conduit grounding alone is not sufficient; all grounding must have a direct path to building earth ground. Ground sensor drain wire shields at controller end.
5. Installer is responsible for correcting all associated ground loop problems.
6. Wiring in panel enclosures shall run in covered wire track.

C. Digital Controllers: Do not divide control of a single mechanical system such as an air-handling unit, chiller, or terminal equipment between two or more controllers. A single controller shall manage control functions for a single mechanical system. It is permissible, however, to manage more than one mechanical system with a single controller. All redundant equipment (AHUs, pumps, chillers, etc.) shall be located on different DDC panels to eliminate the loss of control for and entire system due to a DDC panel failure. In addition, DDC panels shall be fed from separate electrical circuits to eliminate multiple panel failures due to a tripped breaker.

D. Temperature Sensors: Provide temperature sensors in locations to sense the appropriate condition. Provide sensors where they are easy to access and service without special tools. Calibrate sensors to accuracy specified. In no case will sensors designed for one application be installed for another application.

1. Room Temperature Sensors: Provide on interior walls to sense average room temperature conditions. Avoid locations near heat sources or which may be covered by office furniture. Room temperature sensors should not be mounted on exterior walls when other locations are available. Mount center of sensor at 5 feet above finished floor.
2. Duct Temperature Sensors

   a. Provide sensors in ductwork in general locations as indicated. Select specific sensor location within duct to accurately sense appropriate air temperatures. Do not locate sensors in dead air spaces or positions obstructed by ducts or equipment. Install gaskets between the sensor housing and duct wall. Seal duct and insulation penetrations.
   b. String duct averaging sensors horizontally between two rigid supports in a serpentine position to sense average conditions. Insulate temperature sensing elements from supports. Provide hinged duct access doors to install averaging sensors if needed.
   c. Locate freeze protection sensors in appropriate locations to sense lowest temperatures, to avoid potential problems with air stratification. Lowest horizontal pass shall be not more than 1-foot above bottom tube of coil.

3. Immersion Temperature Sensors: Provide thermowells for sensors measuring temperatures in liquid applications or pressure vessels. Locate wells to sense continuous flow conditions. Do not install wells using extension couplings. Where piping diameters are smaller than the length of the wells, provide wells in piping at elbows to sense flow across entire area of well. Wells shall not restrict flow area to less than 70 percent of pipe area. Increase piping size as required to avoid restriction. Provide thermowells with thermal transmission material within the well.
4. Outside Air Temperature Sensors: Provide outside air temperature sensor in weatherproof enclosure on north side of the building, away from exhaust hoods, air

intakes and other areas that may affect temperature readings. Provide sun shields to protect from direct sunlight.

E. Damper Actuators: Actuators shall not be mounted in the air stream.

F. Differential Pressure Sensors

1. Duct Static Pressure Sensing: Locate duct static pressure tip approximately two-thirds of distance from supply fan to end of duct with the greatest pressure drop.
2. Pumping Proof with Differential Pressure Switches: Install high pressure side between pump discharge and check valve.
3. Variable Speed Control: The cycle time and characteristics of the input signal from the differential pressure sensors shall be fully compatible with the variable speed controller. Coordinate the requirements with the provided associated equipment.

G. Control Drawings

1. Post laminated copies of as-built control system drawings in each mechanical room.
2. Provide 3 sets of as-built control drawings to the COTR.

3.2 TEST AND BALANCE SUPPORT

A. Controls installer shall coordinate with and provide full time on-site technical support to test and balance (TAB) personnel specified under Section 23 05 93 “TESTING ADJUSTING AND BALANCING” or any other documents in the project specification. This support shall include:

1. On-site operation of control systems for proper operating modes during all phases of balancing and testing.
2. Control setpoint adjustments for proper balancing of all relevant mechanical systems, including VAV boxes.
3. Setting all control loops with setpoints and adjustments determined by TAB personnel.

3.3 FIELD QUALITY CONTROL

A. General

1. Obtain approval of the field test plan and performance verification test plan for each phase of testing before beginning that phase of testing. Give the Contracting Officer's Technical Representative written notification of planned testing at least 30 days prior to test. Notification shall be accompanied by the proposed test procedures. In no case will the Contractor be allowed to start testing without written Government approval of field test plan and performance verification test plan.
2. Demonstrate compliance of the heating, ventilating, and air conditioning control system with the contract documents. Furnish personnel, equipment, instrumentation, and supplies necessary to perform calibration and site testing. Ensure that test personnel are regularly employed in the testing and calibration of DDC systems.
3. Testing will include field tests and performance verification tests. Field tests shall demonstrate proper calibration of input and output devices, and the operation of specific

equipment. Performance verification test shall ensure proper execution of the sequence of operation and proper tuning of control loops.

4. Before scheduling the performance verification test, furnish field test documentation and written Certified Statement of Field Test Completion to the Contracting Officer's Technical Representative for approval. The statement, certified by the DDC system provider, states that the installed system has been calibrated, tested, and is ready for the performance verification test. Do not start the performance verification test prior to receiving written permission from the Government.
5. Tests are subject to oversight and approval by the Contracting Officer's Technical Representative. The testing shall not be run during scheduled seasonal off-periods of heating and cooling systems.

B. Test Reporting for Field Testing and Performance Verification Tests

1. During and after completion of the Field Tests, and again after the Performance Verification Tests, identify, determine causes, replace, repair or calibrate equipment that fails to meet the specification, and submit a written report to the Government.
2. Document all tests with detailed test results. Explain in detail the nature of each failure and corrective action taken. Provide a written report containing test documentation after the Field Tests and again after the Performance Verification Tests. Convene a test review meeting at the job site to present the results to the Government. As part of this test review meeting, demonstrate by performing all portions of the field tests or performance verification test that each failure has been corrected. Based on the report and test review meeting, the Government will determine either the restart point or successful completion of testing. Do not retest until after receipt of written notification by the Government. At the conclusion of retest, assessment will be repeated.

C. Field Test Plan: Obtain approval of the field test plan for each phase of testing before beginning that phase of testing. Give to the Contracting Officer's Technical Representative written notification of planned testing at least 45 days prior to test. Notification shall be accompanied by the proposed test procedures. In no case will the Contractor be allowed to start testing without written Government approval of test procedures. The field test plan shall consist of detailed instructions for complete testing to prove performance of the heating, ventilating and air-conditioning system and digital control system and shall include tests requirements specified in the PART 3 paragraph entitled "Contractor's Field Tests".

D. Performance Verification Test Plan: Obtain approval of the performance verification test plan for each phase of testing before beginning that phase of testing. These test phases shall cover the same phases as those for the field tests. Submit this test plan along with the field test plan. In no case will the Contractor be allowed to start performance verification testing without written Government approval of the performance verification test plan. The test plan shall consist of detailed step-by-step instructions for complete testing to prove control system maintains setpoints, control loops are tuned, and controllers are programmed for the correct sequence of operation. The test plan shall also cover test requirements specified in the PART 3 paragraph entitled "Performance Verification Test".

E. Contractor's Field Tests: Field tests shall include the following:

1. System Inspection: Observe the HVAC system in its shutdown condition. Check dampers and valves for proper normal positions. Document each position for the test report.

2. Calibration Accuracy and Operation of Inputs Test: Verify correct calibration and operation of input instruments. For each sensor and transmitter, including those for temperature, pressure, humidity, and air quality, record the reading at the sensor or transmitter location using calibrated test equipment. On the same table, record the corresponding reading at the digital controller for the test report. The test equipment shall have been calibrated within one year of use. Test equipment calibration shall be traceable to the measurement standards of the National Institute of Standards and Technology.
3. Actuator Range Adjustment Test: With the digital controller, apply a control signal to each actuator and verify that the actuator operates properly from its normal position to full range of stroke position. Record actual spring ranges and normal positions for all modulating control valves and dampers. Include documentation in the test report.
4. Digital Controller Startup and Memory Test: Demonstrate that programming is not lost after a power failure, and digital controllers automatically resume proper control after a power failure.
5. Surge Protection Test: Show that surge protection, meeting the requirements of this specification, has been installed on incoming power to the digital controllers and on communications lines.
6. Application Software Operation Test: Test compliance of the application software for:

    a. Ability to communicate with digital controllers, uploading and downloading of control programs
    b. Text editing program: Demonstrate ability to edit the control program off line.
    c. Reporting of alarm conditions: Force alarms conditions for each alarm, and ensure workstation receives alarms.
    d. Reporting trend and status reports: Demonstrate ability of software to receive, display, and save trend and status reports.

F. Performance Verification Tests: Conduct the performance verification tests to demonstrate control system maintains setpoints, control loops are tuned, and controllers are programmed for the correct sequence of operation. Conduct performance verification test during 7 days of continuous HVAC and DDC systems operation and before final acceptance of work. Specifically the performance verification test shall demonstrate the following:

1. Execution of Sequence of Operation: Demonstrate the HVAC system operates properly through the complete sequence of operation, for example seasonal, occupied/unoccupied, and warm-up. Demonstrate proper control system response for abnormal conditions by simulating these conditions. Demonstrate hardware interlocks and safeties work. Demonstrate the control system performs the correct sequence of control after a loss of power.
2. Control Loop Stability and Accuracy: Furnish the Government graphed trends of control loops to demonstrate the control loop is stable and that setpoint is maintained. Control loop response shall respond to setpoint changes and stabilize in 3 minutes. Control loop trend data shall be real time and the time between data points shall not be greater than 1 minute. Provide a printer, either the project printer or temporary, at the job site for printing graphed trends. The printer shall remain on the job site throughout Performance Verification Testing to allow printing trends.

3.4 TRAINING

A. Submit a training course schedule, syllabus, and training materials 14 days prior to the start of training. Obtain approval of the training course before beginning that phase of training. Furnish a qualified instructor to conduct training courses for designated personnel in the maintenance and operation of the HVAC and DDC system. Orient training to the specific system being installed under this contract. Use Operation and Maintenance manual as the primary instructional aid in contractor provided activity personnel training. Base training on the Operations and Maintenance manuals and a DDC training manual. Manuals shall be delivered for each trainee with two additional sets delivered for archiving at the project site. Training manuals shall include an agenda, defined objectives and a detailed description of the subject matter for each lesson. Furnish audio-visual equipment and all other training materials and supplies. A training day is defined as 8 hours of classroom or lab instruction, including two 15 minute breaks and excluding lunch time, Monday through Friday, during the daytime shift in effect at the training facility. For guidance, the Contractor should assume the attendees will have a high school education and are familiar with HVAC systems.

B. DDC Training Phase I

1. The first class shall be taught for a period of 5 consecutive training days (40 hours minimum) at least 2 weeks prior to the scheduled Performance Verification Test. Training shall be classroom, but have hands-on operation of similar digital controllers. A maximum of 5 personnel will attend this course. Upon completion of this course, each student should be able to perform elementary operations and describe the general hardware architecture and functionality of the system. This course shall include but not be limited to:

   a. Theory of operation.
   b. Hardware architecture.
   c. Operation of the system.
   d. Operator commands.
   e. Control sequence programming.
   f. Data base entry.
   g. Reports and logs.
   h. Alarm reports.
   i. Diagnostics.

C. DDC Training Phase II

1. The second course shall be taught in the field, using the operating equipment at the project site for a total of 5 consecutive days. A maximum of five personnel will attend the course. The course shall consist of hands-on training under the constant monitoring of the instructor. Course content should duplicate DDC Training Phase I course as applied to the installed system. The instructor shall determine password issued to each student before each session. Upon completion of this course, students should be fully proficient in the operation of each system function.

END OF SECTION 23 09 23

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SECTION 23 21 13 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:

1. Chilled-water piping.
2. Makeup-water piping.
3. Condensate-drain piping.
4. Blowdown-drain piping.
5. Air-vent piping.
6. Safety-valve-inlet and -outlet piping.

1.2 DEFINITIONS

A. PTFE: Polytetrafluoroethylene.

1.3 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:

1. Chilled-Water Piping: 125 psig at 100 deg F.
2. Makeup-Water Piping: 125 psig at 150 deg F .
3. Condensate-Drain Piping: 100 deg F.
4. Blowdown-Drain Piping: 200 deg F .
5. Air-Vent Piping: 200 deg F.
6. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.4 SUBMITTALS

A. Product Data: For each type of the following:

1. Piping
2. Air control devices.
3. Hydronic specialties.

B. Shop Drawings: Detail, at 1/2 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

C. Welding certificates.

D. Qualification Data: For Installer.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

G. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.

1.6 WARRANTY

A. Warranty: Manufacturer's agrees to repair or replace components that fail in materials or workmanship within specified warranty period, after assembly in field.

1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
B. DWV Copper Tubing: ASTM B 306, Type DWV.
C. Wrought-Copper Fittings: ASME B16.22.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Anvil International, Inc.
b. S. P. Fittings; a division of Star Pipe Products.

D. Wrought-Copper Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.

B. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150 and 300 as indicated in Part 3 "Piping Applications" Article.

C. Malleable-Iron Unions: ASME B16.39; Class 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.

D. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.

E. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

F. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

G. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.3 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, silver based lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8, B CuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

E. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

F. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.4 DIELECTRIC FITTINGS

A. Refer to Section 23 05 00, “Common Work Results for HVAC.”

2.5 VALVES

A. Check, Ball, and Butterfly Valves: Comply with requirements specified in Section 23 05 23 "General-Duty Valves for HVAC Piping."

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Section 23 09 23 "Instrumentation And Control For HVAC."

C. Bronze, Calibrated-Orifice, Balancing Valves:

1. Known Acceptable Source: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Armstrong Pumps, Inc.
   b. Bell & Gossett Domestic Pump; a division of ITT Industries.
2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Plug: Resin.
5. Seat: PTFE.
6. End Connections: Threaded or socket.
7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
8. Handle Style: Lever, with memory stop to retain set position.
9. CWP Rating: Minimum 125 psig.
10. Maximum Operating Temperature: 250 deg F.

D. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:

1. Known Acceptable Source: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Armstrong Pumps, Inc.
   b. Bell & Gossett Domestic Pump; a division of ITT Industries.
   c. Taco.
   d. Tour & Andersson; available through Victaulic Company of America.

2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.

4. Stem Seals: EPDM O-rings.
5. Disc: Glass and carbon-filled PTFE.
6. Seat: PTFE.
7. End Connections: Flanged.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position.
10. CWP Rating: Minimum 125 psig.
11. Maximum Operating Temperature: 250 deg F.

E. Automatic Flow-Control Valves:

1. Known Acceptable Source: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Flow Design Inc.
   b. Griswold Controls.

2. Body: Brass or ferrous metal.
3. Piston and Spring Assembly: Corrosion resistant, tamper proof, self cleaning, and removable.
4. Combination Assemblies: Include bonze or brass-alloy ball valve.
5. Identification Tag: Marked with zone identification, valve number, and flow rate.
6. Size: Same as pipe in which installed.
7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
8. Minimum CWP Rating: Minimum 125 psig.
9. Maximum Operating Temperature: 250 def F.

2.6 AIR CONTROL DEVICES

A. Known Acceptable Source: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amtrol, Inc.
2. Armstrong Pumps, Inc.
3. Bell & Gossett Domestic Pump; a division of ITT Industries.

B. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/8.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg F.

C. Automatic Air Vents:

1. Body: Bronze or cast iron.
2. Internal Parts: Nonferrous.
3. Operator: Noncorrosive metal float.
4. Inlet Connection: NPS 1/2
5. Discharge Connection: NPS 1/4
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg F.

D. Diaphragm -Type Expansion Tanks:

1. Tank: Welded steel, rated for 125 psig. working pressure and 225 def F. maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Diaphragm: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
3. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

E. Tangential-Type Air Separators:

1. Tank: Welded steel; ASME constructed and labeled for 125 psig minimum working pressure and 225 deg F. maximum operating temperature.
2. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.

2.7 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 175 psig.

B. Stainless-Steel Bellow, Flexible Connectors:

1. Body: Stainless-steel bellows with double woven, flexible, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/8-inch misalignment.
4. CWP Rating: 220 psig at 100 deg F.
5. Maximum Operating Temperature: 250 deg F.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Chilled-water piping, NPS 2 and smaller shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or brazed joints.
2. Schedule 40 Type S seamless, Grade B black steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

B. Chilled-water piping, NPS 2-1/2 and larger shall be the following:

1. Schedule 40 Type S seamless, Grade B black steel pipe;, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

C. Makeup-water piping installed aboveground shall be either of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or brazed joints.
2. Schedule 40 Type S seamless, Grade B black steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

D. Condensate-Drain Piping: Type M or DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

E. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

F. Air-Vent Piping:

1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
2. Outlet: Type L, annealed-temper copper tubing with soldered or flared joints.

G. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

3.2 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.

3.3 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS ¾ ball valve, and short NPS ¾ threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to Section 23 05 23 "General-Duty Valves for HVAC Piping."

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install strainers on inlet side of each pump, and elsewhere as indicated. Install NPS ¾ nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

T. Identify piping as specified in Section 23 05 53 "Identification for HVAC Piping and Equipment."

3.4 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.

B. Seismic and antiterrorism restraints are specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."

C. Install the following pipe attachments:

1. Steel pipe stanchion saddle, MSS Type 37
2. Steel pipe saddle support, MSS Type 36

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
7. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.
8. NPS 6: Maximum span, 12 feet ; minimum rod size, 1/2 inch.

E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.

3.5 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using silver based lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.6 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Section 23 05 19 "Meters and Gages for HVAC Piping."

3.8 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
4. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Pipe Cleaning:

1. Pipe Exterior: Wash and wipe the pipe exterior to remove constrction dirt, loose scale and flux.
2. Pipe Interior: Fully clean, flush and treat piping. Remove debris wheter the debris was caused by construction activities or existed before the construction. Flush piping wheter new or existing utilizing the flushing procedure described below. Any existing to remain piping that ws left open to the atmosphere during construction must be cleand and flushed. It is recommended that any existing to remain piping be sealed and filled with treated water during the construction process to prevent corrosion during construction.
3. Pipe flushing procedure: Isolate the section of pipe to be cleaned with temporary caps, blind flanges, bypasses and spool pieces. Water shall be circulated through the piping utilizing an adequate temporarily installed strainer and pump with the intent to remove any and all foreign matter from the piping system and to prevent debris from entering any system equipment. During circulation of the water, remove as much foreign matter as possible by draining at low points and equipment inlets. Ensure desired drain flow does not exceed system water makeup capability. When the system appears to be free of foreign matter and the water runs clear, shut pumps down and remove strainer baskets, inspect and clean baskets removing any dirt/debris before re-installing. Repeat above procedures until system is determined by the Government representative to be clean and free of debris. Once the system is determined to be clean by the Government representative, recirculate water through equipment strainers, evaporators, condenser, and piping for (4) four hours. Shut down the temporary pump, drain equipment, remove evaporator and condenser water box covers for visual water box and tube inspection. Clean tubes found to be fouled or obstructed with debris. Repeat this procedure until strainers, evaporators, condensers and heat exchangers are determined to be clean by the Government representative.

C. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Testing of the system with air pressure is an acceptable pretest but will not be accepted as the documented final test.
5. Subject piping system to hydrostatic test pressure that is not less than 150 pisg. Do not use the system water to fill the piping for the test but fill from an external water source and vent air before the test. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
6. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
7. Prepare written report of testing.
8. Testing of the piping shall be applied to new pipe segments only.

D. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 23 21 13

SECTION 23 21 23 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Separately coupled, base-mounted, end-suction centrifugal pumps.
2. Automatic condensate pump units.

1.2 DEFINITIONS

A. Buna-N: Nitrile rubber.

B. EPT: Ethylene propylene terpolymer.

1.3 SUBMITTALS

A. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.

B. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of hydronic pumps and are based on the specific system indicated.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

B. Store pumps in dry location.

C. Retain protective covers for flanges and protective coatings during storage.

D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

E. Comply with pump manufacturer's written rigging instructions.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Mechanical Seals: One mechanical seal(s) for each pump.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Known Acceptable Source: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 SEPARATELY COUPLED, BASE-MOUNTED, END-SUCTION CENTRIFUGAL PUMPS

A. Known Acceptable Source:

1. American-Marsh Pumps.
2. Armstrong Pumps Inc.
3. Aurora Pump; Division of Pentair Pump Group.
4. Bell & Gossett; Div. of ITT Industries.
5. Buffalo Pumps, Inc.; an Ampco Pittsburgh Co.
6. Burks Pumps; Div. of Crane Pumps & Systems.

7. Deming Pumps; Div. of Crane Pumps & Systems.
8. Flowserve Corporation; Div. of Ingersoll-Dresser Pumps.
9. MEPCO (Marshall Engineered Products Co.).
10. PACO Pumps.
11. Scot Pump; Div. of Ardox Corp.
12. Taco, Inc.
13. Thrush Company Inc.
14. Weinman; Div. of Crane Pumps & Systems.

B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal. Rate pump for 125-psig minimum working pressure and a continuous water temperature of 225 deg F.

C. Pump Construction:

1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and threaded companion-flange or flanged connections.
2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
3. Pump Shaft: Stainless steel.
4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket.
5. Packing Seal: Stuffing box, with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
6. Pump Bearings: Grease-lubricated ball bearings contained in cast-iron housing with grease fittings.

D. Shaft Coupling: Molded rubber insert and interlocking spider capable of absorbing vibration.

E. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.

F. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.

G. Motor: Single speed, with permanently lubricated ball bearings, unless otherwise indicated; secured to mounting frame, with adjustable alignment. Comply with requirements in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."

H. Capacities and Characteristics:

1. Refer to drawings for capacities and characteristics.

2.3 AUTOMATIC CONDENSATE PUMP UNITS

A. Known Acceptable Source:

1. Aurora Pump; Division of Pentair Pump Group.
2. Beckett Corporation.
3. Flowserve Corporation; Div. of Ingersoll-Dresser Pumps.
4. Hartell Pumps Div.; Milton Roy Co.
5. Little Giant Pump Co.; Subsidiary of Tecumseh Products Co.
6. MEPCO (Marshall Engineered Products Co.).

B. Description: Packaged units with corrosion-resistant pump, plastic tank with cover, and automatic controls. Include factory- or field-installed check valve and a 72-inch- minimum, electrical power cord with plug.

2.4 PUMP SPECIALTY FITTINGS

A. Suction Diffuser: Angle pattern, 175-psig pressure rating, cast-iron body and end cap, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; bronze or stainless-steel straightening vanes; drain plug; and factory-fabricated support.

B. Triple-Duty Valve: Angle or straight pattern, 175-psig pressure rating, cast-iron body, pump-discharge fitting; with drain plug and bronze-fitted shutoff, balancing, and check valve features. Brass gage ports with integral check valve, and orifice for flow measurement.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONCRETE BASES

A. Install concrete bases of dimensions indicated for pumps and controllers. Refer to Section 23 05 00 "Common Work Results for HVAC."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.3 PUMP INSTALLATION

A. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

B. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

C. Install continuous-thread hanger rods and elastomeric hangers of sufficient size to support pump weight. Vibration isolation devices are specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment." Fabricate brackets or supports as required. Hanger and support materials are specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."

D. Set base-mounted pumps on concrete foundation. Disconnect coupling before setting. Do not reconnect couplings until alignment procedure is complete.

1. Support pump baseplate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1-1/2 inches between pump base and foundation for grouting.
2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.

E. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.

3.4 ALIGNMENT

A. Align pump and motor shafts and piping connections after setting on foundation, grout has been set and foundation bolts have been tightened, and piping connections have been made.

B. Comply with pump and coupling manufacturers' written instructions.

C. Adjust pump and motor shafts for angular and offset alignment by methods specified in HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation."

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.5 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Install check valve and throttling or triple-duty valve on discharge side of pumps.

F. Install Y-type strainer or suction diffuser and shutoff valve on suction side of pumps.

G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

H. Install pressure gages on pump suction and discharge, at integral pressure-gage tapping, or install single gage with multiple input selector valve.

I. Install check valve and gate or ball valve on each condensate pump unit discharge.

J. Install electrical connections for power, controls, and devices.

K. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

L. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Perform the following startup checks for each pump before starting:

    a. Verify bearing lubrication.
    b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    c. Verify that pump is rotating in the correct direction.

5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
6. Start motor.
7. Open discharge valve slowly.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train FAA's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION 23 21 23

SECTION 23 23 00 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes refrigerant piping used for air-conditioning applications.

1.2 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-407C:

1. Suction Lines for Air-Conditioning Applications: 230 psig.
2. Suction Lines for Heat-Pump Applications: 380 psig.
3. Hot-Gas and Liquid Lines: 380 psig.

B. Line Test Pressure for Refrigerant R-410A:

1. Suction Lines for Air-Conditioning Applications: 300 psig.
2. Suction Lines for Heat-Pump Applications: 535 psig.
3. Hot-Gas and Liquid Lines: 535 psig.

1.3 SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:

1. Thermostatic expansion valves.
2. Solenoid valves.
3. Hot-gas bypass valves.
4. Filter dryers.
5. Strainers.
6. Pressure-regulating valves.

B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.

1. Shop Drawing Scale: 1/4 inch equals 1 foot.
2. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

C. Welding certificates.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.5 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.6 COORDINATION

A. Coordinate size and location of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 07 72 00 "Roof Accessories."

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 280, Type ACR.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

E. Brazing Filler Metals: AWS A5.8.

F. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.

3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
4. Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F.

2.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; Type, Grade, and wall thickness as selected in Part 3 piping applications articles.

B. Wrought-Steel Fittings: ASTM A 234/A 234M, for welded joints.

C. Steel Flanges and Flanged Fittings: ASME B16.5, steel, including bolts, nuts, and gaskets, bevel-welded end connection, and raised face.

D. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

E. Flanged Unions:

1. Body: Forged-steel flanges for NPS 1 to NPS 1-1/2 and ductile iron for NPS 2 to NPS 3. Apply rust-resistant finish at factory.
2. Gasket: Fiber asbestos free.
3. Fasteners: Four plated-steel bolts, with silicon bronze nuts. Apply rust-resistant finish at factory.
4. End Connections: Brass tailpiece adapters for solder-end connections to copper tubing.
5. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
6. Pressure Rating: Factory test at minimum 400 psig.
7. Maximum Operating Temperature: 330 deg F.

F. Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, stainless-steel-wire-reinforced protective jacket
2. End Connections:

   a. NPS 2 and Smaller: With threaded-end connections.
   b. NPS 2-1/2 and Larger: With flanged-end connections.

3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
4. Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F.

2.3 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:

1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
3. Operator: Rising stem and hand wheel.
4. Seat: Nylon.
5. End Connections: Socket, union, or flanged.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

B. Packed-Angle Valves:

1. Body and Bonnet: Forged brass or cast bronze.
2. Packing: Molded stem, back seating, and replaceable under pressure.
3. Operator: Rising stem.
4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
5. Seal Cap: Forged-brass or valox hex cap.
6. End Connections: Socket, union, threaded, or flanged.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 275 deg F.

C. Check Valves:

1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 275 deg F.

D. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig.

E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.

1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24-V ac coil.
6. Working Pressure Rating: 400 psig.
7. Maximum Operating Temperature: 240 deg F.
8. Manual operator.

F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.

1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat Disc: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig.
6. Maximum Operating Temperature: 240 deg F.

G. Thermostatic Expansion Valves: Comply with ARI 750.

1. Body, Bonnet, and Seal Cap: Forged brass or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. Suction Temperature: 40 deg F.
6. Superheat: Adjustable.
7. Reverse-flow option (for heat-pump applications).
8. End Connections: Socket, flare, or threaded union.
9. Working Pressure Rating 450 psig .

H. Straight-Type Strainers:

1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig.
5. Maximum Operating Temperature: 275 deg F.

I. Angle-Type Strainers:

1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig.
6. Maximum Operating Temperature: 275 deg F.

J. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm.
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 240 deg F.

K. Replaceable-Core Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina or charcoal.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig .
8. Rated Flow: See Schedule.
9. Working Pressure Rating: 500 psig.
10. Maximum Operating Temperature: 240 deg F.

L. Permanent Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina or charcoal.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig .
8. Rated Flow: See Schedule.
9. Working Pressure Rating: 500 psig.
10. Maximum Operating Temperature: 240 deg F.

M. Receivers: Comply with ARI 495.

1. Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
2. Comply with UL 207; listed and labeled by an NRTL.
3. Body: Welded steel with corrosion-resistant coating.
4. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
5. End Connections: Socket or threaded.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

N. Liquid Accumulators: Comply with ARI 495.

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or threaded.
3. Working Pressure Rating: 500 psig.
4. Maximum Operating Temperature: 275 deg F.

2.4 REFRIGERANTS

A. Known Acceptable Source: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Atofina Chemicals, Inc.

2. DuPont Company; Fluorochemicals Div.
3. Honeywell, Inc.; Genetron Refrigerants.
4. INEOS Fluor Americas LLC.

B. ASHRAE 34, R-407C: Difluoromethane/Pentafluoroethane/1,1,1,2-Tetrafluoroethane.

C. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-407C

A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

B. Suction Lines NPS 2 to NPS 4 for Conventional Air-Conditioning Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

C. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed soldered joints.

D. Safety-Relief-Valve Discharge Piping: Schedule 40, black-steel and wrought-steel fittings with welded joints.

3.2 PIPING APPLICATIONS FOR REFRIGERANT R-410A

A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

B. Suction Lines NPS 2 to NPS 3-1/2 for Conventional Air-Conditioning Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

C. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.

D. Safety-Relief-Valve Discharge Piping: Schedule 40, black-steel and wrought-steel fittings with welded joints.

3.3 VALVE AND SPECIALTY APPLICATIONS

A. Install a full-sized, three-valve bypass around replaceable core filter dryers.

B. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.

C. Install thermostatic expansion valves as close as possible to distributors on evaporators.

1. Install valve so diaphragm case is warmer than bulb.

2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

D. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

E. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

F. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:

1. Solenoid valves.
2. Thermostatic expansion valves.
3. Hot-gas bypass valves.
4. Compressor.

G. Install filter dryers in liquid line between compressor and thermostatic expansion valve.

3.4 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Refer to Section 2309 23 "Instrumentation and Control for HVAC" for solenoid valve controllers, control wiring, and sequence of operation.

K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 08 31 13 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

M. Install refrigerant piping in protective conduit where installed belowground.

N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

O. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

P. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

Q. Before installation of steel refrigerant piping, clean pipe and fittings using the following procedures:

1. Shot blast the interior of piping.
2. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through tubing by means of a wire or electrician's tape.
3. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
4. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
5. Finally, draw a clean, dry, lintless cloth through the tube or pipe.
6. Safety-relief-valve discharge piping is not required to be cleaned but is required to be open to allow unrestricted flow.

R. Install pipe sleeves at penetrations in exterior walls and floor assemblies.

S. Seal penetrations through fire and smoke barriers according to Section 07 84 13 "Penetration Firestopping."

T. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

U. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

V. Seal pipe penetrations through exterior walls according to Section 07 92 00 "Joint Sealants" for materials and methods.

W. Identify refrigerant piping and valves according to Section 23 05 53 "Identification for HVAC Piping and Equipment."

3.5 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

E. Threaded Joints: Thread steel pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry-seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Steel pipe can be threaded, but threaded joints must be seal brazed or seal welded.

G. Welded Joints: Construct joints according to AWS D10.12/D10.12M.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.6 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.

3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
7. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
8. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
9. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
2. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
3. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
4. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.

E. Support multifloor vertical runs at least at each floor.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.

   a. Fill system with nitrogen to the required test pressure.
   b. System shall maintain test pressure at the manifold gage throughout duration of test.
   c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
   d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.8 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

3.9 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.
3. Open compressor suction and discharge valves.
4. Open refrigerant valves except bypass valves that are used for other purposes.
5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 23 23 00

SECTION 23 25 00 - HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following HVAC water-treatment systems:

1. Bypass chemical-feed equipment and controls.
2. HVAC water-treatment chemicals.

1.2 DEFINITIONS

A. EEPROM: Electrically erasable, programmable read-only memory.

B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

C. RO: Reverse osmosis.

D. TDS: Total dissolved solids.

E. UV: Ultraviolet.

1.3 PERFORMANCE REQUIREMENTS

A. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment.

B. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

C. Closed hydronic systems, including hot-water heating and chilled water, shall have the following water qualities:

1. pH: Maintain a value within 9.0 to 10.5.
2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
3. Boron: Maintain a value within 100 to 200 ppm.
4. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
5. Soluble Copper: Maintain a maximum value of 0.20 ppm.
6. TDS: Maintain a maximum value of 10 ppm.
7. Ammonia: Maintain a maximum value of 20 ppm.
8. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
9. Microbiological Limits:

a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/ml.
b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/ml.
c. Nitrate Reducers: Maintain a maximum value of 100 organisms/ml.
d. Sulfate Reducers: Maintain a maximum value of 0 organisms/ml.
e. Iron Bacteria: Maintain a maximum value of 0 organisms/ml.

D. Passivation for Galvanized Steel: For the first 60 days of operation.

1. pH: Maintain a value within 7 to 8.
2. Calcium Carbonate Hardness: Maintain a value within 100 to 300 ppm.
3. Calcium Carbonate Alkalinity: Maintain a value within 100 to 300 ppm.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following products:

1. Bypass feeders.

B. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to HVAC systems. Include plans, elevations, sections, details, and attachments to other work.

C. Field quality-control test reports.

D. Manufacturer Seismic Qualification Certification: Submit certification that components will withstand seismic forces defined in Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Other Informational Submittals:

1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in the "Performance Requirements" Article above.
2. Water Analysis: Illustrate water quality available at Project site.
3. Passivation Confirmation Report: Verify passivation of galvanized-steel surfaces, and confirm this observation in a letter to COTR.

1.5 QUALITY ASSURANCE

A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 MAINTENANCE SERVICE

A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion, scale formation, and biological growth for cooling, chilled-water piping, heating, hot-water piping and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion, and shall include the following:

1. Initial water analysis and HVAC water-treatment recommendations.
2. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
3. Periodic field service and consultation.
4. Customer report charts and log sheets.
5. Laboratory technical analysis.
6. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Known Acceptable Source: For chemical based water treatment systems, Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ampion Corp.
2. Anderson Chemical Co, Inc.
3. Aqua-Chem, Inc.; Cleaver-Brooks Div.
4. Barclay Chemical Co.; Water Management, Inc.
5. Boland Trane Services
6. GE Betz.
7. GE Osmonics.
8. H-O-H Chemicals, Inc.
9. Metro Group. Inc. (The); Metropolitan Refining Div.
10. ONDEO Nalco Company.
11. Watcon, Inc.

2.2 MANUAL CHEMICAL-FEED EQUIPMENT

A. Bypass Feeders: Steel, with corrosion-resistant exterior coating, minimum 3-1/2-inch fill opening in the top, and NPS 3/4 bottom inlet and top side outlet. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.

1. Capacity: 5 gal.
2. Minimum Working Pressure: 125 psig.

2.3 CHEMICAL TREATMENT TEST EQUIPMENT

A. Test Kit: Manufacturer-recommended equipment and chemicals in a wall-mounting cabinet for testing pH, TDS, inhibitor, chloride, alkalinity, and hardness; sulfite and testable polymer tests for high-pressure boilers, and oxidizing biocide test for open cooling systems.

B. Corrosion Test-Coupon Assembly: Constructed of corrosive-resistant material, complete with piping, valves, and mild steel and copper coupons. Locate copper coupon downstream from mild steel coupon in the test-coupon assembly.

1. Two-station rack for closed-loop systems.

2.4 CHEMICALS

A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment, and that can attain water quality specified in Part 1 "Performance Requirements" Article.

PART 3 - EXECUTION

3.1 WATER ANALYSIS

A. Perform an analysis of supply water to determine quality of water available at Project site.

3.2 INSTALLATION

A. Install seismic restraints for equipment and floor-mounting accessories and anchor to building structure. Refer to Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment" for seismic restraints.

B. Bypass Feeders: Install in closed hydronic systems, including hot-water heating and chilled water, and equipped with the following:

1. Install bypass feeder in a bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
2. Install water meter in makeup water supply.

3. Install test-coupon assembly in bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
4. Install a full-port ball isolation valves on inlet, outlet, and drain below feeder inlet.
5. Install a swing check on inlet after the isolation valve.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Dielectric fittings are specified in Section 23 05 00 "Common Work Results for HVAC."

D. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Section 23 05 23 "General-Duty Valves for HVAC Piping."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Inspect field-assembled components and equipment installation, including piping.
2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
3. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
4. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
5. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
6. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
7. Repair leaks and defects with new materials and retest piping until no leaks exist.

D. Remove and replace malfunctioning units and retest as specified above.

E. Sample boiler water at one-week intervals after boiler startup for a period of five weeks, and prepare test report advising FAA of changes necessary to adhere to Part 1 "Performance Requirements" Article for each required characteristic. Sample boiler water at four-week intervals following the testing noted above to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section.

F. At four-week intervals following Substantial Completion, perform separate water analyses on hydronic systems to show that water quality is within performance requirements specified in this Section. Submit written reports of water analysis advising FAA of changes necessary to adhere to Part 1 "Performance Requirements" Article.

G. Comply with ASTM D 3370 and with the following standards:

1. Silica: ASTM D 859.
2. Steam System: ASTM D 1066.
3. Acidity and Alkalinity: ASTM D 1067.
4. Iron: ASTM D 1068.
5. Water Hardness: ASTM D 1126.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train FAA's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment.

B. Training: Provide a "how-to-use" self-contained breathing apparatus video that details exact operating procedures of equipment.

END OF SECTION 23 25 00

SECTION 23 31 13 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.
7. Seismic-restraint devices.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" ASCE/SEI 7. and SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems." Refer to Section 23 05 48, "Vibration and Seismic Controls for HVAC Piping and Equipment" for force calculation requirements.

1. Seismic Hazard Level AA: Seismic force to weight ratio, 1.00.
2. Seismic Hazard Level A: Seismic force to weight ratio, 0.67.
3. Seismic Hazard Level B: Seismic force to weight ratio, 0.42.
4. Seismic Hazard Level C: Seismic force to weight ratio, 0.21.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

1.3 SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.
3. Seismic-restraint devices.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations, including analysis data signed and sealed by the qualified Licensed Professional Engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

D. Welding certificates.

E. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Lindab Inc.
b. McGill AirFlow LLC.
c. SEMCO Incorporated.
d. Sheet Metal Connectors, Inc.
e. Spiral Manufacturing Co., Inc.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

D. Factory- or Shop-Applied Antimicrobial Coating:

1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D 3363.
4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
5. Shop-Applied Coating Color: Black.
6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.

E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. CertainTeed Corporation; Insulation Group.
   b. Johns Manville.
   c. Knauf Insulation.
   d. Owens Corning.
   e. Maximum Thermal Conductivity:

      1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
      2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

   a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Natural-Fiber Duct Liner: 85 percent cotton, 10 percent borate, and 5 percent polybinding fibers, treated with a microbial growth inhibitor and complying with NFPA 90A or NFPA 90B.

1. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. To exceed the minimum requirements set by ASTM C 1071, verify that a particular manufacturer's product can meet the requirements, retain the "Basis-of-Design Product" Subparagraph below, and insert the manufacturer's name and product designation.

   a. Bonded Logic, Inc.
   b. Reflectix Inc.

3. Maximum Thermal Conductivity: 0.24 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature when tested according to ASTM C 518.
4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to ASTM E 84; certified by an NRTL.
5. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

    a. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanized steel ; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

D. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

    a. Fan discharges.
    b. Intervals of lined duct preceding unlined duct.
    c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.

9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.

a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.

10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.5 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 3 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.

5. Use: O.
6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

G. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

2.7 SEISMIC-RESTRAINT DEVICES

A. Refer to Section 23 05 48, “Vibration and Seismic Controls for HVAC Piping and Equipment for additional requirements.

B. Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.; a division of Cooper Industries.
2. Ductmate Industries, Inc.
3. Hilti Corp.
4. Kinetics Noise Control.

5. Mason Industries.
6. TOLCO; a brand of NIBCO INC.
7. Unistrut Corporation; Tyco International, Ltd.

C. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of the ICC Evaluation Service or the Office of Statewide Health Planning and Development for the State of California.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

D. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

E. Restraint Cables: ASTM A 603, galvanized -steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

F. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or Reinforcing steel angle clamped to hanger rod.

G. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems." and ASCE/SEI 7.

1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
2. Brace a change of direction longer than 12 feet.

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an evaluation service member of the ICC Evaluation Service or the Office of Statewide Health Planning and Development for the State of California.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the COTR if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.6 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 23 33 00 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 9 painting Sections.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:

    a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections, selected by COTR from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.

6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by COTR, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

   a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.9 DUCT CLEANING

A. Clean duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 23 33 00 "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.

7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.10 START UP

A. Air Balance: Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing."

3.11 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Supply Ducts:

1. Ducts Connected to Fan Coil Units:

   a. Pressure Class: Positive 1-inch wg.
   b. Minimum SMACNA Seal Class: B.

2. Ducts Connected to Constant-Volume Air-Handling Units :

   a. Pressure Class: Positive 2-inch wg.
   b. Minimum SMACNA Seal Class: B.

3. Ducts Connected to Equipment Not Listed Above:

   a. Pressure Class: Positive 2-inch wg.
   b. Minimum SMACNA Seal Class: B.

C. Return Ducts:

1. Ducts Connected to Fan Coil Units:

   a. Pressure Class: Positive or negative 1-inch wg.
   b. Minimum SMACNA Seal Class: C.

2. Ducts Connected to Air-Handling Units :

   a. Pressure Class: Positive or negative 2-inch wg.
   b. Minimum SMACNA Seal Class: B.

3. Ducts Connected to Equipment Not Listed Above:

   a. Pressure Class: Positive or negative 2-inch wg.
   b. Minimum SMACNA Seal Class: B.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

   a. Pressure Class: Negative 1-inch wg.
   b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Fan Coil Units:

   a. Pressure Class: Positive or negative 1-inch wg.
   b. Minimum SMACNA Seal Class: B.

2. Ducts Connected to Air-Handling Units :

   a. Pressure Class: Positive or negative 2-inch wg.
   b. Minimum SMACNA Seal Class: B.

F. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.

G. Liner:

1. Supply Air Ducts: Fibrous glass, Type I, 1-1/2 inches thick.
2. Return Air Ducts: Fibrous glass, 1 inch thick.
3. Supply Fan Plenums: Fibrous glass, 1-1/2 inches thick.
4. Transfer Ducts: Fibrous glass, 1 inch thick.

H. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."

a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
4) Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.

I. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."

a. Rectangular Main to Rectangular Branch: 45-degree entry.
b. Rectangular Main to Round Branch: 45-degree entry.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 1000 fpm or Lower: 90-degree tap.
b. Velocity 1000 to 1500 fpm: Conical tap.
c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 23 31 13

SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manual volume dampers.
2. Control dampers.
3. Flange connectors.
4. Turning vanes.
5. Duct-mounted access doors.
6. Flexible connectors.
7. Duct accessory hardware.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.
b. Manual volume damper installations.
c. Control damper installations.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

D. Source quality-control reports.

E. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.3 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

1.4 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Exposed-Surface Finish: Mill phosphatized.

C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Air Balance Inc.; a division of Mestek, Inc.
b. American Warming and Ventilating; a division of Mestek, Inc.
c. Flexmaster U.S.A., Inc.
d. McGill AirFlow LLC.
e. METALAIRE, Inc.
f. Nailor Industries Inc.
g. Pottorff; a division of PCI Industries, Inc.
h. Ruskin Company.
i. Trox USA Inc.
j. Vent Products Company, Inc.

2. Standard leakage rating.
3. Suitable for horizontal or vertical applications.

4. Frames:

   a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
   b. Mitered and welded corners.
   c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Galvanized-steel, 0.064 inch thick.

6. Blade Axles: Galvanized steel.
7. Bearings:

   a. Oil-impregnated bronze.
   b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Galvanized steel.

B. Jackshaft:

1. Size: 1-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.3 CONTROL DAMPERS

A. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Duro Dyne Inc.
5. Flexmaster U.S.A., Inc.
6. Greenheck Fan Corporation.
7. Lloyd Industries, Inc.

8. M&I Air Systems Engineering; Division of M&I Heat Transfer Products Ltd.
9. McGill AirFlow LLC.
10. METALAIRE, Inc.
11. Metal Form Manufacturing, Inc.
12. Nailor Industries Inc.
13. NCA Manufacturing, Inc.
14. Ruskin Company.
15. Vent Products Company, Inc.
16. Young Regulator Company.

B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Frames:

1. Hat or U shaped.
2. Galvanized-steel channels, 0.064 inch thick.
3. Mitered and welded corners.

D. Blades:

1. Multiple blade with maximum blade width of 8 inches.
2. Parallel- and opposed-blade design.
3. Galvanized steel.
4. 0.064 inch thick.
5. Blade Edging: Closed-cell neoprene edging.
6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

E. Blade Axles: 1/2-inch- diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F.

F. Bearings:

1. Oil-impregnated bronze.
2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
3. Thrust bearings at each end of every blade.

2.4 FLANGE CONNECTORS

A. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ductmate Industries, Inc.
2. Nexus PDQ; Division of Shilco Holdings Inc.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.5 TURNING VANES

A. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. METALAIRE, Inc.
4. SEMCO Incorporated.
5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

D. Vane Construction: Double wall.

2.6 DUCT-MOUNTED ACCESS DOORS

A. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Ductmate Industries, Inc.
4. Flexmaster U.S.A., Inc.
5. Greenheck Fan Corporation.
6. McGill AirFlow LLC.
7. Nailor Industries Inc.
8. Pottorff; a division of PCI Industries, Inc.
9. Ventfabrics, Inc.
10. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."

1. Door:

a. Double wall, rectangular.
b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
c. Vision panel.
d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:

a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
d. Access Doors Larger than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.7 FLEXIBLE CONNECTORS

A. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Ventfabrics, Inc.
4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd..
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

F. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.8 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel ducts.

C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

D. Set dampers to fully open position before testing, adjusting, and balancing.

E. Install test holes at fan inlets and outlets and elsewhere as indicated.

F. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. At outdoor-air intakes and mixed-air plenums.
2. At drain pans and seals.
3. Downstream from manual volume dampers, control dampers, and equipment.
4. At each change in direction and at maximum 50-foot spacing.
5. Upstream from turning vanes.
6. Control devices requiring inspection.
7. Elsewhere as indicated.

G. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

H. Label access doors according to Section 23 05 53 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

I. Install flexible connectors to connect ducts to equipment.

J. Install duct test holes where required for testing and balancing purposes.

K. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Inspect turning vanes for proper and secure installation.
4. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 23 33 00

SECTION 23 52 30 - COMMERCIAL ELECTRIC BOILERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes packaged, factory-fabricated and -assembled, electric boilers, trim, and accessories for generating hot water.

1.2 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that commercial water heaters, accessories, and components will withstand seismic forces defined in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

   a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Source quality-control test reports.

E. Field quality-control test reports.

F. Operation and Maintenance Data.

G. Warranty: Special warranty specified in this Section.

1.3 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of electric boilers. Refer to Division 01 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. ASME Compliance: The boiler vessel shall be constructed in accordance with ASME Boiler and Pressure Vessel Code: Section IV.

1.4 COORDINATION

A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric boilers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including vessel and supports.
b. Faulty operation of controls.
c. Heating elements.
d. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period(s): From date of Substantial Completion:

a. Commercial Electric Boilers:

1) Pressure Vessel: Three years.
2) Controls and Other Components: One year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Known Acceptable Source: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 COMMERCIAL ELECTRIC BOILERS

A. Description: Comply with UL 174 for household, storage electric water heaters.

1. Known Acceptable Source:

a. Precision Boilers.
b. Lochinvar Corporation.
c. Patterson-Kelly, a division of Harsco Corporation.
d. Chromalox Inc.

2. Pressure Vessel Construction:

a. Tappings: ASME B1.20.1 pipe thread.
b. Pressure Rating: 75 psig.
c. Relief Valve Setting: 50 psig.

3. Factory-Installed Appurtenances:

a. Insulation: Minimum 4” thick fiberglass blanket covering all hot surfaces.
b. Jacket: Steel with enameled finish.
c. Heating Elements: Electric, removable immersion type; wired for simultaneous operation and balanced 3-phase loading..
d. Temperature Control: Step controller matched to manufacturer’s standard capacity increments. Provide proportional controller if more than 4 steps. Status pilot light for each stage of operation.
e. Safety Control: High-temperature-limit cutoff device or system. Low water cutoff device.
f. Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3 for combination temperature and pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.

PART 3 - EXECUTION

3.1 BOILER INSTALLATION

A. Install boilers on concrete bases.

B. Install boilers level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

C. Install seismic restraints for boilers. Anchor to substrate.

D. Install boiler drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for boilers that do not have vessel drains.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to boilers to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace components that do not pass tests and inspections and retest as specified above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train FAA's maintenance personnel to adjust, operate, and maintain boilers. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 23 52 30

SECTION 23 64 23 - SCROLL WATER CHILLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Packaged, air-cooled, electric-motor-driven, scroll water chillers.

1.2 DEFINITIONS

A. COP: Coefficient of performance. The ratio of the rate of heat removal to the rate of energy input using consistent units for any given set of rating conditions.

B. EER: Energy-efficiency ratio. The ratio of the cooling capacity given in terms of Btu/h to the total power input given in terms of watts at any given set of rating conditions.

C. IPLV: Integrated part-load value. A single number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and referenced to ARI standard rating conditions.

D. kW/Ton: The ratio of total power input of the chiller in kilowatts to the net refrigerating capacity in tons at any given set of rating conditions.

E. NPLV: Nonstandard part-load value. A single number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and intended for operating conditions other than the ARI standard rating conditions.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Scroll water chillers shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 SUBMITTALS

A. Product Data: Include refrigerant, rated capacities, operating characteristics, furnished specialties, and accessories.

1. Performance at ARI standard conditions and at conditions indicated.
2. Performance at ARI standard unloading conditions.
3. Minimum evaporator flow rate.

4. Refrigerant capacity of water chiller.
5. Oil capacity of water chiller.
6. Fluid capacity of evaporator.
7. Fluid capacity of condenser.
8. Characteristics of safety relief valves.
9. Retain first two subparagraphs below for water-cooled water chillers.
10. Retain two subparagraphs below for air-cooled water chillers.
11. Minimum entering condenser-air temperature
12. Performance at varying capacity with constant design entering condenser-air temperature. Repeat performance at varying capacity for different entering condenser-air temperatures from design to minimum in 10 deg F increments.

B. Shop Drawings: Complete set of manufacturer's prints of water chiller assemblies, control panels, sections and elevations, and unit isolation. Include the following:

1. Assembled unit dimensions.
2. Weight and load distribution.
3. Required clearances for maintenance and operation.
4. Size and location of piping and wiring connections.
5. Wiring Diagrams: For power, signal, and control wiring.

C. Coordination Drawings: Floor plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural supports.
2. Piping roughing-in requirements.
3. Wiring roughing-in requirements, including spaces reserved for electrical equipment.
4. Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.

D. Certificates: For certification required in "Quality Assurance" Article.

E. Seismic Qualification Certificates: For water chillers, accessories, and components from manufacturers.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

F. Source quality-control test reports.

G. Startup service reports.

H. Operation and Maintenance Data: For each water chiller to include in emergency, operation, and maintenance manuals.

I. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

A. ARI Certification: Certify chiller according to ARI 590 certification program.

B. ARI Rating: Rate water chiller performance according to requirements in ARI 550/590, "Water Chilling Packages Using the Vapor Compression Cycle."

C. ASHRAE Compliance: ASHRAE 15 for safety code for mechanical refrigeration.

D. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

E. ASME Compliance: Fabricate and stamp water chiller heat exchangers to comply with ASME Boiler and Pressure Vessel Code.

F. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Ship water chillers from the factory fully charged with refrigerant and oil.

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate sizes, locations, and anchoring attachments of structural-steel support structures.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of water chillers that fail in materials or workmanship within specified period.

1. Compressor Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PACKAGED AIR-COOLED WATER CHILLERS

A. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Trane.

2. York International Corporation.

B. Description: Factory-assembled and run-tested water chiller complete with base and frame, condenser casing, compressors, compressor motors and motor controllers, evaporator, condenser coils, condenser fans and motors, electrical power, controls, and accessories.

C. Fabricate base, frame, and attachment to water chiller components strong enough to resist movement during a seismic event when water chiller base is anchored to field support structure.

D. Cabinet:

1. Base: Galvanized-steel base extending the perimeter of water chiller. Secure frame, compressors, and evaporator to base to provide a single-piece unit.
2. Frame: Rigid galvanized-steel frame secured to base and designed to support cabinet, condenser, control panel, and other chiller components not directly supported from base.
3. Casing: Galvanized steel.
4. Finish: Coat base, frame, and casing with a corrosion-resistant coating capable of withstanding a 500-hour salt-spray test according to ASTM B 117.
5. Sound-reduction package consisting of the following:

   a. Acoustic enclosure around compressors.
   b. Reduced-speed fans with acoustic treatment.
   c. Designed to reduce sound level without affecting performance.

6. Security Package: Provide security grilles with fasteners for additional protection of compressors, evaporator, and condenser coils. Grilles shall be coated for corrosion resistance and shall be removable for service access.

E. Compressors:

1. Description: Positive-displacement direct drive with hermetically sealed casing.
2. Each compressor provided with suction and discharge service valves, crankcase oil heater, and suction strainer.
3. Operating Speed: Nominal 3600 rpm for 60-Hz applications.
4. Capacity Control: On-off compressor cycling.
5. Oil Lubrication System: Automatic pump with strainer, sight glass, filling connection, filter with magnetic plug, and initial oil charge.
6. Vibration Isolation: Mount individual compressors on vibration isolators.

F. Compressor Motors:

1. Hermetically sealed and cooled by refrigerant suction gas.
2. High-torque, two-pole induction type with inherent thermal-overload protection on each phase.

G. Compressor Motor Controllers:

1. Across the Line: NEMA ICS 2, Class A, full voltage, nonreversing.

H. Refrigeration:

1. Refrigerant: R-407c or R-410a. Classified as Safety Group A1 according to ASHRAE 34.
2. Refrigerant Compatibility: Parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.
3. Refrigerant Circuit: Each circuit shall include a thermal-expansion valve, refrigerant charging connections, a hot-gas muffler, compressor suction and discharge shutoff valves, a liquid-line shutoff valve, a replaceable-core filter-dryer, a sight glass with moisture indicator, a liquid-line solenoid valve, and an insulated suction line.
4. Refrigerant Isolation: Factory install positive shutoff isolation valves in the compressor discharge line and the refrigerant liquid-line to allow the isolation and storage of the refrigerant charge in the chiller condenser.

I. Evaporator:

1. Brazed-plate or shell-and-tube design, as indicated.
2. Shell and Tube:

   a. Description: Direct-expansion, shell-and-tube design with fluid flowing through the shell and refrigerant flowing through the tubes within the shell.
   b. Code Compliance: Tested and stamped according to ASME Boiler and Pressure Vessel Code.
   c. Shell Material: Carbon steel.
   d. Shell Heads: Removable carbon-steel heads with multipass baffles designed to ensure positive oil return and located at each end of the tube bundle.
   e. Shell Nozzles: Fluid nozzles located along the side of the shell and terminated with mechanical-coupling end connections for connection to field piping.
   f. Tube Construction: Individually replaceable copper tubes with enhanced fin design, expanded into tube sheets.

3. Brazed Plate:

   a. Direct-expansion, single-pass, brazed-plate design.
   b. Type 316 stainless-steel construction.
   c. Code Compliance: Tested and stamped according to ASME Boiler and Pressure Vessel Code.
   d. Fluid Nozzles: Terminate with mechanical-coupling end connections for connection to field piping.

4. Heater: Factory-installed and -wired electric heater with integral controls designed to protect the evaporator to minus 20 deg F.
5. Remote Mounting: Designed for remote field mounting where indicated. Provide kit for field installation.

J. Air-Cooled Condenser:

1. Plate-fin coil with integral subcooling on each circuit, rated at 450 psig.

   a. Construct coils of copper tubes mechanically bonded to aluminum fins.
   b. Coat coils with a baked epoxy corrosion-resistant coating after fabrication.
   c. Hail Protection: Provide condenser coils with louvers, baffles, or hoods to protect against hail damage.

2. Fans: Direct-drive propeller type with statically and dynamically balanced fan blades, arranged for vertical air discharge.
3. Fan Motors: Totally enclosed nonventilating (TENV) or totally enclosed air over (TEAO) enclosure, with permanently lubricated bearings, and having built-in overcurrent- and thermal-overload protection.
4. Fan Guards: Steel safety guards with corrosion-resistant coating.

K. Electrical Power:

1. Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to water chiller.
2. House in a unit-mounted, NEMA 250, Type 3R enclosure with hinged access door with lock and key or padlock and key.
3. Wiring shall be numbered and color-coded to match wiring diagram.
4. Install factory wiring outside of an enclosure in a raceway.
5. Field power interface shall be to NEMA KS 1, heavy-duty, nonfused disconnect switch.
6. Provide branch power circuit to each motor and to controls with one of the following disconnecting means:

    a. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
    b. NEMA KS 1, heavy-duty, nonfusible switch.
    c. NEMA AB 1, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

7. Provide each motor with overcurrent protection.
8. Overload relay sized according to UL 1995, or an integral component of water chiller control microprocessor.
9. Phase-Failure and Undervoltage: Solid-state sensing with adjustable settings.
10. Provide power factor correction capacitors to correct power factor to 0.90 at full load.
11. Transformer: Unit-mounted transformer with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.

    a. Power unit-mounted controls where indicated.
    b. Power unit-mounted, ground fault interrupt (GFI) duplex receptacle.

12. Control Relays: Auxiliary and adjustable time-delay relays.
13. Indicate the following for water chiller electrical power supply:

    a. Current, phase to phase, for all three phases.
    b. Voltage, phase to phase and phase to neutral for all three phases.
    c. Three-phase real power (kilowatts).
    d. Three-phase reactive power (kilovolt amperes reactive).
    e. Power factor.
    f. Running log of total power versus time (kilowatt hours).
    g. Fault log, with time and date of each.

L. Controls:

1. Stand-alone, microprocessor based.
2. Enclosure: Share enclosure with electrical power devices or provide a separate enclosure of matching construction.
3. Operator Interface: Keypad or pressure-sensitive touch screen. Multiple-character, backlit, liquid-crystal display or light-emitting diodes. Display the following:

    a. Date and time.
    b. Operating or alarm status.
    c. Operating hours.
    d. Outside-air temperature if required for chilled-water reset.
    e. Temperature and pressure of operating set points.
    f. Entering and leaving temperatures of chilled water.
    g. Refrigerant pressures in evaporator and condenser.
    h. Saturation temperature in evaporator and condenser.
    i. No cooling load condition.
    j. Elapsed time meter (compressor run status).
    k. Pump status.
    l. Antirecycling timer status.
    m. Percent of maximum motor amperage.
    n. Current-limit set point.
    o. Number of compressor starts.

4. Control Functions:

    a. Manual or automatic startup and shutdown time schedule.
    b. Entering and leaving chilled-water temperatures, control set points, and motor load limit. Chilled-water leaving temperature shall be reset based on return-water temperature.
    c. Current limit and demand limit.
    d. External water chiller emergency stop.
    e. Antirecycling timer.
    f. Automatic lead-lag switching.
    g. Automatic restart after power failure.

5. Manual-Reset Safety Controls: The following conditions shall shut down water chiller and require manual reset:

    a. Low evaporator pressure or high condenser pressure.
    b. Low chilled-water temperature.
    c. Refrigerant high pressure.
    d. High or low oil pressure.
    e. High oil temperature.
    f. Loss of chilled-water flow.
    g. Control device failure.

6. Building Automation System Interface: Factory-installed hardware and software to enable building automation system to monitor, control, and display water chiller status and alarms. All points and parameters shall be available to the Building Automation System through a LON interface.

    a. Hardwired Points:

1) Monitoring: On/off status and common trouble alarm.
2) Control: On/off operation, chilled-water discharge temperature set-point adjustment.

b. Coordinate communication interface with building automation system to enable building automation system operator to remotely control and monitor the water chiller from an operator workstation. Control features and monitoring points displayed locally at water chiller control panel shall be available through building automation system.

M. Insulation:

1. Material: Closed-cell, flexible elastomeric, thermal insulation complying with ASTM C 534, Type I, for tubular materials and Type II, for sheet materials.
2. Thickness: 3/4 inch.
3. Factory-applied insulation over cold surfaces of water chiller components.

a. Adhesive: As recommended by insulation manufacturer and applied to 100 percent of insulation contact surface. Seal seams and joints.

4. Apply protective coating to exposed surfaces of insulation.

N. Accessories:

1. Factory-furnished, chilled- water flow switches for field installation.
2. Individual compressor suction and discharge pressure gages with shutoff valves for each refrigeration circuit.

O. Capacities and Characteristics:

1. Refer to drawings for capacities and characteristics.

2.2 PACKAGED REFRIGERANT RECOVERY UNITS

A. Packaged portable unit shall consist of compressor, air-cooled condenser, recovery system, tank pressure gages, filter-dryer, and valves that allow for switching between liquid and vapor recovery mode. Refrigerant recovery unit shall be factory mounted on an ASME-constructed and -stamped refrigerant storage vessel that is sized to hold the full refrigerant charge of the largest water chiller.

2.3 SOURCE QUALITY CONTROL

A. Perform functional test of water chillers before shipping.

B. Factory performance test water chillers, before shipping, according to ARI 550/590, "Water Chilling Packages Using the Vapor Compression Cycle."

1. Allow COTR access to place where water chillers are being tested. Notify COTR 14 days in advance of testing.

C. Factory test and inspect evaporator according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1. Stamp with ASME label.

D. Rate sound power level according to ARI 370 procedure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before water chiller installation, examine roughing-in for equipment support, anchor-bolt sizes and locations, piping, and electrical connections to verify actual locations, sizes, and other conditions affecting water chiller performance, maintenance, and operations.

1. Water chiller locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 WATER CHILLER INSTALLATION

A. Install water chillers on support structure indicated.

B. Equipment Mounting: Install water chiller using elastomeric pads. Comply with requirements for vibration isolation devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."

C. Maintain manufacturer's recommended clearances for service and maintenance.

D. Charge water chiller with refrigerant if not factory charged and fill with oil if not factory installed.

E. Install separate devices furnished by manufacturer and not factory installed.

3.3 CONNECTIONS

A. Comply with requirements in Section 23 21 13 "Hydronic Piping" Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to chiller to allow service and maintenance.

C. Evaporator Fluid Connections: Connect to evaporator inlet with shutoff valve, flexible connector, thermometer, and plugged tee with pressure gage. Connect to evaporator outlet with shutoff valve, balancing valve, flexible connector, flow switch, thermometer, plugged tee with pressure gage, and drain connection with valve. Make connections to water chiller with a flange.

D. Connect each drain connection with a union and drain pipe and extend pipe, full size of connection, to floor drain. Provide a shutoff valve at each connection if required.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.

C. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

1. Verify that refrigerant charge is sufficient and water chiller has been leak tested.
2. Verify that pumps are installed and functional.
3. Verify that thermometers and gages are installed.
4. Operate water chiller for run-in period.
5. Check bearing lubrication and oil levels.
6. Verify proper motor rotation.
7. Verify static deflection of vibration isolators, including deflection during water chiller startup and shutdown.
8. Verify and record performance of chilled -water flow and low-temperature interlocks.
9. Verify and record performance of water chiller protection devices.
10. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

D. Prepare a written startup report that records results of tests and inspections.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train FAA’s maintenance personnel to adjust, operate, and maintain water chillers. Video record the training sessions.

END OF SECTION 23 64 23

SECTION 23 73 13 - MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Constant-air-volume, single-zone air-handling units.
2. Variable-air-volume, air-handling units.

1.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Casing panels shall be self-supporting and capable of withstanding 133 percent of internal static pressures indicated, without panel joints exceeding a deflection of L/200 where "L" is the unsupported span length within completed casings.

B. Seismic Performance: Air-handling units shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.3 SUBMITTALS

A. Product Data: For each air-handling unit indicated.

1. Unit dimensions and weight.
2. Cabinet material, metal thickness, finishes, insulation, and accessories.
3. Fans:

   a. Certified fan-performance curves with system operating conditions indicated.
   b. Certified fan-sound power ratings.
   c. Fan construction and accessories.
   d. Motor ratings, electrical characteristics, and motor accessories.

4. Certified coil-performance ratings with system operating conditions indicated.
5. Dampers, including housings, linkages, and operators.
6. Filters with performance characteristics.

B. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Mechanical-room layout and relationships between components and adjacent structural and mechanical elements.
2. Support location, type, and weight.
3. Field measurements.

C. Seismic Qualification Certificates: For air-handling units, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Source quality-control reports.

E. Field quality-control reports.

F. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

C. ARI Certification: Air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.

D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

E. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

F. Comply with NFPA 70.

1.5 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate sizes and locations of structural-steel support members, if any, with actual equipment provided.

1.6 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan Belts: One set(s) for each air-handling unit fan.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Trane.
2. YORK International Corporation.

2.2 UNIT CASINGS

A. General Fabrication Requirements for Casings:

1. Forming: Form walls, roofs, and floors with at least two breaks at each joint.
2. Casing Joints: Sheet metal screws or pop rivets.
3. Sealing: Seal all joints with water-resistant sealant.
4. Factory Finish for Steel and Galvanized-Steel Casings: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on enamel finish, consisting of prime coat and thermosetting topcoat.
5. Casing Coating: Manufacturer’s standard coating.
6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

B. Casing Insulation and Adhesive:

1. Materials: ASTM C 1071, Type I or Type II.
2. Location and Application: Factory applied with adhesive and mechanical fasteners to the internal surface of section panels downstream from, and including, the cooling-coil section.

   a. Liner Adhesive: Comply with ASTM C 916, Type I.
   b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
   c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service-air velocity.

3. Location and Application: Encased between outside and inside casing.

C. Inspection and Access Panels and Access Doors:

1. Panel and Door Fabrication: Formed and reinforced, single- or double-wall and insulated panels of same materials and thicknesses as casing.
2. Inspection and Access Panels:

   a. Fasteners: Two or more camlock type for panel lift-out operation. Arrangement shall allow panels to be opened against air-pressure differential.
   b. Gasket: Neoprene, applied around entire perimeters of panel frames.
   c. Size: Large enough to allow inspection and maintenance of air-handling unit's internal components.

3. Access Doors:

   a. Hinges: A minimum of two ball-bearing hinges or stainless-steel piano hinge and two wedge-lever-type latches.
   b. Gasket: Neoprene, applied around entire perimeters of panel frames.
   c. Size: At least 18 inches wide by full height of unit casing up to a maximum height of 72 inches.

4. Locations and Applications:

   a. Fan Section: Doors.
   b. Access Section: Doors.
   c. Coil Section: Inspection and access panel.
   d. Damper Section: Doors.
   e. Filter Section: Doors large enough to allow periodic removal and installation of filters.
   f. Mixing Section: Doors.

D. Condensate Drain Pans:

1. Fabricated with two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and from humidifiers and to direct water toward drain connection.

   a. Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1-2004.
   b. Depth: A minimum of 2 inches deep.

2. Formed sections.
3. Double-wall, stainless-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
4. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

   a. Minimum Connection Size: NPS 1.

E. Air-Handling-Unit Mounting Frame: Formed galvanized-steel channel or structural channel supports, designed for low deflection, welded with integral lifting lugs.

1. Seismic Fabrication Requirements: Fabricate mounting base and attachment to air-handling unit sections, accessories, and components with reinforcement strong enough to withstand seismic forces defined in Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment" when air-handling unit frame is anchored to building structure.

2.3 FAN, DRIVE, AND MOTOR SECTION

A. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.

1. Shafts: Designed for continuous operation at maximum-rated fan speed and motor horsepower, and with field-adjustable alignment.

a. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
b. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

B. Centrifugal Fan Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.

1. Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.
2. Horizontal-Flanged, Split Housing: Bolted construction.
3. Housing for Supply Fan: Attach housing to fan-section casing with metal-edged flexible duct connector.
4. Flexible Connector: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized-steel sheet or 0.032-inch- thick aluminum sheets; select metal compatible with casing.

a. Flexible Connector Fabric: Glass fabric, double coated with neoprene. Fabrics, coatings, and adhesives shall comply with UL 181, Class 1.

1) Fabric Minimum Weight: 26 oz./sq. yd..
2) Fabric Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3) Fabric Service Temperature: Minus 40 to plus 200 deg F.

C. Plenum Fan Housings: Steel frame and panel; fabricated without fan scroll and volute housing.

D. Forward-Curved, Centrifugal Fan Wheels: Inlet flange, backplate, and shallow blades with inlet and tip curved forward in direction of airflow and mechanically fastened to flange and backplate; cast-steel hub swaged to backplate and fastened to shaft with set screws.

E. Fan Shaft Bearings:

1. Grease-Lubricated, Tapered-Roller Bearings: Self-aligning, pillow-block type with double-locking collars and 2-piece, cast-iron housing with grease lines extended to outside unit and a rated life of 120,000 hours according to ABMA 11.
2. Grease-Lubricated Bearings: Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing with grease lines extended to outside unit.

F. Belt Drives: Factory mounted, with adjustable alignment and belt tensioning, and with 1.5 service factor based on fan motor.

1. Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
2. Motor Pulleys: Adjustable pitch for use with 5 -hp motors and smaller; fixed pitch for use with motors larger than 5 hp. Select pulley size so pitch adjustment is at the middle of adjustment range at fan design conditions.
3. Belts: Oil resistant, nonsparking, and nonstatic; in matched sets for multiple-belt drives.
4. Belt Guards: Comply with requirements specified by OSHA and fabricate according to SMACNA's "HVAC Duct Construction Standards"; 0.1046-inch- thick, 3/4-inch diamond-mesh wire screen, welded to steel angle frame; prime coated.

G. Internal Vibration Isolation and Seismic Control: Fans shall be factory mounted with manufacturer's standard restrained vibration isolation mounting devices having a minimum static deflection of 1 inch.

1. Seismic Fabrication Requirements: Fabricate fan section, internal mounting frame and attachment to fans, fan housings, motors, casings, accessories, and other fan section components with reinforcement strong enough to withstand seismic forces defined in Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment" when fan-mounting frame and air-handling-unit mounting frame are anchored to building structure.

H. Motor: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."

1. Enclosure Type: Totally enclosed, fan cooled.
2. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
3. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
4. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
5. Mount unit-mounted disconnect switches on exterior of unit.

2.4 COIL SECTION

A. General Requirements for Coil Section:

1. Comply with ARI 410.
2. Fabricate coil section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).

3. Coils shall not act as structural component of unit.
4. Seismic Fabrication Requirements: Fabricate coil section, internal mounting frame and attachment to coils, and other coil section components with reinforcement strong enough to withstand seismic forces defined in Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment" when coil-mounting frame and air-handling-unit mounting frame are anchored to building structure.

2.5 AIR FILTRATION SECTION

A. General Requirements for Air Filtration Section:

1. Comply with NFPA 90A.
2. Provide minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
3. Provide filter holding frames arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.

B. Extended-Surface, Disposable Panel Filters:

1. Factory-fabricated, dry, pleated extended-surface type. Refer to Section 23 41 00, “Particulate Air Filtration” for additional requirements.
2. Thickness: 2 inches.
3. Mounting Frames: Welded, galvanized steel, with gaskets and fasteners, suitable for bolting together into built-up filter banks.

C. Filter Gages:

1. 3-1/2-inch- diameter, diaphragm-actuated dial in metal case.
2. Vent valves.
3. Black figures on white background.
4. Front recalibration adjustment.
5. 2 percent of full-scale accuracy.
6. Range: 0- to 2.0-inch wg .
7. Accessories: Static-pressure tips with integral compression fittings, 1/4-inch aluminum tubing, and 2- or 3-way vent valves.

2.6 DAMPERS

A. Comply with requirements in Section 23 09 23 "Instrumentation and Control for HVAC."

B. Damper Operators: Comply with requirements in Section 23 09 23 "Instrumentation and Control for HVAC."

C. Combination Filter and Mixing Section:

1. Cabinet support members shall hold 2-inch- thick, pleated, flat or throwaway filters.

2.7 Controls: Refer to Section 23 09 23, “Instrumentation and Control for HVAC.

2.8 CAPACITIES AND CHARACTERISTICS

A. Casing:

1. Outside Casing: Galvanized steel, minimum 0.052 inch thick.
2. Inside Casing: Galvanized steel, solid, minimum 0.052 inch thick.
3. Floor Plate: Galvanized steel, minimum 0.052 inch thick.
4. Insulation Thickness: 2 inches.
5. Static-Pressure Classifications for Unit Sections before Fans: 4-inch wg .
6. Static-Pressure Classifications for Unit Sections after Fans: 3-inch wg .

B. Supply Fan:

1. Class I or Class II: AMCA 99-2408.
2. Drive: V-belt.
3. Type: As scheduled on plans.
4. Number of Fan Wheels: 1.

C. Preheat Coil:

1. Coil Type: Continuous circuit.
2. Piping Connections: Threaded or flanged, same end of coil.
3. Tube Material: Copper.
4. Tube Thickness: Minimum of 0.017 inches.
5. Fin Type: Plate or Spiral.
6. Fin Material: Aluminum.
7. Fin and Tube Joint: Mechanical bond.
8. Headers: Headers must be installed inside of the unit casing.

    a. Seamless copper tube with brazed joints, prime coated.
    b. Fabricated steel, with brazed joints, prime coated.

9. Frames: Channel frame, 0.064-inch- thick galvanized steel.
10. Coil Working-Pressure Ratings: 200 psig, 325 deg F.
11. Water:

D. Heating Coil:

1. Coil Type: Continuous circuit.
2. Piping Connections: Threaded or flanged, same end of coil.
3. Tube Material: Copper.
4. Tube Thickness: Minimum of 0.017 inches..
5. Fin Type: Plate or Spiral.
6. Fin Material: Aluminum.
7. Fin and Tube Joint: Mechanical bond.
8. Headers: Headers must be installed inside of the unit casing.
9.
    a. Seamless copper tube with brazed joints, prime coated.

b. Fabricated steel, with brazed joints, prime coated.

10. Frames: Channel frame, 0.064-inch- thick galvanized steel.
11. Coil Working-Pressure Ratings: 200 psig, 325 deg F.

E. Cooling Coil:

1. Coil Type: Continuous circuit.
2. Piping Connections: Threaded or flanged, same end of coil.
3. Tube Material: Copper.
4. Tube Thickness: Minimum of 0.017 inches.
5. Fin Type: Plate or Spiral.
6. Fin Material: Aluminum.
7. Fin and Tube Joint: Mechanical bond.
8. Headers: Headers must be installed inside of the unit casing.

a. Seamless copper tube with brazed joints, prime coated.
b. Fabricated steel, with brazed joints, prime coated.

9. Frames: Channel frame, 0.064-inch- thick galvanized steel.
10. Coil Working-Pressure Ratings: 200 psig, 325 deg F.

2.9 SOURCE QUALITY CONTROL

A. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."

B. Water Coils: Factory tested to 300 psig according to ARI 410 and ASHRAE 33.

C. Refrigerant Coils: Factory tested to 450 psig according to ARI 410 and ASHRAE 33.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for steam, hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Equipment Mounting: Install air-handling units on concrete bases using restrained spring isolators. Secure units to anchor bolts installed in concrete bases. Comply with requirements for concrete bases specified in Section 03 30 00 "Cast-in-Place Concrete." Comply with requirements for vibration isolation devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."

1. Minimum Deflection: 1 inch.
2. Install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Suspended Units: Suspend and brace units from structural-steel support frame using threaded steel rods and spring hangers. Comply with requirements for vibration isolation devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."

C. Arrange installation of units to provide access space around air-handling units for service and maintenance.

D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.

E. Install filter-gage, static-pressure taps upstream and downstream of filters. Mount filter gages on outside of filter housing or filter plenum in accessible position. Provide filter gages on filter banks, installed with separate static-pressure taps upstream and downstream of filters.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to air-handling unit to allow service and maintenance.

C. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.

D. Connect condensate drain pans using ASTM B 88, Type M copper tubing unless noted otherwise. Size to match unit connection size (3/4” minimum). Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

E. Hot- and Chilled-Water Piping: Comply with applicable requirements in Section 23 21 13 "Hydronic Piping." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.

F. Connect duct to air-handling units with flexible connections if fan and motor not internally isolated. Comply with requirements in Section 23 33 00 "Air Duct Accessories."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Leak Test: After installation, fill water coils with water, and test coils and connections for leaks.
2. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Air-handling unit or components will be considered defective if unit or components do not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that shipping, blocking, and bracing are removed.
3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
6. Comb coil fins for parallel orientation.
7. Install new, clean filters.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.

B. Starting procedures for air-handling units include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.
2. Measure and record motor electrical values for voltage and amperage.

3. Manually operate dampers from fully closed to fully open position and record fan performance.

3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing" for air-handling system testing, adjusting, and balancing.

3.7 CLEANING

A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train FAA's maintenance personnel to adjust, operate, and maintain air-handling units.

END OF SECTION 23 73 13

SECTION 23 81 26 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed or concealed mounting, and may be connected to ducts.

1.2 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

F. Warranty: Special warranty specified in this Section.

1.3 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.4 COORDINATION

A. Coordinate size and location of concrete bases for units. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 03 30 00 "Cast-in-Place Concrete."

B. Coordinate size, location, and connection details with roof curbs, equipment supports, and roof penetrations specified in Section 07 72 00 "Roof Accessories."

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set of filters for each unit.
2. Fan Belts: One set of belts for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Known Acceptable Source: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Carrier Air Conditioning; Div. of Carrier Corporation.
2. Evcon Industries, Inc.
3. First Co.
4. Friedrich Air Conditioning Company.
5. Koldwave, Inc.
6. Lennox Industries Inc.
7. Trane Company (The); Unitary Products Group.
8. York International Corp.

2.2 CONCEALED EVAPORATOR-FAN COMPONENTS

A. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.

1. Insulation: Faced, glass-fiber duct liner.
2. Drain Pans: Galvanized steel, with connection for drain; insulated and complying with ASHRAE 62.1-2004.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.

C. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements with refractory ceramic support bushings; automatic-reset thermal cutout; built-in magnetic contactors; manual-reset thermal cutout; airflow proving device; and one-time fuses in terminal box for overcurrent protection.

D. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.

E. Fan Motors: Comply with requirements in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."

1. Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.

F. Disposable Filters: 1 inch thick, in fiberboard frames with ASHRAE 52.2 MERV rating of 6 or higher.

G. Wiring Terminations: Connect motor to chassis wiring with plug connection.

2.3 AIR-COOLED, COMPRESSOR-CONDENSER COMPONENTS

A. Casing: Steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.

B. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

1. Compressor Type: Scroll.
2. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
3. Refrigerant: R-407C or R-410A.

C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler.

D. Fan: Aluminum-propeller type, directly connected to motor.

E. Motor: Permanently lubricated, with integral thermal-overload protection.

F. Low Ambient Kit: Permits operation down to 45 deg F.

G. Mounting Base: Polyethylene.

H. Minimum Energy Efficiency: Comply with ASHRAE/IESNA 90.1-2004, "Energy Standard for Buildings except Low-Rise Residential Buildings."

2.4 ACCESSORIES

A. Control equipment and sequence of operation are specified in Sections 23 09 23 "Instrumentation and Control for HVAC."

B. Thermostat: Low voltage with subbase to control compressor and evaporator fan.

C. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:

1. Compressor time delay.
2. 24-hour time control of system stop and start.
3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
4. Fan-speed selection, including auto setting.

D. Automatic-reset timer to prevent rapid cycling of compressor.

E. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

1. Minimum Insulation Thickness: 1 inch thick.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install ground-mounting, compressor-condenser components on 4-inch- thick, reinforced concrete base; 4 inches larger on each side than unit. Concrete, reinforcement, and formwork are specified in Section 03 30 00 "Cast-in-Place Concrete." Coordinate anchor installation with concrete base.

D. Install seismic restraints.

E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

A. Install piping adjacent to unit to allow service and maintenance.

B. Duct Connections: Duct installation requirements are specified in Section 23 31 13 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply[**and return**] ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 23 33 00 "Air Duct Accessories."

C. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

D. Electrical Connections: Comply with requirements in Division 26 Sections for power wiring, switches, and motor controls.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train FAA's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 23 81 26

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SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. General:

1. The general electrical requirements in this section are applicable to both Government Furnished Equipment (GFE) and non-GFE. Materials and equipment shall comply with all requirements of the contract documents. Materials furnished by the Contractor shall be new, the standard products of manufacturers regularly engaged in the production of such materials, and of the manufacturer's latest designs that comply with the specification requirements. If material and equipment requirements conflict, the order of precedence for selection shall be as follows: special contract provision, the contract drawings, this specification; and then in continuing order of precedence, military specifications, federal specifications, NFPA publications, IEEE standards, UL standards and NEMA standards. Wherever standards have been established by Underwriters Laboratories, Inc., the material shall bear the UL label.

1.2 ELECTRICAL CHARACTERISTICS

A. Provide the following electrical equipment and systems:

1. Equipment, wiring devices and electrical connections required for installation of electrical equipment.
2. Raceways and wiring for power and controls.
3. Grounding systems.
4. Concrete equipment bases.
5. Cutting and patching for electrical construction.
6. Lightning protection system.
7. Excavation and backfill for underground utilities and services.
8. Seismic bracing.

B. Product Requirements:

1. Provide products which conform to and installation that complies with the requirements of Uniform Federal Accessibility Standards (UFAS).

C. Spacing Requirements:

1. Electrical equipment sizes indicated on the drawings are generally based on specified manufacturer. Verify that the equipment proposed will fit in the space indicated on the drawings. Coordinate building dimensions with architectural and structural drawings. Equipment furnished and installed under other Sections of this Specification shall be coordinated with the requirements of this Section. Maintain clearances required by

NFPA 70 around electrical equipment. Establish the exact location of electrical equipment based on the actual field verified dimensions of equipment furnished.

D. Departure from Dimensions Shown:

1. Minor departures from exact dimensions shown in electrical plans may be permitted when required to avoid conflict or unnecessary difficulty in placement of a dimensioned item, provided all contract requirements are met. The Contractor shall promptly obtain written approval from the Contracting Officer's Technical Representative prior to undertaking any such departures and shall provide appropriate documentation of the departure.

1.3 SUBMITTALS

A. Product Data: For each type of product specified.

B. Samples: When the adequacy, quality and safety of a material will be better demonstrated and it will expedite approval, provide single samples of items proposed for use. Conform to the procedures specified. Submit samples of color, lettering style, and other graphic representation required for each identification product for the project.

C. Test Reports:

1. Operating Tests:

a. An interim operating and performance test shall be performed for each major equipment item after installation is complete and before the item is placed in service. After systems have been completely installed and balanced, test each system for proper operation. Tests shall be conducted in the presence of the COTR under design conditions to ensure proper sequence and operation throughout the range of operation. Make adjustments as required to ensure proper functioning of the systems. Special tests on individual systems are specified under individual sections. Tests shall be scheduled and approved in writing by the Contracting Officer's Technical Representative at least 21 calendar days prior to conducting tests. Contractor shall demonstrate, to the Contracting Officer's Technical Representative's satisfaction, proper operation of control devices by simulating actual operating conditions. Devices tested shall include, but not be limited to, flow and pressure controls, temperature controls, and system interlocks and alarms. Operating tests for GFE will be performed by the GFE vendors at the Government's expense. Contractor shall have a representative on site to witness all GFE tests.

b. Submit a summary of the Electrical Test Report and Motor Test Report, noting deviations from requirements listed below:

1) Maximum plus or minus 5 percent variation between nominal system voltage and no load voltage.
2) Variation between motor average phase current and measured individual phase currents does not exceed the manufacturer's specified limits.
3) Maximum plus or minus 10 percent variation between average phase current and measured individual phase currents for panelboards.

D. Operation and Maintenance Data:

1. Provide three copies of operating and maintenance instructions, equipment service manuals, catalog cuts and illustration as described in this section. The operations and maintenance (O&M) data shall be placed in suitable binders for use by maintenance personnel. The material shall include equipment model and serial numbers, performance characteristics, power and utility requirements and manufacturer's recommended maintenance schedules. Final acceptance of this equipment is contingent upon submission of required documents to and approval by the Contracting Officer's Technical Representative prior to the facility turnover.

   Operating and maintenance instructions shall contain the following minimum data and shall comply with submittal requirements specified in individual Division 26 Sections.

   a. Operating instructions shall include illustrations and explanations for controls, initial set points and startup and shutdown procedures for both normal and emergency conditions.
   b. Maintenance instructions shall include periodic inspection and lubrication requirements and where applicable, equipment performance verification requirements.
   c. Troubleshooting and fault diagnosis data shall list trouble symptoms, instructions necessary to determine cause of trouble and the action required to restore equipment to operating condition.

2. Repair instructions.
3. Spare parts list.
4. Include a list of required tools and equipment to maintain the system.
5. Provide names, addresses and telephone numbers of all service organizations that supply repair parts for the system or systems to be furnished.
6. Repair Instructions:

   a. Include equipment disassembly, repair, replacement and re-assembly. Checkout or test data shall also be provided. Reprogramming instructions shall be provided for equipment having a programmable memory. Re-packing instructions shall be provided for sending equipment to the manufacturer or to a repair depot for repairs. The instructions shall contain a list of spare parts recommended by the equipment manufacturer to support the operation of the equipment for a 1-year time period.

7. Parts List:

   a. A parts list shall be furnished that includes part names and part numbers that are shown on illustrations or tables. The parts list shall identify the actual manufacturer of the part, replacement cost and shall also contain a notation of identifying products as commercial grade for common non-special design hardware.

8. Overhaul Instructions:

   a. The O&M data shall include overhaul instructions that are required to return the equipment to full operational capability in the event that the machinery stops working properly.

9. O&M Data:

   a. The O&M binder shall include tabs for insertion of all GFE data. Prepare and distribute operations and maintenance data as specified in Section 01 78 23, “Operation and Maintenance Data.” The O&M data shall contain as appropriate, the following:

      a) Wiring diagrams.
      b) Electrical schematics.
      c) Control diagrams.
      d) Wire terminal assignments.
      e) Equipment layouts.

10. Record electrical drawings, modified to record actual conditions and modifications, including dimensions.
11. Approved shop drawings.
12. A list of all subcontractors used on the project with address and phone number.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 70 and FAA-C-1217f for components and installation. In case of conflict between provisions of codes, laws and ordinances, the more stringent requirement shall apply.

B. Listing and Labeling:

   1. Provide products specified in the Section that are listed and labeled. The terms "listed and labeled" as defined in the National Electrical Code, Article 100. Listing and labeling agency qualifications: NRTL as defined in 29 CFR 1910.7.

C. Summary:

   1. Submit a summary of the Electrical Test Report and Motor Test Report, noting deviations from requirements listed below:

      a. Maximum plus or minus 5 percent variation between nominal system voltage and no load voltage and between no load and full load voltage.
      b. Variation between motor average phase current and measured individual phase currents does not exceed the manufacturer's specified limits.
      c. Maximum plus or minus 20 percent variation between average phase current and measured individual phase currents for panelboards.

D. Equipment Training (Non-GFE):

   1. After final tests and adjustments have been completed, fully instruct the Contracting Officer's Technical Representative and other personnel, as directed by the Contracting Officer's Technical Representative in details of operation and maintenance of special equipment, including control system as installed. Submit outline of proposed instruction

course 21 days prior to start for approval by the Contracting Officer's Technical Representative.

E. Project Record Documents

1. Maintain at the job site a separate set of white prints of the contract documents for the purpose of recording the system and dimension changes of those portions of work in which actual construction is at variance with the contract documents. The Contractor shall record changes for both GFE and Contractor provided equipment. Upon acceptance of the project, submit documents to the Contracting Officer's Technical Representative, with verification of data accuracy. Mark the drawings with colored pencil. Prepare the drawings as the work progresses. Upon completion of work submit drawings clearly indicating the following:

   a. Locations of devices, conduits, equipment and other pertinent items. Indicate the depth of buried ducts and direct burial cable.

   b. Schematic and interconnection wiring diagrams of the completed power and control system incorporating the data derived from the equipment shop drawings and the cable and conduit schedule. The drawings shall be detailed to wire and terminal block numbers, conductor color coding, device designations locations and reflect identifications established at the site.

   c. Cable and conduit schedule for cables and conduits actually installed; include the type, size, origin, destination, and approximate length for each cable and conduit. Indicate for each cable the voltage rating, number of conductors, cable number, color coding and routing.

1.5 POSTED OPERATING INSTRUCTIONS

A. Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

1. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
2. Start up, proper adjustment, operating, lubrication, and shutdown procedures.
3. Safety precautions.
4. The procedure in the event of equipment failure.
5. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

B. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.6 DELIVERY, STORAGE AND HANDLING

A. Contractor provided equipment shall be protected from damage and stored in a dry location from the time of site delivery. Furnish and energize space heaters or provide desiccant recommended by the equipment manufacturer to prevent condensation. Conduct routine inspections of stored equipment to check equipment condition.

1.7 SEQUENCING AND SCHEDULING

A. Coordinate electrical equipment installation with other building components.

1. Arrange for chases, slots and openings in building structure during progress of construction to allow for electrical installations.
2. Coordinate installing required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
3. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the work. Coordinate installing large equipment requiring positioning prior to closing in the building.
4. Coordinate connecting electrical service to components furnished under other Sections.
5. Coordinate connecting electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
6. Coordinate requirements for access panels and doors where electrical items requiring access are concealed by finished surfaces. Access panels and doors are specified in Division 8.
7. Coordinate installing electrical identification after completion of finishing where identification is applied to field-finished surfaces.
8. Coordinate installing electrical identifying devices and markings prior to installing acoustical ceilings and similar finishes that conceal such items.

B. Interruption of Power:

1. Contractor is advised that the project site is located at a fully operational airport. Unscheduled power interruptions to any of the electrical distribution systems is not allowed. Work requiring a temporary or permanent de-energizing of the electrical service shall be scheduled and approved in writing by the Contracting Officer's Technical Representative at least 14 calendar days in advance of performance of the work. Work may not commence until written authorization is received from the Contracting Officer's Technical Representative.

PART 2 - PRODUCTS

2.1 SUPPORTING DEVICES

A. Channel and angle supports, raceway supports, sleeves and fasteners shall be as specified in Section 26 05 29, “Hangers and Supports for Electrical Systems.”

2.2 ELECTRICAL IDENTIFICATION

A. Provide electrical identification as specified in Section 26 05 53, “Identification for Electrical Systems.” Manufacturer's standard products to use colors prescribed by ANSI A13.1 and NFPA 70.

2.3 SOIL MATERIALS

A. Sub-base Materials:

1. Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, or natural crushed sand.

B. Backfill and Fill Materials:

1. Materials complying with ASTM D 2487 soil classification groups GW, GP, GM, SM, SW, and SP; free of clay, rock or gravel larger than 2 inches in any dimension; debris; waste; frozen materials; and vegetable and other deleterious matter.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. All materials and equipment shall be installed in accordance with the contract drawings. Where manufacturer's recommended installation methods conflict with the contract requirements, difference shall be resolved by the Contracting Officer's Technical Representative. The installation shall be accomplished by skilled workers regularly engaged in this type of work. Where required by local regulation, the workers shall be properly licensed. Install components and equipment to provide the maximum possible headroom where mounting heights or other location criteria are not indicated. Install items level, plumb, and parallel and perpendicular to other building systems and components, except where otherwise indicated. Install equipment to facilitate service, maintenance and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations. Give right of way to raceways and piping systems installed at a required slope.

3.2 EXCAVATION FOR ELECTRICAL WORK

A. All excavations shall comply with OSHA requirements. Shore and brace as required for stability of excavation.

B. Shoring and Bracing:

1. Establish requirements for trench shoring and bracing to comply with local codes and authorities. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Remove shoring and bracing when no longer required. Where

sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inches below finished grade elevation.

C. Sediment and Erosion Control:

1. Install sediment and erosion control measures in accordance with local codes and ordinances.

D. De-Watering:

1. Prevent surface water and subsurface or groundwater from flowing into excavations and from flooding project site and surrounding area. Do not allow water to accumulate in excavations. Remove water to prevent softening of bearing materials. Provide and maintain de-watering system components necessary to convey water away from excavations. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey surface water to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches.

E. Material Storage:

1. Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade and shape stockpiles for proper drainage. Locate and retain soil materials away from edge of excavations. Do not store within drip-line of trees indicated to remain. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.

F. Trenching:

1. Excavate trenches for electrical installations as follows:

   a. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches clearance on both sides of raceways and equipment.

   b. Excavate trenches to depth indicated or required.

   c. Limit the length of open trench to that in which installations can be made and the trench backfilled within the same day.

   d. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of raceways and equipment. Provide a minimum of 6 inches of stone or gravel cushion between rock bearing surface and electrical installations. The bedding material shall contain no particles that would be retained in a 1/4-inch sieve. Tamp the bedding material until firm.

G. Cold Weather Protection:

1. Protection excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F:

H. Backfilling and Filling:

1. Place soil materials in layers to subgrade elevations for each area classification listed below, using materials specified in Part 2 of this Section. Backfill excavations as promptly as work permits, but not until completion of inspection, testing, approval, and locations of underground utilities have been recorded; concrete formwork has been removed; shoring and bracing has been removed; voids have been backfilled; and trash and debris has been removed.

    a. Under walks and pavements, use a combination of sub-base materials and excavated or borrowed materials.

    b. Under building slabs, use drainage fill materials.

    c. Under piping and equipment, use sub-base materials where required over rock bearing surface and for correction of unauthorized excavation.

    d. Other areas use excavated or borrowed materials.

I. Placement and Compaction:

1. Place backfill and fill materials in layers of not more than 8 inches in loose depth for material compacted by heavy equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

J. Before Compaction:

1. Moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified. Do not place backfill or material on surfaces that are muddy, frozen, or contain frost or ice.

K. Backfill Placement:

1. Place backfill and fill materials evenly adjacent to structures, piping and equipment to required elevations. Prevent displacement of raceways and equipment by carrying material uniformly around them to approximately the same elevation in each lift.

L. Compaction:

1. Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated.

M. Percentage of Maximum Density Requirements:

1. Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D 1557 and not less than the following percentages of relative density for soils which will not exhibit a well-defined moisture-density relationship (cohesion less soils).

    a. For areas under structures, building slabs and steps, and pavements compact top 12 inches of sub-grade and each layer of backfill or fill material to 90 percent maximum density for cohesive material or 95 percent relative density for cohesion less material.

b. For areas under walkways compact top 6 inches of sub-grade and each layer of backfill or fill material to 90 percent maximum density for cohesive material or 95 percent relative density for cohesion less material.

c. For other areas compact top 6 inches of sub-grade and each layer of backfill or fill material to 85 percent maximum density for cohesive soils and 90 percent relative density for cohesion less soils.

N. Moisture Control:

1. Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water. Apply water in minimum quantity necessary to achieve required moisture content and to prevent water appearing on surface during or subsequent to, compaction operations.

O. Subsidence:

1. Where subsidence occurs at electrical installation excavations during the period 12 months after Substantial Completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material, compact to specified conditions and replace surface treatment. Restore appearance, quality and condition of surface or finish to match adjacent areas.

3.3 INSTALLATION

A. The rules, regulations, and reference documents indicated shall be considered as minimum requirements and shall not relieve the Contractor from furnishing and installing higher grades of materials and workmanship than are specified or when required by the contract drawings. Equipment shall be installed in a manner to provide proper working space, access, and space for removal of the equipment to suit intended application.

B. Contract Drawings:

1. Where the drawings schematically indicate the work, diagrammatically or otherwise, furnish and install equipment, material and labor for a complete and proper installation. Ensure that electrical and communications work is coordinated and compatible with Architectural, Mechanical, Structural, and Civil work.

C. Firestopping:

1. Apply to cable and raceway penetrations of fire-rated floor and wall assemblies. Perform firestopping as specified in Section 07 84 13, “Penetration Firestopping” to re-establish the original fire resistance rating of the assembly at the penetration.

D. Fastening:

1. Unless otherwise indicated, securely fasten electrical items and their supporting hardware to the building structure in accordance with Section 26 05 29, “Hangers and Supports for Electrical Systems.”

E. Identification Devices:

1. Install identification devices where required in accordance with the requirements of Section 26 05 53, “Identification for Electrical Systems.”

F. Wiring Methods:

1. All wiring shall consist of insulated copper conductors installed in metallic raceways, unless otherwise specified.

G. Conductor Routing:

1. Panelboards, surge arresters, disconnect switches, etc., shall not be used as a raceway for conductor routing other than conductors that originate or terminate in these enclosures. Isolated ground conductors will be allowed to traverse these enclosures.

H. Conductor Separation:

1. Power conductors shall be routed separately from all other conductor types. Route power conductors and other conductors in separate raceways, or by a metallic divider between the power conductors and the other conductors in the same raceway.

I. Neutral Conductor:

1. Shared/common neutrals shall not be permitted (i.e., each overcurrent device shall have its own separate neutral conductor). Neutral conductor sizes shall not be less than the respective feeder or phase conductor sizes.

J. Ground Conductor:

1. Shared/common grounding conductors shall not be permitted (i.e., each overcurrent protective device shall have its own separate ground conductor). The equipment grounding conductor shall be installed in the same conduit as its related branch and feeder conductors and shall be connected to the ground bus in the branch or distribution panelboard. Equipment ground conductor shall be the same size as the phase conductors were indicated for special equipment branch or feeder circuits that require parity sized ground conductors to comply with equipment manufacturer's recommendations.

K. Cable Installation in Manholes or Handholes:

1. Power and control cables shall be installed in separate manholes and handholes unless otherwise shown on the drawings. Cable slack sufficient for one splice for each cable shall be left in each manhole.

L. Separation:

1. Where power and control cables share the same manhole, they shall be installed on opposite sides of the manhole. The entire exposed length of control, telephone and signal cables shall be fireproofed by applying a 1/4-inch minimum thickness of arc-proofing. Known acceptable source is 3M No. 7700 or approved equal.

M. Cable Racking:

1. Cables shall be carefully formed around the interior of manholes or handholes, avoiding sharp bends or kinks. Splices and cables shall be tied to cable racks using 1/8-inch nylon line. Manhole cable racks and cable back arms shall be the plastic type provided with porcelain enamel insulators. Splices shall be a minimum of 2 feet from the mouth of the duct opening into the manhole. Splices in different cables shall be staggered.

N. Cable Terminations:

1. Provide terminations in accordance with this Section and manufacturer's requirements. All splices (including those in the building) must be approved by the Contracting Officer's Technical Representative.

3.4 DEMOLITION

A. Protect existing electrical equipment and installations when performing new work. If damaged or disturbed in the course of the work, remove damaged portions and install new products of equal capacity, quality, and functionality. Remove demolished material from the project site. Remove, store, clean, re-install, reconnect, and make operational components indicated for relocation.

B. Accessible Work:

1. Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.

C. Abandoned Work:

1. Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches below the surface of adjacent construction. Cap raceways and patch surface to match existing finish. All wire not removed shall have the Contracting Officer's Technical Representative's written approval.

3.5 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for electrical installations. Cutting shall be performed by skilled mechanics of the trades involved. Repair disturbed surfaces to match adjacent undisturbed surfaces.

3.6 FIELD TESTING

A. Perform the tests specified and other tests necessary to establish the adequacy, quality, safety, completed status, and suitable operation of each system. Repair or replace equipment that does not meet test requirements and retest. Tests shall be scheduled and approved in writing by COTR at least 21 calendar days prior to conducting tests. Unless otherwise indicated, the Contractor shall furnish all test instruments, materials, and labor necessary to perform tests designated in Division 16 Sections. All tests shall be performed in the presence of the Contracting Officer's Technical Representative. All instruments shall have been calibrated

within a period of 1 year preceding testing. Calibrations shall be traceable to applicable industry recognized standards.

B. Interim Operating and Performance Test:

1. Perform for each major equipment item after installation is complete and before the item is placed in service. After mechanical systems have been completely installed and balanced, test each system for proper operation. Tests shall be conducted in the presence of the Contracting Officer's Technical Representative under design conditions to ensure proper sequence of operation throughout the range of operation. Make adjustments as required to ensure proper functioning of the systems. Special tests on individual systems are specified under individual Sections. Provide 21 days written notice to the Contracting Officer's Technical Representative for major tests. Contractor shall demonstrate, to the Contracting Officer's Technical Representative's satisfaction, proper operation of control devices by simulating actual operating conditions. Devices tested shall include, but not be limited to, flow and pressure controls, temperature controls, and system interlocks and alarms.

C. Operation and Maintenance of Equipment:

1. After final tests and adjustments have been completed, fully instruct the Contracting Officer's Technical Representative and other personnel as directed by the Contracting Officer's Technical Representative in details of operation and maintenance of electrical equipment, including control systems and fire alarm system as installed.

D. Electrical Test Report:

1. Complete the Electrical Test Report included as Attachment No. 1. Provide the requested information for each panelboard and its power supply conductors. Perform insulation resistance tests in compliance with Section 26 05 19, “Low-Voltage Electrical Power Conductors and Cables” on wires including the neutral before connection to source and to loads. Perform the tests specified and other tests necessary to establish the adequacy, quality, safety, completed status, and suitable operation of each system. Repair or replace equipment that does not meet test requirements and retest. Notify the Contracting Officer's Technical Representative in writing 21 days prior to conducting tests.

E. Motor Insulation Resistance Test:

1. The manufacturer shall provide the following requested information for each 3-phase electrical squirrel cage, induction motor 1/2-horsepower (HP) and larger supplied to this project. Complete the Motor Test Report included as Attachment No. 2. Motors shall be tested for grounds and short circuits prior to being shipped to the job site. Windings shall test free from short circuits and ground. Minimum insulation resistance for motors, phase to phase to ground, shall not be less than 30 megohm measured within a 500 bolt DC insulation resistance tester. The manufacturer shall apply the test voltage for at least 1 minute after the reading has stabilized.

F. Electrical Main Supply and Distribution Feeders:

1. All electrical main supply and distribution feeders originating from switchboards, distribution panelboards, panelboards, or transformers, and all electrical feeders to 3-

phase electrical squirrel cage, induction motor, 1/2-horsepower (HP) and larger, shall be tested for open/short circuits. Submit the Electrical Test Report included as Attachment No.1. Provide grounding bushings on all feeder circuits (both ends and at pull/junction boxes in between).

G. Lighting, Power, Miscellaneous Power and Receptacle Branch Circuits:

1. In Lighting, power, miscellaneous power and receptacle single pole (1P) branch circuit panelboards, test any random 4 branch circuits (consisting of a phase conductor, a neutral and a grounding conductor) within a 42 pole panelboard or test one branch per every ten branch circuits. If more than 10 test points are above the specified value, then all branch line circuit wiring shall be tested. Submit Attachment No.1, Electrical Test Report to the Contracting Officer's Technical Representative.

H. Other Tests:

1. All insulation resistance test, meggering, continuity tests, open and short circuiting testing that fail to meet the minimum standards as set forth in these electrical specifications shall have their feeder or branch circuit conductors (phase conductor, neutral and ground) removed and replaced. If after retesting, these feeder conductors fail to meet minimum requirements, the work shall be re-performed until such work and retesting passes the minimum design parameter requirements as set forth in these electrical specifications.

I. Circuit Breaker Tests:

1. No 120 volt, single pole (1P) 15-100 amp circuit breaker is required to be tested. All two pole (2P) and all three pole (3P), molded case, insulated case and draw out power circuit breakers shall be tested for short circuit operation and for long term thermal overload protection operation to ascertain that they conform to manufacturer's recommended tolerances and design parameters. They shall be tested for handle operation, trip resetting, and mechanical freedom of movement. The circuit breakers shall have factory recommended electrical insulation resistance and factory recommended electrical conductivity path resistance.

J. Receptacle and Miscellaneous Power Branch Circuit Test Procedures:

1. The following test procedure shall be used:

a. Open the branch overcurrent circuit protection divide (OCPD) and remove all plugs from all of the connected convenience receptacle outlets and devices. For switched receptacles and for single phase, thermal manual motor starters used with fractional horsepower (HP) supply and exhaust fan motors, close circuit the switch.
b. Perform both the continuity test and insulation resistance meggering test. If the continuity and meggering test results are within specified design parameters, disconnect all testing equipment and close the overcurrent circuit protective device (OCPD) / molded case branch circuit breaker. If the results are not within specifications, repair the defective component and retest the branch circuit until satisfactory results are obtained.

K. Lighting Branch Circuit Wiring Test Procedures:

1. The following test procedure shall be used:

   a. For meggering test first open the overcurrent circuit protective device (OCPD), then close circuit for all light switches connected to the branch circuit prior to the first lighting fixture and then disconnect (open circuit) the branch circuit conductors from the first high intensity discharge (HID) or fluorescent lighting fixture in the circuit. Failure to do so can damage all lighting fixture ballasts in the circuit and will also give false low readings. A continuity test can be performed with all of the HID and fluorescent lighting fixtures connected, provided all of their respective light switches are opened and their OCPD is opened. Incandescent and halogen lamp lighting fixtures may be left in the circuit and be successfully tested for continuity and can be successfully meggered without any consequences.

   b. Perform both the continuity test and then the insulation resistance meggering test. If the continuity and meggering test results are within specified design parameters disconnect all testing equipment and close the overcurrent circuit protective device (OCPD) / molded case branch circuit breaker. If the results are not within specifications, repair the defective component and retest the branch circuit until satisfactory results are obtained.

ATTACHMENT NO. 1

Electrical Test Report
Project Name
Sheet No. _____ of _____ Date

Project No. _____ Address _____

SERVICE TRANSFORMER SIZE			
NL SERVICE VOLTAGE			
FL SERVICE VOLTAGE			
PANEL OR SWBD SERVED FROM			
PANEL OR SWITCHBOARD			
LOCATION			
MANUFACTURER			
TYPE			
FEEDER OC PROTECTION			
FEEDER CONDUCTOR SIZE			
GROUND CONDUCTOR SIZE			

MEASURED CONDITIONS	PHASE			PHASE			PHASE		
	A	B	C	A	B	C	A	B	C
NO LOAD FEDDER VOLTAGE									
OPERATING LOAD FEEDER VOLTAGE									
OPERATING LOAD FEEDER CURRENT									
CONDUCTOR INSUL RESISTANCE Ø AB									
CONDUCTOR INSUL RESISTANCE Ø BC									
CONDUCTOR INSUL RESISTANCE Ø CA									
CONDUCTOR INSUL RESISTANCE TO GROUND									
NEUTRAL INSUL RES TO GR W/GR CONN REMOVED									

ATTACHMENT NO.2

Motor Test Report
Project Name
Sheet No. _____ of _____ Date

Project No. _____ Address _____

DESTINATION		
LOCATION		
HORSEPOWER		
NEMA STARTER SIZE		
STARTER MFG & CAT NUMBER		
HEATER CAT NUMBER		
MAXIMUM HEATER AMPS		
CONDUCTOR SIZE		
GROUND COND SIZE		
SERVED FROM PNL OR MCC		

MEASURED CONDITIONS	PHASE				PHASE		
	A	B	C		A	B	C
ACTUAL MOTOR CURRENT							
NAMEPLATE MOTOR CURRENT							
NO LOAD VOLTAGE							
FULL LOAD VOLTAGE							
CONDUCTOR INSUL RESISTANCE Ø AB							
CONDUCTOR INSUL RESISTANCE Ø BC							
CONDUCTOR INSUL RESISTANCE Ø CA							
CONDUCTOR INSUL RESISTANCE TO GROUND							

END OF SECTION 26 05 00

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SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes building wires and cables and associated splices, connectors, and terminations for wiring systems rated volts and less.

1.2 REFERENCE STANDARDS

A. The publications listed below form a part of this Specification to the extent referenced. The publications listed below are referenced as the latest edition published as of the date of this document. The publications are referred to within the text by the basic designation only.

B. American Society for Testing and Materials (ASTM)

1. ASTM B 8 Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
2. ASTM D 1000 Standard Test Method for Pressure-Sensitive Adhesive-Coated Tapes used for electrical and electronic applications.

C. Federal Specifications (FS)

1. FS QQ-W-343 Wire, Electrical, Copper (Uninsulated), with Notice 1
2. FS W-S-610 Splice Connectors

D. International Electrical Testing Association (NETA)

1. NETA ATS Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems

E. National Electrical Contractors Association

1. NECA Standard of Installation

F. National Electrical Manufacturers Association (NEMA)

1. NEMA WC3 Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
2. NEMA WC70 Non-Shielded Power Cable 2000 V or Less

G. National Fire Protection Association (NFPA)

1. NFPA 70 National Electrical Code

H. Occupational Safety and Health Administration (OSHA)

1. 29 CFR 1910.7 Definitions and Requirements for a Nationally Recognized Testing Laboratory (NRTL)

I. Underwriters Laboratories (UL)

1. UL 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors
2. UL 486C Standard for Splicing Wire Connectors
3. UL 486E Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors

1.3 SUBMITTALS

A. The following shall be submitted in accordance with Section 03 30 00, “Cast-in-Place Concrete.”

B. Test Reports: Field test reports indicating and interpreting test results relative to compliance with performance requirements of testing standard.

C. Operation and Maintenance Data: Prepare and distribute operations and maintenance data as specified in Section 01 78 23, “Operation and Maintenance Data.”

1.4 QUALITY ASSURANCE

A. Testing Firm Qualifications: An independent testing firm shall meet OSHA criteria for accreditation of testing laboratories, 29 CFR 1910.7, or shall be a full member company of the International Electrical Testing Association (NETA).

B. Testing Firm's Field Supervisor Qualifications: A person currently certified by the NETA National Institute for Certification in Engineering Technologies to supervise on-site testing specified in PART 3.

C. Components and Installation: Comply with NFPA 70, for components and installation.

D. Listed and Labeled: Provide products specified in this Section that are listed and labeled. The terms "Listed" and "Labeled" as defined in NFPA 70, Article 100.

E. Listing and Labeling Agency Qualifications: A NRTL as defined in 29 CFR 1910.7.

F. Installer Qualifications: Cable splices shall be performed by experienced and qualified cable splices. The workman shall be licensed if required by the authority having jurisdiction.

1.5 SEQUENCING AND SCHEDULING

A. Coordinate layout and installation of cable with other installations. Revise locations and elevations form those indicated as required to suit field conditions and as approved by the Contracting Officer's Technical Representative.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Wires and Cables:

1. American Insulated Wire Corporation, Leviton Manufacturing Co.
2. Brand-Rex Cable Systems, Brintec Corp.
3. Carol Cable Company, Inc.
4. Senator Wire & Cable Co.
5. Southwire Co.

B. Connectors for Wires and Cables

1. AFC, Monogram Co.
2. AMP, Inc.
3. Anderson, Square D Co.
4. Electrical Products Division, 3M Co.
5. O-Z/Gedney Unit, General Signal

2.2 BUILDING WIRES AND CABLES

A. Specified Applications: UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified in PART 3.

B. Rubber Insulation: Conform to NEMA WC3.

C. Thermoplastic Insulation: Conform to NEMA WC70, NEMA WC71,and NEMA WC74.

D. Stranded Conductors: Solid conductor for 10 AWG and smaller; stranded conductor for larger than 10 AWG. Stranded conductors rating shall be tin coated, ASTM B 8, Class B.

E. Wire and Conduit Sizes: All wire and conduit sizes are based on copper insulated conductors with 7 degrees C temperature rating, ambient temperature of 30 degrees C and a minimum conduit size of 3/4".

F. Sizes: Minimum 12 AWG. Minimum 10 AWG for 120 volt circuits where circuit length (one way) exceeds 75 feet from source, and 10 AWG for 277 volt circuits where circuit length (one way) exceeds 150 feet from source. Communication systems wiring size shall be in accordance with manufacturer's requirements. Fire alarm and control systems wiring size shall be in accordance with manufacturer's requirements or as specified in Section 28 30 00, “Master Fire Alarm System.”

1. Stranded conductors may be used with wire compression connectors or a pressure washer type lug.
2. Conductor Type
3. Soft drawn, annealed copper (aluminum conductors are not acceptable).
4. Power conductors shall be single conductor type.
5. Control interconnection between equipment shall be jacketed type multiconductor.

6. Instrumentation conductor shall be twisted pair, shielded, jacketed type.
7. Conductors used for lighting and receptacle branch circuits shall be single conductor type.

G. Conductor Color Codes: Refer to Section 26 05 53, “Identification for Electrical Systems” for conductors No. 4 AWG and larger, where factory color-coding is not available. Feeder conductors to panels and three phase circuits shall be factory color coded as follows:

1. 208/120 Volt System:
   a. Phase A: Black
   b. Phase B: Red
   c. Phase C: Blue
   d. Neutral: White
   e. Ground: Green

2. Single-phase branch circuits shall be factory color coded as stated above, or identified in accordance with Section 26 05 53, “Identification for Electrical Systems.”

3. Control cables shall be IAW NEMA WC50

H. Un-insulated Conductors: Un-insulated conductors shall be copper and comply with FS QQ-W-343.

2.3 CONNECTORS AND SPLICES

A. UL-listed factory-fabricated wiring connectors of size, ampacity rating, material, and type and class for applications and for service indicated. Select to comply with project's installation requirements and as specified in PART 3.

B. Connectors, Splice Sleeves, and Terminal Lugs: Wire and cable connectors, lugs, and sleeves shall be in compliance with UL 486A, and the following:

1. For splices of 10 AWG and smaller building wires in power circuits, use tin plated copper compression type connector caps with nonflammable, self-extinguishing insulation grip with temperature rating equal to that of conductor insulation.
2. Use ring tongue compression type terminators with insulated barrel on all stranded conductors used in control wiring.
3. Crimp type connectors are not permitted on solid conductors.

C. Insulating Tape: ASTM D 1000. As a minimum, rate equal to conductor insulation. Rubber tape shall be silicon rubber with silicon pressure sensitive adhesive.

D. Bundling Straps: Nylon straps with a locking hub or head on one end and a taper on the other.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine raceway and building finishes to receive wires and cables for compliance with installation tolerances and other conditions. Verify that the duct or conduit is open, continuous, and clear of debris before installing cable. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Feeders: Type THHN/THWN, copper conductor, in raceway.

B. Indoor Branch Circuits: Type THHN/THWN, copper conductor, 75 degrees C insulation, in raceway.

C. Exterior Branch Circuits: Type THHN/THWN, copper conductor, 75 degrees C insulation, in raceway.

3.3 INSTALLATION

A. Install wires and cables as indicated, according to manufacturer's written instructions and NECA. Pull conductors into raceway simultaneously where more than one is being installed in same raceway.

1. Use pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation, and must be non-flammable.
2. Use pulling means; including fish tape, cable, rope, and basketweave wire/cable grips that will not damage cables or raceway.
3. Bend to radii not less than the minimum bending recommended by manufacturer or 12 times the outer diameter of cable. Do not exceed the pulling tension recommended by manufacturer.
4. All box connectors shall have insulated throat.

B. Cable shall be installed in a manner to prevent harmful stretching of the conductor, injury to the insulation or damage tot he outer protective covering. Install exposed cable, parallel and perpendicular to surfaces or exposed structural members, and follow surface contours where possible. The ends of cables shall be sealed with moisture-seal tape before pulling, and it shall be left sealed until connections are made.

C. Conductor Splices: Keep to a minimum.

D. No splices shall be allowed on critical circuits and feeders.

E. Splices shall be made only at outlets, junction boxes, or accessible raceways.

F. Wire nuts may only be used to splice conductors sized No. 10 AWG and smaller.

G. Compression connectors shall be used to splice conductors No. 8 AWG and larger.

H. All splices, including those made with insulated wire nuts, shall be insulated with electrical tape or heat-shrink tubing to a level equal to that of the factory insulated conductors.

I. Splicing of underground conductors in panelboards is not permitted.

J. Splices shall be made with solderless connectors conforming to UL 486A, UL 486C, UL 486E and FS W-S-610.

K. Install splices and insulating tapes that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.

L. Use splice and tap connectors that are compatible with conductor material.

M. Splice methods and material shall be of a type recommended by the manufacturer of the splicing material for the particular type of cable being spliced and shall be approved by the Contracting Officer's Technical Representative prior to installation.

N. Wiring at Outlets: Install with at least 6 inches of slack conductor at each outlet.

O. Connecting Outlets and Components: Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL 486A.

P. Critical Circuits: Conductors for critical circuits, emergency lighting, security systems, and fire alarm systems shall be kept completely independent from any other system as well as each other.

Q. Cable/Conductor Installation: Cables/Conductors sized 250 kCMIL and greater shall be installed with the sue of a hydraulic cable bender. Cable supports shall be required for stress relief. A splice shall not be pulled into a duct or conduit under any circumstance.

R. Neutral and Ground: Separate neutral and ground wires shall be provided for each over current protection device. Each branch circuit shall have its own neutral and ground conductor. Common neutral or ground is not acceptable. Neutral conductors shall extend from the neutral bus where the phase conductors originate. Install conductors only after the raceway system is complete.

S. Electrical Identification: Install electrical identification devices specified in Section 26 05 53, “Identification for Electrical Systems” at terminations, immediately after installing wires and cables.

3.4 FIELD QUALITY CONTROL

A. Testing, General:

1. Cables shall be tested prior to installation and again upon completion of the installation. Testing shall be accomplished before connection is made. Tests shall be performed in the presence of the Contracting Officer's Technical Representative.
2. Upon installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
3. Perform each visual and mechanical inspection and electrical test state in NETA ATS. Certify compliance with test parameters.
4. Test wire and cable for continuity or circuitry, and also for short circuits.

B. Insulation Resistance Tests: Feeder and branch circuit insulation tests shall be performed after installation, but before connection to equipment.

1. Conductors shall test free from short circuits and grounds, and have a minimum phase-to-phase and phase-to-ground insulation resistance of 30 megohms when measured with a 500-volt DC insulation tester. The Contractor shall submit a letter type test report to the COTR prior to final inspection of the work. The report shall list the tests performed and results obtained.
2. Apply the test voltage for at least one minute after meter reading has stabilized.

C. Malfunctioning Products: Correct malfunctioning products on site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units, and retest.

ATTACHMENT NO. 3

Megger Test Report:

600 V CABLE INSULATION AND CONTINUITY TEST (power/control wire & cable)

Project Name _____ Date _____ Sheet No. _____ of ____
Project No. _____ Address _____

NOTE: 500 VOLT MEGOHMETER, MEGGER ALL PHASES, RECORD MINIMUM READING

Panel No. Ckt. No. Fedder No.	VOLTS	A-B	A-C	B-C	A-N	B-N	C-N	A-G	B-G	C-G	N-G	Supervisor O.K.

END OF SECTION 26 05 19

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment.

1.2 REFERENCES

A. The publications listed below form a part of this Specification to the extent referenced. The publications listed below are referenced as the latest edition published as of the date of this document. The publications are referred to within the text by the basic designation only.

1. American Society for Testing and Materials (ASTM)

a.	ASTM B 3	Standard Specification for Soft or Annealed Copper Wire
b.	ASTM B 33	Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes
c.	ASTM B 8	Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

2. FAA Specifications and Standards

a.	FAA-STD-019e	Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements

3. Institute of Electrical and Electronics Engineers (IEEE)

a.	IEEE 1100	Powering and Grounding Sensitive Electronic Equipment
b.	IEEE 81	Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
c.	IEEE C62.41	Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits

4. National Fire Protection Association (NFPA)

a.	NFPA 70	National Electrical Code
b.	NFPA 780	Standard for the Installation of Lightning Protection Systems

5. Occupational Safety and Health Administration (OSHA)

a. 29 CFR 1910.7	Definitions and Requirements for a Nationally Recognized Testing Laboratory (NRTL)

6. Underwriters Laboratories (UL)

a. UL 467	Grounding and Bonding Equipment
b. UL 486A	Wire Connectors and Soldering Lugs for Use with Copper Conductors

1.3 SUMMARY

A. This Section includes solid grounding of electrical systems and equipment and basic requirements for grounding for protection of life, equipment, circuits, and systems. Grounding requirements specified in this Section may be supplemented in other Sections of this Specification. Grounding requirements for FAA-occupied spaces often exceed NFPA 70 criteria. Install grounding systems in accordance with this Section and as indicated on the drawings.

1.4 SUBMITTALS

A. The following shall be submitted in accordance with Section 01 33 00, “Submittal Procedures:”

B. Product Data:

1. Ground Rods
2. Connectors and Connection Materials
3. Grounding Fittings
4. Qualifications
5. Qualification data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include lists of complete projects with project names and addresses, names and addresses of architects and owners, and other information specified.

C. Test Reports:

1. Field Tests and Observation Reports: Reports shall be certified by the testing organization and indicating and interpreting the test reports for compliance with performance requirements.

D. Operation and Maintenance Data: Prepare and distribute operations and maintenance data as specified in Section 01 78 23, “Operation and Maintenance Data.”

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: A nationally recognized testing laboratory as defined by 29 CFR 1910.7, or a full member company of NETA.

B. Testing Agency Field Supervision: Use persons currently certified by NETA or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in PART 3. Comply with NFPA 70 and UL 467.

C. Listing and Labeling: Provide products specified in this Section that are listed and labeled as defined in NFPA 70, Article 100.

1. Listing and Labeling Agency: Qualifications as defined in 29 CFR 1910.7.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products that may be incorporated into work include, but are not limited to, the following:

1. Kearney/Cooper Power Systems.
2. Chance/Hubbell.
3. Erico, Inc.
4. Lyncole XIT Grounding.
5. Harger.
6. O-Z/Gedney Co.; a business of the EGS Electrical Group.
7. Salisbury: W.H. Salisbury & Co.
8. Thomas & Betts Electrical.
9. Thompson Lightning Protection Inc.

2.2 WIRING AND CABLE GROUNDING CONDUCTORS

A. Comply with Section 26 05 19, “Low-Voltage Electrical Power Conductors and Cables.” Conform to NFPA 70, except as otherwise indicated for conductor properties, including stranding.

B. Material: Copper. Use only copper wire for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone and similar materials.

C. Size: Comply with FAA-STD-019e.

D. Equipment Grounding Conductors: Insulated with green color insulation. Insulated conductors larger than #6 AWG with black color insulation shall be allowed to be re-identified with green tape.

1. The equipment grounding conductor shall be routed in the same raceway as its’ related phase and neutral conductors. Cord-connected equipment requiring an equipment ground shall include the equipment grounding conductor as an integral part of the power cord. Where power is supplied to electronic equipment through a cable and connector, the connector shall contain a pin to continue the equipment grounding conductor to the equipment chassis. Conduit or cable shields shall not be used as the equipment grounding conductor.

2. Parity-sized equipment grounding conductors (same size as the associated phase conductors) shall be used. The resulting size equipment grounding conductor shall be maintained as the minimum size permitted upstream to the source of a separately derived system, or, in the absence of an intervening separately derived system, all the way back to the service entrance. The parity size equipment grounding conductor shall be bonded to bonding bushings at each end of each raceway section with a bonding jumper the same size as the initially established minimum size equipment grounding conductor – installed as shown by Figure 1. Where flexible metal conduit is required, liquid tight flexible metal conduit must be used, with a bonding terminal integral to an end connector listed for grounding.

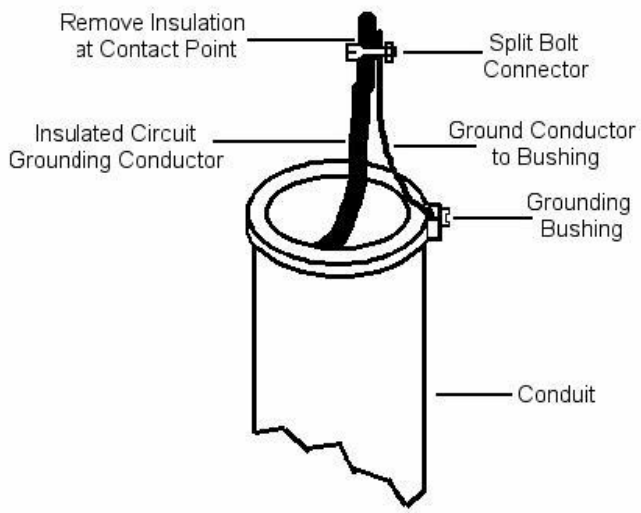

Figure 1 – Bonding of Conduit and Equipment Grounding Conductor

3. Grounding terminals in all receptacles on multioutlet assemblies shall be hardwired to an equipment grounding conductor. Strips that depend upon serrated or toothed fingers for grounding shall not be used.

4. All flexible metal conduits in TRACON rooms or electronic equipment rooms supporting the TRACON room, and all operational areas at the top of the ATCT shaft, shall be provided with an external bonding jumper in addition to the internal equipment grounding conductor. Therefore, liquid tight flexible metal conduit must be used where any flexible metal conduit is required – as in paragraph 2) preceding. The bonding jumper shall be a #6 AWG green-insulated stranded copper conductor – or the largest jumper the conduit grounding bushing permits. The bonding jumper shall terminate on fittings listed for grounding at each end of the liquid tight flexible metal conduit.

5. A separate equipment grounding conductor shall be provided for each overcurrent device and as required by the NEC.

E. Isolated Grounding Conductors: Insulated, with green color insulation and yellow and red bands.

F. Single Point Grounding Conductors: Insulated; color shall be green with a bright yellow tracer.

G. Electronic Multipoint Ground System: Insulated; color shall be green with bright orange tracer. Where cables are concealed and not color coded any exposed portion of the cable and each end of the cable for a minimum of 2 feet shall be color coded by green tape overlaid with bright orange tape to form the tracer. Where routed through raceways or wireways, or under raised floors, the color coding shall be such that by removing or opening any cover, color coding shall be visible. Where conductors are routed through cable trays, color coding for a minimum length of 4 inches shall be accomplished at intervals not exceeding 3 feet between codings.

H. Grounding Electrode Conductors: Stranded cable.

I. Underground Conductors: Bare, tinned, stranded, except as otherwise indicated.

J. Bare Copper Conductors: Conform to the following:

1. Solid conductors: ASTM B 3.
2. Assembly of stranded conductors: ASTM B 8.
3. Tinned conductors: ASTM B 33.

2.3 MISCELLANEOUS CONDUCTORS

A. Braided Bonding Jumpers: Where electrical continuity across the shock mounts is necessary, bonding jumpers shall be installed across each shock mount. Jumpers of this application shall have a maximum thickness of 0.025-inch, so that the damping efficiency of the mount is not impaired. In severe shock and vibration environments, solid straps may be corrugated, or flexible wire braid may be used. Braids are to be terminated with copper ferrules.

B. Raceway Bonding Jumpers: Copper, minimum size #6 AWG unless otherwise noted.

2.4 CONNECTOR PRODUCTS

A. Exothermic-Welded Connections: These connections shall be provided in kit form and selected per manufacturer's written instructions for specific types, sizes, and combinations of conductors and connected items.

PART 3 - EXECUTION

3.1 APPLICATION

A. Equipment Grounding Conductors: All metallic non-current carrying parts of electrical equipment shall be grounded with equipment grounding conductors whether or not shown on the drawings. Equipment grounding conductors shall be green insulated copper conductors unless otherwise indicated. When these conductors are not sized nor shown on the contract drawings, size them in accordance with FAA-STD-019e. In no case, however, shall these conductors be smaller than No. 12 AWG. Install green, equipment grounding conductor with all feeder and branch circuit conductors.

1. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and above, including air cleaners and heaters. Bond conductor to each unit and to air duct.
2. Water Heater, Heat-Tracing, and Antifrost Heater Circuits: Install a separate equipment grounding conductor to each electric water heater, heat-tracing assembly, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components.

3.2 INSTALLATION

A. Grounding Conductors: Route along the shortest and straightest paths possible, except as otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact or damage.

B. Equipment Enclosure Grounding:

1. Bare wire, wrapped around connecting screws or mounting bolts and screws is not acceptable as a grounding connection. All ground lugs shall be of a noncorrosive material suitable for use as a grounding connection, and must be compatible with the type of metal being grounded. Ground lugs shall be mounted on clean, bare metal surfaces that are free of paint, rust, etc.

C. Raceway Grounding:

1. Surface metal raceways, wireways, or cable rack systems shall be installed in a manner that ensures electrical continuity, or short bare copper bonding jumpers shall be installed between adjacent raceway sections to ensure proper bonding. Unless otherwise indicated, the minimum size for these bonding jumpers shall be #6 AWG.

D. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding-clamp connectors.

E. Interior Metal Piping and Air Ducts: Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.

F. Fault Protection: Prevent equipment parts subject to human contact during operation and maintenance from being electrically energized when powering faults or components fail. Ground parts with a low impedance path to the chassis or cabinets in which they are mounted.

3.3 CONNECTIONS

A. Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series. Make connections with clean, bare metal at points of contact. Coat and seal connections having dissimilar metals with inert materials to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Use for connections to structural steel, for underground connections, ground plates and where indicated on drawings. Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Terminations: Terminate insulated equipment grounding conductors for feeders with pressure-type grounding lugs. Where metallic raceways terminate at nonmetallic or nonconductive housings, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing. Bond electrically non-continuous conduits at both entrances and exits with grounding bushings and bare grounding conductors.

D. Raceway Grounding: Surface metal raceways, wireways, or cable rack systems shall be installed in a manner that ensures electrical continuity. Insulated copper bonding jumpers shall be installed between adjacent raceway sections to ensure proper bonding. Uninsulated conductors shall not be used. Unless otherwise indicated, the minimum size for these bonding jumpers shall be #6 AWG. All metallic raceway penetrations into a facility structure shall be bonded to the earth electrode system.

E. Tightening of Connectors: Tighten grounding and bonding connectors and terminators, including screws and bolts, in accordance with torque tightening values specified in UL 486A.

F. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Mechanical connections using a Burndy "Hyground Connector", Thomas and Betts Compression Connector or FAA approved equivalent equipment when operated at the manufacturer's recommended pressure to develop a minimum force of 12 tons is acceptable as approved pressure connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on ground conductor. Hydraulically crimped connectors are not acceptable in the lightning protection system.

3.4 ADJUSTING AND CLEANING

A. Restore surface features, including vegetation, at areas disturbed by work of this Section. Reestablish original grades, except as otherwise indicated. Where sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include top soiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 26 05 00, “Common Work Results for Electrical.” Maintain restored surfaces.

END OF SECTION 26 05 26

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SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

1.2 REFERENCE STANDARDS

A. The publications listed below form a part of this Specification to the extent referenced. The publications listed below are referenced as the latest edition published as of the date of this document. The publications are referred to within the text by the basic designation only.

B. ASTM International (ASTM)

1. ASTM A 36 Standard Specification for Carbon Structural Steel
2. ASTM A 53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

C. National Fire Protection Association (NFPA)

1. NFPA 70 National Electrical Code

D. Underwriters Laboratories (UL)

1.3 SUBMITTALS

A. Product data for each type of product specified.

1.4 QUALITY ASSURANCE

A. Electrical Component Standards: Components and installation shall comply with NFPA 70. Electrical components shall be listed and labeled by UL or other approved, nationally recognized testing and listing agency that provides third-party certification follow-up services.

PART 2 - PRODUCTS

2.1 COATINGS

A. Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic. Product for use outdoors shall be hot-dip galvanized.

2.2 MANUFACTURED SUPPORTING DEVICES

A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.

B. Fasteners: Types, materials, and construction features as follows:

1. Expansion Anchors: Carbon steel wedge or sleeve type.
2. Toggle Bolts: All steel springhead type.
3. Powder Actuated Fasteners: Not Allowed.

C. U-Channel Systems: 16-gage steel channels, with 9/16-inch diameter holes, at a minimum of 8 inches on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacture.

D. Conduit Sealing Bushings: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in conduits subject to exposure to water and/or oil penetration at conduit joints. Provide plugs with number and size of conductor gripping holes as required to suit installation. Construct body of malleable iron casting with hot-dipped galvanized finish. Support systems shall be capable of carrying the weight of the box and its contents.

E. Fasteners for Plastic-Laminated and Metal Signs: Self-tapping stainless steel screws or No. 10/32 stainless steel machine screws with nuts and flat end lock washers. Provide steel channel supports with 9/16-inch diameter holes at a maximum of 8 inches on center, in at least one surface. Fittings and accessories to mate and match with channels and to be from the same manufacturer.

2.3 FABRICATED SUPPORTING DEVICES

A. General

1. Shop or Field-fabricated supports or manufactured supports assembled from U-channel components.

B. Steel Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.

C. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.

1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with welded spiral seams or welded longitudinal joint. Fabricate sleeves from the following gage metal for sleeve diameter noted:

a. 3-inch and smaller: 20-gage
b. 4-inch to 6-inch: 16 gage
c. over 6-inch: 14 gage
d. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe.

D. Supplementary Structural Supports: ASTM A 36 steel shapes.

1. Supports and supporting devices shall be designed and installed to withstand the local code equivalent of a minimum UBC Seismic Zone 4 force.
2. Provide the installation of supplementary structural supports required for attachment of hangers and other devices supporting electrical equipment and conduits.
3. Members welded to main structural members shall be equal to the specification for the main structural member.
4. Size support members for their actual loads and safety factors without excessive deflection and with consideration for rigidity under vibration.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install supporting devices to fasten electrical components securely and permanently in accordance with NFPA 70. Coordinate with the building structural system and with other electrical installation.

B. Raceway Supports: Comply with NFPA 70 and the following requirements:

1. Conform to manufacturer's recommendations for selection and installation of supports.
2. Strength of each support shall be adequate to carry design load plus 25 percent for future use, multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 pounds, provide additional strength until there is a minimum of 200 pounds safety allowance in the strength of each support.
3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceway. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
4. Support parallel runs of horizontal raceways together on trapeze-type hangers.
5. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1 1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4-inch diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.
6. Space supports for raceway in accordance with Table I of this Section. Space supports for raceway types not covered by the above in accordance with NFPA 70.
7. Support exposed and concealed raceway within 1-foot of unsupported boxes and access fittings. In horizontal runs, support at the boxes and access fittings may be omitted where boxes or access fittings are independently supported and raceway terminals are not made with chase nipples or threadless box connectors.
8. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors are carried entirely by the conduit supports with no weight load on raceway terminals.
9. Neither raceways nor boxes shall be fastened to suspended ceiling supports.
10. Cable tray support (Unistrut) shall run the entire length of the Electronic Equipment and Telco Rooms so that the Unistrut is one continuous piece from wall to wall.

C. Miscellaneous Supports: Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks

for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.

D. Open Overhead Spaces: In open overhead spaces, cast boxes threaded to raceways need not be supported separately except where used for fixture support; support sheet metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved type of fastener not more than 24 inches from the box. Cast metal boxes having thread-less connectors and sheet-metal boxes shall be supported directly from the building structure or by bar hangers.

E. Sleeves: Install in concrete slabs and walls and all other fire-rated floors and walls for raceway and cable installations. For sleeves through fire-rated wall or floor construction, apply UL-listed firestopping sealant in gaps between sleeves and enclosed conduits and cables in accordance with requirements of Section 07 92 00, “Joint Sealants.”

F. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, square duct, cabinets, panel boards, transformers, boxes, disconnect switches, lighting fixtures, and control components in accordance with the following:

1. Fasten by means of wood screws, nails, screw-type nails, carriage bolts, or lag screws of equal holding strength on wood; toggle bolts on hollow masonry units concrete inserts or expansion bolts on concrete or solid masonry; and machine screws, welded threaded studs, or spring-tension clamps on steel. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine or wood screws. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.
2. Holes cut to a depth of more than 1 1/2 inches in reinforced concrete beams or to a depth of more than 3/4-inch in concrete shall not cut the main reinforcing bars. Patch holes that are not used with like and kind materials.
3. Coordinate any cutting or boring of structural beams with Structural Engineer prior to any work being done.
4. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration- and shock-resistant fasteners for attachments to concrete slabs.
5. Coordinate with structural engineer on expansion joints used to support raceway.

G. Tests: Provide all calibrated jacks, jigs, and fixtures, indicate scales required for reliable testing. Obtain the Structural Engineer's approval before transmitting loads to the structure. Test to 90 percent of rated proof load for fastener. If fastening fails test, revise all similar fastener installations and retest until satisfactory results are achieved. Test pull-out resistance of one of each type, size, and anchorage material for expansion anchors and toggle bolts.

3.2 TABLE I: SPACING FOR RACEWAY SUPPORTS

Raceway Size (Inches)	No. of Conduits In Run	Location	RMC & IMC (1)	EMT (1)
HORIZONTAL RUNS				
1/2,3/4	1 or 2	Flat ceiling or wall.	5	5
1/2,3/4	1 or 2	Where it is difficult to provide supports except at intervals fixed by the building construction.	7	7
1/2,3/4	3 or more	Any location.	7	7
1/2	13 or more	Any location.		
1 & larger		1 or 2 flat ceiling or wall	6	6
1 & larger		1 or 2 where it is difficult To provide supports except at intervals fixed by the building construction	10	10
1 & larger		3 or more any location	10	10
Any		Concealed	10	10
VERTICAL RUNS				
1/2, 3/4		Exposed	7	7
1, 1-1/4		Exposed	8	8
1-1/2 and larger		Exposed	10	10
Up to 2		Shaftway	14	10
2-1/2		Shaftway	16	10
3 & larger		Shaftway	20	10
Any		Concealed	10	10

NOTES:
(1) Maximum spacing of supports (feet).
(2) Maximum spacing for IMC above apply to straight runs only.
Otherwise, the maximums for EMT apply.

Abbreviations:
EMT: Electrical metallic tubing
IMC: Intermediate metallic conduit
RMC: Rigid metallic conduit

END OF SECTION 26 05 29

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SECTION 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 REFERENCES

A. The publications listed below form a part of this Specification to the extent referenced. The publications listed below are referenced as the latest edition published as of the date of this document. The publications are referred to within the text by the basic designation only.

1. American National Standards Institute (ANSI)

a.	ANSI C80.1	Rigid Steel Conduit, Zinc-Coated
b.	ANSI C80.3	Electrical Metallic Tubing, Zinc-Coated
c.	ANSI C80.6	Intermediate Metal Conduit Zinc-Coated

2. FAA Standards (FAA)

a.	FAA 1217f	Electrical Work, Interior
b.	FAA STD 019E	Lightning Protection, Grounding, Bonding and Shielding Requirements for Facilities

3. Federal Specifications (FS)

a.	WW-C-566	Conduit, Metal flexible

4. National Electrical Contractors Association (NECA)

a.	NECA	Standard of Installation

5. National Electrical Manufacturers Association (NEMA)

a.	NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
b.	NEMA FB1	Fitting, Cast Metal Boxes, and Conduit Bodies, and Cable Assemblies
c.	NEMA ICS-6	Industrial Control System Enclosure
d.	NEMA OS1	Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
e.	NEMA RN1	Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit

6. National Fire Protection Association (NFPA)

a.	NFPA 70	National Electrical Code

7. Occupational Safety and Health Administration (OSHA)

a.	29 CFR 1910.7	Definitions and Requirements for a Nationally Recognized Testing Laboratory (NRTL)

8. Underwriters Laboratories (UL)

a.	UL 1	Flexible Metal Conduit
b.	UL 1242	Intermediate Metal Conduits
c.	UL 360	Liquid-tight Flexible Metal Conduit
d.	UL 486A	Wire Connectors and Soldering Lugs for Use with Copper Conductors
e.	UL 5	Surface Metal Raceways and Fittings
f.	UL 50	Enclosures for Electrical Equipment
g.	UL 514A	Metallic Outlet Boxes
h.	UL 514B	Fittings for Conduit and Outlet Boxes
i.	UL 6	Rigid Metal Conduit
j.	UL 797	Electric Metallic Tubing
k.	UL 870	Wireways, Auxiliary Gutter, and Associated Fittings

9. Steel Structures Painting Council (SSPC)

a.	SSPC PS-10.01	Hot-Applied Coal Tar Enamel Painting System

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring. Refer to Section 26 05 26, “Grounding and Bonding for Electrical Systems” for related grounding requirements.

1.3 RACEWAY COMPONENTS

A. Raceways include the following:

1. Rigid metal conduit (RMC).
2. Intermediate metal conduit (IMC).
3. Electrical metallic tubing (EMT).
4. Flexible metal conduit (FMC).
5. Liquidtight flexible conduit (LFMC).
6. Wireway.
7. Nonmetallic tubing and conduit.

1.4 BOXES, ENCLOSURES AND CABINETS

A. Boxes, enclosures, and cabinets include the following:

1. Device boxes.
2. Outlet boxes.

3. Pull and junction boxes.
4. Conduit bodies.
5. Cable access boxes.
6. Cabinets and hinged cover enclosures.

1.5 SUBMITTALS

A. The following shall be submitted in accordance with Section 01 33 00, “Submittal Procedures”:

1. Nonstandard boxes, enclosures and cabinets: Include layout drawings showing components, wiring, supports, and seismic bracing.
2. Surface raceway
3. Wireway and fittings
4. Floor boxes
5. Hinged cover enclosures and cabinets
6. Operation and Maintenance Data: Submit in accordance with Section 01 78 23, “Operation and Maintenance Data.”

1.6 QUALITY ASSURANCE

A. Comply with the latest edition of NFPA 70 for components and installation. Boxes shall be sized in accordance with NFPA 70 Article 376. Comply with NECA.

B. Listing and Labeling: Provide products specified in this Section that are listed and labeled. The terms "Listed and Labeled" as defined in NFPA 70 Article 100.

C. Listing and Labeling Agency Qualifications: A NRTL as defined in 29 CFR 1910.7.

D. Layout Coordination: Coordinate layout and installation of raceways and boxes with other construction elements to ensure adequate headroom, working clearance and access. All outdoor boxes shall be rated minimum NEMA 4X.

PART 2 - PRODUCTS

2.1 GENERAL

A. Enclosures shall conform to NEMA standards. All materials procured under this Section shall be in accordance with FAA 1217f and FAA STD 019E.

2.2 METAL CONDUIT AND TUBING

A. Rigid Metal Conduit (RMC)

B. ANSI C80.1 and UL 6.

C. Plastic-Coated Steel Conduit and Fittings: NEMA RN1.

D. Intermediate Metal Conduit (IMC): ANSI C80.6 and UL 1242.

E. Electrical Metallic Tubing (EMT) and Fittings: UL 797 and ANSI C80.3 with compression-type fittings. Screw-type fittings are not acceptable. Use for lighting, building power, fire alarm, environmental, and communication circuits in concealed areas where not subject to physical damage, such as suspended ceilings and furred walls. Connectors shall have insulated-throat, smooth bell shaped end.

F. Flexible Metal Conduit (FMC): Zinc-coated steel; UL 1 and WW-C-566. Conduit and fittings shall be type listed for grounding. Provide FMC in minimum 24 inches or 10 diameter lengths for connection to motors and equipment subject to vibration and movement.

G. Liquidtight Flexible Metal Conduit (LFMC): Flexible steel conduit with PVC jacket; UL 360.

H. Flexible Non-Metallic Conduit: Shall not be used.

I. Fittings: NEMA FB1 and UL 514B, compatible with conduit and of the threaded type. Set screw fittings are not allowed. Conduit expansion and deflection fittings shall be watertight. Fabricate from material compatible with conduit to be used. Expansion and deflection fittings shall be equipped with bonding jumper cable to provide electrical continuity. Bushings inside boxes or enclosures shall be insulated grounding type.

J. Underground Fittings: Shall be protected by field wrapping, 0.01-inch thick pipe wrapping plastic tape applied with 50 percent overlap.

2.3 WIREWAYS

A. Material: Sheet metal sized and shaped as indicated.

B. Fittings and Accessories: UL 870. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps and other fittings to match and mate with wireway as required for complete system. Provide insulated grounding bushings on all conduit terminations to wireways and galvanized rigid steel as indicated in PART 3 of this Section. Select features where not otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

C. Wireway Covers: Hinged type with clamps to close, unless noted otherwise.

D. Finish: Manufacturer's standard enamel finish. Provide NEMA rating appropriate for use intended.

2.4 OUTLET AND DEVICE BOXES

A. Boxes shall not contain concentric knockouts.

B. Sheet Metal Boxes: NEMA OS1 and UL 514A.

C. Cast Metal Boxes: NEMA FB1, type FD, cast ferro-alloy box with gasketed cover.

D. Exposed Outlet Boxes: UL 514A steel, malleable iron or cast iron boxes with threaded conduit entry for surface-mounting in areas having exposed conduit systems.

E. Flush Outlet Boxes: UL 514A hot-dip galvanized steel, square or rectangular, 2 1/8 inches deep by 4 inches square, with extension ring where necessary.

F. Fittings: UL 514B.

G. Boxes in concrete shall be cast metal.

2.5 PULL AND JUNCTION BOXES

A. Small Sheet Metal Boxes: NEMA OS1 and UL 514A.

B. Cast Metal Boxes: Threaded-hub type conforming to UL 514A and UL 514B. Galvanized steel conforming to UL 514A and UL 514B.

2.6 CABINETS AND ENCLOSURES

A. Hinged Cover Enclosures: NEMA 250, steel enclosure with continuous hinge cover and handle. Finish inside and out with manufacturer's standard enamel.

B. Cabinets: NEMA 250, type 1 code gauge galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Hinged doors for large enclosures (particularly panelboards) shall have a minimum of a double latch or 4 screws for ease of opening and closing doors. Include metal barriers to separate wiring of different systems and voltage, and include accessory feet where required for freestanding equipment. Cabinets shall be constructed with interior dimensions not less than those indicated on the drawings. Provide 5/8 inch plywood backboard unless otherwise indicated. Key latch to match panelboards. Provide two keys with each cabinet unless otherwise notified.

C. Safety: UL 50.

D. Control Enclosures: NEMA ICS-6.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive raceways, boxes, enclosures and cabinets for compliance with installation tolerances and other conditions affecting performance of the raceway system. Do not proceed with installation until unsatisfactory conditions have been corrected. Examine raceways prior to installation. No crushed or deformed raceways shall be installed.

3.2 WIRING METHODS

A. Outdoors: Use the following wiring methods:

1. Exposed: RMC.
2. Concealed: RMC.
3. Underground, Single Run: Concrete encased PVC conduit and fittings.
4. Underground, Grouped: Concrete encased PVC conduit and fittings.
5. Connection to Vibrating Equipment (including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment): LFMC.
6. Boxes and Enclosures: NEMA Type 4X.

B. Indoors: Use the following wiring methods:

1. Connection to Vibrating Equipment (including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment): LFMC.
2. Damp or Wet Locations: RMC.
3. Exposed: RMC or IMC. Rigid metal conduit shall be used in the electrical/mechanical room to a height of 8 feet above finished floor.
4. Concealed: EMT, IMC, RMC (EMT shall only be used for lighting, receptacles, communications, fire alarm, security and environmental wiring in concealed locations indoors).
5. Boxes and Enclosures: NEMA Type 1, except in damp or wet locations use NEMA Type 4X, stainless steel.
6. Conduit Use: Install RMC or IMC for all branch circuit panelboard feeders, distribution panel board feeders, transformer feeders, motor control center feeders and distribution switchboard feeders. Install EMT for communication, lighting and power branch circuits. USE RMC for all exposed conduit systems within electrical and mechanical equipment rooms and electrical closets from floor level to a height of 8 feet above finished floor. Conduit for communications, lighting and power branch circuits may be transitioned to EMT above 8 feet above finished floor.

3.3 INSTALLATION

A. Products shall be installed in accordance with FAA 1217f and FAA STD 019E. Install raceways, boxes, enclosures and cabinets as indicated, according to manufacturer's written instructions. Minimum size raceway shall be ¾ inch, unless otherwise noted. Conduit for telephone and signal systems shall be as follows:

1. ¾ inch conduit may be used for lengths not exceeding 100 feet.
2. 1 inch conduit shall be used for lengths exceeding 100 feet.
3. No run shall contain more than four 90 degree bends, or the equivalent.
4. Provide pull and junction boxes as required to meet the above criteria.

B. Conduit/Raceway Installation: Conceal conduit, including EMT, unless otherwise indicted, within finished walls, ceilings and floors. Raceways shall not be attached to the ceiling suspension system. Raceways shall not be attached to or supported by roof decks. Do not anchor or strap raceways to wall furring channels or to other raceways. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot water pipes. Do not install raceways

near uninsulated high temperature services without prior approval of the Contracting Officer's Technical Representative. Install horizontal raceway runs above water and steam piping.

1. Install raceways level and square and at proper elevations. Provide adequate headroom. Conduits and raceways shall run parallel or perpendicular to building structural members.
2. Install conduit to drain moisture to nearest outlet or pull box.
3. Inside radii of bends in conduits shall not be less than 6 times the nominal diameter.
4. No run shall contain more than four 90 degree bends, or the equivalent between conduit terminations.
5. Signal raceway 2 inches and smaller shall have no run of ¾ inch exceed 50 feet; or 100 feet for 1 inch or larger and a maximum of four 90 degree bends, or the equivalent. Install pull boxes or junction boxes where necessary to comply with these requirements.
6. Provide conduit bodies, pull and junction boxes required to meet the bends criteria.
7. Conduit bodies shall be used for all critical power circuits.
8. Install a pull wire in all empty tubing and conduit systems. Pull wire shall be No. 14 AWG zinc-coated steel or plastic with a minimum 200 pound tensile strength. Provide 10 inches of slack at each end of the pull wire.
9. Complete raceway installation before starting conductor installation. Raceways shall be fished and swabbed before conductors are pulled.

C. Support of Raceways: Support raceways and boxes as specified in Section 26 05 29, “Hangers and Supports for Electrical Systems.” Boxes for fixtures on suspended ceilings shall be supported independently of the ceiling supports. Boxes shall not be supported from sheet metal roof decks.

D. Raceway Protection: Use temporary closures to prevent foreign matter from entering raceway. Prevent the lodgment of plaster, dirt or trash in raceways, boxes, fittings, and equipment during construction. Clogged raceways shall be entirely freed of obstructions or shall be replaced. Clean each conduit run before pulling in conductors. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above finished slab.

E. Bends and Offsets: Make bends and offsets so the inside diameter is not reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel. IMC bends shall be fabricated with tooling specifically designed for bending IMC. Signal conduit that is 1-inch and larger shall have a minimum inside radii 12 times the nominal conduit diameter. No run shall contain more than four 90 degree bends or the equivalent. Provide pull and junction boxes required to meet the bends criteria. For critical power conduits, only conduit bodies are allowed.

F. Raceway Fittings: Use raceway fittings compatible with raceway and suitable for use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings, except as otherwise indicated.

G. Concealed Raceways: Run concealed raceways with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions, except as otherwise indicated.

H. Raceways Embedded in Slabs: Install in middle third of the slab thickness where practical and leave at least 1 inch concrete cover. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement. Space raceways laterally to prevent voids in the concrete.

Run conduit larger than 1 inch trade size parallel to or at right angles to main reinforcement. When at right angles to reinforcement, place conduit close to slab support.

I. Raceways in Damp, Concealed or Underground Locations: Raceways or sections of raceways which pass through to damp, concealed, or underground locations shall be of a type allowed for such locations by NFPA 70 and shall extend a minimum of 12 inches beyond the damp, concealed, or underground area.

J. Floor and Wall Penetrations: Penetrations through walls or floors shall be sealed to prevent moisture and rodent entry and to deter air transfer. Seal penetrations of walls, which separate individually temperature or humidity controlled areas to prevent air circulation. Type of sealants shall be as specified in Section 07 92 00, "Joint Sealants."

K. Installation at Structural Members: Install raceways parallel to or at right angles to nearby surfaces of structural members and follow the surface contours as much as practical. Run parallel or banked raceways together, on common supports where practical. Make bends in parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where they can be installed parallel; otherwise, provide field bends for parallel raceways.

L. Joining of Raceway Fittings: Join raceway fittings designed and approved for the purpose and make joints tight. Use bonding locknuts and bushings at connections subject to vibration. Use bonding jumpers where joints cannot be made tight. Use insulated bushings for all conduits to protect conductors. Provide expansion fittings for all raceways passing through the building expansion joints and for conduit runs longer than 300 feet.

M. Terminating: Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box and tighten the chase nipple so no threads are exposed.

N. Pull Wires: Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line having not less than 200 pound tensile strength. Leave not less than 12 inches of slack at each end of the pull wire.

O. Stub-Up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs and set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; flexible metal conduit may be used 6 inches above the floor. Where equipment connections are not made under this Contract, install screwdriver-operated threaded plugs flush with floor.

P. Flexible Connections: Use maximum of 6 feet of flexible conduit for recessed and semi-recessed lighting fixtures; for equipment subject to vibration, noise transmission or movement; and for all motors. Use liquidtight flexible conduit in wet or damp locations. Provide #6 AWG stranded insulated copper bonding jumper terminated on an approved grounding fitting at each end of the flex metal conduit.

Q. Under Raised Floor: Flexible, liquidtight conduit may be used for branch circuits in lengths longer than 6 feet in Computer Room locations which meet requirements of NFPA 70 Article 645. Fittings and junction boxes shall be liquidtight under raised floor.

R. Metal Conduits: Metal conduits shall be mechanically and electrically continuous between outlets, junction boxes and pull boxes, panels, cabinets and similar equipment. Conduits shall enter and be secured to enclosures so that each system is electrically continuous throughout.

S. Enclosures and Cabinets: Install hinged cover enclosures and cabinets plumb. Support at each corner.

T. Grounding Connections: Provide grounding connections for raceways, boxes, and components. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque tightening values. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL 486A. Provide ground bushings for all feeder conduits at switchgear, switchboards, panelboards, transformers, pull boxes and all other termination points. Where knockouts are used, provide double locknuts, one on each side with a grounding bushing or grounding locknut used on the inside (use grounding bushings on conduit 1-inch and larger).

U. Field-Cut Conduit: Where conduit has to be cut in the field, it shall be cut square. The cut ends of the field-cut conduit shall be reamed to remove burs and sharp edges.

V. Field-Threaded Conduit: Where threads have to be cut on conduit, the threads shall have the same effective length and shall have the same thread dimensions and taper as specified for factor-cut threads on conduit.

W. Boxes: Shall be provided in the wiring or raceway system for pulling wires, making connections and mounting devices or fixtures. Each box shall have the volume required by NFPA 70 for the number and size of conductors in the box. Label all junction/pull boxes with panelboard name and circuit number with permanent marker.

X. Outlet Boxes: Each outlet box shall have a machine screw which fits into a tapped hole in the box for the ground connection. Attach boxes to ceilings which are not suspended in at least two places. Distribute lighting fixture load over the ceiling boxes.

Y. Mounting Light Fixtures: Boxes for fixtures shall not be less than 4 inches square and shall be above ceiling or in structure. Provide flex conduit to light fixture from box. Conduit shall not pass through light fixture.

Z. Concealed Wiring: Boxes installed for concealed wiring shall be provided with extension rings or plaster covers. The front edge of the box shall be flush or recessed not more than 1/4-inch from the finished wall surface (whether the finished surface is drywall, or drywall and a sound absorbing material).

AA. Boxes in Masonry Block or Tile Walls: Shall be square-cornered title-type, or standard boxes shall have square-cornered tile-type covers.

BB. Wet Locations: Cast metal boxes installed in wet locations, in concrete and boxes installed flush with exterior surfaces shall be gasketed.

CC. Mounting: Install switch box on the strike side of the door at mounting height of 48 inches. Unless otherwise indicated, mounting height of receptacle boxes shall be 18 inches. Height of wall-mounted outlet box is defined as the height from finished floor to horizontal centerline of the cover plate. Where outlets are indicated adjacent to each other, mount outlets in a

symmetrical pattern with tops at the same elevation. Where outlets are indicated adjacent, but with different mounting heights, line up outlets on a vertical line. Verify the final location of each outlet before installation. Remove and relocate outlet boxes placed in an unacceptable position. At fire-rated partitions, offset boxes to prevent back-to-back installation.

DD. Box Openings: Provide only the openings necessary to accommodate the conduits at the individual location. When this is not practical, plug unused openings.

EE. Junction, Transition, and Pull Boxes: Install junction, transition, and pull boxes so that covers are not readily accessible. Boxes in concealed areas of ceiling or wall shall be accessible through removable panels. Locate pull boxes to permit easy pulling of wire or cables. Securely attach boxes to structural and framing members using compatible fasteners of adequate size. Bolt wall-mounted boxes to steel profiles fastened to the wall.

FF. Grounding: Provide each box with a green machine screw. Screw into tapped hole in the box for ground wire or lug connection.

GG. RMC or IMC Below Slab on Grade or Underground: The conduit shall conform to SSPC PS-10.01 or shall be field wrapped with 0.01 inch thick pipe wrapping plastic tape applied with 50 percent overlay.

HH. EMT Entering Enclosure Without Threaded Hubs: Provide a connector with threads and cast or machined locknut. The connector body and locknut shall be installed so that firm contact is made on each side of the enclosure.

3.4 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, to ensure that coatings, finishes, and cabinets are without damage or deterioration at substantial completion. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer. Repair damage to PVC or paint finishes with matching touch-up coating recommended by the manufacturer. Cap stubbed up raceways, including raceways in cabinets, immediately upon installation. The use of paper or rag wads is not acceptable.

B. Galvanic Corrosion Protection: Avoid dissimilar metals in contact anywhere in conduit runs. Where contact cannot be avoided at conduit terminations, treat the connection with joint compound that eliminates galvanic corrosion. Where dissimilar metals are in contact, such as at aluminum cable tray or enclosures and steel supports, separate contact surfaces by using gaskets, non absorptive tape or coating to prevent galvanic corrosion.

3.5 CLEANING

A. Upon completion of installation of system, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

END OF SECTION 26 05 33

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

1. This Section included identification of electrical materials, equipment, and installations. It includes requirements for electrical identification components, including but not limited to buried electrical line warnings; identification labeling for raceways, cables, and conductors; operational instruction signs; warning and caution signs; and equipment labels and signs.

1.2 REFERENCES

A. The publications listed below form a part of this Specification to the extent referenced. The publications listed below are referenced as the latest edition published as of the date of this document. The publications are referred to within the text by the basic designation only.

B. American National Standards Institute (ANSI)

1. ANSI A13.1 Scheme for the Identification of Piping Systems.

C. National Fire Protection Association (NFPA)

1. NFPA 70 National Electrical Code.2011

1.3 SUBMITTALS

A. The following shall be submitted in accordance with Section 01 33 00, “Submittal Procedures.”

B. Product Data: For each type of product specified.

C. Schedule of Identification Nomenclature: Provide a schedule of identification nomenclature to be used for identification signs and labels.

D. Labels and Signs: Samples for each color, lettering style and other graphic representation required for identification materials.

E. Operation and Maintenance Data: Prepare and distribute operations and maintenance data as specified in Section 01 78 23, “Operation and Maintenance Data.”

1.4 QUALITY ASSURANCE

A. Components and installation shall comply with NFPA 70. Comply with requirements of ANSI A13.1 with regard to type and size of lettering for raceway and cable labels.

1.5 SEQUENCING AND SCHEDULING

A. Coordinate installing electrical identification after completing of finishing where identification is applied to field-finished surfaces. Coordinate installing electrical identifying devices and markings prior to installing acoustical ceilings and similar finishes that conceal such items.

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials procured and installed in this Section, as well as identification and nameplates shall be in accordance with FAA 1217f.

2.2 RACEWAY AND CABLE LABELS

A. Manufacturer's Standard Products:

1. Where more than one type is listed for a specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.

B. Size: Conform to ANSI A13.1 for minimum size of letters for legend and minimum length of color field for each raceway or cable size.

1. Color: Black legend on orange field.
2. Legend: Indicates voltage and service.

C. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl. Legend is laminated with a clear, weather- and chemical-resistant coating.

D. Pre-tensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic bands sized to suit the diameter of the line it identifies and arranged to stay in place by pre-tensioned gripping action when placed in position.

E. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

F. Underground Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape not less than 6 inches wide by 4 mils thick, compounded for permanent direct-burial service, and embedded continuous metallic strip or core.

G. Printed Legend: Indicates type of underground line.

H. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

I. Plasticized Card Stock Tags: Vinyl cloth with preprinted and field-printed legends. Orange background, except as otherwise indicated, with eyelet for fastener.

J. Brass Tags: Metal tags with stamped legend, punched for fastener, 2 inches by 2 inches by 0.05-inch thick.

2.3 ENGRAVED NAMEPLATES AND SIGNS

A. Manufacturer's Standard Products: Where more than one type is listed for a specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and this Specification.

B. Engraving Stock: Melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 square inches or 8 inches in length; 1/8-inch thick for larger sizes:

1. Engraved Legend: White letters on black face.
2. Punched for mechanical fasteners.

C. Baked-Enamel Signs for Interior Use: Preprinted aluminum signs, punched for fasteners, with colors, legend and size as indicated or as otherwise required for the application. 1/4-inch grommets in corners for mounting.

D. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, non-fading, preprinted, cellulose acetate butyrate signs with 0.0396-inch galvanized steel backing, with colors, legend and size appropriate to the application. 1/4-inch grommets in corners for mounting.

E. Fasteners for Plastic-Laminated and Metal Signs: Self-tapping stainless steel screws or No. 10/32 stainless steel machine screws with nuts and flat and lock washers.

2.4 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking, type 6/6 nylon cable ties with 3/16-inch minimum width; 50 lb minimum tensile strength; minus 40 to plus 185 degree F temperature range; and color as indicated where used for color-coding.

B. Paint: Alkyd-urethane enamel over primer as recommended by enamel manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install identification devices according to manufacturer's written instructions. Install labels where indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

B. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations used in the contract documents or required by codes and standards. Use consistent designations throughout the project.

C. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

D. Self-Adhesive Identification Products: Clean surfaces of dust, loose material, and oily films before applying.

E. Painted Identification: Install painted identification as follows:

1. Clean surfaces of dust, loose material, and oily films before painting.
2. Prime surfaces. For galvanized metal use single-component, acrylic vehicle coating formulated for galvanized surfaces. For concrete masonry units use heavy-duty, acrylic-resin block filler. For concrete surfaces use clear, alkali-resistant, alkyd binder-type sealer.
3. Apply one intermediate and one finish coat of silicone alkyd enamel.
4. Apply primer and finish materials according to manufacturer's instructions.

F. Raceway Identification: Identify raceways with color banding and lettering appropriately sized for conduit. Band exposed and accessible raceways of the systems listed below for identification:

1. Bands: Pre-tensioned, snaparound, colored plastic sleeves; colored adhesive tape; or a combination of both. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of 2-color markings in contact, side-by-side.
2. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25 feet in congested areas.
3. Colors: As follows:

   a. Fire alarm system – red.
   b. Fire suppression supervisory and control system - red and yellow.
   c. Security system - blue and yellow banding only, no lettering.
   d. Mechanical and electrical supervisory direct digital control system - green and blue.
   e. Telecommunications system - green and yellow.

G. Circuit Box Identification Labels: Install circuit identification labels on boxes. Label externally as follows:

1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover, as well as "permanent magic marker" on inside cover.
2. Concealed Boxes: Plasticized card stock tags, as well as "permanent magic marker" on inside cover.
3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.
4. Underground Electrical Line Paths: During trench backfilling, for exterior underground power, control, signal and communications lines, install continuous underground warning tape located directly above line at 6 to 8 inches below finished grade. Where multiple lines installed in a common trench or concrete envelope, do not exceed an overall width of 16 inches, use a single line marker. Install warning tape for underground wiring, both direct buried and in raceway.
5. Color-Code Conductors: The following field-applied color-coding methods may be used in lieu of factory-coded wire listed in Section 26 05 19, “Low-Voltage Electrical Power Conductors and Cables”, for sizes larger than No. 4 AWG. Contractor shall demonstrate non-availability of factory-colored wire before using this application:

a. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply the last 2 turns of tape with no tension to prevent possible unwinding. Use 1-inch wide tape in colors as specified. Adjust tape bands to avoid obscuring cable identification markings.

b. Where conductors are color-coded by this method, they shall be color-coded in accessible raceways, panelboards, outlets, and switches, as well as at all terminations. Conductors in accessible raceways shall be color-coded so that by removing or opening any cover, the coding will be visible.

c. Phase, ground, and neutral conductors shall be color-coded in accordance with Section 26 05 19, "LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES."

d. Green insulated conductors shall not be re-identified for purposes other than grounding.

e. White or neutral gray conductors shall not be re-identified for purposes other than grounded neutrals.

H. Power Circuit Identification: Use metal tags for cables, power feeders in pull boxes, junction boxes, handholes, and switchboard rooms:

1. Legend: 1/4-inch steel letter and number stamping or embossing with legend corresponding to indicated circuit designations and conductor size.
2. Fasten tags with nylon cable ties; fasten bands using integral ears.

I. Conductor Identification: Apply identification to conductors as follows:

1. Conduits and Conductors to be extended in the Future: Indicate source and circuit numbers.
2. Multiple Power or Lighting Circuits in Same Enclosure: Identify each conductor with source, voltage, circuit number and phase. Use color-coding for voltage and phase indication of secondary circuit.
3. Multiple Control and Communication Circuits in Same Enclosure: Identify each conductor by its system and circuit designation at enclosure and terminations. Use a consistent system of tags, color-coding or cable marking tape.
4. Warning, Caution, and Instruction Signs: Install warning, caution, and instruction signs where indicated or required to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved, plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.
5. Equipment Identification: Apply equipment identification labels of engraved plastic laminate on each major unit of equipment, including central or master unit of each system. This includes communication, signal and alarm systems, unless units are specified with their own self-explanatory identification. Provide equipment, required under Division 16 with nameplate indicating equipment name, system voltage(s) and phase. Except as otherwise indicated, provide a single line of text with 1/2-inch high lettering on 1 1/2-inch high label; where 2 lines of text are required, use larger 2-inch high label. Use white lettering on black field. Apply labels for each unit of the following categories of equipment.

a. Panelboards, electrical cabinets and enclosures.
b. Access doors and panels for concealed electrical items.
c. Electrical switchboards.
d. Motor starters.
e. Push-button stations.
f. Power transfer equipment.
g. Contactors.
h. Remote-controlled switches.
i. Dimmers.
j. Control devices.
k. Transformers.
l. Telephone switching equipment.
m. Fire alarm master station or control panel.
n. Security monitoring master station or control panel.

J. Conduit Labeling: Label conduit at each end and at pull boxes with characters a minimum 1/4-inch high.

K. Other Components Labeling: Apply identification labels of engraved plastic laminate for disconnect switches, breakers, push buttons, pilot lights, and similar items for power distribution control components above, except panelboards, and alarm/signal components where labeling is specified elsewhere. For panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker. Install labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

END OF SECTION 26 05 53

SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

This Section includes individually mounted switches and circuit breakers used for feeder and equipment disconnect switches; feeder overcurrent protection; motor disconnect switches; and enclosed circuit breakers.

1.2 REFERENCES

The publications listed below form a part of this Specification to the extent referenced. The publications listed below are referenced as the latest edition published as of the date of this document. The publications are referred to within the text by the basic designation only.

1. Federal Standards (FS)

   a. FS WC-375 — Circuit Breakers, Molded Case, Branch Circuit and Service

2. International Electrical Testing Association (NETA)

   a. NETA ATS — Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems

3. National Electrical Manufacturers Association (NEMA)

   a. NEMA AB1 — Molded Case Circuit Breakers and Molded Case Switches
   b. NEMA KS1 — Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)

4. National Fire Protection Association (NFPA)

   a. NFPA 70 — National Electrical Code

5. Occupational Safety and Health Administration (OSHA)

   a. 29 CFR 1910.7 — Definitions and Requirements for a Nationally Recognized Testing Laboratory (NRTL)

6. Underwriters Laboratories (UL)

   a. UL 486A — Wire Connectors and Soldering Lugs for Use with Copper Conductors

1.3 SUBMITTALS

The following shall be submitted in accordance with 01 33 00 SUBMITTAL PROCEDURES:

A. Product Data

1. Switches
2. Circuit Breakers
3. Other specified accessories
4. Include descriptive data, time-current curves, and let-through current curves for circuit breakers with current-limiting characteristics. Coordinate charts, tables, and related data.

B. Test Reports

1. Field Testing
2. Field test reports indicating and interpreting test results.

C. Certificates

Provide qualification data for firms and persons specified in the "Quality Assurance" article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

D. Operations and Maintenance Data

Prepare and distribute operations and maintenance data as specified in Section 01 78 23, “Operation and Maintenance Data.”

1.4 QUALITY ASSURANCE

A. Comply with NFPA 70 for components and installation.

B. Testing Agency Qualifications: Independent testing agency shall meet 29 CFR 1910.7 criteria for accreditation of testing laboratories, or shall be a full-member company of the International Electrical Testing Association (NETA).

C. Testing Agency's Field Supervisor: Person currently certified by NETA or the National Institute for Certification in Engineering Technologies, to supervise on-site testing specified in PART 3.

D. Source Limitations: Obtain disconnect switches and circuit breakers from one source and by a single manufacturer.

E. Listed and Labeled: Provide disconnect switches and circuit breakers specified in this Section that are listed and labeled. The terms "Listed" and "Labeled" are defined in NFPA 70, Article 100.

F. Listing and Labeling Agency Qualifications: A NRTL as defined in 29 CFR 1910.7.

G. Single Source Responsibility: All enclosed switches and circuit breakers shall be product of a single manufacturer and shall be coordinated with Section 26 00 01, "General Provisions for Government-Furnished Equipment (GFE)."

H. Available Fault Current: All provided gear from this Section shall be suitable for the available fault current in the area of use.

PART 2 PRODUCTS

2.1 MANUFACTURERS

Subject to compliance with requirements, provide disconnect switches and breakers by Square D Co.

2.2 DISCONNECT SWITCHES

A. Switches shall be heavy duty and of the voltage and current ratings indicated on the drawings, and each shall be capable of interrupting the locked rotor current of the motor for which it is to be used. The locked rotor current will be assumed to be 10 times the full rated load current. Switches shall be the quick-make, quick-break type. Except for ground lugs which shall be bonded to the housing, parts shall be mounted on insulating bases to permit replacement of any part from the front of the switch. All current carrying parts shall be of high conductivity copper unless otherwise specified, and shall be designed to carry rated current without excessive heating. Switch contacts shall be silver or tungsten plated to minimize corrosion, pitting and oxidation and to assure suitable conductivity.

B. Enclosed, Non-Fusible Switch: NEMA KS1, type HD, lockable handle, with 2 padlocks.

C. Enclosed, Fusible Switch, Below 800 Amperes: NEMA KS1, type HD, clips to accommodate specified fuses, enclosure consistent with environment where located, handle lockable with 2 padlocks, and interlocked with cover in CLOSED position. Provide rejection type fuse clips with switches.

D. Spare Fuses: Provide 2 sets of spare fuses for each fusible device.

E. Enclosures: NEMA KS1, type 1, unless otherwise specified or required to meet environmental conditions of installed location.

1. Outdoor Locations: Type 4X, stainless steel.
2. Other Wet or Damp Indoor Locations: Type 4X, stainless steel.

F. Auxiliary Contact for Variable Frequency Drive Equipment: One normally open, one normally closed (where applicable).

2.3 ENCLOSED CIRCUIT BREAKERS

A. Enclosed, Molded-Case Circuit Breaker: NEMA AB1, lockable handle, with 2 padlocks complying with FS WC-375.

B. Characteristics: Interrupting rating, frame size, trip rating, number of poles, and auxiliary devices as indicated. Circuit breakers shall have a quick-make and quick-break toggle

mechanism, inverse-time trip characteristics and shall be trip-free on overload or short-circuit. Automatic release shall be secured by bi-metallic thermal element releasing the mechanism latch. A magnetic armature shall be provided to trip the breaker instantaneously for short-circuit currents above the overload range. Automatic tripping shall be indicated by a handle position between the manual OFF and ON positions.

C. Interchangeable Trips: Circuit breakers 200 amperes and larger, with trip units interchangeable within frame size.

D. Field-Adjustable Trips: Circuit breakers 400 amperes and larger, with adjustable short-time and continuous-current settings.

E. Molded-Case Switch: Where indicated, molded-case circuit breaker without trip units.

F. Lugs: Mechanical lugs and power-distribution connectors shall be provided for number, size, and material of conductors indicated.

G. Shunt Trip: Where indicated. 120 volts, 60 Hz.

H. Accessories: As indicated.

I. Enclosure: NEMA AB1, Type 1, unless otherwise specified or required to meet environmental conditions of installed location.

1. Outdoor Locations: Type 4X.
2. Other Wet or Damp Indoor Locations: Type 4.

J. Motor Disconnect: Provide each motor with a disconnecting means and a manually operated switch as shown on the drawings or when required by NFPA 70.

K. Single Phase Motors: Provide a single-pole or double-pole toggle switch, rated only for AC, for motor capacities less than 30 amperes, providing that the ampere rating of the switch is at least 125 percent of the motor rating. Switches shall disconnect all ungrounded conductors.

PART 3 EXECUTION

3.1 INSTALLATION

Install disconnect switches and circuit breakers in locations as indicated, according to manufacturer's written instructions. Install disconnect switches and circuit breakers level and plumb. Install wiring between disconnect switches, circuit breakers, control and indication devices. Connect disconnect switches, circuit breakers, and components to wiring system and to ground as indicated and instructed by manufacturer. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A. Identify each disconnect switch and circuit breaker according to requirements specified in Section 26 05 53, “Identification for Electrical Systems.”

3.2 FIELD QUALITY CONTROL

A. Testing: After installing disconnect switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

B. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS for disconnect switches and molded-case circuit breakers. Certify compliance with test parameters. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

3.3 ADJUSTING

Set field-adjustable circuit-breaker trip ranges as indicated.

3.4 CLEANING

After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, and abrasions.

END OF SECTION 26 28 16

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SECTION 26 29 13 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 REFERENCES

A. The publications listed below form a part of this Specification to the extent referenced. The publications listed below are referenced as the latest edition published as of the date of this document. The publications are referred to within the text by the basic designation only.

1. ASTM International (ASTM)

   a. ASTM E 699 — Practice for Criteria for Evaluation of Agencies Involved in Testing Quality Assurance, and Evaluating Building Components in Accordance with Test Methods Promulgated by ASTM Committee

2. International Electrical Testing Association (NETA)

   a. NETA ATS — Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems

3. National Electrical Manufacturers Association (NEMA)

   a. NEMA 250 — Enclosures for Electrical Equipment (1000 Volts Maximum)
   b. NEMA ICS 2 — Standard for Industrial Control Devices, Controllers and Assemblies

4. National Fire Protection Association (NFPA)

   a. NFPA 70 — National Electrical Code

5. Occupational Safety and Health Administration (OSHA)

   a. 29 CFR 1910.7 — Definitions and Requirements for a Nationally Recognized Testing Laboratory (NRTL)

6. Underwriters Laboratories (UL)

   a. UL 486A — Wire Connectors and Soldering Lugs for Use with Copper Conductors
   b. UL 508 — Industrial Control Equipment

1.2 SUMMARY

A. This Section includes AC motor control devices rated 600 V and below that are supplied as an integral part of motor/controller packages.

1.3 DEFINITIONS

A. Motor Controller: A device that controls, protects, and energizes an electric motor, and where required, controls its speed or the torque or power delivered by it.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00, “Submittal Procedures.”

A. Product Data

1. Specified Products
2. Include dimensions, ratings, and data on features and components.
3. Load-Current and Overload-Relay Heater List
4. Compile after motors have been installed and arrange to demonstrate that selection of heaters suit actual motor nameplate full-load currents.

B. Test Reports

1. Field Testing
2. Indicate and interpret test results for compliance with performance requirements.

C. Certificates

1. Qualification Data for Field Testing Agency
2. Certificates, signed by Contractor, certifying that agency complies with requirements specified in "Quality Assurance".

D. Operation and Maintenance Data

1. Prepare and distribute operations and maintenance data as specified in Section 01 78 23, “Operation and Maintenance Data.”

1.5 QUALITY ASSURANCE

A. Comply with NEMA ICS 2 and UL 508.

B. Manufacturer Qualifications: Provide controllers from a manufacturer regularly engaged in the manufacture of equipment of the types and capacities indicated, with such products in satisfactory use in similar service for not less than 5 years. Manufacturer must also maintain, within 100 miles of the project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

C. Field Testing Agency Qualifications: An independent testing agency with experience and capability to satisfactorily conduct testing indicated without delaying the work. Evaluation criteria shall be according to ASTM E 699.

D. Components and Installation: NFPA 70.

E. Listed and Labeled: Provide products specified in this Section that are listed and labeled. The terms "listed" and "labeled" shall be defined as they are in NFPA 70, Article 100.

F. Listing and Labeling Agency Qualifications: A NRTL as defined in 29 CFR 1910.7.

G. Single-Source Responsibility: Obtain similar motor-control devices from a single manufacturer.

H. Available Fault Current: All provided gear from this Section shall be suitable for the available fault current in the area of use.

1.6 COORDINATION

A. Coordinate features of controllers and control devices with pilot devices and control circuits provided in Section, “Instrumentation and Controls for HVAC.”

1.7 EXTRA MATERIALS

A. Spare Fuses and Pilot Light Indicating Lamps: Furnish 1 spare for every 5 installed units, but not less than 1 set of 3 of each kind.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable manufacturer is Square D Company. No substitution is allowed.

2.2 MOTOR CONTROLLERS, GENERAL

A. Coordinate the features of each motor controller with the ratings and characteristics of the supply circuit, the motor, the required control sequence, the duty cycle of the motor, drive, and load, and the pilot device, and control circuit affecting controller functions. Provide controllers that are horsepower rated to suit the motor controlled and are of the manual reset type. Contacts shall open each ungrounded connection to the motor.

B. Overload Relays: Motors 1/8-horsepower or larger shall have overload protection in each phase, or other equally rated method in accordance with NFPA 70. Provide ambient-compensated type with inverse time-current characteristic. Provide with heaters or sensors matched to nameplate full-load current of the specific motor to which connected, with appropriate adjustment for duty cycle. Provide with reset button in an accessible location.

C. Enclosures: For individually mounted motor controllers and control devices, comply with NEMA 250. Provide enclosures suitable for the environmental conditions at the controller location. Provide NEMA Type 1 enclosures except as otherwise indicated.

2.4 MAGNETIC MOTOR CONTROLLERS

A. Provide full-voltage, non-reversing, across-the-line, magnetic controller, horsepower rated, tested and labeled at NEMA size indicated on the drawings, with field replaceable main contacts, external manual resets, ambient compensated melting-alloy overload protection in all phases, low voltage release, and the following accessories.

1. Auxiliary contacts: 4 normally open and 4 normally closed.
2. Pilot lights.
3. Start-stop pushbutton.
4. Three position "Hand-Off-Automatic" switch.

B. Reversal and Phase Loss Protection: Each 3-phase magnetic motor controller shall be provided with reversal and phase loss protection. Protective device shall cause controller to open upon loss of any one phase or reversal of phase.

C. Control Circuit: Provide control power transformer with 120 volt AC secondary holding coil with fused primary and secondary integral with controller where no other supply of 120 V control power to controller is indicated. Provide control power transformer with adequate capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.

D. Combination Controller: Provide motor circuit protector type with magnetic-only trip element calibrated to coordinate with the actual locked-rotor current of the connected motor and the controller overload relays. Provide breakers that are factory assembled with the controller, interlocked with unit cover or door, and arranged to disconnect the controller. Provide motor-circuit protectors with field-adjustable trip elements.

E. Enhanced-Protection Overload Relay: Provide overload relays with NEMA class 10 tripping characteristics where indicated. Select to protect motor against voltage unbalance and single phasing.

2.5 AUXILIARY CONTROL DEVICES

A. Devices shall be factory installed in controller enclosure, except as otherwise indicated. Where separately mounted, provide NEMA 1 enclosure, except as otherwise indicated.

B. Push-Button Stations, Pilot Lights, and Selector Switches: Heavy-duty type.

C. Stop and Lockout Push-Button Station: Momentary-break push-button station with a factory-applied hasp arranged so that a padlock can be used to lock the push-button in the depressed position with the control circuit open.

D. Control Relays: Auxiliary and adjustable time-delay relays.

E. Elapsed Time Meters: Heavy duty with digital readout in hours.

F. Current Sensors: Rated to suit application.

G. Phase-Failure and Undervoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection. Provide adjustable undervoltage setting.

H. Current-Sensing, Phase-Failure Relay: Provide solid-state sensing circuit with isolated contacts for hard-wired connection, arranged to operate on phase failure, phase reversal, current unbalance from 30 to 40 percent, or loss of supply voltage. Provide adjustable response delay.

PART 3 EXECUTION

3.1 GENERAL

A. Comply with manufacturer's requirements in accordance with the direction of the Contracting Officer's Technical Representative.

3.2 APPLICATIONS

A. Select features of each motor controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, drive, and load; and configuration of pilot device and control circuit affecting controller functions. Select horsepower rating of controllers to suit motor controlled. Use fractional-horsepower manual controllers for single-phase motors, unless otherwise indicated.

B. Push-Button Stations: In covers of magnetic controllers for manually started motors where indicated, start contact connected in parallel with sealing auxiliary contact for low-voltage protection.

C. Hand-Off-Automatic Selector Switches: In covers of manual and magnetic controllers of motors started and stopped by automatic controls or interlocks with other equipment.

3.3 INSTALLATION

A. Install independently mounted motor control devices according to manufacturer's written instructions.

B. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components, including the pre-testing and adjustment of solid-state controllers. Locate controllers within sight of motors controlled, unless otherwise indicated. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks conforming to Section 26 05 29, “Hangers and Support for Electrical Systems.”

3.4 IDENTIFICATION

A. Identify motor-control components and control wiring according to Section 26 05 53, “Identification for Electrical Systems.”

3.5 CONTROL WIRING INSTALLATION

A. Install wiring between motor control devices according to Section 26 05 19, “Low-Voltage Electrical Power Conductors and Cables.” Bundle, train, and support wiring in enclosures.

Connect hand-off-automatic switch and other automatic control devices where available. Connect selector switches to bypass only the manual and automatic control devices that have no safety functions when switch is in the hand position. Connect selector switches with motor-control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.6 CONNECTIONS

A. Tighten connectors, terminals, bus joints, and mountings. Tighten field-connected connectors and terminals, including screws and bolts, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Provide services of a qualified independent testing agency to perform specified testing.

B. Testing: After installing motor controllers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

C. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters. Use instruments bearing records of calibration within 3 months of testing. Provide 2 weeks advance notice to the Contracting Officer's Technical Representative prior to testing and schedule test at least 1 week in advance of the test commencement. Remove and replace malfunctioning units with new units, and retest.

3.8 CLEANING

A. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean devices internally, using methods and materials recommended by manufacturer.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to demonstrate solid-state and variable-speed controllers and train Government's maintenance personnel. Conduct a minimum of 4 hours of training in operation, maintenance, and related equipment. Schedule training with the Contracting Officer's Technical Representative at least 7 days in advance.

END OF SECTION 26 29 13

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APPENDIX 1. FAA PRE-CONSTRUCTION AND MAINTENANCE PROJECT SAFETY AND HEALTH CHECKLIST

Purpose

This checklist is intended to be used as a tool by RE/COTRs, designated facility POCs, or SSC managers who oversee construction and maintenance activities that potentially have Occupational Safety, Health, and Environmental (OSH/E) related impacts on AT/AF operations. This tool shall be used, as appropriate, during critical phases of construction and maintenance activities (e.g. the pre-construction meeting, 30-60 days prior to commencement of work, weekly/daily construction meetings, etc.). Emphasis should be placed on using this checklist as a tool to assess as well as reassess hazards as the project progresses. Specifically, this checklist is intended to:

- Promote sensitivity to potential OSH/E hazards associated with projects and stress the importance of not disrupting NAS operations
- Assist in identifying and validating potential project hazards and associated risks
- Assist in preventing safety and health incidents/accidents and facility shutdowns
- Ensure appropriate contractor measures and controls are in place to address potential project hazards
- Facilitate discussion with the contractor regarding plans to prevent/minimize potential incidents/accidents
- Enhance coordination between OSH/E professionals, project personnel and contractors
- Facilitate review of critical FAA OSH/E procedures with contractors
- Raise OSH/E awareness

- This checklist relies on the training and professional judgment of the user. OSH/E personnel should be consulted as needed.
- A facility POC with a thorough understanding of facility procedures and equipment considerations should participate in the site walk-through.

NOTE: For small procurements (e.g. credit card purchases) and internal FAA projects (e.g. field maintenance party projects), without specifications, immediately contact the designated OSH/E professional for assistance in completing this checklist.

1 Project Summary Information

Fill in the requested site specific information.

Project Name and Description: _____

_____

_____

_____

Project/Activity/Task: _____

Planned Start: _____

Expected Completion Date: _____

Contractor Contact: Name: _____ Phone: _____

OSH/E Contact: Name: _____ Phone: _____

Facility POC: Name: _____ Phone: _____

2 Facility Procedures

Review site specific FAA procedures and considerations with the contractor. For example, discuss when or how during the project, emergency plans will be used/required. After the procedures have been reviewed, perform a site walk-through with the contractor.

Facility Procedures	Reviewed? Yes	N/A	No	Notes
Asbestos Contingency Plan				
Critical Power Systems Awareness				
Lock Out/Tag Out				
Work Permits (e.g. Asbestos, Lead)				
Emergency Plans (e.g. Occupant Emergency Plan)				
Impacts to Fire Alarm and Suppression Systems				
Site Walk-Through (With Facility POC & Contractor(s))				
Hazard Communications (e.g. MSDSs)				
Other (e.g. Access/Security/Communications Equip.)				

3 Project Hazard/Risk Analysis

Think about your project and its potential hazards and risks. Consider sensitive NAS operations and all facility personnel that may be impacted by your projects. As an example: Construction activities with potential for impacting asbestos materials in or near sensitive operations could result in incidents which disrupt NAS operations. Fo each potential project hazard indicate (with a checkmark) a level of potential risk for exposure/release/incident.

Potential Project Hazards	Level of Potential Risk For Exposure/Release/Incident* High	Low	N/A	Notes
Consider Sensitive AT/AF Operations:				
Hazardous Substances and Environmental Controls				
Asbestos (e.g. Tiles & Insulation)				
Chemical, Gas, Fumes, Dust, Radiation				
Indoor Air				
Ventilation System				
Lead-based Paint				
Electrical Power Systems				
Pressurized Equipment and Systems				
Work at Heights (>6 feet)				
Other (e.g. Confined Space)				

* Consult with your SECM or designated OSH/E professional for additional guidance and assistance.

4 Site Safety and Health

After reviewing the potential hazards and risks in block 3, ensure that the contractor has identified measures and controls to address applicable site safety and health risks (e.g. through discussions, available site safety plans, or other applicable documents). In your judgment, if the contractor has appropriate measures to address the potential project hazards (see block 3), check the appropriate YES boxes below. If a potential project hazard has been identified in block 3 and no associated measures or controls are evident, then check the appropriate NO boxes below. If a NO box is checked, use the close-out date box to indicate when appropriate measures or controls have been incorporated into the contractor's site safety and health approach.

Program Elements	YES	N/A	NO*	If No, Indicate Close-out Date	Notes
Hazardous Substances & Environmental Controls					
Asbestos					
Chemicals (e.g. Introduced to site)(Provide MSDS)					
Gas					
Fumes					
Lead Paint/Other Coatings					
Radiation and Electric Fields					
Ventilation and Exhaust Systems					
Electrical Power Systems					
Procedures for Critical Power Systems Coordination					
Provisions for GFCI					
Control of Hazardous Energy (Lockout/Tagout) (e.g. Electrical, Mechanical, Hydraulic, Thermal, Radiation)					
Pressurized Equipment and Systems					
Work at Heights (>6 feet)					
Safe Access and Fall Protection					
Work Platforms					
Floor and Wall Holes and Openings					
Personal Protective and Safety Equipment					
Fire Prevention					
Accident Prevention					
Excavations (New Construction or Tie in)					
Welding and Cutting					
Demolition of Existing Facility in Whole or Part					
Medical and First Aid Requirements					
Hand and Power Tools					
Material Handling, Storage, and Disposal					
Rigging					
Machinery and Mechanized Equipment (e.g. Equipment & Operator Certifications)					
Sanitation					
Lighting					
Concrete & Masonry Construction & Steel Erection					
Hazardous, Toxic, Radioactive Waste Activities					
Other (e.g. Noise)					

5 Review Information

The appropriate FAA point of contact and the contractor shall sign below to document discussion of the items on this form.

Reviewed By:	Date
FAA POC: _____	
Contractor: _____	

Incident Prevention and Hazard Control Methods Discussed? Yes ☐ No ☐

This block indicates routing of this checklist for project coordination.

This form has been forwarded to:	Name	Date
SECM, OSH/E Contact:		
AF Facility Manager:		
AT Facility Manager:		
Other:		

Notes (e.g. Provide further explanation of potential hazards, locations, etc. below and attach additional sheets if necessary.)

* Consult with your SECM or designated OSH/E professional for additional guidance and assistance.

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FAA-C-1217f
February 26, 1996
SUPERSEDING
FAA-C-1217e,

US DEPARTMENT
01/25/91
OF TRANSPORTATION
Federal Aviation
Administration

U. S. Department of Transportation
Federal Aviation Administration
Specification

ELECTRICAL WORK, INTERIOR

FORWARD

This document has been revised to reflect current technology changes and to incorporate the latest commercial standards.

l. SCOPE

1.1 Scope.- This specification covers the ***minimum requirements*** for electrical work at FAA facilities. Where the phrase "unless otherwise indicated" or similar wording appears, it refers exclusively to other documents that are specific parts of the contract. Where there are requirements peculiar to specific FAA facility types, e.g., air route traffic control centers (ARTCCs), metroplex control facilities (MCFs), terminal radar control (TRACONs), etc., these requirements will be added following the appropriate paragraph.

2. APPLICABLE DOCUMENTS.- The current issues of the following documents in effect on the date of the invitation-for-bids or request-for-proposals form a part of this specification, and are applicable to the extent specified herein.

2.1 Federal specifications

J-C-30	Cable and Wire, Electrical (Power, Fixed Installation)
W-C-375	Circuit Breakers, Molded Case; Branch Circuit and Service
W-F-414	Fixture, Lighting (Fluorescent, Alternating Current, Pedant Mounting)
W-L-305	Light Set, General Illumination (Emergency or Auxiliary)
W-P-115	Panel, Power Distribution
WW-C-566	Conduit, Metal, Flexible
QQ-W-343	Wire, Electrical, (uninsulated)

(To obtain copies of federal specifications, contact General Services Administration offices in Washington DC, Atlanta, Boston, Chicago, Dallas, Denver, Kansas City MO, Los Angeles, New York, San Francisco, or Seattle.)

2.2 Steel Structures Painting Council standards

SSPC-PS 10.01 Hot-Applied Coal Tar Enamel Painting System

(Single copies of SSPC Standards can be obtained from the Steel Structures Painting Council, 4400 Fifth Avenue, Pittsburgh, Pa 15213, 412/578-3327)

2.3 Federal Aviation Administration specification/standards/orders

FAA specification:

FAA-C-1391 Installation and Splicing of Underground Cables

FAA standards:

FAA-STD-019 Lightning Protection, Grounding, Bonding and Shielding Requirements for Facilities

FAA-STD-020 Transient Protection, Grounding, Bonding and Shielding Requirements for Electronic Equipment

FAA orders:

3900.49 Control of Hazardous Energy During Maintenance, Servicing and Repair

6950.19 Practices and Procedures for Lightning Protection, Grounding, Bonding and Shielding Implementation

6950.20 Fundamental Consideration of Lightning, Protection, Grounding, Bonding and Shielding

6950.22 Maintenance of Electrical Power and Control Cables

6950.27 Short Circuit Analysis and Protective Device Coordination Study

(Copies of FAA specifications may be obtained from the Contracting Officer in the office issuing the invitation-for-bids or request-for-proposals. Requests should fully identify material desired, i.e., specifications, standard, amendment, and drawing numbers and dates. Requests should cite the invitation-for-bids, request-for-proposals, or the contract involved or other use to be made of the requested material.)

2.4 National Fire Protection Association (NFPA) publications

NFPA 70 National Electrical Code (NEC)

(Requests for copies of NFPA publications should be addressed to the National Fire Protection Association, Batterymarch Park, Quincy MA 02269.)

2.5 National Electrical Manufacturers Association (NEMA) standards

OS-1 Sheet Steel Outlet Boxes, Device Boxes, covers and Box Supports

MG-1 Standard for Motors and Generators

ST 20 Dry Type Transformers for General Applications

VE 1 Cable Tray Systems

WC 5 Thermoplastic Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

WD 1 General Requirements for Wiring Devices

(For copies of NEMA standards, contact the National Electrical Manufacturers Association, 2101 L Street N.W. Washington DC 20057, 202/457-8400.)

2.6 Underwriters' Laboratories (UL) Inc. standards

UL 5 Surface Metal Raceways and Fittings

UL 6 Rigid Metal Conduit

UL 50 Enclosures for Electrical Equipment

UL 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors

UL 486C Splicing Wire Connectors

UL 486E Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors

UL 514A Metallic Outlet Boxes

UL 514B Fittings for Conduit and Outlet Boxes

UL 542 Lampholders, Starters, and Starter Holders for Fluorescent Lamps

UL 651 Schedule 40 and 80 Rigid PVC

UL 797 Electrical Metallic Tubing

UL 870 Wireways, Auxiliary Gutters and Associated Fittings

UL 935 Fluorescent-Lamp Ballasts

UL 1242 Intermediate Metal Conduit

(For copies of UL standards, contact Underwriters' Laboratories Inc., Publication Department, 333 Pfingsten Rd., Northbrook IL 60062.)

2.7 Institute of Electrical and Electronics Engineers (IEEE) Inc. standards

STD C57.12.80 Standard Terminology for Power Distribution Transformers

STD 141 Recommended Practice for Electric Power Distribution for Industrial Plants

STD 519 Recommended Practices and Requirements for Harmonic Control and Electrical Power Systems

STD 1100 Recommended Practice for Powering and Grounding Sensitive Electronic Equipment

For copies of this standard, contact the IEEE Inc., Service Department, 445 Hoes Lane, PO Box 1331, Piscataway NJ 08855-1331.)

2.8 Other documents

2.8.1 Local utility companies.- The rules and regulations of the local utility companies providing service.

2.8.2 Local governing bodies.- The rules, regulations, and codes of local governing bodies.

3. MATERIALS

3.1 General.- The contractor shall furnish all materials not specifically identified as Government Furnished Materials in the invitation-for-bids or contract. Materials and equipment shall comply with all requirements of the contract documents. Materials furnished by the contractor shall be new, the standard

products of manufacturers regularly engaged in the production of such materials, and of the manufacturer's latest designs that comply with the specification requirements. If materials and equipment requirements conflict, the order of precedence for selection shall be as follows: special contract provision, the contract drawings, this specification, and then continuing order of precedence, referenced FAA documents, Military documents, Federal specifications, NFPA publications, IEEE standards; UL standards and NEMA standards. Wherever standards have been established by Underwriters' Laboratories, Inc., the material shall bear the UL label.

4. INSTALLATION

NOTE: Unscheduled interruptions of the electrical service to FAA facilities may cause aircraft accidents and loss of life. Work requiring a temporary or permanent deenergization of equipment shall be scheduled in writing with the onsite FAA maintenance personnel. Only onsite FAA maintenance personnel are authorized to energize, deenergize equipment or to operate a circuit breaker, switch, or fuse in an FAA facility. Work procedures shall include lock-out/tag-out procedures in accordance with FAA Order 3900.49.

4.1 General.- The rules, regulations and reference specifications enumerated herein shall be considered as minimum requirements. FAA requirements often exceed those of other standards organizations such as the NEC. Adherence to other standards shall not relieve the contractor from furnishing and installing higher grades of materials and workmanship when so required by this specification. Adherence to this specification shall not relieve the contractor from furnishing and installing higher grades of materials and workmanship when so required by the contract drawings or special contract provisions. This specification shall govern when conflicts occur between it and the documents referenced in paragraph 2, Applicable documents, and in the order of precedence established in paragraph 3, Materials.

4.1.1 Short circuit analysis and protective device coordination (SCA/PDC). - The distribution system and all component parts, when installed or as modified, shall be in accordance with IEEE Standard 519, Recommended Practices and Requirements for Harmonic Control and

Electrical Systems, and shall include a short circuit analysis and protective device coordination study in accordance with FAA Order 6950.27.

4.2 Workmanship.- All materials and equipment shall be installed in accordance with the contract drawings. When manufacturers recommended installation methods conflict with contract requirements, differences shall be resolved by the Contracting Officer. The installation shall be accomplished by qualified workers regularly engaged in this type of work. Where required by local regulations, the workers shall be properly licensed.

4.3 Contract drawings.- Where the electrical drawings indicate (by diagram or otherwise) the work intended and the functions to be performed, even though some details are not shown, the contractor shall furnish all equipment, material (other than the Government-furnished items, see paragraph 3.1) and labor to complete the installation work and to accomplish all the indicated functions of the electrical installation. Further, the contractor shall be responsible for taking the necessary actions to ensure that all electrical work is coordinated and compatible with architectural, mechanical, and structural plans, and the layout of any special electronic equipment.

4.3.1 Minor departures.- Minor departures from exact dimensions shown on the electrical plans may be permitted when required to avoid conflict or unnecessary difficulty in placement of a dimensioned item, provided all contract requirements are met. The contractor shall promptly obtain approval from the Contracting Officer prior to undertaking any such departure and shall provide appropriate documentation of the departure.

4.4 Grounding

4.4.1 General.- FAA grounding requirements often exceed those of the NEC. Grounding systems shall be as indicated on the contract drawings and as specified herein. Reference IEEE Standard 1100-1992, Recommended Practice for Powering and Grounding Sensitive Electronic Equipment, when installing all NAS equipment. In no case, however, shall the NEC be violated.

4.4.2 Grounding electrode conductor.- The grounding electrode conduct shall be bare or insulated copper and shall be sized as shown in the contract documents. When not indicated in the contract documents, the conductor shall be copper and sized in accordance with Table 250-94, "Grounding Electrode Conductor for AC Systems", of the NEC, except that the conductor shall not be smaller than No. 6 AWG. Where the grounding electrode conductor is routed through a metal raceway, the raceway shall be electrically continuous and bonded to the conductor at each end. The grounding electrode conductor shall be bonded to the earth electrode system with an exothermic welded joint. For a separately derived system such as an isolation transformer, the grounding electrode conductor shall be connected in accordance with the NEC. This conductor shall be permitted to terminate by exothermic welding to an equipment room's perimeter ground cable under a raised floor.

4.4.3 — Earth electrode system.- The earth electrode system shall be installed as shown in the contract documents. Unless otherwise indicated in these documents, the earth electrode system shall consist of a minimum of four (4) ground rods located at the corners of a structure. Rods shall be spaced apart a distance equal to or greater than the length of the rods. Ground rods shall be 3/4 inch by 10 feet, copper or copper-clad steel. Sectionalized type or exothermic butt welded rods shall be used when deeper earth penetration is required. Rods shall be interconnected by a bare copper cable forming a closed loop around a structure. The cable shall be a minimum No. 4/0 AWG and shall be buried at least 2 feet below grade. The top of the vertically-driven ground rods shall be a minimum of 12 inches below grade. All underground metal pipes (excluding gas piping systems), tanks, and the telephone ground, if present, shall be connected to the earth electrode system by a copper cable no smaller than No. 2 AWG. All underground connections shall be made by exothermic welding process unless otherwise indicated.

4.4.4 Earth electrode system resistance.- The resistance of the earth electrode system shall not exceed 10 ohms, as tested per paragraph 5.3.6, unless otherwise indicated. If the measured resistance exceeds 10 ohms,

the Contracting Officer shall be notified immediately for further guidance.

4.4.5 Equipment grounding conductor

4.4.5.1 General.- All metallic non-current carrying parts of electrical equipment shall be grounded with equipment grounding conductors whether or not shown on the drawings. Equipment grounding conductors shall always be green insulated copper conductors unless otherwise indicated. Non-insulated equipment grounding conductors are not allowed. When these conductors are not sized, or shown on the contract drawings, they shall be sized in accordance with Table 250-95, "Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment", of the NEC.

4.4.5.2 Connections.- There shall be no interconnection between equipment grounding conductors and neutral conductors except at the main service and separately derived sources. All connections to equipment to be grounded shall be made with a grounding connector specifically intended for that purpose. Bare wire, wrapped around mounting bolts and screws, is not acceptable as a grounding connection. All ground lugs shall be of a noncorrosive material suitable for use as a grounding connection, and must be compatible with the type of metal being grounded. All mating surfaces and connections shall be between cleaned bare metal to bare metal surfaces.

4.4.5.3 Installation.- Each overcurrent device shall have its own equipment grounding conductor, i.e., a single-pole single-phase overcurrent device shall be supplied with an equipment grounding conductor; a two-pole, single-phase overcurrent device shall be supplied with its own equipment grounding conductor; a three-pole, three-phase overcurrent device shall be supplied with its own equipment grounding conductor. The equipment grounding conductor shall be installed in the same conduit as its related branch and feeder conductors and shall be connected to the ground bus in the branch or distribution panelboard. Metal conduit housing the equipment grounding conductor shall be electrically continuous, forming a parallel path to the equipment grounding conductor, except as allowed by the NEC. Where parallel feeders are installed in more than one raceway,

a full sized equipment grounding conductor shall be installed in each raceway.

4.4.6 Raceway grounding.- Surface metal raceways, wireways, or cable rack systems shall be installed in a manner that assures electrical continuity. Insulated copper bonding jumpers shall be installed between adjacent raceway sections to assure proper bonding. Uninsulated conductors shall not be used. Unless otherwise indicated, the minimum size for these bonding jumpers shall be No. 6 AWG. Where aluminum raceways are used, the jumpers shall be bonded with approved connectors for the dissimilar metals. All metallic raceway penetrations into a facility structure shall be bonded to the earth electrode system in accordance with FAA-STD-019.

4.4.7 Other grounding systems.- Any additional grounding systems used for electronic equipment shall be connected directly to the exterior earth electrode system or the perimeter ground cable under a raised floor in an equipment room. Other grounding systems shall not be used in place of the equipment grounding conductor system. The conductor used for other grounding (i.e., NEC 250-74, exception #4) systems shall be color coded green with a yellow stripe for single point isolated signal ground, green with an orange stripe for multipoint signal ground, green with a red stripe for high energy ground, green with a violet stripe for isolated equipment grounding connections.

4.5 Electrical surge protection

4.5.1 General.- All electrical surge protection systems shall be installed in accordance with FAA-STD-019.

4.5.2 Supply transformer.- For utility owned transformers, protective devices shall be at the discretion of the utility. For FAA—owned transformers, proper protection shall be provided on the primary side of the transformer.

4.5.3 Service entrance surge arrester.- A fused surge arrester provided with disconnect capability shall be installed on the line, (supply-side) of the service as close as possible to the service terminals. Separate terminating lugs shall be provided for the surge

arrester. This arrester shall be compatible with the service voltage, and shall be wired to avoid loops, sharp bends and kinks, and to minimize the number of bends. There shall be no interconnection between neutral and ground within the arrester. Arrester conductors shall be No. 4 AWG insulated copper or larger, unless a smaller size is recommended by the arrester manufacturer.

4.5.4 Transient suppression installations.- Where transient suppression devices are installed in the electrical power distribution system they shall be installed in accordance with manufacturers instructions unless otherwise specified.

4.5.5 Land line/cable penetration installations.- Suppression systems shall be provided for land line and cable penetration systems in accordance with FAA-STD-019. High energy grounding conductors shall be bonded directly to the earth electrode system or to the perimeter ground cable under raised floors in equipment rooms.

4.6 Wiring methods

4.6.1 General.- All wiring shall consist of insulated copper conductors installed in metallic raceways, unless otherwise specified.

4.6.1.1 Conductor routing.- Panelboards, surge arresters, disconnect switches, etc., shall not be used as raceway for conductor routing other than conductors that originate or terminate in these enclosures. Isolated ground conductors will be allowed to traverse these enclosures.

4.6.1.2 Conductor separation - Power conductors shall be routed separately from all other conductor types. This may be accomplished by routing power conductors and other conductors in separate raceways, or by a metallic divider between the power conductors and the other conductors in the same raceway.

4.6.2 Neutral conductor.- Shared/common neutrals shall not be permitted, i.e., each overcurrent device shall have its' own separate neutral conductor. Neutral conductor sizes shall not be less than the respective feeder or phase conductor sizes.

4.6.3 Raceway systems

4.6.3.1 General.- Each run shall be complete, and shall be fished and swabbed before conductors are installed. Ends of raceway systems not terminated in boxes or cabinets shall be capped. Exposed raceways shall be installed parallel to or at right angles with the lines of the structure. Crushed or deformed raceways shall not be installed. A pull wire shall be installed in all empty tubing and conduit systems in which wiring is to be installed by others. The pull wire shall be No. 14 AWG zinc-coated steel, or plastic with a minimum 200-pound tensile strength. Ten inches of slack shall be left at each end of the pull wire. Sections of raceways which pass through to damp, concealed, or underground locations shall be of a type allowed for such locations by NEC Article 300-5, and shall extend a minimum of 12 inches beyond the damp, concealed, or underground area. Where raceway has to be cut in the field, it shall be cut square and burrs and sharp edges removed. Where conduits penetrate walls or floors separating the building interior from the exterior, they shall be sealed to prevent moisture and rodent entry and to deter air transfer. In addition, where conduits penetrate walls separating individually controlled temperature or humidity controlled areas, they shall be sealed to prevent air circulation. Sealing methods and sealants shall be accordance with NEC Article 300-7. Openings around penetrations through fire-resistant-rated walls, partitions, floors, or ceilings shall be fire stopped using approved methods to maintain the fire resistance rating.

4.6.3.2 Conduit. — Minimum conduit size shall be 3/4 inch unless otherwise specified. Conduit for telephone and signal systems shall be allowed to be 1/2 inch. Where threads have to be cut on conduit, the threads shall have the same effective length and shall have the same thread dimensions and taper as specified for factory cut threads on conduit.

NOTE:

For ARTCCs, MCFs, and Large TRACONs, rigid steel conduit (RSC)or intermediate metal conduit (IMC) shall be used for all distribution panel feeders, transformer feeders, motor control center feeders and distribution

switchboards. Electrical metallic tubing (EMT) maybe used for communication, lighting and branch circuits.

4.6.3.2.1 Zinc coated rigid steel conduit (RSC).- Zinc coated rigid steel conduit (RSC) shall conform to UL 6. RSC, may be used in all locations and shall be used for all underground service conductors. For installation below slab, on-grade, or underground, the conduit shall conform to Steel Structures Painting Council Standard, SSPC-PS 10.01, or shall be field wrapped with 0.01-inch thick pipe wrapping plastic tape applied with 50% overlap. Fittings used underground shall be protected by field wrapping as specified herein for conduit. All fittings used with rigid steel conduit shall be the threaded type, of the same material as the conduit. Where conduits enter enclosures without threaded hubs, double locknuts (one on each side of the enclosure wall) shall be used to securely bond the conduit to the enclosure. In addition, a bushing shall be installed on the interior threaded end of the conduit to protect conductor insulation.

4.6.3.2.2 Intermediate metal conduit (IMC). IMC shall be zinc coated steel, shall conform to UL Standard 1242, and shall bear the UL label. For installation below slab on grade or underground, the conduit shall conform to Steel Structures Painting Council Standard, SSPC-PS 10.01, or shall be field wrapped with 0.01-inch thick pipe wrapping plastic tape applied with 50% overlay. Fittings used underground shall be protected by field wrapping as specified herein for conduit. Where it is necessary to fabricate IMC bends in the field, the tooling required to fabricate those bends shall be specifically designed for IMC. All fittings shall be of the threaded type, of the same material as the conduit. Where conduits enter enclosures without threaded hubs, double locknuts (one on each side of the enclosure wall) shall be used to securely bond the conduit to the enclosure. In addition, a bushing shall be installed on the interior threaded end of the conduit to protect conductor insulation.

4.6.3.2.3 Electrical metallic tubing (EMT).- EMT shall conform to UL 797. EMT may be used only in dry interior locations, and where not subject to physical damage. EMT shall not be used on circuits above 600 volts nor in sizes greater than 34 inches in diameter. Fittings used

with EMT shall be standard compression-type fittings designed for this type of EMT, unless otherwise indicated. Screw-type fittings are not acceptable. Where EMT enters enclosures without threaded hubs, an appropriate connector with threads and cast or machined (not sheet metal) locknut shall be used to securely bond the conduit to the enclosure. The connector body and locknut shall be installed so that firm contact is made on each side of the enclosure. In addition the connectors shall have an insulated-throat, smooth bell shaped end, or a bushing.

4.6.3.2.4 Rigid aluminum conduit.- Aluminum raceways shall not be used for any installation.

4.6.3.2.5 Rigid nonmetallic conduit.- Rigid nonmetallic conduit shall be heavywall PVC conforming to UL 651. Rigid nonmetallic conduit used to protect electrical power conductors may only be used underground, or in concrete, or as a vertical riser to 6 inches above grade or floor surface for connection to metal conduit; and only when required by the contract drawings or specific job specifications. PVC fittings shall be used with PVC conduit and shall be assembled in accordance with manufacturer's instructions. A PVC threaded fitting with locknut and plastic bushing shall be used to connect PVC conduit to boxes or cabinets without threaded hubs. Rigid nonmetallic conduit may be used to protect lightning protection system conductors and, in interior locations, to protect signal grounding conductors.

4.6.3.2.6 Flexible metal conduit.- Flexible metal conduit shall conform to Federal Specification, WW-C-566. Flexible metal conduit shall be used for terminal connections to motors or motor driven equipment, and in lengths only up to 6 feet for other applications permitted by the NEC. Liquid-tight flexible metal conduit shall be used outdoors and in wet locations. All flexible metal conduit shall be of a type where both the conduit and fittings are listed for grounding. This last requirement shall not apply to factory assembled equipment.

NOTE: Flexible metal conduit may be used under raised floor for branch circuits in lengths longer than 6 feet in computer room locations that meet all the requirements

of Article 645 of the NEC. All fittings and junction boxes shall be liquid tight types under the raised floor.

4.6.3.2.7 Flexible nonmetallic conduit.- Flexible nonmetallic conduit shall not be used.

4.6.3.3 Surface raceways.- Nonmetallic surface raceways shall not be used. Surface metal raceways shall conform to UL 5. Surface metal raceways shall be installed only in exposed, dry locations not subject to physical damage. Surface metal raceways shall meet NEC requirements, however, they shall not be used for circuits above 600 volts.

4 .6.3.4 Wireways.- Wireways shall conform to UL 870. Wireways shall only be installed in accessible locations. Wireways installed in wet or outdoor locations shall be rated for these locations.

4.6.3.5 Cable rack systems

4.6.3.5.1 General.- Cable rack systems shall be of the ladder or ventilated trough type conforming to NEMA Standard VE l, unless otherwise indicated. All components for each cable rack system shall be the product of a single manufacturer. Cable rack support spacing shall be as recommended by the manufacturer except that in no case shall spacing of supports exceed 6 feet. Cable racks shall be supported from structural members only.

4.6.3.5.2 Dimensions.- Straight sections, bends, tees, offsets, reducers, etc., for ladder-type cable rack systems shall consist of 3 inch minimum side channels with suitable cross channels (rungs) installed on 6 inch centers unless otherwise indicated. Straight sections, fittings, etc., for ventilated-type cable rack systems, shall have 3 inch minimum high sides and a ventilated bottom with cross pieces 2 inches (maximum) wide on 3 inch (maximum) centers and openings 2 inches (maximum) wide. Cable rack widths shall be as shown on the drawings.

4.6.4 Raceway support systems

4.6.4.1 General.- Raceways shall be securely supported at intervals specified in the NEC Article 300-11,

"Securing and Supporting", and fastened in place with pipe straps, wall brackets, hangers, or ceiling trapezes. Fastenings shall be by wood screws, nails or screw-type nails to wood; by toggle bolts on hollow masonry units; by expansion-bolts on concrete or brick; by machine screws, welded threaded studs, or spring tension clamps on steel work. Nail type nylon anchors or threaded studs driven by a power charge and provided with lock washers and nuts may be used in lieu of expansion bolts, machine screws, or wood screws. Threaded C clamps with retainers may be used. Raceways or pipe straps depth of more than 1-1/2 inch in reinforced concrete beams, or to a depth of more than 3/4 inch in reinforced concrete joists, shall not cut the main reinforcing bars. Holes not used shall be filled. In partitions of light steel construction, sheet-metal screws may be used. Raceways shall not be supported from sheet-metal roof decks. In suspended-ceiling construction, raceways shall not be fastened to the suspended-ceiling supports.

4.6.4.2 Telephone and signal raceways.- Telephone and signal system raceways shall be installed in accordance with the previous requirements for conduit and tubing, with the additional requirements that no length of run shall exceed 50 feet for 1/2-inch and 3/4-inch sizes, and 100 feet for-1-inch or larger sizes; and shall not contain more than two 90-degree bends or the equivalent. Pull or junction boxes shall be installed to comply with these limitations, whether or not indicated on the drawings. Bends in conduit, 1 inch and larger, shall have minimum inside radii of 12 times the nominal conduit diameter.

4.6.5 Conductors

4.6.5.1 Uninsulated conductors.- Uninsulated conductors shall be copper and in accordance with Federal Specification QQ-W-343.

4.6.5.2 Insulated conductors.- Unless otherwise indicated, insulated conductors shall be copper with thermoplastic or thermosetting insulation, type THW, THWN, and XHHW for general use, or type THHN for use in dry locations only, all insulated for 600 volts in accordance with Federal Specification J-C-30. Unless otherwise indicated, conductors No. 10 AWG and smaller shall be solid. Conductors No. 8 AWG and larger shall be

stranded. Minimum branch circuit conductor size shall be No. 12 AWG. Stranded conductors may be used with wire compression connectors or a pressure washer type lug; lugs with screw only compression are not allowed. Minimum control wire size shall be No. 14 AWG unless noted otherwise. Stranded conductors smaller than 10 AWG is allowed in applications where vibration and flexing may be encountered.

4.6.5.2.1 Fixture wiring.- Fixture wiring shall be thermoplastic insulated copper, rated for 600 volts, in accordance with Federal Specification J-C-30 and the NEC.

4.6.5.2.2. Color coding.- All feeder and branch circuits, including neutral conductors, shall be identified at both ends of the conductor with panel and circuit number indicated. This shall be accomplished using shrink embossed labels only. The color coding shall be continuous throughout the facility on each phase conductor to its point of utilization so that the conductor phase connection is readily identifiable. Equipment grounding conductors shall be color coded green. Conductors covered with green insulation with yellow, orange, violet or red tracers shall be used for other grounding systems. Neutral conductors shall be white insulated for 120/208/240 volt systems and gray insulated for 277/480 volt systems. For conductors, No. 4 AWG and larger, where appropriate insulation color is not available, color coded tape, half lapped for a minimum length of 3 inches shall be used. Switch leg conductors shall be violet insulated. Green, white, and gray insulated conductors shall not be reidentified. All conductor color codes including reidentified conductors shall be visible at all junction boxes, pullboxes, panelboards, outlets, switches, at access locations in closed raceways, every three (3) feet in open raceways, under all raised floors and at all terminations. Phase conductors shall be color coded as follows:

Single Phase

120 Volts	120/208/240 Volts
Line 1 - Black	Line 1 - Black
	Line 2 - Red
Neutral - White	Neutral - White

Three Phase

120/208/240 Volts	277/480 Volts
Phase A - Black	Phase A - Yellow
Phase B - Red	Phase B - Brown
Phase C - Blue	Phase C - Orange
Neutral - White	Neutral - Gray

Color coding for conductors in control cables shall be in accordance with NEMA Standard WC 5. DC power conductors. shall be color coded as follows: positive conductor, red with brown tracer; negative conductor, brown with red tracer; neutral conductors, if used, shall be white.

4.6.5.3 Splices.- Splices shall be made only at outlets , junction boxes or accessible raceways. Splicing of ungrounded conductors in panelboards is not permitted. Splices shall be made with solderless connectors conforming to UL 486A, UL 486C, AND UL 486E. Insulated wire nuts may only be used to splice conductors sized No. 10 AWG and smaller. Compression connectors shall be used to splice conductors No. 8 AWG and larger. All splices, including those made with insulated wire nuts, shall be insulated with electrical tape or shrink tubing to a level equal to that of the factory insulated conductors. All underground splicing shall be accomplished in accordance with FAA-C-1391.

NOTE:

Conductors in critical power systems shall not be spliced.

4.7 Boxes.- Boxes shall be either the cast-metal threaded-hub type conforming to UL 514A and UL514B, galvanized steel type conforming to UL 514A and UL 514B, or metal outlet boxes conforming to NEMA OS l. All enclosures shall conform to NEMA standards.

4.7.1 Applications.- Boxes shall be provided in the wiring or raceway system for pulling wires, making connections, and mounting devices or fixtures. All outdoor boxes shall be rated minimum NEMA 3R. In hazardous areas, boxes shall be explosion proof. Each electrical outlet box shall have a machine screw which

fits into a tapped hole in the box for the ground connection. Boxes shall be sized in accordance with the NEC Article 370. Boxes for mounting lighting fixtures shall not be less than 4 inches square. Boxes installed for concealed wiring shall be provided with extension rings or plaster covers. The front edge of the box shall be flush or recessed not more than 1/4-inch from the finished wall surface. Boxes for use in masonry-block or tile walls shall be square-cornered tile-type, or standard boxes having square-cornered tile-type covers. Cast-metal boxes installed in wet locations and boxes installed flush with exterior surfaces shall be gasketed. Separate boxes shall be provided for flush or recessed fixtures where required by the fixture terminal operating temperature, and fixtures shall be readily removable for access to the boxes unless ceiling access panels are provided. Boxes for fixtures on suspended ceilings shall be supported independently of the ceiling supports. Boxes shall not be supported from sheet-metal roof decks. Non-metallic boxes may be used only with non-metallic raceway systems.

4.7.2 Supports.- Boxes and supports shall be securely fastened to wood with wood screws, nails, screw-type nails, carriage bolts, or lag screws of equal holding strength, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel work. Support systems shall be capable of carrying the weight of the box and its contents. Threaded studs driven by powder charge and provided with lockwashers and nuts, or nail-type nylon anchors may be used in lieu of expansion shields, or machine screws. In open overhead spaces, cast-metal boxes threaded to raceways need not be separately supported except where used for fixture support; cast-metal boxes having threadless connectors and sheet-metal boxes shall be supported directly from the building structure or by bar hangers. Where bar hangers are used, the bar shall be attached to raceways on opposite sides of the box and the raceway shall be supported with an approved fastener not more than 24 inches from the box. Penetration shall be no more than 1-1/2 inches into reinforced concrete beams nor more than 3/4-inch into reinforced concrete joists. Main reinforcing steel shall not be cut.

4.8 Wiring devices

4.8.1 Receptacles.- All receptacles shall be specification grade in accordance with NEMA STD WD-l. Unless otherwise indicated, general purpose duplex receptacles shall be specification grade, 20 ampere rating, 125 volt, grounding type NEMA 5-20R. Receptacles with push-in connections or a combination of screw-type and push-in connectors are not acceptable. Unless noted otherwise, receptacles shall be installed 12 inches above finished floor. All receptacles, unless they are of the isolated-ground type, shall be grounded by the installation of a green grounding pigtail from the receptacle grounding screw directly to the grounding screw on the outlet box where the green equipment grounding conductor is terminated.

NOTE: For all critical power circuits, the receptacles shall be twist lock type except where the receptacles are not subject to be kicked or bumped (e.g., receptacles mounted inside an equipment rack).

4.8.1.1 General.

4.8.1.2 Ground fault circuit-interrupter (GFCI) receptacles.- GFCI receptacles shall be installed in all locations required by the NEC and in other locations as indicated on the drawings. GFCI receptacles shall be 125-volt, duplex, UL Group I, Class A, rated for 20 amperes minimum. All exterior GFCI receptacles shall be mounted in weatherproof boxes with weatherproof covers.

4.8.1.3 Reserved

4.8.1.4. Isolated ground terminal receptacles.- When isolated ground terminal receptacles are shown in the contract documents, they shall be installed in accordance with Article 250-74 exception #4, of the NEC. Isolated ground terminal receptacles shall only be used where shown on the drawings. All isolated ground terminal receptacles shall be colored orange.

4.8.1.5 Plug-in strip outlets

4.8.1.5.1 General.- Fixed multi-outlet assemblies shall consist of a surface metal raceway with grounding type

receptacles. Phase and neutral conductors shall not be smaller than No. 12 AWG and shall have the type of insulation specified for branch circuit conductors. In addition, a No. 12 AWG or larger green insulated equipment grounding conductor having the same insulation as the phase conductors shall be installed. This grounding conductor shall connect all receptacle ground terminals and each section of the surface metal raceway, and shall be securely connected to the equipment grounding conductor from the branch power panel. Where more than one circuit is indicated as serving a group of similar receptacles in a common raceway, adjacent receptacles shall not be connected to the same circuit.

4.8.1.5.2 Associated hardware.- Surface metal raceways shall be provided with snap-on blank covers and/or snap-on receptacle covers for the receptacles furnished, all manufactured by the raceway manufacturer. They shall be installed to prevent open cracks. Where industry standard device plates are to be installed on raceways, snap-on blank covers shall be accurately cut to avoid open cracks. Fittings, elbows, clips, mounting straps, connection blocks, and insulators, shall be provided as required for a complete installation.

4.8.1.6 Emergency light receptacles.- Emergency light receptacles shall be grounding type single receptacles in accordance with NEMA standard WD 1.

4.8.2 Wall switches.- Single-pole and three-way wall switches shall be specification grade, rated 120/277 volts, and shall be fully rated 20 amperes, AC only. Wiring terminals shall be of the screw type. Switches with push-in connections or a combination of screw-type and push-in connections are not acceptable. Switches shall be equipped with grounding terminals and shall be grounded with a green grounding pigtail connected from the switch grounding screw directly to the grounding lug or screw on the outlet box where the green equipment grounding conductor is terminated. Switches shall be the quiet-operating type. Not more than one switch shall be installed in a single gang position.

4.8.3 Device plates.- Plates of the one-piece type shall be provided for all outlets and fittings to suit the devices installed. Plate screws shall be of metal with countersunk heads, in a color to match the finish of the

plate. Telephone and communication outlets shall be provided with a blank cover plate unless otherwise indicated. Plates shall be installed with all four edges in continuous contact with finished wall surfaces with the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed with an alignment tolerance of 1/16 inch. The use of sectional type device plates will not be permitted. Plates installed in wet locations shall be gasketed. Device plates for telephone and intercommunication outlets shall have a 3/8-inch bushed opening in the center or a dome-shaped grommet on the side.

4.8.4 Photoelectric control.- Unless otherwise indicated, photoelectric controls for floodlighting or obstruction lighting shall be 120 volt, 3000 watt, single-pole, single-throw, double-break type. Photoelectric controls shall be mounted in an appropriate weatherproof housings installed on the building exterior. The housing should be vented if possible, faced in a northerly direction. At no time shall the controllers be mounted in the same enclosure with thre batteries.

4.9 Service equipment

4.9.1 Power.- Service entrance equipment and installation for power shall be in accordance with the regulations of the local utility providing service and NEC Article 230.

4.9.1.1 Service entrance conduits.- Service entrance conduits shall be installed as shown on the drawings and shall be heavywall zinc coated rigid steel unless otherwise indicated. Grounding bushings shall be installed on both ends of the service entrance conduit.

4.9.1.1.1 Underground service.- Underground service entrance conduits shall be installed a minimum of 2 feet below finished grade. Service entrance conduit shall be electrically continuous between the service disconnecting means and the facility transformer housing. The conduit shall be bonded to the counterpoise.

4.9.1.1.2 Aerial service.- A minimum of 4 feet of slack in all service entrance conductors shall be extended from an appropriate weatherproof entrance fitting to permit connection to the service drop. Conduit shall be

concealed within the building where possible and conduit penetrations into the building shall be caulked with sealing compound.

4.9.1.2 Service disconnecting means.- Service equipment shall be a fused disconnect switch, separately mounted circuit breaker, or main circuit breaker in the main distribution panel. All switches and circuit breakers used as service entrance disconnecting means shall be UL rated for service equipment.

4.10 Panelboards

4.10.1 General.- Panelboards shall be dead-front type, shall conform to Federal Specification W-P-115, Type I, Class l, and shall be listed by UL except for installations which require special panelboards to incorporate items not available as UL listed. Panelboards shall be mounted so that the height to the top of the panelboard shall not exceed 81 inches above the finished floor level. Unless otherwise specified, panelboards shall have a full hinged front cover with a hinged door in that cover for access to circuit breaker switches. Doors shall have flush type cylinder locks and catches. Doors over 48 inches in height shall have auxiliary fasteners on top and bottom. All locks in a project shall be keyed alike, and two keys shall be furnished with each lock. Directories shall be type written to indicate the load served by each circuit and shall be mounted on the inside of the door in a holder with a protective covering. Circuits shall be connected as indicated on the drawing. The directory shall be arranged so that the typed entries simulate circuit breaker positions in the panelboard.

4.10.2 Wiring gutters.- The minimum size of side wiring gutters shall be 4 inches for power feeders up to and including 100 amperes, 6 inches for power feeders over 100 amperes and up to 225 amperes, and 8 inches for power feeders over 225 amperes and up to 600 amperes.

4.10.3 Circuit breakers.- Circuit breaker ratings shall be in accordance with the SCA/PDC study, FAA Order 6950.27. All circuit breakers shall be UL listed thermal magnetic type or electronic solid state type, as described herein, and with a minimum rating of 10,000 AIC. Circuit breakers shall also have trip ratings,

voltage ratings, and number of poles as defined on the drawings. All circuit breakers shall have a trip indicating feature. Single-pole breakers shall be full-size modules. Two-pole and three-pole breakers shall be physically sized in even multiples of a single-pole breaker. Breakers shall be sized so that two single-pole breakers can not fit in a single housing. Multipole circuit breakers shall have an internal common trip mechanism. All circuit breakers and the panelboards in which the breakers are installed shall be products of the same manufacturer. Plug in type load centers and/or plug in type branch or feeder circuit breakers shall not be used. Positive integral locking plug-in circuit breakers, and associated panelboards, may be used.

4.10.3.1 Thermal magnetic.- All thermal magnetic breakers shall be quick make, quick break type conforming to Federal specification W-C-375. Adjustable breakers shall have setting adjustments readily accessible and visible from the front of the panel board, after installation.

4.10.3.2 Solid state.- Adjustable, solid-state or microprocessor-controlled circuit breakers shall have adjustments readily accessible and visible from the front of the panelboard, after installation. Individual circuit breaker frame size shall not exceed the panelboard bus rating.

4.10.3.3 Self enclosed circuit breakers

4.10.3.3.1 General.- Circuit breakers shall be UL listed thermal magnetic type or electronic solid state type, as described herein. Multiple circuit breakers shall have an internal common trip mechanism. Circuit breakers shall comply with Federal Specification W-C-375.

4.10.3.3.2 Thermal magnetic.- These circuit breakers shall be of the molded-case type, shall have a quick-make and quick-break toggle mechanism, inverse-time trip characteristics and shall be trip-free on overload or short-circuit. Automatic release shall be secured by a BI-metallic thermal element releasing the mechanism latch. In addition, a magnetic armature shall be provided to trip the breaker instantaneously for short-circuit currents above the overload range.

Automatic tripping shall be indicated by a handle position between the manual OFF and ON positions.

4.10.3.3.3 Solid state/microprocessor.- These circuit breakers may be used providing they meet or exceed the performance characteristics given by paragraph 4.10.3.3.2 above.

4.10.4 Bus bars.- All phase bus bars shall be copper or plated copper. Neutral and ground bus bars shall be copper or plated copper. Bus capacity shall be as indicated on the drawings. Where bus capacity is not indicated on the drawings, the capacity shall be equal to or greater than the panelboard feeder overcurrent protective device. Except as indicated paragraph 4.10.3, circuit breaker current-carrying connections shall be bolted. Bus bar connections to branch circuit breakers shall be of the sequence phase type. The neutral bus shall be insulated from all panelboards except where the panelboard is used as the service disconnecting means. Where "provisions for," "future," or "space" is noted on the drawings, the panelboard shall be equipped with bus connections for the future installation of circuit breakers.

4.10.4.1 Ground bus.- All panelboards shall have an uninsulated ground bus that is separate from the neutral bus. The ground bus shall be securely bonded to the cabinet and adequately sized for the panelboard capacity and with the number of terminations equal to the number of poles in the panelboard. The ground bus shall only be bonded to the neutral bus at the service disconnecting means. The ground bus bar shall be structurally integral to the panelboard or attached to the panelboard with a bolt, nut and lock washer. If the ground bus bar is mounted to the enclosures with screw threads only (i.e., tapped blind hole) a separate, bolted ground lug shall be installed on the panelboard and bonded to the ground bus bar. The bond conductor shall have the same current carrying capacity as the largest equipment grounding conductor terminated to the ground bus bar.

4.11 Reserved.

4.12 Safety switches.- Safety switches shall be type "HD," heavy duty, locking type unless otherwise indicated. Switches mounted in dry locations shall be

NEMA type 1 enclosures. Switches installed outdoors, or in damp locations shall be mounted in NEMA type 3R enclosures. Switches shall be of the voltage and current ratings indicated on the drawings. Switches shall be the quick-make, quick-break type. Except for ground lugs which shall be bonded to the housing, all parts shall be mounted on insulating bases to permit replacement of any part from the front of the switch. All current-carrying parts shall be of high-conductivity copper unless otherwise specified. Switch contacts shall be silver-tungsten or plated to minimize corrosion, pitting and oxidation. When used for motors a safety switch shall be sized in accordance with NEC Article 380. Switches shall disconnect all ungrounded conductors.

4.13 Cabinets.- Telephone and signal systems cabinets shall be constructed of zinc coated sheet steel in accordance with NEC Article 373-10, and shall meet the requirements of UL 50. Cabinets shall be constructed with interior dimensions not less than those indicated on the drawings. Cabinets shall be mounted so that the height to the top of the cabinet does not exceed 81 inches above the finished floor level. A locking catch and two keys shall be provided with each cabinet unless otherwise indicated. All locks in a project shall be keyed alike. Cabinets shall also be provided with a 5/8-inch plywood backboard unless otherwise indicated.

4.14 Motors and controls

4.14.1 Motors.- Motors furnished under this specification shall be of sufficient size for the duty to be performed, and shall not exceed the full-load rating when the driven equipment is operating at specified capacity. Motors shall be rated for the voltage of the system to which they are to be connected. Unless otherwise indicated, all motors shall have open frames, and continuous-duty classifications. Polyphase motors shall conform to NEMA Standard MG-1, and shall be type II, class 3, minimum insulation class B, squirrel-cage type, having normal starting-torque and low-starting-current characteristics, unless otherwise specified. When motor horsepower ratings are indicated on electrical drawings, these ratings are only approximate. Higher ratings may be required to adequately power driven equipment selected by the contractor for the duty to be performed.

4.14.2 Motor controls.- Each motor, 1/8 horsepower or larger, shall have overload protection in each phase, or other equally rated method in accordance with the NEC. The overload-protection device shall be provided either integral with the motor, or with the control, or shall be mounted in a separate enclosure. In any case the reset button shall be in an accessible location. Unless otherwise indicated, the protective device shall be of the manual reset type. Single or double-pole tumbler switches specifically designed for AC operation may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating. Automatic control devices such as thermostats and float or pressure switches may control the starting and stopping of motors directly, provided the devices used are designed for that purpose and have an adequate horsepower rating. When the automatic control device operates the motor directly, a double-throw, three-position tumbler or rotary switch shall be provided for manual control.

4.14.2.1 Reduced-voltage controllers.- Reduced voltage starting methods when required shall be as indicated on the drawings.

4.14.3 Motor disconnecting means.- Each motor shall be provided with a disconnecting means and a manually operated switch as shown on the drawings or when required by the NEC. For single-phase motors, a single-pole or double-pole toggle switch, rated only for AC, will be acceptable for capacities less than 30 amperes, provided the ampere rating of the switch is at least 125 percent of the motor full load amperages (FLA). Enclosed safety switches shall conform with paragraph 4.12 above.

4.15 Dry-type transformers

4.15.1 General.- Dry-type transformers shall be of the sizes and characteristics shown on drawings. Unless otherwise indicated, the design, manufacture, and testing of dry-type transformers, and the methods of conducting tests and preparing reports shall be in accordance with NEMA ST 20, and UL standards. These transformers shall be dry-type self-cooled (Class AA) as defined by ANSI/IEEE C57.12.80. Unless otherwise indicated, minimum Basic Insulation Levels (BIL) shall be in accordance with IEEE STD 141.

4.15.2 Windings and taps.- Dry-type transformers shall be provided with separate primary and separate secondary windings for each phase. The transformers shall be provided with copper windings. Unless otherwise indicated, each primary winding of each transformer rated 15 KVA and greater shall be provided with four taps, two of which shall provide 2-1/2 percent increments above full rated voltage and two of which shall provide 2-1/2 percent increments below full rated voltage. Each primary winding of each transformer rated below 15 KVA shall, be provided with not less than two taps, each providing a 5 percent increment above and below full rated voltage.

4.15.3 Insulation.- Insulation provided in transformers having ratings not exceeding 25 KVA shall have 185°C rise rating. Insulation provided in transformers having ratings exceeding 25 KVA shall have 220°C rise rating.

4.15.4 Terminal compartments.- Each dry-type transformer shall be provided with a suitable terminal compartment to accommodate the required primary and secondary wiring connections, and side or bottom conduit entrance. Transformers having ratings not exceeding 25 KVA shall be provided with terminal leads equipped with factory installed and supported connectors. Transformers rated greater than 25 KVA shall have terminal boards equipped with factory installed clamp-type connectors. The terminal compartment temperature shall not exceed 75°C when the transformer is operating continuously at rated load with an ambient temperature of 40°C.

4.15.5 Sound pressure levels and vibration isolation.- Sound pressure levels of dry-type transformers shall be determined in accordance with NEMA Standard ST 20. Levels shall not exceed 40 db for transformers rated at 9 KVA or less; 45 db for transformers rated over 9 KVA but not over 50 KVA; and 50 db for transformers rated over 50 KVA but not over 150 KVA. All dry-type transformers 45 KVA and greater shall have integral vibration isolation supports between the core and coil assembly and the transformer enclosure. Transformers of lesser rating shall have either integral or external vibration isolation supports. Conduit connections to transformers shall be made with flexible metal conduit, nominally 12 inches length but not more than 36 inches in length.

4.15.6 Enclosures.- Single-phase transformers larger than 25 KVA and three-phase transformers larger than 15 KVA shall be fully encased in steel enclosures. Transformers smaller than 15 KVA shall be fully encased in steel enclosures with or without compound fill, or shall have exposed cores, impregnated windings, and steel enclosures encircling all live parts. Enclosures shall be bonded to the grounding system. The surface temperature of the transformer shall not exceed 65°C when the transformer is operating continuously at rated load with an ambient temperature of 40°C.

4.15.7 Mounting.- Transformers shall be mounted to allow for adequate ventilation. Unless otherwise indicated on drawings, dry-type transformers having ratings not exceeding 25 KVA shall be suitable for wall mounting. Shop drawings of wall brackets and platforms for transformers shall be submitted for approval.

4.16 Identification.- Motor controllers, panelboards, safety switches and self-enclosed circuit breakers shall be identified with a name plate showing the functional name of the unit, voltage utilized, the number of phases, and other pertinent formation. Switches for local lighting need not be identified. Additional equipment shall be identified if called for on the drawings.

4.16.1 Name plates.- Name plates shall be non-ferrous metal or rigid plastic, stamped, embossed or engraved with 3/8-inch minimum height characters. The plates shall be secured to the equipment with a weather-proof bonding material or a minimum of two screws.

4.17 Fuses.- A complete set of fuses shall be installed and one set of spares shall be furnished for each fusible device. Time and current tripping characteristics of fuses serving motors or connected in series with circuit breakers shall be determined by the facility Protective Device Coordination Study (PDC). Fuses shall have a voltage rating not less than the circuit voltage. Required fuse interrupting ratings, determined by the Short Circuit Analysis (SCA) calculations, shall be as shown on the drawings, except that these interrupting ratings shall not be less than 100,000 amperes in branch and feeder circuits, and not less than 200,000 amperes in a service entrance switch.

4.18 Lamps and lighting fixtures

4.18.1 General.- Lamps and lighting fixtures shall be of the types indicated on the drawings. All lighting fixtures shall be UL approved and shall bear the UL label. All incandescent lamps shall be rated for 130 volts unless otherwise indicated. Flexible metal conduit, minimum 3/8 inch nominal trade size is permitted. External bonding jumpers are not required across the lighting fixture flexible conduit.

4.18.2 Fluorescent fixtures.- Unless otherwise indicated, fluorescent fixture lenses shall be the prismatic-type, made of virgin acrylic. Fluorescent lamps shall be rapid start, cool white unless otherwise indicated. Ballasts for fluorescent fixtures shall be class P, protected (including inherent automatic thermal reset and fuse) rapid start, high power factor type, conforming to UL Standard UL 935. Unless otherwise indicated, all ballasts shall be provided with factory installed choke-type radio frequency interference suppressers. Lampholders shall have silver plated contacts, and shall conform to standard UL 542.

4.18.2.1 Recessed fluorescent fixtures.- Recessed fluorescent fixtures shall conform to NEC Article 410-64 through 410-72, and shall be installed in suspended ceiling openings. These fixtures shall have adjustable fittings to permit alignment with ceiling panels.

4.18.2.2 Suspended fluorescent fixtures.- Pendant-mount fluorescent fixtures shall conform to Federal Specification W-F-414 and shall be of the types indicated on the drawings. Single-unit suspended fluorescent fixtures shall have twin-stem hangers. Multiple-unit or continuous row fluorescent units shall have tubing or a stem for wiring at one point, and tubing or a stem suspension provided for each unit length of chassis, including one at each end.

4.18.3 Suspended incandescent fixtures.- Pendant-mounted incandescent fixtures shall be provided with swivel hangers to insure a plumb installation.

4.18.4 Emergency lights.- Emergency lights shall conform to Federal Specification W-L-305, type I, class I, style D or E, with the number of heads as indicated on the

drawings. Emergency light sets shall be connected to the wiring system by a cord no more than 3 feet in length to a single receptacle.

4.18.5. High intensity discharge (HID) lamps.- HID lamps including mercury vapor, metal halide, and high or low pressure sodium shall be as indicated on the drawings. High power factor, constant wattage ballasts shall be furnished with HID lamps. Mercury vapor lamps shall be the color improved type.

4.19 Signal and communications

4.19.1 Entrance conduits.- Conduit materials shall be RSC unless otherwise indicated. Except where otherwise indicated, underground conduits shall be a minimum of 2 feet below finished grade and extend at least 5 feet beyond the grounding electrode system. The conduits shall be bonded to the grounding electrode system with No. 2 AWG bare copper conductor by exothermic welds or FAA-approved pressure connectors. Conduits installed for future use by others, such as for telephone, communications, electronic signals, etc., shall have both ends capped.

4.19.2 Transient protection demarcation box for electronic landlines.- A metallic, appropriately rated NEMA junction box, shall be installed where electronic landlines or conduits enter the facility. This box will house terminal boards, cables, and circuit transient protectors as shown on the contract drawings.

4.19.3 Fiber optics.- The use of fiber optics is recommended to replace metallic, control cables. Using fiber optics will eliminate outages and loss of service due to lightning strikes.

4.20 Painting and finishing.- Where factory finishes are not adequate to protect metal surfaces from corrosion, the contractor shall paint exposed surfaces prior to or after installation. All marred or damaged surfaces, except exposed metal for grounding purposes, shall be refinished to leave a smooth, uniform finish at final inspection.

4.21 Repair of existing work.- Electrical work shall be carefully planned. Where cutting, channeling, chasing,

or drilling of floors, wall partitions, ceilings, or other surfaces is necessary for the proper installation, support, or anchorage of the conduit, raceways, or other electrical work, it shall be carefully done. The contractor shall repair, with equal material by skilled workers, any damage to facilities caused by the contractor's workers or equipment. Contracting Officer's prior approval must be obtained for the materials, workers, time of day or night, repair method, and for temporary or permanent repairs purposes. On completion, repair work shall be inspected and approved by the Contracting Officer with the concurrence of any other affected parties such as utility companies and airport authorities.

5. QUALITY ASSURANCE PROVISIONS

5.1 List of materials and equipment.- When required by the contract the contractor shall submit a list of materials and equipment to the Contracting Officer for approval.

5.1.1 Information required.- This list shall include manufacturer's style or catalog numbers. Partial lists submitted from time to time shall not be considered as fulfilling this requirement. Approval of materials will be based on manufacturer's published data. Approval of materials and equipment will be tentative, subject to submission of complete shop drawings, when required, indicating compliance with the contract documents.

5.1.2 Statement.- A manufacturer's statement indicating complete compliance with the applicable federal specification, military specification, or standards of ASTM, NEMA, or other commercial standard, is acceptable as indicating compliance with contract documents.

5.2 Shop drawings.- When required by the contract or by direction of the contracting officer, the contractor shall submit shop drawings for materials and equipment not completely identified by information submitted in the materials and equipment lists. This information shall include, but is not limited to panelboards, lighting fixtures, cable trays, switchgear, transformers, busways, cabinets, and lightning protection systems. In addition, the contractor shall provide the completed Short Circuit

Analysis/Protective Device (SCA/PDC) study, FAA Order 6950.27.

5.2.1 Coordination.- Drawings and submitted data shall be checked and coordinated with the work of other construction trades involved, before they are submitted for approval, and shall bear the contractor's stamp of approval as evidence of such checking and coordination.

5.2.2 Required data.- Drawings and submitted data shall be complete, assembled in sets and shall bear the date, drawing revision number, name of project or facility, name of contractor and subcontractor, and the clear identity of contents and location of work.

5.2.3 Approval.- The approval of drawings and submitted data shall not be construed as (1) permitting any departure from the contract requirements; (2) relieving the contractor of the responsibility for any errors, including details, dimensions, materials, etc.; or (3) approving departures from full size details furnished by the Contracting Officer.

5.2.4 Variations.- If drawings show variations from the contract requirements because of standard shop practice or for other reasons, the contractor shall describe such variations in a letter of transmittal to the Contracting Officer. If acceptable, the Contracting Officer may approve any or all such variations, subject to a proper adjustment in the contract. Contractors failing to describe such variations shall not be relieved of the responsibility for executing the work in accordance with the contract, even though such drawings have been approved.

5.2.5 Submission.- The contractor shall submit and obtain approval of shop drawings by the Contracting Officer before ordering materials or proceeding with any work associated with the shop drawings.

5.3 Tests

5.3.1 General.- Unless otherwise indicated, the contractor shall furnish all test instruments, materials and labor necessary to perform the following tests. All tests shall be performed in the presence of the Contracting Officer or his designated representative.

All instruments shall have been calibrated within a period of two years preceding testing. Calibrations shall be traceable to applicable industry recognized standards.

5.3.2 Cables.- All cables shall be tested in accordance with FAA Order 6950.22 prior to installation and again upon completion of the installation. All testing shall be accomplished before connection is made to any existing equipment.

5.3.3 Load balancing.- After the electrical installation has been completed, the contractor shall take current readings with a true RMS ammeter for the purpose of load balancing. These readings shall be taken at the service entrance, each feeder panelboard, each branch panelboard, and each separately derived source. The contractor shall redistribute single-phase loads where there is greater than a 20% difference between readings in any two phases. The contractor shall also be required to notify the Contracting Officer of current readings taken before and after installation, and any phase loaded above 80% of the rating of its overcurrent protective device.

5.3.4 Insulation resistance tests.- Feeder and branch circuit insulation tests shall be performed after installation, but before connection to fixtures or appliances. Motors shall be tested for grounds or short circuits after installation but before start-up. All conductors shall test free from short circuits and grounds, and have a minimum phase-to-phase and phase-to-ground insulation resistance of 30 megohms when measured with a 500-volt DC insulation resistance tester. Apply the test voltage for at least one minute after the meter reading has stabilized. The contractor shall submit a letter type test report to the Contracting Officer prior to final FAA inspection of the contractor's work. The report shall list the tests performed and results obtained.

5.3.5 Neutral isolation tests.- For all new installations, the neutral in the service entrance switch shall be tested for isolation from ground with an ohmmeter capable of reading greater than 20,000 ohms. This procedure to be used is detailed in the Appendix. This procedures can also be used to determine if there

are any other neutral-ground connections on the load side of the service disconnecting means.

5.3.6 Earth resistance test.- To demonstrate compliance with paragraph 4.4.4, the contractor shall measure the resistance of the grounding electrode system. Tests shall not be conducted within 48 hours of a rainfall or in frozen soil. The contractor shall immediately notify the Contracting Officer if the specified resistance is not obtained. Upon project completion, the contractor shall also submit a written test report to the Contracting Officer, defining the test procedure and results obtained.

5.3.7 Operating test.- After the interior wiring system installation is completed, and at such time as the Contracting Offer may direct, the contractor shall conduct an operating test for approval. The equipment shall be demonstrated to operate in accordance with the requirements of this specification. The test shall be performed in the presence of the Contracting Officer or designated representative.

6. NOTES

6.1 General.- This specification is to be used as part of the contract documentation for construction and facility modification projects that do not require major design efforts. No waivers to contractors, other than those indicated as alternatives, are allowed. This specification is not to be used as a design guide. For design information, consult FAA-STD-019, Lightning Protection, Grounding, Bonding and Shielding Requirements for Facilities; FAA-STD-020, Transient Protection, Grounding, Bonding and Shielding Requirements for Equipment; FAA Order 6950.19, Practices and Procedures for Lightning Protection, Grounding, Bonding, and Shielding Implementation; FAA Order 6950.20, Fundamental Considerations for Lightning Protection, Grounding, Bonding and Shielding and other documentation as applicable.

6.2 Conflicts between documents.- In all but the smallest of modification or construction contracts, conflicts are unavoidable between the various documents cited in the contract or referenced in an included specification. Any proposal request using this document

should contain the following provisions: "Prospective contractors shall, as part of their proposals, enumerate, identify, and list conflicts that exist with the contract documents, and between those documents and the rules, regulations, and codes of the local utility company and local, county or state governing bodies."

Appendix

FACILITY NEUTRAL/GROUND ISOLATION TESTING.

The following testing is to be utilized to verify required isolation between facility neutral and ground systems within the electrical distribution system and facility equipment. Neutral grounding at the service entrance disconnect means is still required by NFPA, NEC Article 250.

EQUIPMENT NEEDED: Volt-ohm meter, flash light, allen wrenches, screw drivers, socket wrenches, and wire markers.

NOTE l: A resistance value of greater than 20,000 ohms is the minimum value for an acceptable neutral/ground isolation test. Any lesser value indicates an unacceptable isolation condition that must be investigated.

NOTE 2: Capacitors on the neutral line or capacitive effects of the distribution system will impact resistance readings. Always use the final, stabilized readings.

NOTE 3: High impedance meters are susceptible to acting as an antenna, picking up stray fields that would not be picked up by lower impedance meters. For this series of tests, it is highly recommended that low impedance meters be used, such as an analog meter the Simpson 260 or its equivalent, or use a digital meter the Fluke 8060a series or its equivalent.

STEPS:

1. Schedule a facility outage in order to conduct the tests.

2. Review one-line diagrams of the facility electrical distribution system.

3. Isolate and lock out all standby power sources.

4. Remove facility power by opening the service disconnect means.

CAUTION: Voltage is still present at the supply side (line side) of the service entrance disconnect.

5. Verify that no voltage is present at the load side of the service disconnect means with the voltmeter using progressively lower scales.

6. Open all circuit breakers in the facility distribution system.
7. Disconnect load side neutral conductor(s).

8. Measure resistance between disconnected load side neutral conductor(s) and the service entrance enclosure ground bus.

9. If resistance reading is acceptable, reconnect neutral conductor(s) and terminate testing.

10. If resistance reading is unacceptable, tag the grounded neutral conductor(s) and leave the conductor(s) disconnected.

11. Trace the tagged conductor(s) to the load and correct the unacceptable neutral/ground bond, or to the next downstream (towards the load) neutral termination.

12. At the next downstream location, remove each load side neutral conductor one at a time and measure resistance between the conductor and the enclosure. If the resistance reading is acceptable, re-terminate the conductor. If the resistance reading is unacceptable, tag the grounded neutral conductor and leave it disconnected. Measure resistance of the rest of the neutral bus immediately after identifying a grounded conductor, to possibly verify the rest of the bus as acceptable.

13. Continue downstream as described above until all unintentional neutral/ground bonds are found and corrected.

14. Reconnect all neutral conductor(s) except at the service entrance disconnect means. Measure resistance between the load side neutral conductor(s) and the service entrance enclosure to verify successful isolation of neutral/ground conductors.

15. Reconnect neutral conductor(s), close service entrance disconnect means.

16. Place standby power source on line.

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CHANGE

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

6950.2D CHG 1

10/6/03

SUBJ: ELECTRICAL POWER POLICY IMPLEMENTATION AT NATIONAL AIRSPACE SYSTEM FACILITIES.

1. PURPOSE. This order provides guidance for electrical power policy implementation at the National Airspace System Facilities (NAS) in accordance with the latest version of Order 6030.20, Electrical Power Policy. This order identifies standard electrical power configurations to ensure NAS facility availability commensurate with its assigned mission.

2. DISTRIBUTION. This order is distributed to the division level in the Airway Facilities; Office of Communication, Navigation, and Surveillance Systems; Office of System Architecture and Investment Analysis; and Office of Acquisitions in Washington; to division level in the FAA Logistics Center and the FAA Academy at the Aeronautical Center; to the division level in the Office of Communication, Navigation, and Surveillance Engineering and Test Division at the Technical Center; to the branch level in the regional Airway Facilities divisions; and to all Airway Facilities field offices with a standard distribution.

3. EXPLANATION OF CHANGES.

a. Extensive revisions to this order have been performed to comply with Public Law 104-113, H.R. 2196, the National Technology Transfer and Advancement Act of 1996, and to modernize outdated requirements contained in the existing order.

b. Specific changes have been made to incorporate sensitive electronic power requirements, especially in the power quality area. Appendix 1, Facility Power Source Codes, has been revised to reflect the current facility types. Also, appendix 1 has been divided into two sections - Part A - General National Airspace System (GNAS) and Part B - Air Route Traffic Control Center (ARTCC). Appendix 2, Current Distortion Guidelines, has been added to provide guidance for individual system/equipment harmonic assessment. Appendix 3, Power Criteria, has been added to give a description of the general power quality to be provided to mission related electronic equipment.

4. DISPOSITION OF TRANSMITTAL. After filing the revised appendices, this change transmittal should be retained.

Distribution: A-W(AF/OS/NI/SR/OP/ND/SD/SU)-2; A-X(AF)-3; A-Y(ML/MA)-2 Copies; A-Z(ACT-300)-3 Copies; A-FAF-0 (STD)

Initiated By: AOS-1000

PAGE CONTROL CHART

Remove Pages	Dated	Insert Pages	Dated
Appendix 1 Part A and B	10/1/98	Appendix 1 Part A and B	10/6/03
Appendix 2	10/1/98	Appendix 2 Pages 1 and 2	10/6/03
Appendix 3	10/1/98	Appendix 3 Page 1 and 2	10/6/03

Steven B. Zaidman
Director of Airway Facilities

ORDER

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

6950.2D

10/1/98

SUBJ: ELECTRICAL POWER POLICY IMPLEMENTATION AT NATIONAL AIRSPACE SYSTEM FACILITIES.

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1. **PURPOSE.** This order provides guidance for electrical power policy implementation at the National Airspace System Facilities (NAS) in accordance with the latest version of Order 6030.20, Electrical Power Policy. This order identifies standard electrical power configurations to ensure NAS facility availability commensurate with its assigned mission.

2. **DISTRIBUTION.** This order is distributed to the division level in the Airway Facilities; Office of Communication, Navigation, and Surveillance Systems; Office of System Architecture and Investment Analysis; and Office of Acquisitions in Washington; to division level in the FAA Logistics Center and the FAA Academy at the Aeronautical Center; to the division level in the Office of Communication, Navigation, and Surveillance Engineering and Test Division at the Technical Center; to the branch level in the regional Airway Facilities divisions; and to all Airway Facilities field offices with a standard distribution.

3. **CANCELLATION.** Order 6950.2C, Electrical Power Policy Implementation at National Airspace System Facilities, dated November 16, 1987, is canceled.

4. **BACKGROUND.** The modernization of the NAS and revisions to the Electrical Power Policy created the need to revise this implementation order.

5. **EXPLANATION OF CHANGES.**

a. Extensive revisions to this order have been performed to comply with Public Law 104-113, H.R. 2196, the National Technology Transfer and Advancement Act of 1996, and to modernize outdated requirements contained in the existing order.

b. Specific changes have been made to incorporate sensitive electronic power requirements, especially in the power quality area. Appendix 1, Facility Power Source Codes, has been revised to reflect the current facility types. Also, appendix 1 has been divided into two sections - Part A - General National Airspace System (GNAS) and Part B - Air Route Traffic Control Center (ARTCC). Appendix 2, Current Distortion Guidelines, has been added to provide guidance for individual system/equipment harmonic assessment. Appendix 3, Power Criteria, has been added to give a description of the general power quality to be provided to mission related electronic equipment.

Distribution: A-W(AF/ND/SD/SU)-3; A-X(AF)-3; A-Y(ML/MA)-2; A-Z(ACT-300, 3 Copies); A-FAF-0 (STD)

Initiated By: ANS-600

6. **APPLICATION.** This order applies to all Federal Aviation Administration (FAA) NAS facilities without regard to maintenance and operational responsibility. The guidance and electrical power configurations identified by this order shall be used by the responsible organizations in establishing configuration requirements for FAA and non-FAA owned facilities. Those facilities solely for military or private use are exempted from this order. Standby power requirements for non-FAA airport lighting systems are identified in Advisory Circular 150/5340-17B, Standby Power for Non-FAA Airport Lighting Systems.

7. **RESPONSIBILITIES.**

a. NAS Transition and Integration (ANS) will issue technical standards and guidance to implement the power configurations necessary to meet requirements of this order and Order 6030.20.

b. Regional Airway Facilities divisions shall periodically review the performance of facility power systems and recommend changes consistent with operational requirements.

c. The appropriate program office or Integrated Product Team shall identify and budget for the power requirements of new facility types during the development process. The NAS Infrastructure Power Systems (NIPS) Product Team shall identify and budget for sustained power support programs required by the latest version of Federal Aviation Administration Acquisition Management System (AMS).

8. **GENERAL GUIDANCE.**

a. For definitions of facility types and services and facility contractions listed in appendix 1, of this order, use the latest version of Order 6000.5, Facility, Service, and Equipment Profile. Where contractions are not contained in Order 6000.5, they will be identified in the latest version of Order 1380.40, Airway Facilities Sector Level Staffing Standard System, Appendix 1, Facility Types, Contractions, and Definitions and the latest version of Order 1375.4, Standard Data Elements and Codes - Facility Identification and Supplemental Standards.

b. Appendix 1, of this order, identifies the standard power configuration which is effective upon issuance of the order. In many cases these standards will differ from present facility installations due to facility and equipment replacement programs or changes to operational service requirements. Changes to standard configurations in this order do not in themselves provide authority or desirability for change from the present configuration. Transition to new standards shall be accomplished under approved projects through normal budgetary actions. Deviations from the configurations in appendix 1 of this order or changes to baseline configurations shall be requested through the NAS Change Proposal (NCP) process in accordance with the latest version of Order 1800.8, National Airspace System Configuration Management, for all new facility or equipment installations. NCPs are not required for present installations which deviate from these standard configurations provided they are in conformance with prior standards and meet the operational requirements of the facility.

c. The Power Source Codes listed in appendix 1, of this order, are defined in Order 6000.5, Appendix 3, Special Use Facilities Master File Reporting Codes, and are further described as follows:

(1) A - denotes a commercial power source, a standby engine generator and an Uninterruptible Power Supply (UPS). This configuration shall provide uninterruptible, conditioned power with AC voltage in and AC voltage out.

(2) D - denotes a commercial power source and a battery standby power system. A UPS is not included in this category.

(3) V - denotes a photovoltaic or wind generator with a battery system.

(4) Z - denotes a single source of power continuously generated by an independent generating device; e.g., thermoelectric, prime power engine generator, nuclear, fuel cell, etc.

(5) 1 - denotes a commercial power source and a standby engine generator.

(6) 4 - denotes a single source of power.

(7) 8 - denotes dual, independent sources of commercial power; i.e., two separate substations.

d. For an airport identified as a Continuous Power Airport (CPA), as defined in Order 6030.20, only the facilities associated with the operation of the one designated CPA runway shall be configured with CPA facility power service levels indicated in appendix 1 of this order.

e. Where specified, power equipment used for support of Category II and III operations shall be capable of transferring to an alternate source within 1 second. The 1-second transfer time can be obtained by powering the facility with the engine generator during the Category II or III conditions and using commercial power as the standby source. Should the engine generator fail, the facility load will automatically transfer back to commercial power within the required 1-second transfer time. Once the Category II or III conditions have subsided, the facility shall be returned to the commercial (primary) power source.

f. Appendix 1, of this order, indicates the standard power service for each facility type. In some instances, an alternate configuration may satisfy facility requirements more cost-effectively. Requests for the following alternate configurations shall be accomplished through the NCP process:

(1) Power Source Code V may be used in place of Codes 4, 1, and D where reliability and life cycle cost considerations are favorable compared with engine generator systems or the installation and costs of primary commercial power. Battery reserve power for these systems should be sized for a minimum of 4 hours service based on the worst case environmental conditions for the particular facility location.

(2) Power Source Code Z may be used in place of Code 4 where reliability and life cycle cost considerations are favorable compared with the installation and costs of primary commercial power.

(3) Power Source Code D should be used in lieu of Code 1 when equipment upgrade allows facility's operational requirements to be satisfied by a battery standby power system.

g. Facilities with standby power systems, capable of being remotely monitored, should monitor the status of commercial power and standby power systems.

h. FAA facilities with standby power systems authorized by appendix 1, of this order, which are owned and operated by a non-FAA authority, must meet the requirements of the latest version of Order 6950.11, Reduce Electrical Power Interruptions at FAA Facilities.

9. **TECHNICAL GUIDANCE.**

a. Electrical power characteristics of the power provided to electronics equipment shall meet the conditions defined in appendix 3 of this order. Should the electrical power characteristics deviate from appendix 3 requirements, refer to the latest version of Order 6950.25, Use of Electrical Power Conditioning Devices at FAA Facilities, for corrective actions.

b. The quality of electrical power provided shall be of the reliability, availability, and voltage and frequency standards required for the facility. VOLTAGE Total Harmonic Distortion (THD) shall not exceed 5% THD or 3% HD for any single harmonic. These limits shall apply at the service entrance only. These limits are goals at all other facility voltage bus locations. Distortion exceeding these limits, including at the engine generator output, should be evaluated by personnel, who are competent in the technical power quality discipline, for adverse impact to equipment and power distribution system. For CURRENT distortion considerations, refer to paragraph 9j(5).

c. Specific requirements for various power services are as follows:

(1) Facilities which utilize a standby engine generator, Power Source Code 1, shall provide standby power within 15 seconds of a failure of the prime power source and shall be capable of sustained operation. ARTCC facilities using Power Source Code 1, will be provided standby power service as defined in the latest version of Order 6470.5, Maintenance of ARTCCs.

(a) In general, a 72 hour fuel supply shall be maintained. A reduced fuel supply may be maintained at locations where fuel is readily available and delivery agreements are in place; e.g., major airports and where fuel volume is continuously monitored. At facilities with difficult access, fuel supplies shall be determined on a site-by-site basis. In all cases, fuel supplies shall be based on actual engine generator loading, not on maximum engine fuel consumption rates.

(b) Facilities with pipeline-fed standby engine generators do not require stored fuel supplies, with the exception of facilities located in areas subject to pipeline failures. At these locations, fuel supplies shall be established on a site-by-site basis.

(c) Closed transition switching; e.g., Uninterruptible Power Transfer (UPT), shall be installed where justified by operational requirements, after coordination with the electric utility.

(2) Facilities which utilize a battery standby power system, Power Source Code D, shall provide standby power immediately (without interruption) upon failure of the prime power source and shall be capable of sustained operation for a minimum of 4 hours at the lowest normal operating temperature of the facility, usually the inside ambient temperature.

(a) A permanently wired means of connection with an appropriate transfer switch may be provided to permit a safe and accurate means to connect and disconnect an external generator to the facility's electrical system to permit recharge of the batteries in the event of a prolonged prime power outage.

(b) The battery system outputs shall be in multiples of 12 volts; e.g., 12, 24, 36, 48 volts and be sized for the systems served.

d. Facilities which utilize a dual source (Power Source Code 8) shall provide transfer from source to source within a maximum of 15 seconds.

e. Site generated power systems (Power Source Code V and Z) shall be established to provide continuous power without required on-site maintenance activity more frequent than the normal facility preventive maintenance schedule.

f. Agency owned prime engine generator power systems shall only be utilized where no other source of power is available or where the expense of other sources of power would exceed that of establishing and operating such a system. The system shall consist of at least two engine generators specifically designed for continuous operations, and shall have either automatic transfer switches designed in accordance with agency standards or 24-hour attendance.

g. Where system/equipments or subsidiary components are co-located at a facility or shelter and different power configurations are required by appendix 1, of this order, or where "same as host facility" appears in appendix 1, the following criteria shall be used, provided that power quality, capacity, and availability are not degraded:

(1) Where engine generator standby power is available, equipment, systems and components may be configured to Power Source Code 1. Standby battery systems connected to engine generators are not required to have the minimum 4-hour battery reserve.

(2) At facilities where batteries are the primary source of standby power, new equipment that has requirements for standby power may be reconfigured to Power Source Code D.

(3) At facilities with Power Source Code A, only systems/equipments designated as Power Source Code A in appendix 1, of this order, shall be allowed on the output of the facility UPS.

h. Power distribution systems shall be in accordance with FAA orders and specifications and with applicable national and local codes.

i. Power conditioning devices, not addressed by the power source codes in appendix 1, of this order, may be required at some facilities to provide a stable regulated power source. Each installation shall be separately justified, in accordance with the requirements of Order 6950.25. Prior to the installation of a power conditioning device to power specific loads in an existing facility, the following analyses shall be obtained:

(1) An analysis of the existing electronic equipment load characteristics to establish power consumption, current harmonics, inrush current profile, power factor, etc.

(2) An analysis to insure compatibility between the equipment load analysis obtained and the proposed power conditioning device.

(3) An analysis of the impact of the proposed power conditioning device on its source and the rest of the facility; e.g., voltage regulation, harmonic distortion, inrush currents and transient generation, resulting from powering the equipment load.

(4) On a study conducted in accordance with the latest version of Order 6950.27, Short Circuit Analysis and Protective Device Coordination Study (SCA/PDC).

(5) An analysis of the potential to introduce or worsen a "single point of failure" and the subsequent impact to the NAS.

j. Before connecting any equipment to a power bus/system, the following criteria must be satisfied:

(1) The equipment shall be operated and maintained in accordance with established FAA practices. For leased equipment that will be operated or maintained by a contractor, the contract shall require the equipment to be operated and maintained in accordance with FAA practices. Maintenance records and equipment shall be available at each leased equipment location for review and technical evaluation by designated FAA personnel. Equipment shall be tested until the FAA is assured it is compatible with the system from which it will be powered. Testing shall not be performed on a critical power system or on the output of a Power Source Code A system, unless there is an UPS specifically provided for testing purposes. All testing shall be completed and approved prior to the equipment being connected in an operational environment. At no time shall any equipment be connected to an existing facility's power system if it adversely affects the operation or performance of other equipment.

(2) The power required by the equipment must be analyzed to insure that the facility power system does not become overloaded or unbalanced.

(3) Peak inrush current and current THD of electronic equipment shall not exceed the limits specified in Specification FAA-G-2100, Electronic Equipment, General Requirements. All other loads shall have a peak inrush current characteristic that will not cause power anomalies detrimental to the facility operation, nuisance over-current device operation, or operational problems with the source.

(4) Power factor at the service entrance shall be within 0.8 lagging to 1.0 or as required by the local utility contract. Power factor at the engine generator output shall be 0.8 lagging to 1.0. Power factor at all other locations shall be considered with regard to energy conservation and performance of power sources and power conditioners. The total power factor is the product of the displacement power factor and the distortion power factor, $PF_{TOT} = (PF_{disp})(PF_{dist})$.

(5) The impact to the bus of the CURRENT THD of each electronic equipment/ system and environmental equipment/system (such as air conditioners, lighting, UPS, etc.) shall be considered when connecting to a bus. The curve in the graph, Current Distortion as a Function of System Load, in appendix 2 shall be used as a guideline to indicate when current distortion mitigation may be necessary to prevent the connection of high harmonic generative loads that will affect the VOLTAGE THD and thus, the power budget of the facility. When the distortion exceeds the curve for the specific load, an evaluation/analysis shall be performed by personnel, who are competent in the technical power quality discipline, to insure that there are no adverse impacts to equipment operation or the power distribution system.

10. **SPECIAL CONSIDERATIONS.** At some facilities, special situations may dictate a power configuration different from that described in paragraph 8 and assigned in appendix 1. Some of the special situations are discussed below:

a. **Meteorological.** A facility located in an area with a history of electrical, ice, or wind storms, which have caused abnormally frequent prime power disruptions and/or excessively long outages, may qualify for a higher grade power configuration if such disruptions cannot be tolerated.

b. **Accessibility**. A facility located in a remote area where a prime power outage is likely to be of a duration incompatible with operating requirements, and could result in excessive exposure of maintenance personnel to hazards, may qualify for a higher grade power configuration.

c. **Defense Readiness**. In some cases, the requirement to maintain an effective defense readiness posture differs from the normal operational requirement.

d. **Military Requirements**. A higher grade power configuration may be necessary due to specific military requirements.

e. **Power Quality**. A facility located in an area of poor utility power quality, that would adversely affect facility operation.

11. **IMPLEMENTATION**. All commissioned facilities shall be provided with power that is within the prescribed limits established by the facility standards and this order.

a. New installations shall be configured in accordance with this order.

b. An exception to the standard configuration identified by facility standards and this order shall be separately justified in accordance with paragraph 8b when a retention, establishment, modification or improvement project is proposed.

c. Changes to the power system or the installation of new equipment requires the accomplishment or update of short circuit analysis and protective device coordination studies in accordance with FAA-STD-032, Design Standards for National Airspace System Physical Facilities, and Order 6950.27.

Stanley Rivers
Director of Airway Facilities

APPENDIX 1. PART A, FACILITY POWER SOURCE CODES: GNAS

FACILITY TYPE	DEFINITION	POWER SOURCE CODE	COMMENTS
AFSS	Automated Flight Service Station	Automation Equip = A All other equipment = 1	
ALS	Approach Lighting System	4 (CAT I) 1 (CAT II/III) 1 (CPA)	CAT II/III requires 1 sec. transfer
ANICS	Alaska Interfacility Communication System	A	
ARMS	Airport Remote Monitoring System	D	
ARSR	Air Route Surveillance Radar	1	
ARTS - II	Automated Radar Terminal System	1	
ARTS-IIA		1	
ARTS - III	Automated Radar Terminal System	A	
ASDE-3 ASDE-X	Airport Surface Detection Equipment	A 1	Includes Antenna
ASI	Altimeter Setting Indicator		same as host facility
ASOS	Automated Surface Observation System	4	
ASR	Airport Surveillance Radar	A	
ATCBI	Air Traffic Control Beacon Interrogator	1	
ATCBI-6		A	
ATCRB	Air Traffic Control Radar Beacon	1	
ATCT (As defined by Order 6480.7)	Airport Traffic Control Tower	4 (Low and Intermediate activity with non-radar approach control) 1 (Low and Intermediate activity with radar approach control, major activity)	"critical services" (per Order 6480.7)=D "critical services" (per Order 6480.7)=1

Power Source Code Definitions:
A = Commercial Power + Engine Generator + UPS
D = Commercial Power + Batteries
V = Photovoltaic/Wind Generator + Battery
Z = Independent Generation
1 = Commercial Power + Engine Generator
4 = Commercial Power
8 = Dual Independent Commercial Power

APPENDIX 1. PART A, FACILITY POWER SOURCE CODES: GNAS

FACILITY TYPE	DEFINITION	POWER SOURCE CODE	COMMENTS
		A (level 4 and 5 towers)	"critical services" (per Order 6480.7)=A
ATIS	Automatic Terminal Information System		same as host facility
AWANS	Aviation Weather and NOTAM System	4	
AWIS	Airport Weather and Information System		same as host facility
AWOS	Automated Weather Observation System	4	
BDIS - Class A	Automatic Interchange Service B - Solid State	A	
BRITE	Brite Radar Indicator Terminal Equipment		same as host facility
BUEC	Back-up Emergency Communications	Code1 at sites with PSC 1; Code D at sites with PSC D - and a compatible external battery source; PSC 4 at all other sites	
CCMS	Central Control Monitoring System	A	"CPU only"
CCTV	Closed Circuit TV	4	
CD	Common Digitizer	A	
CERAP	Combined Center/Rapcon	1	
CFCC	Central Flow Control Computer	A	
CMLT	Communication Microwave Link Terminal	1	
COMCO	Command Communication Outlet	1	
CONUS/ NORAD	Radio	A	
DASI	Digital Altimeter Setting Indicator		same as host

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APPENDIX 1. PART A, FACILITY POWER SOURCE CODES: GNAS (CONTINUED)

FACILITY TYPE	DEFINITION	POWER SOURCE CODE	COMMENTS
DF	Direction Finder	4	
DFI	Direction Finder Indicator		same as host facility
DME	Distance Measuring Equipment		same as host facility
DMUX	Data Multiplex		same as host facility
DVRS	Digital Voice Recording System		same as host facility
EARTS	En Route Automated Radar Tracking System	A	
EOF	Emergency Operation Facility	1	
ERMS	Environmental Remote Monitoring System	TBD	
ETVS	Enhanced Terminal Voice Switching		same as host facility
FAATSAT	FAA Telecommunications Satellite	A	Ground-based equipment only
FCPU	Facility Central Processor Unit		same as host facility
FDEP	Flight Data Entry and Printout Equipment		same as host facility
FDIOR	Flight Data Input/Output Remote		same as host facility
FFM	ILS Far Field Monitor	D	
FLP	Field Lighting Panel		same as host facility
FM	Fan Marker	D	
FOTS	Fiber Optic Transmission System		same as host facility
FSDPS	Flight Service Data Processing System	A	
FSS	Flight Service Station	4	

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APPENDIX 1. PART A, FACILITY POWER SOURCE CODES: GNAS (CONTINUED)

FACILITY TYPE	DEFINITION	POWER SOURCE CODE	COMMENTS
GATR	Ground/Air Transmitter/Receiver	D	
GDL	Guidance Light Facility	4	
GMMS	GNAS Maintenance Control Center	1	
GOES	Geostationary Operational Environmental Satellite System		same as host facility
GS	Glide Slope		same as LOC
GWDS	Graphics Weather Display System		same as host facility
HCVR	High Capacity Voice Recorder	A	
ICSS	Integrated Communications Switching System	A (AFSS, TRACONS With ARTS III) Other	same as host facility same as host facility
IM	Inner Marker	D	
ISD	Interim Situation Display	A	
ITWS	Integrated Terminal Weather System	A	
LCOT	UHF/VHF Link Terminal	4	
LDA	Localizer Directional Aid	D	
LDIN	Lead in Light Facility	4	
LFDS	Large Facility Demarcation System	A	same as host facility
LLWAS	Low-Level Wind Shear Alert System	D (sensor) Central/Display Equipment	same are host facility
LMM	Compass Locator at the ILS Middle Marker	D	
LNKR	Link Repeater	4	
LOC	Localizer	D 1 (CPA)	
LOM	Compass Locator at the ILS Outer Marker	D	

Power Source Code Definitions:
A = Commercial Power + Engine Generator + UPS
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APPENDIX 1. PART A, FACILITY POWER SOURCE CODES: GNAS (CONTINUED)

FACILITY TYPE	DEFINITION	POWER SOURCE CODE	COMMENTS
LRNCM	Long Range Navigation C Monitor		same as host facility
MALS; MALSR	Medium Intensity Approach Lighting System; Medium Intensity ALS (MALS) with Runway Alignment Indicator Lights	4 (CAT I) 1 (CPA)	
MAPS	Meteorological and Aeronautical Presentation System	4	
MCC	Maintenance Control Center	1	
MCR	Multichannel Recorder		same as host facility
MLS	Microwave Landing System	D	
MM	Middle Marker	D	
MODE S	Mode Select Beacon System	1	
MTI Reflector	Moving Target Indicator - Reflector	V	
NDB	Non-Directional Beacon	4	
NXRAD (NEXRAD)	Next Generation Weather Radar	A	
OASIS	Operational And Supportability Implementation System	TBD	
OCC	Operational Control Center	A	
ODALS	Omnidirectional Airport Lighting System	4	
ODAPS	Oceanic Display and Planning System	A	
OFDPS	Offshore Flight Data Processing System	A	
OM	Outer Marker	D	
PAPI	Precision Approach Path Indicator	4	
PRM	Precision Runway Monitor	1	
RBC	Rotating Beam Ceilometer	4	

Power Source Code Definitions:
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APPENDIX 1. PART A, FACILITY POWER SOURCE CODES: GNAS (CONTINUED)

FACILITY TYPE	DEFINITION	POWER SOURCE CODE	COMMENTS
RCAG	Remote Center Air/Ground	D 1 with AC Linear Power Amplifier (LPA)	
RCE	Radio Control Equipment	A	
RCIU	Remote Control Interface Unit		same as host facility
RCLR	Radio Communications Link Repeater	D (Single Path) 1 Co-located Link Paths	
RCLT	Radio Communications Link Terminal		same as host facility
RCO	Remote Communications Outlet	4	
RDVS	Rapid Deployment Voice Switch	1	
REIL	Runway End Indentification Lights	4	
RMCC	Remote Monitor Control Center		same as host facility
RMCF	Remote Monitor Control Facility		same as host facility
RMLR	Radar Microwave Link Repeater	1 (single Long Range (LRR) Path) A (dual/triple LRR path)	
RMLT	Radar Microwave Link Terminal		same as host facility
RMVC	Remote Maintenance VORTAC Concentrator		same as host facility
RRH	Remote Readout Hygrothermometers	4	
RRCS	Remote Radio Control System		same as host facility
RRWDS	Radar Remote Weather Display System		same as host facility

Power Source Code Definitions:
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Z = Independent Generation
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APPENDIX 1. PART A, FACILITY POWER SOURCE CODES: GNAS (CONTINUED)

FACILITY TYPE	DEFINITION	POWER SOURCE CODE	COMMENTS
RTR	Remote Transmitter/Receiver	D	
RVR	Runway Visual Range	4 (CAT I) 1 (CAT II TD) 1 (CAT III) (TD, MP, RO) 1 (CPA TD) D New Generation RVR	 RO, MP = 4 RO, MP =4 (CAT I, CAT II, CAT III)
SALS, SSALR, SSALS	Shortened Approach Light System Simplified Short Approach Lighting System with Runway Alignment Indicator Lights Simplified Short Approach Light System	4 (CAT I) 1 (CPA)	
SCC	Systems Command Center	1	
SCIP	Surveillance and Communications Interface Processor		same as host facility
STARS	Standard Terminal Automation Replacement System	1 (ARTS II Replacement) A (ARTS III Replacement)	
STVSS	Small Tower Voice Switching System		same as host facility
TACAN	Tactical Air Navigation	1 (RTA-2) D (LPTA)	

Power Source Code Definitions:
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APPENDIX 1. PART A, FACILITY POWER SOURCE CODES: GNAS (CONTINUED)

FACILITY TYPE	DEFINITION	POWER SOURCE CODE	COMMENTS
TCCC	Tower Control Computer Complex		same as host facility
TCS	Tower Communications System		same as host facility
TDLS2		A	
TDWR	Terminal Doppler Weather Radar	A	
TMCC	Traffic Management Computer Complex		same as host facility
TMLI	Television Microwave Link Indicator		same as host facility
TMLR	Television Microwave Link Repeater		same as host facility
TMLT	Television Microwave Link Terminal		same as host facility
TMU	Traffic Management Unit	A	
TOWB	Tower Building	4 (Low and Intermediate Activity with non-radar approach control) 1 (Low and Intermediate Activity with radar approach control, major activity) 1 (All towers over 65 feet in height (cab floor) with elevator)	

Power Source Code Definitions:
A = Commercial Power + Engine Generator + UPS
D = Commercial Power + Batteries
V = Photovoltaic/Wind Generator + Battery
Z = Independent Generation
1 = Commercial Power + Engine Generator
4 = Commercial Power
8 = Dual Independent Commercial Power

APPENDIX 1. PART A, FACILITY POWER SOURCE CODES: GNAS (CONTINUED)

FACILITY TYPE	DEFINITION	POWER SOURCE CODE	COMMENTS
TRACO (TRACON)	Terminal Radar Approach Control Facility	1	
TWEB	Transcribed Weather Broadcast		same as host facility
VASI	Visual Approach Slope Indicator	4	
VOR	Very High Frequency Omnidirectional Range	D	
VOT	VHF Omnidirectional Range Test	4	
VSCS	Voice Switching and Control System		same as host facility
WAAS	Wide Area Augmentation System	A	

Power Source Code Definitions:
A = Commercial Power + Engine Generator + UPS
D = Commercial Power + Batteries
V = Photovoltaic/Wind Generator + Battery
Z = Independent Generation
1 = Commercial Power + Engine Generator
4 = Commercial Power
8 = Dual Independent Commercial Power

APPENDIX 1. PART B, FACILITY POWER SOURCE CODES: ARTCC (CONTINUED)

FACILITY TYPE	DEFINITION	POWER SOURCE CODE	COMMENTS
ADAS	AWOS Data Acquisition System	A	
AIS	Aeronautical Information System	A	
AMCC	ARTCC Maintenance Control Center	A	
ARTCC	Air Route Traffic Control Center	A	
ATOPS	Advance Technologies Oceanic Procedures System	A	
AWP	Aviation Weather Processor	A	
BWM	Bandwidth Manager	A	When FAA compliant power supplies are installed
BUEC	Back-up Emergency Communications	A	
CCCH	Central Computer Complex Host	A	
CCMS	Central Computer Monitoring System	A	"CPU only"
CCTV	Closed Circuit TV	1	
CDC	Computer Display Channel	A	
CFCC	Central Flow Control Computer	A	
CHILR	Chiller System	1	
CTRB	Center Building	1	
CTS	Coded Time Source	A	
CUE	Computer Update Equipment	A	
CWP	Central Weather Processor	A	
DARC	Direct Access Radar Channel	A	
DCCR	Display Channel Complex Replacement	A	
DLP	Data Link Processor	A	
DMN	Data Multiplexing Network	A	
DMUX	Data Multiplexer	A	
DRG	Data Receiver Group	A	
DSR	Display System Replacement	A	

Power Source Code Definitions:
A = Commercial Power + Engine Generator + UPS
D = Commercial Power + Batteries
V = Photovoltaic/Wind Generator + Battery
Z = Independent Generation
1 = Commercial Power + Engine Generator
4 = Commercial Power
8 = Dual Independent Commercial Power

APPENDIX 1. PART B, FACILITY POWER SOURCE CODES: ARTCC (CONTINUED)

FACILITY TYPE	DEFINITION	POWER SOURCE CODE	COMMENTS
DSRCE	Down Scoped Radio Control Equipment	A	
DYSIM	Dynamic Simulator	A	
DVRS	Digital Voice Recording System	A	
EARTS	En Route Automated Radar Tracking System	A	
EOF	Emergency Operation Facility	1	
ERMS	Environmental Remote Monitoring System	TBD	
FAATSAT	FAA Telecommunications Satellite	A	
FAB	Center Fan and Blower System	1	
FDEP	Flight Data Entry and Printout Equipment	A	
FDIOC	Flight Data Input/Output Center	A	
FOTS	Fiberoptic Transmission System	A	
FSDPS	Flight Service Data Processing System	A	
GOES	Geostationary Operational Environmental Satellite System	A	
HCVR	High Capacity Voice Recorder	A	
HID/NAS /LAN		A	
HOCSR	Host and Oceanic Computer System Replacement	A	
ITWS	Integrated Terminal Weather System	TBD	
LFDS	Large Facility Demarcation System	A	
LINCS	Leased Interfacility NAS Communications System	A	UPS provided by Lesser
MPS	Maintenance Processing System	A	
NADIN	National Airspace Data Interchange Network	A	

Power Source Code Definitions:
A = Commercial Power + Engine Generator + UPS
D = Commercial Power + Batteries
V = Photovoltaic/Wind Generator + Battery
Z = Independent Generation
1 = Commercial Power + Engine Generator
4 = Commercial Power
8 = Dual Independent Commercial Power

APPENDIX 1. PART B, FACILITY POWER SOURCE CODES: ARTCC (CONTINUED)

FACILITY TYPE	DEFINITION	POWER SOURCE CODE	COMMENTS
NRCS (NARACS)	National Radio Communications System	1	
NXRAD (NEXRAD)	Next Generation Weather Radar	A	
OCC	Operational Control Center	A	
PAMRI	Peripheral Adapter Module Replacement Item	A	
RACD	Remote ARTS Color Display		"same as host facility"
RCAG	Remote Center Air/Ground	A	
RCE	Radio Control Equipment	A	
RCIU	Remote Control Interface Unit	A	
RCLT	Radio Communications Link Terminal	A	
RMLT	Radar Microwave Link Terminal	A	
RRWDS	Radar Remote Weather Display System	A	
RMSC	Remote Monitoring Subsystem Concentrator	A	
RUMS	Remote User Monitoring System	A	
TDS	Telecommunications Demarcation System	A	
TMS	Traffic Management System	A	
TMU	Traffic Management Unit	A	
UNCS		1	UPS provided by lessor
VEARS	VSCS Emergency Access Radio System	A	
VSCS	Voice Switching and Control System	A	
VTROL	Center Environmental Control System	1	
VTS	Voice Transmission Switch	A	
WAAS	Wide Area Augmentation System	A	
WARP	Weather and Radar Processor	A	
WMSC	Weather Message Switching Center	1	

Power Source Code Definitions:
A = Commercial Power + Engine Generator + UPS
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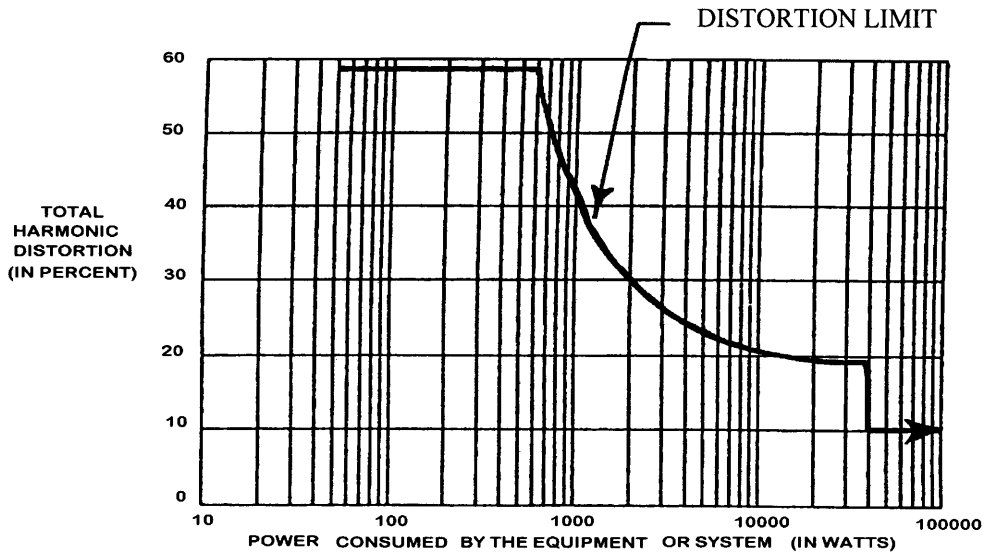
APPENDIX 2: CURRENT DISTORTION GUIDELINES



Distortion as a Function of System Load

Current Distortion as a Function of System Load

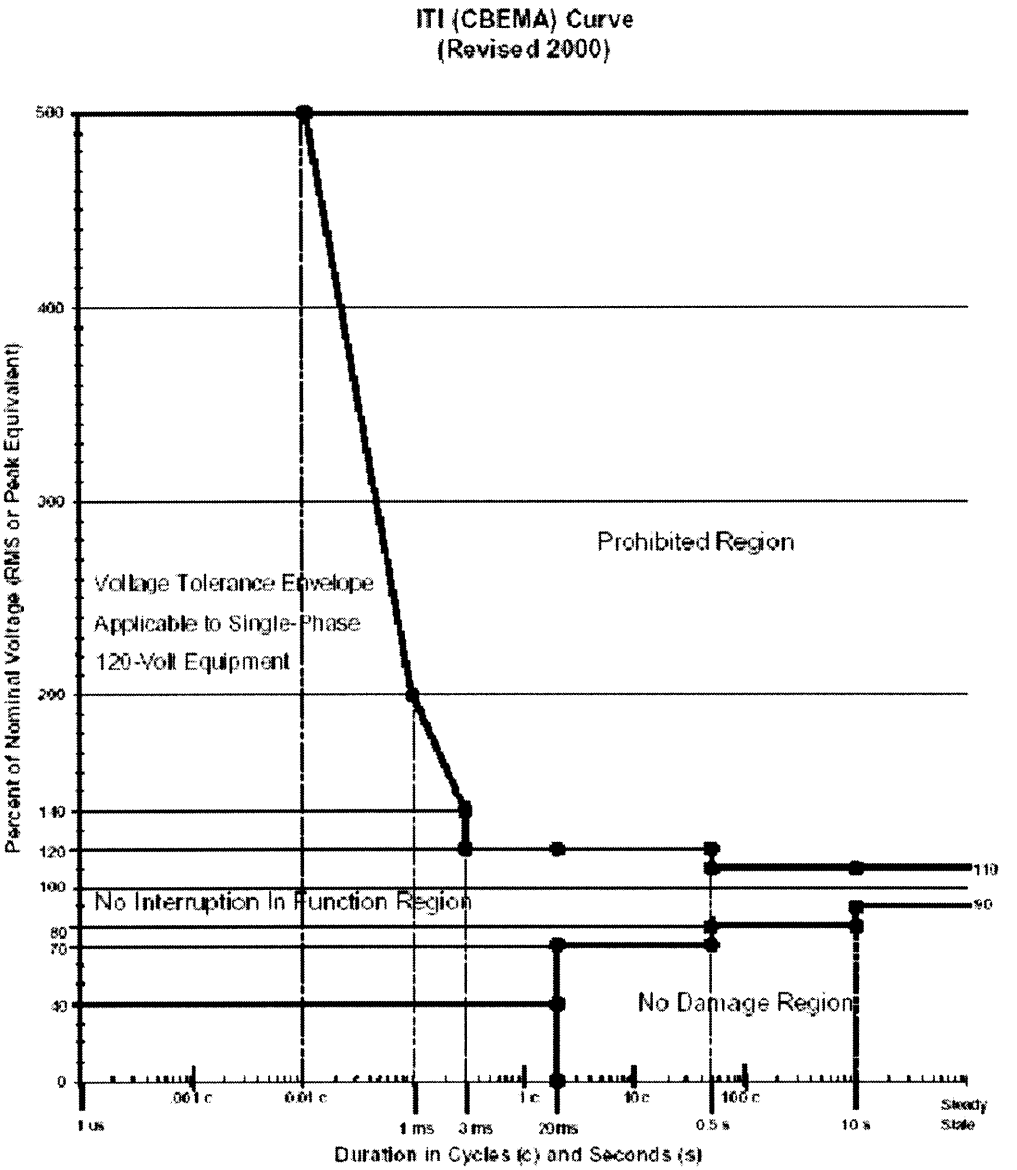
NOTE: This curve shall only be used as a guideline to indicate the possible need for an in-depth analysis to determine if there is a need for harmonic mitigation action for loads that exceed the harmonic level shown on the graph. The harmonic values shown on the graph from 50 to 60 watts and greater than 40,000 watts are arbitrary and not defining.

TABLE 1. LIMITS OF INDIVIDUAL HARMONICS		
Harmonic Order	**Maximum Limits (ma) For 50 < W < 600 (1 Phase)**	**Maximum Limits (ma) For 600 < W < 40K (1 or 3 Phase**
2	**1.00 x W**	**400+ (0.05 x W)**
3	**3.60 x W**	**1440 + (1.20 x W)**
4	**1.00 x W**	**400 + (0.05 x W)**
5	**2.00 x W**	**800 + (0.66 x W)**
6	**0.50 x W**	**200 + (0.02 x W)**
7	**1.50 x W**	**600 + (0.50 x W)**
8	**0.50 x W**	**200 + (0.02 x W)**
9	**1.00 x W**	**400 + (0.33 x W)**
10	**0.10 x W**	**100 + (0.01 x W)**
11	**0.06 x W**	**240 + (0.20 x W)**
12	**0.10 x W**	**100 + (0.01 x W)**
13	**0.51 x W**	**203 + (0.17 x W)**
14	**0.10 x W**	**50 + (0.01 x W)**
15	**0.44 x W**	**176 + (0.15 x W)**
16	**0.10 x W**	**50 + (0.01 x W)**
17	**0.39 x W**	**155+ (0.13 x W)**
18	**0.10 x W**	**50 + (0.01 x W)**
19	**0.35 x W**	**139 + (0.12 x W)**
20	**0.10 x W**	**50 + (0.01 x W)**

NOTE: W EQUALS POWER IN WATTS

NOTE: W EQUALS POWER IN WATTS.

APPENDIX 3: POWER CRITERIA



Published by:

FAA-G2100G

APPENDIX 3: POWER CRITERIA (CONTINUED)

1. Voltage

Nominal FAA Voltage	Voltage Range	
208/120 3 Phase	+10%,-15%	
480\277 3 Phase	"	
240/120 3 Phase	"	
120/240 1 Phase	"	
DC 48 Volts	+ or – 20%	AC Ripple less than or = 5%
DC 24 Volts	"	"
DC 12 Volts	"	"

These are standard FAA Voltages and are widely used in COTS equipments as well as being readily available from utility companies.

2. Voltage phase imbalance, phase to phase: 2% as defined by IEEE STD 141-1986 Paragraph 3.8.2

$$\text{Phase-voltage unbalance} = \frac{\text{Maximum deviation from average phase voltage}}{\text{average phase voltage}}$$

3.
   a. Frequency
      1. Steady state 60hz +or – 3 hz
      2. Steady state rate of change 1.5 Hz/sec`
      3. Steady state frequency variation + or – 0.5hz
   b. Momentary deviations (.5 cycles to 3 seconds)
      1. 60 Hz + 5 Hz, - 7 Hz
      2. Rate of change 5hz per sec.

NOTE: some of the information was derived from table 4-3, "Matching Sensitive Load and Power Source Requirements With Expected Environments" of IEEE STD 1100-1992 modified to be FAA specific.

CLEARANCE RECORD (See Instructions on Reverse)	KIND OF DOCUMENT: Order	IDENTIFICATION (If Any): 6950.2D, Chg 1

SUBJECT: Electrical Power Policy Implementation at National Airspace System Facilities

PERSON MOST FAMILIAR WITH ATTACHED

NAME	ROUTING SYMBOL	TELEPHONE
Lloyd Harrison	AOS-1000	202-493-4334

REASON FOR ATTACHED. WHAT DOES IT DO? *(Continue on reverse)*

CHANGE SUMMARY: Specific changes have been made to incorporate sensitive electronic power requirements, especially in the power quality area. Appendix 1, Facility Power Source Codes, has been revised to reflect the current facility types. Also, appendix 1 has been divided into two sections - Part A - General National Airspace System (GNAS) and Part B - Air Route Traffic Control Center (ARTCC). Appendix 2, Current Distortion Guidelines, has been added to provide guidance for individual system/equipment harmonic assessment. Appendix 3, Power Criteria, has been added to give a description of the general power quality to be provided to mission related electronic equipment.

PROPOSED DISTRIBUTION *(Spell out - Do not use code)*

ORIGINATING OFFICE CLEARANCE

ROUTING SYMBOL	INIT	ROUTING SYMBOL	DATE	SIGNATURE AND ROUTING SYMBOL	DATE	OFFICE FORMS APPROVAL	OFFICE REPORTS APPROVAL
		AOS-1020	9/10/03				
AOS-1000			9/29/03	Robert J. Morgan Jr.			

CLEARANCE ROUTING

DEADLINE DATE

ROUTING SYMBOL	INTERNAL CLEARANCE INIT	INTERNAL CLEARANCE ROUTING SYMBOL	INTERNAL CLEARANCE DATE	SIGNATURE AND ROUTING SYMBOL	DATE	CONCUR (Substance & Distribution) No Comment	CONCUR (Substance & Distribution) Comment Attached	NON-CONCUR Comment Attached	COMMENT ACCEPTED Changes Made
AFZ-300		AFZ-300	10/2/03	Labor Relations Specialist NO UNION COORDINATION REQD	10/2/03	X			
AOS-1				Program Director for Operational Support	10/2/03				
AFZ-600	FINAL ADMINISTRATIVE CLEARANCE				10/3/03				
AAF-1 AAF-3	RE FINAL APPROVAL (Authorizing Release)			Steven B. Zaidman, Director of Airway Facilities		DATE APPROVED 10/6/03			

AFTER APPROVAL SEND TO:

FAA Form 1300-2 (Facsimile)

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ASBESTOS SURVEY INVENTORY
TRI-CITY REGIONAL AIRPORT
AIR TRAFFIC CONTROL TOWER
BLOUNTVILLE, TENNESSEE

PREPARED FOR:

FEDERAL AVIATION ADMINISTRATION
NATIONAL HEADQUARTERS
ANS-204
800 INDEPENDENCE AVENUE, SW
WASHINGTON, DC 20591

NOVEMBER 16, 1992

PREPARED BY:

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FAA CONTRACT NO. DTFA01-91-Y-01035

RMCI PROJECT NO. A137-002-S081

FLING/MEYER

SECTION		PAGE
1.0	**GENERAL PROJECT INFORMATION**	**1-1**
1.1	INTRODUCTION	1-1
1.2	INSPECTION AND SAMPLING PROCEDURE	1-1
1.3	METHOD OF ANALYSIS	1-2
1.4	QUALITY CONTROL PROCEDURES	1-2
1.5	INSPECTION LIMITS	1-2
1.6	INSPECTION DATE	1-3
1.7	AIR TRAFFIC CONTROL TOWER INFORMATION	1-3
1.8	INSPECTION SUMMARY	1-3
2.0	**USES AND CLASSIFICATION OF ASBESTOS PRODUCTS**	**2-1**
2.1	INTRODUCTION	2-1
2.2	ASBESTOS PRODUCTS	2-1
2.2.1	Friction Products	2-1
2.2.2	Plastic Products	2-1
2.2.3	Cement Pipe and Sheet	2-1
2.2.4	Paper Products	2-2
2.2.5	Textile Products	2-2
2.2.6	Thermal Insulation and Decorative Products	2-2
2.2.7	Thermal System Insulation	2-2
2.2.8	Other Asbestos Uses	2-3
2.3	ASBESTOS CONTENT DETERMINATION	2-3
2.4	ASBESTOS HEALTH EFFECTS AND ROUTES OF ENTRY	2-3
2.4.1	The Human Respiratory System	2-4
2.4.2	Epidemiology	2-4
2.4.3	Diseases Associated With Asbestos Exposures	2-4
3.0	**FLOOR BY FLOOR ASBESTOS LOCATION SUMMARY**	**3-1**
3.1	ASBESTOS LOCATION SUMMARY	3-1

SECTION		PAGE
3.2	FIRST FLOOR	3-1
3.2.1	Floor Description	3-1
3.2.2	Suspect Material Summary	3-1
3.2.3	Asbestos-Containing Materials (ACM) Floor Discussion	3-1
3.3	SECOND FLOOR	3-2
3.3.1	Floor Description	3-2
3.3.2	Suspect Material Summary	3-2
3.3.3	Asbestos-Containing Materials (ACM) Floor Discussion	3-2
3.4	THIRD FLOOR	3-2
3.4.1	Floor Description	3-2
3.4.2	Suspect Material Summary	3-2
3.4.3	Asbestos-Containing Materials (ACM) Floor Discussion	3-3
3.5	FOURTH FLOOR	3-3
3.5.1	Floor Description	3-3
3.5.2	Suspect Material Summary	3-3
3.5.3	Asbestos-Containing Materials (ACM) Floor Discussion	3-3
3.6	FIFTH FLOOR	3-3
3.6.1	Floor Description	3-3
3.6.2	Suspect Material Summary	3-4
3.6.3	Asbestos-Containing Materials (ACM) Floor Discussion	3-4

SECTION		PAGE
3.7	SIXTH FLOOR	3-4
3.7.1	Floor Description	3-4
3.7.2	Suspect Material Summary	3-4
3.7.3	Asbestos-Containing Materials (ACM) Floor Discussion	3-5
3.8	SEVENTH FLOOR	3-5
3.8.1	Floor Description	3-5
3.8.2	Suspect Material Summary	3-5
3.8.3	Asbestos-Containing Materials (ACM) Discussion	3-5
3.9	OUT BUILDING	3-5
3.8.1	Out Building Description	3-5
3.8.2	Suspect Material Summary	3-6
3.8.3	Asbestos-Containing Materials (ACM) Discussion	3-6
3.10	RECOMMENDATIONS	3-6
3.11	LIMITATIONS	3-7

LIST OF TABLES

			FOLLOWS PAGE
TABLE 3-1	--	FIRST FLOOR SUSPECT MATERIAL SUMMARY	3-1
TABLE 3-2	--	SECOND FLOOR SUSPECT MATERIAL SUMMARY	3-2
TABLE 3-3	--	THIRD FLOOR SUSPECT MATERIAL SUMMARY	3-2
TABLE 3-4	--	FOURTH FLOOR SUSPECT MATERIAL SUMMARY	3-3
TABLE 3-5	--	FIFTH FLOOR SUSPECT MATERIAL SUMMARY	3-4
TABLE 3-6	--	SIXTH FLOOR SUSPECT MATERIAL SUMMARY	3-4
TABLE 3-7	--	SEVENTH FLOOR SUSPECT MATERIAL SUMMARY	3-5
TABLE 3-8	--	OUT BUILDING SUSPECT MATERIAL SUMMARY	3-6

LIST OF APPENDICES

APPENDIX A	--	DATA SUMMARY TABLE COLUMN DEFINITIONS AND DATA SUMMARY TABLE	-
APPENDIX B	--	EXHIBITS	-
APPENDIX C	--	PHOTOGRAPHS	-
APPENDIX D	--	LABORATORY RESULTS	-

OTHER

GLOSSARY	-

1.1 INTRODUCTION

This asbestos inspection report presents data which describe the condition and location of Asbestos-Containing Materials in the Tri-City Regional Airport Air Traffic Control Tower (ATCT). Asbestos-Containing Material (ACM) is defined as any material with an asbestos content of greater than one percent by area. This report is to be used as a program planning tool for all construction and maintenance activities scheduled at this ATCT.

All ACM identified in this report should be handled in accordance with all applicable federal, state and local regulatory requirements. This inspection report should also be used in conjunction with the FAA Operations and Maintenance Policy Manual for Asbestos-Containing Materials to insure minimal employee exposure and compliance with FAA management policy. All affected individuals should be trained to use this inspection report in conjunction with planned Operations & Maintenance (O&M) activities or renovations so that these activities are carried out properly. This will prevent unnecessary exposure to airborne asbestos fibers or the creation of an emergency abatement operation.

1.2 INSPECTION AND SAMPLING PROCEDURE

All inspection procedures and sample collections were conducted in accordance with AHERA and EPA guidelines.

An initial facility walk-through was conducted to familiarize the inspectors with the tower layout. The facility drawings were reviewed for accuracy and suspect materials were identified on each floor. The tower was then divided into functional spaces and suspect homogeneous materials were selected for bulk sampling. Samples were collected, floor-by-floor, and placed into zip-lock bags. Each sample was individually numbered and sample information was entered onto a field data sheet. Sample locations were recorded on plan drawings prepared for this purpose and are shown in Appendix B (Exhibits). Sample tools were decontaminated after each sample collection. The samples were delivered to an EPA-accredited laboratory for analysis, each accompanied by a completed chain-of-custody form.

Friable materials are materials which can be crumbled, pulverized, or reduced to powder by hand pressure. These materials were wetted prior to sampling to protect the inspector and FAA employees from exposure or accidental fiber release. At the inspector's discretion, personal protective equipment (PPE) was used as an added precaution.

Samples were collected using EPA guidelines for the type of suspect material. Where practical, sample locations were determined using random sampling methods. Within each area, samples were located where minimal aesthetic effect would occur to facility structures or finishes. A particular suspect material may be located in various separate places throughout the tower. The EPA does not require that these materials be sampled in each location, provided the materials are of the same type, age, appearance, have the same date of installation, and are sampled in accordance with AHERA requirements to provide statistically reliable data which can be extrapolated onto all remaining non-sampled areas.

Suspect materials were divided into three categories: 1) surfacing materials, such as plaster surface coatings, 2) thermal system insulation, such as mudded TSI fittings, duct insulation, and pipe insulation and 3) miscellaneous material, such as ceiling tile, mastics, and floor tile. AHERA protocol determines the number of samples of each material to be collected, depending on its category and amount of material present. The goal of AHERA is to insure statistically reliable data and it accomplishes this by requiring or suggesting a minimum number of samples to be collected, and in some cases, by using random sampling techniques to determine sample locations. However, in every case, AHERA relies on the judgment of inspectors who are experienced in AHERA methodology and the type of facilities being inspected. Sample collection points on each of the floors of the ATCT are identified on the Exhibits in Appendix B (Section 3.0 discusses these Exhibits in more detail).

1.3 METHOD OF ANALYSIS

Samples were analyzed in accordance with AHERA requirements using the following reference methods:

- EPA Interim Method for the Detection of Asbestos in Bulk Insulation Samples (EPA 600/M4-82020, December 1982).

- McCrone Research Institute's The Asbestos Particle Atlas.

All samples were analyzed using a polarized light microscope. Additional treatment and tests may be used as required to accurately define composition (i.e. ashing and extractions). All bulk sample laboratory reports were verified through an established quality assurance procedure. Unused portions of samples are archived for a minimum of six months.

1.4 QUALITY CONTROL PROCEDURES

All samples were analyzed by laboratories accredited by the National Voluntary Laboratory Accreditation Program (NVLAP). These laboratories participate in the NVLAP, as well as the American Industrial Hygienists Association (AIHA) Bulk Asbestos Sample Quality Assurance Program.

A minimum of five percent of all samples collected were divided into replicates and were analyzed by a laboratory other than the primary laboratory (Appendix D). Results from the two laboratories were compared for consistency.

RMCI verified all of the sample data for accuracy. This was accomplished by cross-referencing field data sheets, chain-of-custodies, and field notes.

1.5 INSPECTION LIMITS

All interior spaces and rooms owned, occupied, and/or maintained by the FAA were inspected for asbestos-containing materials. The facility roofs and attached exterior surfaces of FAA owned facilities were also inspected. Bulk samples of roofs and exterior surfaces were collected only if damage to the substrates could be avoided. RMCI did not inspect underground conduit, appurtenances, electrical systems, or any above-ground structures not directly attached to the ATCT.

In areas that were not owned, maintained, or occupied by FAA, but where FAA personnel require access, the asbestos-containing material inspection was limited to photo and field documentation, unless these areas contained HVAC equipment that could affect FAA personnel. In these cases RMCI sampled the suspect ACM. Roofs and exteriors of facilities not owned by the FAA were photographed and documented, but no samples were collected.

1.6 INSPECTION DATE

The Tri-City Regional Airport ATCT was inspected on May 13, 1992.

1.7 AIR TRAFFIC CONTROL TOWER CONSTRUCTION INFORMATION

The Tri-City Regional Airport ATCT is a Low Activity Rad (LAR) tower with elevator. The tower consists of seven floors and a five-sided cab with an existing mop-down roof, all occupied by the FAA. The exterior walls are composed of painted metal panels and the facility was constructed on a poured concrete slab. The stair, cable shaft, and pipe chase extend vertically through the tower, beginning on the first floor and terminating on the sixth floor. No major renovations have taken place in the last few years according to on-site FAA personnel. An unattached building, which measures 32 feet x 16 feet and constructed of painted metal panels and a sloping metal roof, contains an electrical generator to provide stand-by electricity for the tower building. Because it is accessed by FAA personnel, suspect material samples were collected in the engine generator room of that building.

1.8 INSPECTION SUMMARY

The following ACM was identified in the Tri-City Regional Airport ATCT (all quantities are approximate):

- First Floor Cable Access Room
  - 52 sq ft of 1 ft x 1 ft blue floor tile mastic
- First Floor Elevator Car
  - 16 sq ft of 1 ft x 1 ft beige floor tile mastic
- First Floor Elevator Machine Room
  - 68 sq ft of 1 ft x 1 ft blue floor tile mastic
- First Floor Entry
  - 130 sq ft of 1 ft x 1 ft beige speckled floor tile mastic
- First Floor Hall
  - 100 sq ft of 1 ft x 1 ft beige speckled floor tile mastic

1.8 INSPECTION SUMMARY (Continued) -- all quantities are approximate.

- First Floor Mechanical Equipment Room
  - 154 sq ft of 1 ft x 1 ft blue floor tile mastic
- First Floor Pipe Chase
  - inaccessible; assume ACM
- First Floor Stair
  - 25 sq ft of 1 ft x 1 ft beige speckled floor tile mastic (mid-landing)
- First Floor Storage Room
  - 140 sq ft of 1 ft x 1 ft blue floor tile mastic
- Second Floor Entry
  - 60 sq ft of 1 ft x 1 ft beige speckled floor tile mastic
- Second Floor Mechanical Equipment and Storage Room
  - 168 sq ft of 1 ft x 1 ft blue floor tile mastic
- Second Floor Pipe Chase
  - inaccessible; assume ACM
- Second Floor Stair
  - 25 sq ft of 1 ft x 1 ft beige speckled floor tile mastic (mid-landing)
- Third Floor Entry
  - 75 sq ft of 1 ft x 1 ft beige speckled floor tile mastic
- Third Floor Mechanical Equipment and Storage Room
  - 154 sq ft of 1 ft x 1 ft blue floor tile mastic
- Third Floor Pipe Chase
  - inaccessible; assume ACM

1.8 INSPECTION SUMMARY (Continued) -- all quantities are approximate.

- Third Floor Stair
  - 25 sq ft of 1 ft x 1 ft beige speckled floor tile mastic (mid-landing)
- Third Floor Storage Room
  - 85 sq ft of 1 ft x 1 ft blue floor tile mastic
- Fourth Floor Electronic Equipment Room
  - 650 sq ft of 1 ft x 1 ft blue floor tile mastic
- Fourth Floor Entry
  - 60 sq ft of 1 ft x 1 ft blue floor tile mastic
- Fourth Floor Janitor's Closet
  - 25 sq ft of 1 ft x 1 ft blue floor tile mastic
- Fourth Floor Mechanical Equipment Room
  - 165 sq ft of 1 ft x 1 ft blue floor tile mastic
- Fourth Floor Pipe Chase
  - inaccessible; assume ACM
- Fourth Floor Stair
  - 25 sq ft of 1 ft x 1 ft beige speckled floor tile mastic (mid-landing)
- Fifth Floor ATCT Administration Supervisor's Office
  - 165 sq ft of 1 ft x 1 ft blue floor tile mastic
- Fifth Floor Entry
  - 78 sq ft of 1 ft x 1 ft beige floor tile mastic
- Fifth Floor Pipe Chase
  - inaccessible; assume ACM

1.8 INSPECTION SUMMARY (Continued) – all quantities are approximate.

- Fifth Floor TRACON
  - 340 sq ft of 1 ft x 1 ft blue floor tile and mastic (behind equipment)
- Sixth Floor Breakroom
  - 525 sq ft of 1 ft x 1 ft blue floor tile mastic
- Sixth Floor Entry
  - 60 sq ft of 1 ft x 1 ft blue floor tile mastic
- Sixth Floor Mechanical Equipment and Storage Room
  - 184 sq ft of 1 ft x 1 ft blue floor tile mastic
- Sixth Floor Pipe Chase
  - inaccessible; assume ACM
- Sixth Floor TELCO Room
  - 72 sq ft of 1 ft x 1 ft blue floor tile mastic
- Sixth Floor Roof
  - 100 lin ft of roof flashing
  - rolled roofing (not sampled to avoid damage; assume ACM)
  - roof mastic (not sampled to avoid damage; assume ACM)
  - roof tar (not sampled to avoid damage; assume ACM)
- Seventh Floor Cab Roof
  - 100 lin ft of roof flashing
  - rolled roofing (not sampled to avoid damage; assume ACM)
  - roof mastic (not sampled to avoid damage; assume ACM)
  - roof tar (not sampled to avoid damage; assume ACM)

2.1 INTRODUCTION

Asbestos minerals are hydrated magnesium silicates which display a crystalline structure and occur naturally as parallel bundles of minute fibers. The physical disturbance of these bundles generally results in separation into smaller bundles of individual fibers.

Asbestos minerals are divided into two groups - serpentine and amphiboles. Serpentine minerals display a sheet or layered crystalline structure, while amphiboles demonstrate a chain-like crystalline structure. Chrysotile, a serpentine, is the most commonly used type of asbestos and accounts for approximately 95 percent of the asbestos found in buildings in the United States. In the amphibole group, amosite is the most likely asbestos type to be found in buildings, followed by crocidolite. Anthophyllite, tremolite, and actinolite are also in the amphibole group, but are of little commercial value.

2.2 ASBESTOS PRODUCTS

Asbestos has been used in more than 3000 commercial products because of its high strength and flexibility, its noncombustible properties and chemical stability, and its poor conduction of heat and electricity. Building materials which contain asbestos are referred to as Asbestos-Containing Materials, or ACM. Based on fiber release potential, ACM is classified as either: 1) friable; or 2) non-friable. Friable is defined as the ability to crush or reduce to powder by hand pressure. Under normal operating or use conditions, friable material is thought to release asbestos fibers more readily and under less disturbance than non-friable materials, thus increasing the chance for employee exposure. Below is a brief discussion of product types which use asbestos.

2.2.1 Friction Products

Asbestos is used in brake linings for automobiles, buses, trucks, railcars, industrial machinery, and in vehicle or industrial clutch linings. Friction materials are generally considered non-friable, but asbestos dust may be released during fabrication, installation, and product use.

2.2.2 Plastic Products

Plastic products include vinyl-asbestos tile (VAT), asphalt floor coverings, asphalt roof coatings, and traditional molded plastic products. The asbestos in these products is usually tightly bound. However, any sawing, drilling, or sanding will result in the release of asbestos dust.

2.2.3 Cement Pipe and Sheet

Asbestos-cement (A-C) pipe has been widely used for water and sewer mains, and is occasionally used for electrical conduit, drainage pipes, and vent pipes. Asbestos-cement sheets (transite), manufactured in flat or corrugated panels and shingles, have been used primarily for roofing and siding.

The normal use of A-C pipe for water or sewer mains has been shown to release asbestos fibers to the fluid being carried through them. The asbestos in A-C pipe and sheets is tightly bound, and is not released to the air under normal use. However, any sawing, drilling or sanding of these materials during installation, renovation or removal will result in fiber releases. In addition, normal breakage and crushing involved in the demolition of structures can result in asbestos fiber release. For this reason, these materials are subject to NESHAP regulations during demolition operations.

2.2.4 Paper Products

Roofing felts, gaskets, pipeline wrap, insulating paper, aircell, and other paper products were manufactured using asbestos fibers instead of cellulose. The asbestos fibers in most paper products are sufficiently bound to prevent their release during normal product use, however, some are considered friable. In addition, cutting or tearing the material during installation, use, or removal may result in a release of asbestos dust.

2.2.5 Textile Products

Asbestos yarn, cloth, rope, and other textiles are used to manufacture fire-resistant curtains or blankets, protective clothing, gaskets, vibration collars, electrical insulation, thermal insulation, and packing seals. These raw textile products have a high asbestos content (85 percent). However, they are typically coated or impregnated with polymers before assembly into final products. These products may release asbestos fibers if cut or torn, or for some products, during normal use.

2.2.6 Thermal Insulation and Decorative Products

These types of products were commonly applied to steel I-beams and decks, concrete ceilings, and walls. Most of these materials are considered friable and may contain 50 to 90 percent asbestos. Most sprayed-on materials were banned for fireproofing or insulation in 1973, and for decorative purposes in 1978.

Asbestos insulation board was used as a thermal or fireproofing barrier in many types of walls and ceilings, as well as ducts and pipe enclosures. High asbestos dust levels have been measured during many board handling operations, including simple unloading of uncut sheets.

2.2.7 Thermal System Insulation

Asbestos-containing thermal system insulation (TSI) generally refers to sprayed, troweled, molded (prefabricated), and/or wet-applied asbestos insulation used to cover boilers, piping, and tank heating systems. These materials generally have an asbestos content ranging from 50 to 90 percent by volume, and were placed on systems to increase energy efficiency and prevent condensation. TSI coverings are considered friable.

Heating, Ventilation, and Air Conditioning (HVAC) systems, including pipe and boiler equipment, were also covered with ACM to increase their efficiency and reduce energy requirements. HVAC ducting may also be covered with aircell-like materials, batting, felts, transite-like sheeting, paints, mastics, and wrap.

2.2.8 Other Asbestos Uses

Other uses of asbestos have included exterior siding shingles, shotgun shell base wads, asphalt paving mix, spackle and joint compounds, artificial logs for gas fireplaces, artificial snow, and various thermal paints. Use of asbestos as an ingredient in spackle and joint compounds was banned in 1978.

2.3 ASBESTOS CONTENT DETERMINATION

The positive identification of asbestos in a material or product can only be made through laboratory analysis. Visual inspection or common knowledge is not a positive test. The asbestos content of suspect materials is determined by collecting a bulk sample and having it analyzed by polarized light microscopy (PLM). The PLM technique determines both the percent and species of asbestos in the bulk sample.

If an asbestos fiber release is suspected, air samples may be collected to determine the ambient air concentration of fibers in a given location or workplace. These samples are analyzed by phase contrast microscopy (PCM) to determine if suspect fibers are present in the ambient air samples based on a specific morphology; i.e., shape and size. In this instance, a "fiber" refers only to a specific shape and size, and does not specifically mean asbestos fiber. To confirm the presence of asbestos, the air samples must be analyzed by either scanning or transmission electron microscopy (SEM/TEM) techniques. RMCI did not collect air samples in this tower.

Trace amounts of asbestos can be detected on surfaces through the collection of vacuum samples. These samples are vacuumed onto an air collection cassette and then analyzed by PCM or TEM. Tape samples are also used to detect the presence of ACM on surfaces by collecting the material on an adhesive surface. The tape is then mounted on a clear slide and analyzed by PLM.

2.4 ASBESTOS HEALTH EFFECTS AND ROUTES OF ENTRY

Asbestos exposure may be occupational, para-occupational, or environmental in origin. Although asbestos exposure may have occurred during childhood, the manifestation of asbestos-related diseases may not occur for many years. Furthermore, asbestos may enhance the carcinogenic effects of other materials.
Most of the conclusive evidence regarding asbestos exposure health effects is derived from studies of occupational exposure of asbestos-application workers. These workers experienced asbestos fiber concentrations many times higher than those encountered by the public or by most office workers in buildings containing ACM. Individuals who work in facilities which contain friable ACM may experience higher than normal risks when compared to the general public. The available data, however, are not conclusive and do not allow precise estimates of actual risk.

The primary route of exposure leading to the development of a disease caused by asbestos is inhalation of airborne fibers. Although digestion and dermal penetration have been demonstrated as possible exposure routes in clinical and laboratory studies, they generally are not viewed as occupational exposure routes in most settings. In most cases where negative health effects occurred due to asbestos exposure, the diseases manifested themselves in the respiratory system.

2.4.1 The Human Respiratory System

The respiratory tract is the channel by which air flows into and out of the lungs. The respiratory system is sensitive to bacteria, viruses, and airborne particles that can be inhaled. Reaction to these irritants can disrupt the functioning of the system, resulting in ailments such as the common cold, hay fever, sinusitis, sore throat, acute or chronic bronchitis, emphysema, and lung cancer.

When air-suspended asbestos particles enter the airway and reach air sacs in the lungs, white blood cells may attempt to engulf and digest the particles. As a secondary defense, the white blood cells may also deposit a calcium-like coating on the fiber. These coated fibers clog and scar the lung tissue, and accumulate if exposure continues. As a result, the lungs may lose their ability to supply oxygen to the blood stream. If the white blood cells do not engulf the fibers and the body does not eliminate the foreign material, the fiber may migrate through the lung tissue to the mesothelium or enter the bloodstream. This may result in the development of a carcinoma in other organs or tissues of the body.

2.4.2 Epidemiology

More than 30 major epidemiological studies have been conducted to determine the health effects of occupational asbestos exposure. These data suggest that asbestos is a human carcinogen which causes lung cancer, mesothelioma, and some other cancers, as well as asbestosis.

Epidemiological data suggest a synergistic relationship between asbestos and smoking. Workers exposed to the same level of asbestos as insulation workers historically increase their risk of developing lung cancer by five times. The smoker exposed to asbestos fibers is at least 50 times more likely to develop lung cancer than non-smokers who do not work with asbestos.

2.4.3 Diseases Associated With Asbestos Exposures

The link between asbestos and the lung disease "asbestosis" dates to 1900. Autopsy reports from 1928 to 1949 indicated that a large number of persons who died with asbestosis also had lung cancer. In the 1960s the link between asbestos and a rare form of cancer called "mesothelioma" was established. Diseases attributed to asbestos exposures are asbestosis, mesothelioma, and lung cancer. Other diseases noted in workers exposed to asbestos include cancer of the larynx, esophagus, stomach, colon-rectum, kidney, and pancreas. However, this correlation is not conclusive.

3.1 ASBESTOS LOCATION SUMMARY

This section discusses inspection findings and analytical results for suspect Asbestos-Containing Material (ACM) sampled in the tower. Potential for asbestos fiber release and recommendations for future action are presented for all ACM identified. A suspect material summary table has been prepared for each floor of the tower, and is organized to show the material analyzed, its asbestos content, location, and record number, on a room-by-room basis. The record number has been assigned to access additional inspection information from the Data Summary Table found in Appendix A. This table provides additional inspection data and cross-referenced information relevant to each suspect material identified in each room. ACM is also shown in the Exhibits located in Appendix B.

3.2 FIRST FLOOR

3.2.1 Floor Description

The first floor of the Tri-City Regional Airport ATCT measures approximately 1,150 square feet. The first floor is divided into twelve areas including: the entry, mechanical equipment room, AF Radar Unit Supervisor's office, cable pit, pipe chase, cable access room, elevator machine room, elevator car, elevator shaft, storage room, hall, and stair. The first floor layout and sample locations are shown in Exhibit 1 (Appendix B).

3.2.2 Suspect Material Summary

All areas on the first floor were assigned to specific functional spaces. The following suspect materials were identified on the first floor: 1 ft x 1 ft beige speckled floor tile and mastic, 1 ft x 1 ft blue floor tile and mastic, baseboard mastic, spray-on insulation, 2 ft x 4 ft fissured ceiling tile, drywall, drywall tape and joint compound, and a vibration collar (HVAC).

Representative samples of these materials were sent to an accredited laboratory for analysis. Results are summarized in Table 3-1. Additional inspection information can be found in the Data Summary Table (Appendix A).

3.2.3 Asbestos-Containing Materials (ACM) Floor Discussion

Samples of the 1 ft x 1 ft beige speckled floor tile mastic, located in the entry, elevator car, hall, and stair landing, contain 25 percent chrysotile asbestos. Samples of the 1 ft x 1 ft blue floor tile mastic, located in the mechanical equipment room, cable access room, elevator machine room and storage room, contain 25 percent chrysotile asbestos. The floor tile mastics were classified as non-friable and were in good condition at the time of the inspection. The pipe chase was not accessible for sampling at the time of the inspection and should be assumed to contain ACM. Recommendations regarding the ACM can be found in Section 3.10. Approximate ACM locations can be found in Exhibit 1 (Appendix B).

NOVEMBER 16, 1992

TABLE 3-1
TRI CITY REGIONAL AIRPORT
FIRST FLOOR SUSPECT MATERIAL SUMMARY

NAME OF ROOM	MATERIAL DESCRIPTION	COMMENTS	PERCENT ASBESTOS	LOCATION	ACTUAL SAMPLE	RECORD NUMBER
AF RADAR UNIT SUPERVISOR						
	2 FT X 4 FT FISSURED CEILING TILE			C		1
	BASEBOARD MASTIC			W		2
	DRYWALL			W		3
	DRYWALL TAPE & JOINT COMPOUND			W		4
CABLE ACCESS ROOM						
	1 FT X 1 FT BLU FLOOR TILE	MASTIC, ONLY, CONTAINS ASBESTOS		F		5
	1 FT X 1 FT BLU FLOOR TILE MASTIC		25.0	F		6
	BASEBOARD MASTIC			W		7
	DRYWALL			W		8
	DRYWALL TAPE & JOINT COMPOUND			W	1- 9S	9
	DRYWALL TAPE & JOINT COMPOUND			W	1-10S	10
CABLE PIT						
	SPRAY-ON INSULATION			M	1- 3S	11
	SPRAY-ON INSULATION			M	1- 4S	12
ELEVATOR CAR						
	1 FT X 1 FT BGE SPCKLD FLOOR TILE	MASTIC, ONLY, CONTAINS ASBESTOS		F		13
	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC		25.0	F		14
ELEVATOR MACHINE ROOM						
	1 FT X 1 FT BLU FLOOR TILE	MASTIC, ONLY, CONTAINS ASBESTOS		F		15
	1 FT X 1 FT BLU FLOOR TILE MASTIC		25.0	F		16
	BASEBOARD MASTIC			W		17
	DRYWALL			W		18
	DRYWALL TAPE & JOINT COMPOUND			W		19
	SPRAY-ON INSULATION			C		20
ELEVATOR SHAFT						
	SEE COMMENTS	NO SUSPECT MATERIALS				21
ENTRY						
	1 FT X 1 FT BGE SPCKLD FLOOR TILE	MASTIC, ONLY, CONTAINS ASBESTOS		F		22

FOR LOCATION: F = FLOOR W = WALL C = CEILING R = ROOF M = MISCELLANEOUS SAMPLE NUMBERS: P = PREVIOUS INSPECTION

NOVEMBER 16, 1992

TABLE 3-1
TRI CITY REGIONAL AIRPORT
FIRST FLOOR SUSPECT MATERIAL SUMMARY

NAME OF ROOM	MATERIAL DESCRIPTION	COMMENTS	PERCENT ASBESTOS	LOCATION	ACTUAL SAMPLE	RECORD NUMBER
ENTRY						
	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC		25.0	F		23
	BASEBOARD MASTIC			W		24
	SPRAY-ON INSULATION			C		25
	2 FT X 4 FT FISSURED CEILING TILE			C	1- 7M	26
	2 FT X 4 FT FISSURED CEILING TILE			C	1- 8M	27
HALL						
	1 FT X 1 FT BGE SPCKLD FLOOR TILE	MASTIC, ONLY, CONTAINS ASBESTOS		F		28
	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC		25.0	F		29
	2 FT X 4 FT FISSURED CEILING TILE			C		30
	BASEBOARD MASTIC			W		31
MECHANICAL EQUIPMENT RM						
	DRYWALL			W		32
	DRYWALL TAPE & JOINT COMPOUND			W		33
	SPRAY-ON INSULATION			C		34
	1 FT X 1 FT BLU FLOOR TILE	MASTIC, ONLY, CONTAINS ASBESTOS		F	1- 1M	35
	1 FT X 1 FT BLU FLOOR TILE MASTIC		25.0	F	1- 1M	36
	BASEBOARD MASTIC			W	1- 2M	37
PIPE CHASE						
	SEE COMMENTS	INACCESSIBLE; ASSUME ACM				38
STAIR						
	1 FT X 1 FT BGE SPCKLD FLOOR TILE	MASTIC, ONLY, CONTAINS ASBESTOS		F		39
	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC	MID-LANDING	25.0	F		40
	DRYWALL			W		41
	DRYWALL TAPE & JOINT COMPOUND			W		42
STORAGE						
	1 FT X 1 FT BLU FLOOR TILE	MASTIC, ONLY, CONTAINS ASBESTOS		F		43
	1 FT X 1 FT BLU FLOOR TILE MASTIC		25.0	F		44
	BASEBOARD MASTIC			W		45
	DRYWALL			W		46

FOR LOCATION: F = FLOOR W = WALL C = CEILING R = ROOF M = MISCELLANEOUS SAMPLE NUMBERS: P = PREVIOUS INSPECTION

NOVEMBER 16, 1992

TABLE 3-1
TRI CITY REGIONAL AIRPORT
FIRST FLOOR SUSPECT MATERIAL SUMMARY

NAME OF ROOM	MATERIAL DESCRIPTION	COMMENTS	PERCENT ASBESTOS	LOCATION	ACTUAL SAMPLE	RECORD NUMBER
STORAGE						
	DRYWALL TAPE & JOINT COMPOUND			W		47
	SPRAY-ON INSULATION			C		48

FOR LOCATION: F = FLOOR W = WALL C = CEILING R = ROOF M = MISCELLANEOUS SAMPLE NUMBERS: P = PREVIOUS INSPECTION

3.3 SECOND FLOOR

3.3.1 Floor Description

The second floor of the Tri-City Regional Airport ATCT measures approximately 1,150 square feet. The floor is divided into ten areas including: the AT Manager's office, secretary/receptionist's area, Area Manager's office, lavatory, mechanical equipment and storage room, stair, cable shaft, elevator shaft, pipe chase, and entry. The second floor layout and sample locations are shown in Exhibit 2 (Appendix B).

3.3.2 Suspect Material Summary

All areas on the second floor were assigned to specific functional spaces. The following suspect materials were identified on the second floor: 1 ft x 1 ft beige speckled floor tile and mastic, 1 ft x 1 ft blue floor tile and mastic, drywall, spray-on insulation, 2 ft x 4 ft fissured ceiling tile, pipe wrap, baseboard mastic, and drywall tape and joint compound. Representative samples of these materials were sent to an accredited laboratory for analysis. Results are summarized in Table 3-2. Additional inspection information can be found in the Data Summary Table (Appendix A).

3.3.3 Asbestos-Containing Materials (ACM) Floor Discussion

Samples of the 1 ft x 1 ft beige speckled floor tile mastic, located in the entry and stair landing, contain 25 percent chrysoltile asbestos. Samples of the 1 ft x 1 ft blue floor tile mastic, located in the mechanical equipment and storage room, contain 25 percent chrysotile asbestos. The floor tile mastics were classified as non-friable and were in good condition at the time of the inspection. The pipe chase was not accessible for sampling at the time of the inspection and should be assumed to contain ACM. Recommendations regarding the ACM can be found in Section 3.10. Approximate ACM locations can be found in Exhibit 2 (Appendix B).

3.4 THIRD FLOOR

3.4.1 Floor Description

The third floor of the Tri-City Regional Airport ATCT measures approximately 1,150 square feet. The floor is divided into ten areas including: the entry, lavatory, QA Specialist's office, training room, mechanical equipment and storage room, storage room, stair, cable shaft, pipe chase, and elevator shaft. The third floor layout and sample locations are shown in Exhibit 3 (Appendix B).

3.4.2 Suspect Material Summary

All areas on the third floor were assigned to specific functional spaces. The following suspect materials were identified on the third floor: 1 ft x 1 ft beige speckled floor tile and mastic, 1 ft x 1 ft blue floor tile and mastic, drywall, spray-on insulation, 2 ft x 4 ft fissured ceiling tile, baseboard mastic, and drywall tape and joint compound. Representative samples of these materials were sent to an accredited laboratory for analysis. Results are summarized in Table 3-3. Additional inspection information can be found in the Data Summary Table (Appendix A).

NOVEMBER 16, 1992

TABLE 3-2
TRI CITY REGIONAL AIRPORT
SECOND FLOOR SUSPECT MATERIAL SUMMARY

NAME OF ROOM	MATERIAL DESCRIPTION	COMMENTS	PERCENT ASBESTOS	LOCATION	ACTUAL SAMPLE	RECORD NUMBER
AREA MANAGER						
	2 FT X 4 FT FISSURED CEILING TILE			C		49
	BASEBOARD MASTIC			W		50
	DRYWALL TAPE & JOINT COMPOUND			W		51
	SPRAY-ON INSULATION			C		52
	DRYWALL			W	2-11M	53
	DRYWALL			W	2-12M	54
AT MANAGER						
	2 FT X 4 FT FISSURED CEILING TILE			C		55
	BASEBOARD MASTIC			W		56
	DRYWALL			W		57
	DRYWALL TAPE & JOINT COMPOUND			W		58
	SPRAY-ON INSULATION			C		59
CABLE SHAFT						
	SPRAY-ON INSULATION			C		60
ELEVATOR SHAFT						
	SEE COMMENTS	NO SUSPECT MATERIALS				61
ENTRY						
	1 FT X 1 FT BGE SPCKLD FLOOR TILE	MASTIC, ONLY, CONTAINS ASBESTOS		F		62
	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC		25.0	F		63
	2 FT X 4 FT FISSURED CEILING TILE			C		64
	DRYWALL			W		65
	DRYWALL TAPE & JOINT COMPOUND			W		66
	SPRAY-ON INSULATION			C		67
LAVATORY						
	2 FT X 4 FT FISSURED CEILING TILE			C		68
	SPRAY-ON INSULATION			C		69
MECH EQUIPMENT & STORAGE						
	1 FT X 1 FT BLU FLOOR TILE	MASTIC, ONLY, CONTAINS ASBESTOS		F		70

FOR LOCATION: F = FLOOR W = WALL C = CEILING R = ROOF M = MISCELLANEOUS SAMPLE NUMBERS: P = PREVIOUS INSPECTION

NOVEMBER 16, 1992

TABLE 3-2
TRI CITY REGIONAL AIRPORT
SECOND FLOOR SUSPECT MATERIAL SUMMARY

NAME OF ROOM	MATERIAL DESCRIPTION	COMMENTS	PERCENT ASBESTOS	LOCATION	ACTUAL SAMPLE	RECORD NUMBER
MECH EQUIPMENT & STORAGE						
	1 FT X 1 FT BLU FLOOR TILE MASTIC		25.0	F		71
	BASEBOARD MASTIC			W		72
	DRYWALL			W		73
	DRYWALL TAPE & JOINT COMPOUND			W		74
	SPRAY-ON INSULATION			C		75
PIPE CHASE						
	SEE COMMENTS	INACCESSIBLE; ASSUME ACM				76
SECRETARY/RECEPTIONIST						
	2 FT X 4 FT FISSURED CEILING TILE			C		77
	BASEBOARD MASTIC			W		78
	DRYWALL			W		79
	DRYWALL TAPE & JOINT COMPOUND			W		80
	SPRAY-ON INSULATION			C		81
STAIR						
	1 FT X 1 FT BGE SPCKLD FLOOR TILE	MASTIC, ONLY, CONTAINS ASBESTOS		F		82
	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC	MID-LANDING	25.0	F		83
	DRYWALL			W		84
	DRYWALL TAPE & JOINT COMPOUND			W		85

FOR LOCATION: F = FLOOR W = WALL C = CEILING R = ROOF M = MISCELLANEOUS SAMPLE NUMBERS: P = PREVIOUS INSPECTION

NOVEMBER 16, 1992

TABLE 3-3
TRI CITY REGIONAL AIRPORT
THIRD FLOOR SUSPECT MATERIAL SUMMARY

NAME OF ROOM	MATERIAL DESCRIPTION	COMMENTS	PERCENT ASBESTOS	LOCATION	ACTUAL SAMPLE	RECORD NUMBER
CABLE SHAFT						
	SPRAY-ON INSULATION			C	3-19S	86
ELEVATOR SHAFT						
	SEE COMMENTS	NO SUSPECT MATERIALS				87
ENTRY						
	1 FT X 1 FT BGE SPCKLD FLOOR TILE	MASTIC, ONLY, CONTAINS ASBESTOS		F		88
	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC		25.0	F		89
	2 FT X 4 FT FISSURED CEILING TILE			C		90
	BASEBOARD MASTIC			W		91
	DRYWALL			W		92
	DRYWALL TAPE & JOINT COMPOUND			W		93
	SPRAY-ON INSULATION			C		94
LAVATORY						
	2 FT X 4 FT FISSURED CEILING TILE			C		95
MECH EQUIPMENT & STORAGE						
	1 FT X 1 FT BLU FLOOR TILE	MASTIC, ONLY, CONTAINS ASBESTOS		F		96
	1 FT X 1 FT BLU FLOOR TILE MASTIC		25.0	F		97
	BASEBOARD MASTIC			W		98
	DRYWALL			W		99
	DRYWALL TAPE & JOINT COMPOUND			W		100
	SPRAY-ON INSULATION			C		101
PIPE CHASE						
	SEE COMMENTS	INACCESSIBLE; ASSUME ACM				102
QA SPECIALIST						
	2 FT X 4 FT FISSURED CEILING TILE			C		103
	BASEBOARD MASTIC			W		104
	DRYWALL			W		105
	DRYWALL TAPE & JOINT COMPOUND			W		106
	SPRAY-ON INSULATION			C		107

FOR LOCATION: F = FLOOR W = WALL C = CEILING R = ROOF M = MISCELLANEOUS SAMPLE NUMBERS: P = PREVIOUS INSPECTION

NOVEMBER 16, 1992

TABLE 3-3
TRI CITY REGIONAL AIRPORT
THIRD FLOOR SUSPECT MATERIAL SUMMARY

NAME OF ROOM	MATERIAL DESCRIPTION	COMMENTS	PERCENT ASBESTOS	LOCATION	ACTUAL SAMPLE	RECORD NUMBER
STAIR						
	1 FT X 1 FT BGE SPCKLD FLOOR TILE	MASTIC, ONLY, CONTAINS ASBESTOS		F		108
	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC	MID-LANDING	25.0	F		109
	DRYWALL			W		110
	DRYWALL TAPE & JOINT COMPOUND			W		111
STORAGE						
	1 FT X 1 FT BLU FLOOR TILE	MASTIC, ONLY, CONTAINS ASBESTOS		F		112
	1 FT X 1 FT BLU FLOOR TILE MASTIC		25.0	F		113
	2 FT X 4 FT FISSURED CEILING TILE			C		114
	BASEBOARD MASTIC			W		115
	DRYWALL			W		116
	DRYWALL TAPE & JOINT COMPOUND			W		117
	SPRAY-ON INSULATION			C		118
TRAINING						
	2 FT X 4 FT FISSURED CEILING TILE			C		119
	BASEBOARD MASTIC			W		120
	DRYWALL			W		121
	DRYWALL TAPE & JOINT COMPOUND			W		122
	SPRAY-ON INSULATION			C		123

FOR LOCATION: F = FLOOR W = WALL C = CEILING R = ROOF M = MISCELLANEOUS SAMPLE NUMBERS: P = PREVIOUS INSPECTION

3.4.3 Asbestos-Containing Materials (ACM) Floor Discussion

Samples of the 1 ft x 1 ft beige speckled floor tile mastic, located in the entry and stair landing, contain 25 percent chrysotile asbestos. Samples of the 1 ft x 1 ft blue floor tile mastic, located in the storage room and the mechanical equipment storage room, contain 25 percent chrysotile asbestos. The floor tile mastics were classified as non-friable and were in good condition at the time of the inspection. The pipe chase was not accessible for sampling at the time of the inspection and should be assumed to contain ACM. Recommendations regarding the ACM can be found in Section 3.10. Approximate ACM locations can be found in Exhibit 3 (Appendix B).

3.5 FOURTH FLOOR

3.5.1 Floor Description

The fourth floor of the Tri-City Regional Airport ATCT measures approximately 1,150 square feet. The floor is divided into nine areas including: the electronic equipment room, lavatory, janitor's closet, entry, stair, cable shaft, pipe chase, elevator shaft, and mechanical equipment room. The fourth floor layout and sample locations are shown in Exhibit 4 (Appendix B).

3.5.2 Suspect Material Summary

All areas on the fourth floor were assigned to specific functional spaces. The following suspect materials were identified on the fourth floor: 1 ft x 1 ft beige speckled floor tile and mastic, 1 ft x 1 ft blue floor tile and mastic, baseboard mastic, drywall, drywall tape and joint compound, 2 ft x 4 ft fissured ceiling tile, and spray-on insulation. Representative samples of these materials were sent to an accredited laboratory for analysis. Results are summarized in Table 3-4. Additional inspection information can be found in the Data Summary Table (Appendix A).

3.5.3 Asbestos-Containing Materials (ACM) Floor Discussion

Samples of the 1 ft x 1 ft beige speckled floor tile mastic, located in the stair landing, contain 25 percent chrysotile asbestos. Samples of the 1 ft x 1 ft blue floor tile mastic, located in the electronic equipment room, janitor's closet, entry, and mechanical equipment room, contain 25 percent chrysotile asbestos. The floor tile mastics were classified as non-friable and were in good condition at the time of the inspection. The pipe chase was not accessible for sampling at the time of the inspection and should be assumed to contain ACM. Recommendations regarding the ACM can be found in Section 3.10. Approximate ACM locations can be found in Exhibit 4 (Appendix B).

3.6 FIFTH FLOOR

3.6.1 Floor Description

The fifth floor of the Tri-City Regional Airport ATCT measures approximately 1,150 square feet. The floor is divided into eight areas including: an entry, lavatory, ATCT Administrative Supervisor's office, TRACON, stair, cable shaft, pipe chase, and elevator shaft. The fifth floor layout and sample locations are shown in Exhibit 5 (Appendix B).

NOVEMBER 16, 1992

TABLE 3-4
TRI CITY REGIONAL AIRPORT
FOURTH FLOOR SUSPECT MATERIAL SUMMARY

NAME OF ROOM	MATERIAL DESCRIPTION	COMMENTS	PERCENT ASBESTOS	LOCATION	ACTUAL SAMPLE	RECORD NUMBER
CABLE SHAFT						
	SPRAY-ON INSULATION			C		124
ELECTRONIC EQUIPMENT RM						
	1 FT X 1 FT BLU FLOOR TILE	MASTIC, ONLY, CONTAINS ASBESTOS		F		125
	1 FT X 1 FT BLU FLOOR TILE MASTIC		25.0	F		126
	2 FT X 4 FT FISSURED CEILING TILE			C		127
	BASEBOARD MASTIC			W		128
	DRYWALL TAPE & JOINT COMPOUND			W		129
	SPRAY-ON INSULATION			C		130
	DRYWALL			W	4-15M	131
ELEVATOR SHAFT						
	SEE COMMENTS	NO SUSPECT MATERIALS				132
ENTRY						
	1 FT X 1 FT BLU FLOOR TILE	MASTIC, ONLY, CONTAINS ASBESTOS		F		133
	1 FT X 1 FT BLU FLOOR TILE MASTIC		25.0	F		134
	2 FT X 4 FT FISSURED CEILING TILE			C		135
	BASEBOARD MASTIC			W		136
	DRYWALL			W		137
	DRYWALL TAPE & JOINT COMPOUND			W		138
	SPRAY-ON INSULATION			C		139
JANITOR'S CLOSET						
	BASEBOARD MASTIC			W		140
	SPRAY-ON INSULATION			C		141
	1 FT X 1 FT BLU FLOOR TILE	MASTIC, ONLY, CONTAINS ASBESTOS		F	4-16M	142
	1 FT X 1 FT BLU FLOOR TILE MASTIC		25.0	F	4-16M	143
	1 FT X 1 FT BLU FLOOR TILE	MASTIC, ONLY, CONTAINS ASBESTOS		F	4-17M	144
	1 FT X 1 FT BLU FLOOR TILE MASTIC	REFLECTED BY ACTUAL SAMPLE NUMBER 4-16M		F	4-17M	145
	2 FT X 4 FT FISSURED CEILING TILE			C	4-18M	146
	2 FT X 4 FT FISSURED CEILING TILE			C	4-20M	147
	PIPE JOINT COMPOUND			M	4-21M	148

FOR LOCATION: F = FLOOR W = WALL C = CEILING R = ROOF M = MISCELLANEOUS SAMPLE NUMBERS: P = PREVIOUS INSPECTION

NOVEMBER 16, 1992

TABLE 3-4
TRI CITY REGIONAL AIRPORT
FOURTH FLOOR SUSPECT MATERIAL SUMMARY

NAME OF ROOM	MATERIAL DESCRIPTION	COMMENTS	PERCENT ASBESTOS	LOCATION	ACTUAL SAMPLE	RECORD NUMBER
LAVATORY						
	2 FT X 4 FT FISSURED CEILING TILE			C		149
	SPRAY-ON INSULATION			C		150
MECHANICAL EQUIPMENT RM						
	1 FT X 1 FT BLU FLOOR TILE	MASTIC, ONLY, CONTAINS ASBESTIS		F		151
	1 FT X 1 FT BLU FLOOR TILE MASTIC		25.0	F		152
	DRYWALL			W		153
	DRYWALL TAPE & JOINT COMPOUND			W		154
	SPRAY-ON INSULATION			C		155
	BASEBOARD MASTIC			W	4-13M	156
	BASEBOARD MASTIC			W	4-14M	157
PIPE CHASE						
	SEE COMMENTS	INACCESSIBLE; ASSUME ACM				158
STAIR						
	1 FT X 1 FT BGE SPCKLD FLOOR TILE	MASTIC, ONLY, CONTAINS ASBESTOS		F		159
	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC	MID-LANDING	25.0	F		160
	DRYWALL			W		161
	DRYWALL TAPE & JOINT COMPOUND			W		162

FOR LOCATION: F = FLOOR W = WALL C = CEILING R = ROOF M = MISCELLANEOUS SAMPLE NUMBERS: P = PREVIOUS INSPECTION

3.6.2 Suspect Material Summary

All areas on the fifth floor were assigned to specific functional spaces. the following suspect materials were identified on the fifth floor: 1 ft x 1 ft beige speckled floor tile and mastic, 1 ft x 1 ft blue floor tile and mastic, 1 ft x 1 ft black rubber floor tile, baseboard mastic, drywall, drywall tape and joint compound, 2 ft x 4 ft fissured ceiling tile, 2 ft x 4 ft rough surface black ceiling tile, pipe sealant caulk, and spray-on insulation. Representative samples of these materials were sent to an accredited laboratory for analysis. Results are summarized in Table 3-5. Additional inspection information can be found in the Data Summary Table (Appendix A).

3.6.3 Asbestos-Containing Materials (ACM) Floor Discussion

Samples of the 1 ft x 1 ft beige speckled floor tile mastic, located in the entry and stair, contain 25 percent chrysotile asbestos. Samples of the 1 ft x 1 ft blue floor tile mastic, located in the ATCT Administrative Supervisor's office, and the TRACON, contain 25 percent chrysotile asbestos. Recommendations regarding the ACM can be found in Section 3.10. Approximate ACM locations can be found in Exhibit 5 (Appendix B).

3.7 SIXTH FLOOR

3.7.1 Floor Description

The sixth floor of the Tri-City Regional Airport ATCT measures approximately 1,150 square feet. The floor is divided into nine areas including: an entry, lavatory, mechanical equipment and storage room, TELCO, breakroom, cable shaft, pipe chase, elevator shaft, and stair to cab. The sixth floor layout is shown in Exhibit 6 (Appendix B). The sixth floor roof measures approximately 1,150 square feet. The roof layout and sample locations are shown in Exhibit 7 (Appendix B).

3.7.2 Suspect Material Summary

All areas on the sixth floor were assigned to specific functional spaces. The following suspect materials were identified on the sixth floor: 1 ft x 1 ft blue floor tile and mastic, baseboard mastic, drywall, drywall tape and joint compound, 2 ft x 4 ft fissured ceiling tile, spray-on insulation, stepping pads, rolled roofing, roof mastic, roof tar, and roof flashing. Representative samples of these materials were sent to an accredited laboratory for analysis. Results are summarized in Table 3-6. Additional inspection information can be found in the Data Summary Table (Appendix A).

NOVEMBER 16, 1992

TABLE 3-5
TRI CITY REGIONAL AIRPORT
FIFTH FLOOR SUSPECT MATERIAL SUMMARY

NAME OF ROOM	MATERIAL DESCRIPTION	COMMENTS	PERCENT ASBESTOS	LOCATION	ACTUAL SAMPLE	RECORD NUMBER
ATCT ADMIN SUPERVISOR						
	1 FT X 1 FT BLU FLOOR TILE	MASTIC, ONLY, CONTAINS ASBESTOS		F		163
	1 FT X 1 FT BLU FLOOR TILE MASTIC		25.0	F		164
	BASEBOARD MASTIC			W		165
	DRYWALL			W		166
	SPRAY-ON INSULATION			C		167
	DRYWALL TAPE & JOINT COMPOUND			W	5-24S	168
	PIPE SEALANT CAULK			M	5-25S	169
CABLE SHAFT						
	SPRAY-ON INSULATION			C		170
ELEVATOR SHAFT						
	SEE COMMENTS	NO SUSPECT MATERIALS				171
ENTRY						
	2 FT X 4 FT FISSURED CEILING TILE			C		172
	BASEBOARD MASTIC			W		173
	DRYWALL			W		174
	DRYWALL TAPE & JOINT COMPOUND			W		175
	SPRAY-ON INSULATION			C		176
	1 FT X 1 FT BGE SPCKLD FLOOR TILE	MASTIC, ONLY, CONTAINS ASBESTOS		F	5-22M	177
	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC		25.0	F	5-22M	178
	1 FT X 1 FT BGE SPCKLD FLOOR TILE	MASTIC, ONLY CONTAINS ASBESTOS		F	5-23M	179
	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC	REFLECTED BY ACTUAL SAMPLE NUMBER 5-22M		F	5-23M	180
LAVATORY						
	2 FT X 4 FT FISSURED CEILING TILE			C		181
	SPRAY-ON INSULATION			C		182
PIPE CHASE						
	SEE COMMENTS	INACCESSIBLE; ASSUME ACM				183
STAIR						
	DRYWALL			W		184

FOR LOCATION: F = FLOOR W = WALL C = CEILING R = ROOF M = MISCELLANEOUS SAMPLE NUMBERS: P = PREVIOUS INSPECTION

NOVEMBER 16, 1992

TABLE 3-5
TRI CITY REGIONAL AIRPORT
FIFTH FLOOR SUSPECT MATERIAL SUMMARY

NAME OF ROOM	MATERIAL DESCRIPTION	COMMENTS	PERCENT ASBESTOS	LOCATION	ACTUAL SAMPLE	RECORD NUMBER
STAIR						
	DRYWALL TAPE & JOINT COMPOUND			W		185
	1 FT X 1 FT BGE SPCKLD FLOOR TILE	MASTIC, ONLY, CONTAINS ASBESTOS		F	5-37M	186
	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC	MID-LANDING	25.0	F	5-37M	187
TRACON						
	1 FT X 1 FT BLU FLOOR TILE	MASTIC, ONLY, CONTAINS ASBESTOS		F		188
	1 FT X 1 FT BLU FLOOR TILE MASTIC	BEHIND EQUIPMENT	25.0	F		189
	BASEBOARD MASTIC			W		190
	DRYWALL			W		191
	DRYWALL TAPE & JOINT COMPOUND			W		192
	SPRAY-ON INSULATION			C		193
	2 FT X 4 FT ROUGH SURFACE BLK CEILING TILE			C	5- 5M	194
	2 FT X 4 FT ROUGH SURFACE BLK CEILING TILE			C	5- 6M	195
	1 FT X 1 FT BLK RUBBER FLOOR TILE			F	5-26M	196
	1 FT X 1 FT BLK RUBBER FLOOR TILE			F	5-27M	197
	1 FT X 1 FT BLK RUBBER FLOOR TILE			F	5-28M	198

FOR LOCATION: F = FLOOR W = WALL C = CEILING R = ROOF M = MISCELLANEOUS SAMPLE NUMBERS: P = PREVIOUS INSPECTION

NOVEMBER 16, 1992

TABLE 3-6
TRI CITY REGIONAL AIRPORT
SIXTH FLOOR SUSPECT MATERIAL SUMMARY

NAME OF ROOM	MATERIAL DESCRIPTION	COMMENTS	PERCENT ASBESTOS	LOCATION	ACTUAL SAMPLE	RECORD NUMBER
BREAKROOM						
	1 FT X 1 FT BLU FLOOR TILE	MASTIC, ONLY, CONTAINS ASBESTOS		F		199
	1 FT X 1 FT BLU FLOOR TILE MASTIC		25.0	F		200
	2 FT X 4 FT FISSURED CEILING TILE			C		201
	BASEBOARD MASTIC			W		202
	DRYWALL			W		203
	DRYWALL TAPE & JOINT COMPOUND			W		204
	SPRAY-ON INSULATION			C		205
CABLE SHAFT						
	SPRAY-ON INSULATION			C		206
ELEVATOR SHAFT						
	SEE COMMENTS	NO SUSPECT MATERIALS				207
ENTRY						
	1 FT X 1 FT BLU FLOOR TILE	MASTIC, ONLY, CONTAINS ASBESTOS		F		208
	1 FT X 1 FT BLU FLOOR TILE MASTIC		25.0	F		209
	2 FT X 4 FT FISSURED CEILING TILE			C		210
	BASEBOARD MASTIC			W		211
	DRYWALL			W		212
	DRYWALL TAPE & JOINT COMPOUND			W		213
	SPRAY-ON INSULATION			C		214
LAVATORY						
	2 FT X 4 FT FISSURED CEILING TILE			C		215
	SPRAY-ON INSULATION			C		216
MECH EQUIPMENT & STORAGE						
	1 FT X 1 FT BLU FLOOR TILE	MASTIC, ONLY, CONTAINS ASBESTOS		F		217
	1 FT X 1 FT BLU FLOOR TILE MASTIC		25.0	F		218
	BASEBOARD MASTIC			W		219
	DRYWALL			W		220
	DRYWALL TAPE & JOINT COMPOUND			W		221
	SPRAY-ON INSULATION			C		222

FOR LOCATION: F = FLOOR W = WALL C = CEILING R = ROOF M = MISCELLANEOUS SAMPLE NUMBERS: P = PREVIOUS INSPECTION

NOVEMBER 16, 1992

TABLE 3-6
TRI CITY REGIONAL AIRPORT
SIXTH FLOOR SUSPECT MATERIAL SUMMARY

NAME OF ROOM	MATERIAL DESCRIPTION	COMMENTS	PERCENT ASBESTOS	LOCATION	ACTUAL SAMPLE	RECORD NUMBER
PIPE CHASE						
	SEE COMMENTS	INACCESSIBLE; ASSUME ACM				223
ROOF						
	ROLLED ROOFING	NOT SAMPLED TO AVOID DAMAGE; ASSUME ACM		R		224
	ROOF MASTIC	NOT SAMPLED TO AVOID DAMAGE; ASSUME ACM		R		225
	ROOF TAR	NOT SAMPLED TO AVOID DAMAGE; ASSUME ACM		R		226
	ROOF FLASHING		30.0	R	6-29M	227
	ROOF FLASHING	REFLECTED BY ACTUAL SAMPLE 6-29M		R	6-30M	228
	ROOF FLASHING	REFLECTED BY ACTUAL SAMPLE 6-29M		R	6-31M	229
	STEPPING PADS			R	6-32M	230
	STEPPING PADS			R	6-33M	231
	STEPPING PADS			R	6-34M	232
STAIR TO CAB						
	DRYWALL			W		233
	DRYWALL TAPE & JOINT COMPOUND			W		234
TELCO						
	1 FT X 1 FT BLU FLOOR TILE	MASTIC, ONLY, CONTAINS ASBESTOS		F		235
	1 FT X 1 FT BLU FLOOR TILE MASTIC		25.0	F		236
	BASEBOARD MASTIC			W		237
	DRYWALL			W		238
	DRYWALL TAPE & JOINT COMPOUND			W		239
	SPRAY-ON INSULATION			C		240

FOR LOCATION: F = FLOOR W = WALL C = CEILING R = ROOF M = MISCELLANEOUS SAMPLE NUMBERS: P = PREVIOUS INSPECTION

3.7.3 Asbestos-Containing Materials (ACM) Floor Discussion

Samples of the 1 ft x 1 ft blue floor tile mastic, located in the entry, mechanical equipment and storage room, TELCO, and breakroom, contain 25 percent chrysotile asbestos. The floor tile mastic was classified as non-friable and was in good condition at the time of the inspection. The pipe chase was not accessible for sampling at the time of the inspection and should be assumed to contain ACM. The roof flashing contains 30 percent chrysotile asbestos. The rolled roofing, roof mastic, and roof tar were not sampled to avoid damage to the roof. These materials should be assumed ACM until sampling and analysis determines otherwise. The roofing materials were classified as non-friable and in good condition at the time of the inspection. Recommendations regarding the ACM can be found in Section 3.10. Approximate ACM locations can be found in Exhibits 6 and 7 (Appendix B).

3.8 SEVENTH FLOOR

3.8.1 Floor Discussion

The seventh floor of the Tri-City Regional Airport ATCT is divided into two areas including: the cab and the cab roof. The cab measures approximately 450 square feet and the cab roof measures approximately 775 square feet. The seventh floor layout and sample locations are shown in Exhibit 7 (Appendix B).

3.8.2 Suspect Material Summary

The cab and the cab roof were assigned to specific functional spaces. The following suspect materials were identified on the seventh floor: baseboard mastic, 2 ft x 2 ft rough textured black ceiling tile, ceiling tile mastic, spray-on insulation, rolled roofing, roof mastic, roof tar, stepping pads, and roof flashing. Representative samples of these materials were sent to an accredited laboratory for analysis. Results are summarized in Table 3-7. Additional inspection information can be found in the Data Summary Table (Appendix A).

3.8.3 Asbestos-Containing Materials (ACM) Floor Discussion

Samples of the roof flashing contain 30 percent chrysotile asbestos. The rolled roofing, roof mastic, and roof tar were not sampled to avoid damage to the roof. These materials should be assumed ACM until sampling and analysis determine otherwise. The roofing materials were classified as non-friable and in good condition at the time of the inspection. Recommendations regarding the ACM can be found in Section 3.10. Approximate ACM locations can be found in Exhibit 7 (Appendix B).

3.9 OUT BUILDING

3.9.1 Building Description

The unattached building that provides stand-by electricity for the tower measures approximately 500 square feet. The only area accessed by FAA personnel is the engine generator room. Floor plans for this area are not available.

NOVEMBER 16, 1992

TABLE 3-7
TRI CITY REGIONAL AIRPORT
SEVENTH FLOOR SUSPECT MATERIAL SUMMARY

NAME OF ROOM	MATERIAL DESCRIPTION	COMMENTS	PERCENT ASBESTOS	LOCATION	ACTUAL SAMPLE	RECORD NUMBER
CAB						
	BASEBOARD MASTIC			W		241
	SPRAY-ON INSULATION			C		242
	CEILING TILE MASTIC			C	7-35M	243
	2 FT X 2 FT ROUGH TEXTURED BLK CEILING TILE			C	7-36M	244
CAB ROOF						
	ROLLED ROOFING	NOT SAMPLED TO AVOID DAMAGE; ASSUME ACM		R		245
	ROOF FLASHING		30.0	R		246
	ROOF MASTIC	NOT SAMPLED TO AVOID DAMAGE; ASSUME ACM		R		247
	ROOF TAR	NOT SAMPLED TO AVOID DAMAGE; ASSUME ACM		R		248
	STEPPING PADS			R		249

FOR LOCATION: F = FLOOR W = WALL C = CEILING R = ROOF M = MISCELLANEOUS SAMPLE NUMBERS: P = PREVIOUS INSPECTION

3.9.2 Suspect Material Summary

The engine generator room was assigned to a specific functional space. The only suspect material identified in this area was TSI pipe insulation. Representative samples of this material was sent to an accredited laboratory for analysis. Results are summarized in Table 3-8. Additional inspection information can be found in the Data Summary Table (Appendix A).

3.9.3 Asbestos-Containing Materials (ACM) Floor Discussion

No ACM was identified in this area, therefore, no further action is required.

3.10 RECOMMENDATIONS

RMCI recommends the following:

Development and implementation of an Operations and Maintenance program (O&M) in accordance with the FAA's standard guidelines and specific to the Tri-City Regional Airport ATCT.

The principal objective of an O&M program is to minimize exposure of all building occupants to asbestos fibers. To accomplish this objective, an O&M program includes work practices to (1) maintain ACM in good condition, (2) ensure proper cleanup of asbestos fibers previously released, (3) prevent further release of asbestos fibers, and (4) monitor the condition of ACM.

The specified O&M work practices and procedures should be employed by trained personnel during building, cleaning, maintenance, renovation, and general operational activities that may involve surfacing, thermal, or miscellaneous ACM. To achieve its objectives, a successful O&M program should include the following elements:

- **Notification:** A program to tell workers, tenants, and building occupants where ACM is located, and how and why to avoid disturbing the ACM. All persons affected should be properly informed and all friable ACM should be properly labeled.

- **Surveillance:** Regular ACM surveillance and re-inspection to note, assess, and document any changes in the ACM's condition.

- **Controls:** Work control/permit system to control activities which might disturb ACM.

- **Work Practices:** O&M work practices to avoid or minimize fiber release during activities affecting ACM.

- **Record Keeping:** To document O&M activities.

- **Worker Protection:** Medical and respiratory protection programs, as applicable.

- **Training:** Facility Asbestos Coordinator, and custodial and maintenance staff training.

NOVEMBER 16, 1992

TABLE 3-8
TRI CITY REGIONAL AIRPORT
OUT-BUILDING SUSPECT MATERIAL SUMMARY

NAME OF ROOM	MATERIAL DESCRIPTION	COMMENTS	PERCENT ASBESTOS	LOCATION	ACTUAL SAMPLE	RECORD NUMBER
OUT-BLDG ENG GENERATOR RM						
	TSI PIPE INSULATION			M	0-38T	250
	TSI PIPE INSULATION			M	0-39T	251
	TSI PIPE INSULATION			M	0-40T	252

FOR LOCATION: F = FLOOR W = WALL C = CEILING R = ROOF M = MISCELLANEOUS SAMPLE NUMBERS: P = PREVIOUS INSPECTION

- **Emergency Procedures:** Proper emergency response procedures.

- **Air Monitoring:** Track and monitor health concerns and action levels.

Floor tile mastic is classified as a non-friable material unless it is in a severely damaged and dry condition. While protected under floor tile, the mastic requires no special care. However, if the floor tile is damaged or removed, care should be exercised to avoid disturbing the mastic and causing it to become friable. Abrasive actions such as dry buffing, drilling, grinding, hammering, sawing, etc. should not be performed unless proper precautions are followed. Alterations or removal of floor tile mastic requires adherence to all applicable local, state, and federal regulations concerning asbestos removal and disposal. Periodic condition inspections are recommended until the material is removed.

Roofing materials are classified as non-friable material, unless severely damaged by heat, air or water erosion. Generally, if roofing materials are damaged to the extent where the materials are classified as friable, the roofing system will fail and replacement will be necessary. If a roofing system needs replaced due to failure or for renovations, all applicable local, state and federal regulations concerning asbestos removal and disposal must be adhered to. Abrasive actions such as cutting, drilling, grinding, etc. should not be performed on asbestos-containing roofing materials. Periodic condition inspections are recommended until the materials are removed. All roofing materials identified as suspect but not sampled to avoid damage to the roof should be assumed to be asbestos-containing. All roofing materials assumed to be ACM should be core-sampled prior to any planned penetrations or alterations.

Areas that were inaccessible for sampling at the time of the inspection should be assumed to contain ACM. Any suspect materials identified should be cared for and maintained in accordance with the O&M guidelines and procedures until sampling and analysis of these materials determines that they are non-ACM.

It is recommended that the ACM identified in this report not be disturbed or removed unless planned renovations, repairs or damaged ACM require such actions. If the ACM must be disturbed or removed for any reason, personal protective equipment and properly trained personnel must be utilized.
An inspection should be conducted at least once a year to determine any change in the condition of ACM.

3.11 LIMITATIONS

This report describes the locations and conditions of ACM in the Tri-City Regional Airport ATCT at the time of inspection. RMCI represents that our services are performed within the limits prescribed by applicable regulations and in a manner consistent with the level of care and skill ordinarily exercised by other professional consultants under similar circumstances. No other representation is made to the client, expressed or implied, and no warranty or guarantee is included or intended.

APPENDIX A

DATA SUMMARY TABLE COLUMN DEFINITIONS
AND
DATA SUMMARY TABLE

DATA SUMMARY TABLE COLUMN DEFINITIONS

The Data Summary Table lists these columns in the following order:

1. RECORD NUMBER - Sequential number representing each row of data.

2. LOC ID - Location Identifier. Specific identifier unique to the facility.

3. FLOOR - Floor in which inspection, sampling, and assessment occurred.

4. ROOM DESCRIPTION - Type of room, based on use.

5. MATERIAL DESCRIPTION - Type of building material inspected and assessed.

6. SAMPLE LOCATION - Specific building component on which suspect material is found. F = Floor, W = Wall, C = Ceiling, R = Roof, M = Miscellaneous.

7. ACTUAL SAMPLE - The sample (if any) collected in the area identified by that record.

8. REFERENCE SAMPLE - Multiple samples of the same material often vary in asbestos content. This may be a reflection of manufacturing inconsistencies and/or mixing of materials such as mastics or spray-on insulation prior to application. For the purpose of discussion, one sample is chosen to represent the asbestos content of the suspect material. This is termed the reference sample.

9. RELATED SAMPLES - All samples, other than the reference sample, collected of the same suspect material.

10. PERCENT ASBESTOS - Total percentage of all forms of asbestos minerals contained in the reference sample.

11. TYPE ASBESTOS - The specific type of asbestos which is identified in the reference sample. CHRY = chrysotile, AMO = amosite, CROC = crocidolite, ANTH = anthophyllite, TREM = tremolite, ACT = actinolite.

12. FRIABLE - Material that may be crumbled or reduced to powder by hand pressure.

13. POTENTIAL FOR DISTURBANCE - Indicates the likelihood of ACM being disturbed in the future. Related to: 1) the frequency of contact between the ACM and human activity, 2) location of ACM with respect to vibration sources, and 3) the potential for air erosion. Three categories exist under AHERA: 1) "Potential for Significant Damage" (PSD), 2) "Potential for Damage" (PD), and 3) "Low Potential" (LP).

14. DISTURBANCE SOURCE - The type of condition or action which may disturb the ACM. Under AHERA, three types of disturbance exist: 1) physical contact with material (C), 2) vibration influence (V), and 3) air erosion (A).

15. **CONDITION** - A description of the physical condition of the ACM based on a visual inspection. AHERA defines three categories: 1) "Good Condition" (G), 2) "Damaged" (D), and 3) "Significantly Damaged" (SD).

16. **HAZARD RANK** - A numerical score which provides the management planner with a qualitative tool for selecting an appropriate response action. In addition, the Hazard Rank allows the FAA to compare in a relative way, the condition of different facilities in different locations. A score of "1" indicates a low hazard, while a score of "7" indicates a significant hazard. The method used to rank facilities follows the AHERA Categorizing of Assessed Material with a few notable exceptions.

    Both AHERA and this ranking system evaluate material on the basis of its condition and potential for disturbance. However, AHERA only addresses friable material. The presence of non-friable ACM is documented, but it is not assessed. Non-friable ACM is included in the Hazard Rank. AHERA also categorizes on the basis of material type (surfacing, TSI, or miscellaneous). This is not appropriate for determination of the Hazard Rank since all material types present similar concerns. In summary, the Hazard Rank considers friability, condition and potential for disturbance in its calculation.

17. **RECOMMENDED ACTION** - Describes the type of activity recommended to respond to the presence of asbestos within the ATCT. Recommended actions are as follows:

    Action 1: O&M Deferred - Maintain material in good condition. Monitor for deterioration of material.

    Action 2: O&M Abatement - Remove, repair, enclose or encapsulate all damaged ACM to mitigate potential release.

    Action 3: Emergency O&M Abatement - Evacuate and isolate the area. Remove, repair, enclose or encapsulate all damaged ACM. Clean all potentially contaminated areas.

    Action 4: Full-Scale Emergency Abatement - Evacuate and isolate the area. Abate all damaged ACM via full-scale abatement operation. Clean all potentially contaminated areas.

18. **APPROXIMATE QUANTITY OF MATERIAL/ROOM** - The total estimated linear or square footage of ACM in the room.

19. **COST ESTIMATE** - The anticipated cost to implement recommended removal actions.

20. **COMMENTS** - Additional information (if any).

RECORD NUMBER	LOC ID	FLOOR NUMBER	ROOM DESCRIPTION	MATERIAL DESCRIPTION	SAMPLE LOCATION	ACTUAL SAMPLE	REFERENCE SAMPLE	RELATED SAMPLES
1	TRI	1.0	AF RADAR UNIT SUPERVISOR	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
2	TRI	1.0	AF RADAR UNIT SUPERVISOR	BASEBOARD MASTIC	W		1-2M	4-13M/14M
3	TRI	1.0	AF RADAR UNIT SUPERVISOR	DRYWALL	W		2-11M	2-12M 4-15M
4	TRI	1.0	AF RADAR UNIT SUPERVISOR	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
5	TRI	1.0	CABLE ACCESS ROOM	1 FT X 1 FT BLU FLOOR TILE	F		1- 1M	4-16M/17M
6	TRI	1.0	CABLE ACCESS ROOM	1 FT X 1 FT BLU FLOOR TILE MASTIC	F		1- 1M	4-16M/17M
7	TRI	1.0	CABLE ACCESS ROOM	BASEBOARD MASTIC	W		1-2M	4-13M/14M
8	TRI	1.0	CABLE ACCESS ROOM	DRYWALL	W		2-11M	2-12M 4-15M
9	TRI	1.0	CABLE ACCESS ROOM	DRYWALL TAPE & JOINT COMPOUND	W	1- 9S	1-9S	1-10S 5-24S
10	TRI	1.0	CABLE ACCESS ROOM	DRYWALL TAPE & JOINT COMPOUND	W	1-10S	1-9S	1-10S 5-24S
11	TRI	1.0	CABLE PIT	SPRAY-ON INSULATION	M	1- 3S	1-3S	1-4S 3-19S
12	TRI	1.0	CABLE PIT	SPRAY-ON INSULATION	M	1- 4S	1-3S	1-4S 3-19S
13	TRI	1.0	ELEVATOR CAR	1 FT X 1 FT BGE SPCKLD FLOOR TILE	F		5-22M	5-23M/37M
14	TRI	1.0	ELEVATOR CAR	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC	F		5-22M	5-23M/37M
15	TRI	1.0	ELEVATOR MACHINE ROOM	1 FT X 1 FT BLU FLOOR TILE	F		1- 1M	4-16M/17M
16	TRI	1.0	ELEVATOR MACHINE ROOM	1 FT X 1 FT BLU FLOOR TILE MASTIC	F		1-1M	4-16M/17M
17	TRI	1.0	ELEVATOR MACHINE ROOM	BASEBOARD MASTIC	W		1-2M	4-13M/14M
18	TRI	1.0	ELEVATOR MACHINE ROOM	DRYWALL	W		2-11M	2-12M 4-15M
19	TRI	1.0	ELEVATOR MACHINE ROOM	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
20	TRI	1.0	ELEVATOR MACHINE ROOM	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
21	TRI	1.0	ELEVATOR SHAFT	SEE COMMENTS				
22	TRI	1.0	ENTRY	1 FT X 1 FT BGE SPCKLD FLOOR TILE	F		5-22M	5-23M/37M
23	TRI	1.0	ENTRY	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC	F		5-22M	5-23M/37M
24	TRI	1.0	ENTRY	BASEBOARD MASTIC	W		1-2M	4-13M/14M
25	TRI	1.0	ENTRY	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
26	TRI	1.0	ENTRY	2 FT X 4 FT FISSURED CEILING TILE	C	1- 7M	1-7M	1-8M 4-18M/20M
27	TRI	1.0	ENTRY	2 FT X 4 FT FISSURED CEILING TILE	C	1- 8M	1-7M	1-8M 4-18M/20M
28	TRI	1.0	HALL	1 FT X 1 FT BGE SPCKLD FLOOR TILE	F		5-22M	5-23M/37M
29	TRI	1.0	HALL	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC	F		5-22M	5-23M/37M
30	TRI	1.0	HALL	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
31	TRI	1.0	HALL	BASEBOARD MASTIC	W		1-2M	4-13M/14M
32	TRI	1.0	MECHANICAL EQUIPMENT RM	DRYWALL	W		2-11M	2-12M 4-15M
33	TRI	1.0	MECHANICAL EQUIPMENT RM	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
34	TRI	1.0	MECHANICAL EQUIPMENT RM	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S

FOR SAMPLE LOCATION: F = FLOOR C = CEILING W = WALL R = ROOF M = MISCELLANEOUS SAMPLE NUMBERS: P = PREVIOUS INSPECTION

FLOOR NUMBERS: 0.0 = BASE BUILDING 0.4 = MECHANICAL (MACHINE) LEVEL 0.5 = TOWER BASEMENT LEVEL 0.9 = BUILDING EXTERIOR 90.0 + = DETACHED BUILDINGS AND TRAILERS

RECORD NUMBER	PERCENT ASBESTOS	TYPE ASBESTOS	FRIABLE	POTENTIAL FOR DISTURBANCE	DISTURBANCE SOURCE	CONDITION	HAZARD RANK	RECOMMENDED ACTION	APPROXIMATE QUANTITY OF MATERIAL/ROOM	COST ESTIMATE	COMMENTS
1										0.00	
2										0.00	
3										0.00	
4										0.00	
5										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
6	25.0	CHRY	N	LP	C	G	1	1	52 SQ FT	0.00	
7										0.00	
8										0.00	
9										0.00	
10										0.00	
11										0.00	
12										0.00	
13										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
14	25.0	CHRY	N	LP	C	G	1	1	16 SQ FT	0.00	
15										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
16	25.0	CHRY	N	LP	C	G	1	1	68 SQ FT	0.00	
17										0.00	
18										0.00	
19										0.00	
20										0.00	
21										0.00	NO SUSPECT MATERIALS
22										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
23	25.0	CHRY	N	LP	C	G	1	1	130 SQ FT	0.00	
24										0.00	
25										0.00	
26										0.00	
27										0.00	
28										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
29	25.0	CHRY	N	LP	C	G	1	1	100 SQ FT	0.00	
30										0.00	
31										0.00	
32										0.00	
33										0.00	
34										0.00	

RECORD NUMBER	LOC ID	FLOOR NUMBER	ROOM DESCRIPTION	MATERIAL DESCRIPTION	SAMPLE LOCATION	ACTUAL SAMPLE	REFERENCE SAMPLE	RELATED SAMPLES
35	TRI	1.0	MECHANICAL EQUIPMENT RM	1 FT X 1 FT BLU FLOOR TILE	F	1- 1M	1- 1M	4-16M/17M
36	TRI	1.0	MECHANICAL EQUIPMENT RM	1 FT X 1 FT BLU FLOOR TILE MASTIC	F	1- 1M	1- 1M	4-16M/17M
37	TRI	1.0	MECHANICAL EQUIPMENT RM	BASEBOARD MASTIC	W	1- 2M	1-2M	4-13M/14M
38	TRI	1.0	PIPE CHASE	SEE COMMENTS				
39	TRI	1.0	STAIR	1 FT X 1 FT BGE SPCKLD FLOOR TILE	F		5-22M	5-23M/37M
40	TRI	1.0	STAIR	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC	F		5-22M	5-23M/37M
41	TRI	1.0	STAIR	DRYWALL	W		2-11M	2-12M 4-15M
42	TRI	1.0	STAIR	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
43	TRI	1.0	STORAGE	1 FT X 1 FT BLU FLOOR TILE	F		1- 1M	4-16M/17M
44	TRI	1.0	STORAGE	1 FT X 1 FT BLU FLOOR TILE MASTIC	F		1- 1M	4-16M/17M
45	TRI	1.0	STORAGE	BASEBOARD MASTIC	W		1-2M	4-13M/14M
46	TRI	1.0	STORAGE	DRYWALL	W		2-11M	2-12M 4-15M
47	TRI	1.0	STORAGE	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
48	TRI	1.0	STORAGE	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
49	TRI	2.0	AREA MANAGER	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
50	TRI	2.0	AREA MANAGER	BASEBOARD MASTIC	W		1-2M	4-13M/14M
51	TRI	2.0	AREA MANAGER	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
52	TRI	2.0	AREA MANAGER	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
53	TRI	2.0	AREA MANAGER	DRYWALL	W	2-11M	2-11M	2-12M 4-15M
54	TRI	2.0	AREA MANAGER	DRYWALL	W	2-12M	2-11M	2-12M 4-15M
55	TRI	2.0	AT MANAGER	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
56	TRI	2.0	AT MANAGER	BASEBOARD MASTIC	W		1-2M	4-13M/14M
57	TRI	2.0	AT MANAGER	DRYWALL	W		2-11M	2-12M 4-15M
58	TRI	2.0	AT MANAGER	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
59	TRI	2.0	AT MANAGER	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
60	TRI	2.0	CABLE SHAFT	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
61	TRI	2.0	ELEVATOR SHAFT	SEE COMMENTS				
62	TRI	2.0	ENTRY	1 FT X 1 FT BGE SPCKLD FLOOR TILE	F		5-22M	5-23M/37M
63	TRI	2.0	ENTRY	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC	F		5-22M	5-23M/37M
64	TRI	2.0	ENTRY	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
65	TRI	2.0	ENTRY	DRYWALL	W		2-11M	2-12M 4-15M
66	TRI	2.0	ENTRY	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
67	TRI	2.0	ENTRY	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
68	TRI	2.0	LAVATORY	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M

FOR SAMPLE LOCATION: F = FLOOR C = CEILING W = WALL R = ROOF M = MISCELLANEOUS SAMPLE NUMBERS: P = PREVIOUS INSPECTION

FLOOR NUMBERS: 0.0 = BASE BUILDING 0.4 = MECHANICAL (MACHINE) LEVEL 0.5 = TOWER BASEMENT LEVEL 0.9 = BUILDING EXTERIOR 90.0 + = DETACHED BUILDINGS AND TRAILERS

RECORD NUMBER	PERCENT ASBESTOS	TYPE ASBESTOS	FRIABLE	POTENTIAL FOR DISTURBANCE	DISTURBANCE SOURCE	CONDITION	HAZARD RANK	RECOMMENDED ACTION	APPROXIMATE QUANTITY OF MATERIAL/ROOM	COST ESTIMATE	COMMENTS
35										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
36	25.0	CHRY	N	LP	C	G	1	1	154 SQ FT	0.00	
37										0.00	
38										0.00	INACCESSIBLE; ASSUME ACM
39										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
40	25.0	CHRY	N	LP	C	G	1	1	25 SQ FT	0.00	MID-LANDING
41										0.00	
42										0.00	
43										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
44	25.0	CHRY	N	LP	C	G	1	1	140 SQ FT	0.00	
45										0.00	
46										0.00	
47										0.00	
48										0.00	
49										0.00	
50										0.00	
51										0.00	
52										0.00	
53										0.00	
54										0.00	
55										0.00	
56										0.00	
57										0.00	
58										0.00	
59										0.00	
60										0.00	
61										0.00	NO SUSPECT MATERIALS
62										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
63	25.0	CHRY	N	LP	C	G	1	1	60 SQ FT	0.00	
64										0.00	
65										0.00	
66										0.00	
67										0.00	
68										0.00	

RECORD NUMBER	LOC ID	FLOOR NUMBER	ROOM DESCRIPTION	MATERIAL DESCRIPTION	SAMPLE LOCATION	ACTUAL SAMPLE	REFERENCE SAMPLE	RELATED SAMPLES
69	TRI	2.0	LAVATORY	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
70	TRI	2.0	MECH EQUIPMENT & STORAGE	1 FT X 1 FT BLU FLOOR TILE	F		1- 1M	4-16M/17M
71	TRI	2.0	MECH EQUIPMENT & STORAGE	1 FT X 1 FT BLU FLOOR TILE MASTIC	F		1- 1M	4-16M/17M
72	TRI	2.0	MECH EQUIPMENT & STORAGE	BASEBOARD MASTIC	W		1-2M	4-13M/14M
73	TRI	2.0	MECH EQUIPMENT & STORAGE	DRYWALL	W		2-11M	2-12M 4-15M
74	TRI	2.0	MECH EQUIPMENT & STORAGE	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
75	TRI	2.0	MECH EQUIPMENT & STORAGE	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
76	TRI	2.0	PIPE CHASE	SEE COMMENTS				
77	TRI	2.0	SECRETARY/RECEPTIONIST	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
78	TRI	2.0	SECRETARY/RECEPTIONIST	BASEBOARD MASTIC	W		1-2M	4-13M/14M
79	TRI	2.0	SECRETARY/RECEPTIONIST	DRYWALL	W		2-11M	2-12M 4-15M
80	TRI	2.0	SECRETARY/RECEPTIONIST	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
81	TRI	2.0	SECRETARY/RECEPTIONIST	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
82	TRI	2.0	STAIR	1 FT X 1 FT BGE SPCKLD FLOOR TILE	F		5-22M	5-23M/37M
83	TRI	2.0	STAIR	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC	F		5-22M	5-23M/37M
84	TRI	2.0	STAIR	DRYWALL	W		2-11M	2-12M 4-15M
85	TRI	2.0	STAIR	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
86	TRI	3.0	CABLE SHAFT	SPRAY-ON INSULATION	C	3-19S	1-3S	1-4S 3-19S
87	TRI	3.0	ELEVATOR SHAFT	SEE COMMENTS				
88	TRI	3.0	ENTRY	1 FT X 1 FT BGE SPCKLD FLOOR TILE	F		5-22M	5-23M/37M
89	TRI	3.0	ENTRY	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC	F		5-22M	5-23M/37M
90	TRI	3.0	ENTRY	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
91	TRI	3.0	ENTRY	BASEBOARD MASTIC	W		1-2M	4-13M/14M
92	TRI	3.0	ENTRY	DRYWALL	W		2-11M	2-12M 4-15M
93	TRI	3.0	ENTRY	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
94	TRI	3.0	ENTRY	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
95	TRI	3.0	LAVATORY	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
96	TRI	3.0	MECH EQUIPMENT & STORAGE	1 FT X 1 FT BLU FLOOR TILE	F		1-1M	4-16M/17M
97	TRI	3.0	MECH EQUIPMENT & STORAGE	1 FT X 1 FT BLU FLOOR TILE MASTIC	F		1-1M	4-16M/17M
98	TRI	3.0	MECH EQUIPMENT & STORAGE	BASEBOARD MASTIC	W		1-2M	4-13M/14M
99	TRI	3.0	MECH EQUIPMENT & STORAGE	DRYWALL	W		2-11M	2-12M 4-15M
100	TRI	3.0	MECH EQUIPMENT & STORAGE	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
101	TRI	3.0	MECH EQUIPMENT & STORAGE	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
102	TRI	3.0	PIPE CHASE	SEE COMMENTS				

FOR SAMPLE LOCATION: F = FLOOR C = CEILING W = WALL R = ROOF M = MISCELLANEOUS SAMPLE NUMBERS: P = PREVIOUS INSPECTION

FLOOR NUMBERS: 0.0 = BASE BUILDING 0.4 = MECHANICAL (MACHINE) LEVEL 0.5 = TOWER BASEMENT LEVEL 0.9 = BUILDING EXTERIOR 90.0 + = DETACHED BUILDINGS AND TRAILERS

RECORD NUMBER	PERCENT ASBESTOS	TYPE ASBESTOS	FRIABLE	POTENTIAL FOR DISTURBANCE	DISTURBANCE SOURCE	CONDITION	HAZARD RANK	RECOMMENDED ACTION	APPROXIMATE QUANTITY OF MATERIAL/ROOM	COST ESTIMATE	COMMENTS
69										0.00	
70										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
71	25.0	CHRY	N	LP	C	G	1	1	168 SQ FT	0.00	
72										0.00	
73										0.00	
74										0.00	
75										0.00	
76										0.00	INACCESSIBLE; ASSUME ACM
77										0.00	
78										0.00	
79										0.00	
80										0.00	
81										0.00	
82										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
83	25.0	CHRY	N	LP	C	G	1	1	25 SQ FT	0.00	MID-LANDING
84										0.00	
85										0.00	
86										0.00	
87										0.00	NO SUSPECT MATERIALS
88										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
89	25.0	CHRY	N	LP	C	G	1	1	75 SQ FT	0.00	
90										0.00	
91										0.00	
92										0.00	
93										0.00	
94										0.00	
95										0.00	
96										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
97	25.0	CHRY	N	LP	C	G	1	1	154 SQ FT	0.00	
98										0.00	
99										0.00	
100										0.00	
101										0.00	
102										0.00	INACCESSIBLE; ASSUME ACM

RECORD NUMBER	LOC ID	FLOOR NUMBER	ROOM DESCRIPTION	MATERIAL DESCRIPTION	SAMPLE LOCATION	ACTUAL SAMPLE	REFERENCE SAMPLE	RELATED SAMPLES
103	TRI	3.0	QA SPECIALIST	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
104	TRI	3.0	QA SPECIALIST	BASEBOARD MASTIC	W		1-2M	4-13M/14M
105	TRI	3.0	QA SPECIALIST	DRYWALL	W		2-11M	2-12M 4-15M
106	TRI	3.0	QA SPECIALIST	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
107	TRI	3.0	QA SPECIALIST	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
108	TRI	3.0	STAIR	1 FT X 1 FT BGE SPCKLD FLOOR TILE	F		5-22M	5-23M/37M
109	TRI	3.0	STAIR	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC	F		5-22M	5-23M/37M
110	TRI	3.0	STAIR	DRYWALL	W		2-11M	2-12M 4-15M
111	TRI	3.0	STAIR	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
112	TRI	3.0	STORAGE	1 FT X 1 FT BLU FLOOR TILE	F		1-1M	4-16M/17M
113	TRI	3.0	STORAGE	1 FT X 1 FT BLU FLOOR TILE MASTIC	F		1-1M	4-16M/17M
114	TRI	3.0	STORAGE	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
115	TRI	3.0	STORAGE	BASEBOARD MASTIC	W		1-2M	4-13M/14M
116	TRI	3.0	STORAGE	DRYWALL	W		2-11M	2-12M 4-15M
117	TRI	3.0	STORAGE	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
118	TRI	3.0	STORAGE	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
119	TRI	3.0	TRAINING	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
120	TRI	3.0	TRAINING	BASEBOARD MASTIC	W		1-2M	4-13M/14M
121	TRI	3.0	TRAINING	DRYWALL	W		2-11M	2-12M 4-15M
122	TRI	3.0	TRAINING	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
123	TRI	3.0	TRAINING	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
124	TRI	4.0	CABLE SHAFT	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
125	TRI	4.0	ELECTRONIC EQUIPMENT RM	1 FT X 1 FT BLU FLOOR TILE	F		1-1M	4-16M/17M
126	TRI	4.0	ELECTRONIC EQUIPMENT RM	1 FT X 1 FT BLU FLOOR TILE MASTIC	F		1-1M	4-16M/17M
127	TRI	4.0	ELECTRONIC EQUIPMENT RM	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
128	TRI	4.0	ELECTRONIC EQUIPMENT RM	BASEBOARD MASTIC	W		1-2M	4-13M/14M
129	TRI	4.0	ELECTRONIC EQUIPMENT RM	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
130	TRI	4.0	ELECTRONIC EQUIPMENT RM	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
131	TRI	4.0	ELECTRONIC EQUIPMENT RM	DRYWALL	W	4-15M	2-11M	2-12M 4-15M
132	TRI	4.0	ELEVATOR SHAFT	SEE COMMENTS				
133	TRI	4.0	ENTRY	1 FT X 1 FT BLU FLOOR TILE	F		1-1M	4-16M/17M
134	TRI	4.0	ENTRY	1 FT X 1 FT BLU FLOOR TILE MASTIC	F		1-1M	4-16M/17M
135	TRI	4.0	ENTRY	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
136	TRI	4.0	ENTRY	BASEBOARD MASTIC	W		1-2M	4-13M/14M

FOR SAMPLE LOCATION: F = FLOOR C = CEILING W = WALL R = ROOF M = MISCELLANEOUS SAMPLE NUMBERS: P = PREVIOUS INSPECTION

FLOOR NUMBERS: 0.0 = BASE BUILDING 0.4 = MECHANICAL (MACHINE) LEVEL 0.5 = TOWER BASEMENT LEVEL 0.9 = BUILDING EXTERIOR 90.0 + = DETACHED BUILDINGS AND TRAILERS

RECORD NUMBER	PERCENT ASBESTOS	TYPE ASBESTOS	FRIABLE	POTENTIAL FOR DISTURBANCE	DISTURBANCE SOURCE	CONDITION	HAZARD RANK	RECOMMENDED ACTION	APPROXIMATE QUANTITY OF MATERIAL/ROOM	COST ESTIMATE	COMMENTS
103										0.00	
104										0.00	
105										0.00	
106										0.00	
107										0.00	
108										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
109	25.0	CHRY	N	LP	C	G	1	1	25 SQ FT	0.00	MID-LANDING
110										0.00	
111										0.00	
112										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
113	25.0	CHRY	N	LP	C	G	1	1	85 SQ FT	0.00	
114										0.00	
115										0.00	
116										0.00	
117										0.00	
118										0.00	
119										0.00	
120										0.00	
121										0.00	
122										0.00	
123										0.00	
124										0.00	
125										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
126	25.0	CHRY	N	LP	C	G	1	1	650 SQ FT	0.00	
127										0.00	
128										0.00	
129										0.00	
130										0.00	
131										0.00	
132										0.00	NO SUSPECT MATERIALS
133										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
134	25.0	CHRY	N	LP	C	G	1	1	60 SQ FT	0.00	
135										0.00	
136										0.00	

RECORD NUMBER	LOC ID	FLOOR NUMBER	ROOM DESCRIPTION	MATERIAL DESCRIPTION	SAMPLE LOCATION	ACTUAL SAMPLE	REFERENCE SAMPLE	RELATED SAMPLES
137	TRI	4.0	ENTRY	DRYWALL	W		2-11M	2-12M 4-15M
138	TRI	4.0	ENTRY	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
139	TRI	4.0	ENTRY	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
140	TRI	4.0	JANITOR'S CLOSET	BASEBOARD MASTIC	W		1-2M	4-13M/14M
141	TRI	4.0	JANITOR'S CLOSET	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
142	TRI	4.0	JANITOR'S CLOSET	1 FT X 1 FT BLU FLOOR TILE	F	4-16M	1-1M	4-16M/17M
143	TRI	4.0	JANITOR'S CLOSET	1 FT X 1 FT BLU FLOOR TILE MASTIC	F	4-16M	1-1M	4-16M/17M
144	TRI	4.0	JANITOR'S CLOSET	1 FT X 1 FT BLU FLOOR TILE	F	4-17M	1-1M	4-16M/17M
145	TRI	4.0	JANITOR'S CLOSET	1 FT X 1 FT BLU FLOOR TILE MASTIC	F	4-17M	1-1M	SEE COMMENTS
146	TRI	4.0	JANITOR'S CLOSET	2 FT X 4 FT FISSURED CEILING TILE	C	4-18M	1-7M	1-8M 4-18M/20M
147	TRI	4.0	JANITOR'S CLOSET	2 FT X 4 FT FISSURED CEILING TILE	C	4-20M	1-7M	1-8M 4-18M/20M
148	TRI	4.0	JANITOR'S CLOSET	PIPE JOINT COMPOUND	M	4-21M	4-21M	
149	TRI	4.0	LAVATORY	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
150	TRI	4.0	LAVATORY	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
151	TRI	4.0	MECHANICAL EQUIPMENT RM	1 FT X 1 FT BLU FLOOR TILE	F		1-1M	4-16M/17M
152	TRI	4.0	MECHANICAL EQUIPMENT RM	1 FT X 1 FT BLU FLOOR TILE MASTIC	F		1-1M	4-16M/17M
153	TRI	4.0	MECHANICAL EQUIPMENT RM	DRYWALL	W		2-11M	2-12M 4-15M
154	TRI	4.0	MECHANICAL EQUIPMENT RM	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
155	TRI	4.0	MECHANICAL EQUIPMENT RM	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
156	TRI	4.0	MECHANICAL EQUIPMENT RM	BASEBOARD MASTIC	W	4-13M	1-2M	4-13M/14M
157	TRI	4.0	MECHANICAL EQUIPMENT RM	BASEBOARD MASTIC	W	4-14M	1-2M	4-13M/14M
158	TRI	4.0	PIPE CHASE	SEE COMMENTS				
159	TRI	4.0	STAIR	1 FT X 1 FT BGE SPCKLD FLOOR TILE	F		5-22M	5-23M/37M
160	TRI	4.0	STAIR	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC	F		5-22M	5-23M/37M
161	TRI	4.0	STAIR	DRYWALL	W		2-11M	2-12M 4-15M
162	TRI	4.0	STAIR	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
163	TRI	5.0	ATCT ADMIN SUPERVISOR	1 FT X 1 FT BLU FLOOR TILE	F		1-1M	4-16M/17M
164	TRI	5.0	ATCT ADMIN SUPERVISOR	1 FT X 1 FT BLU FLOOR TILE MASTIC	F		1-1M	4-16M/17M
165	TRI	5.0	ATCT ADMIN SUPERVISOR	BASEBOARD MASTIC	W		1-2M	4-13M/14M
166	TRI	5.0	ATCT ADMIN SUPERVISOR	DRYWALL	W		2-11M	2-12M 4-15M
167	TRI	5.0	ATCT ADMIN SUPERVISOR	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
168	TRI	5.0	ATCT ADMIN SUPERVISOR	DRYWALL TAPE & JOINT COMPOUND	W	5-24S	1-9S	1-10S 5-24S
169	TRI	5.0	ATCT ADMIN SUPERVISOR	PIPE SEALANT CAULK	M	5-25S	5-25S	
170	TRI	5.0	CABLE SHAFT	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S

FOR SAMPLE LOCATION: F = FLOOR C = CEILING W = WALL R = ROOF M = MISCELLANEOUS SAMPLE NUMBERS: P = PREVIOUS INSPECTION

FLOOR NUMBERS: 0.0 = BASE BUILDING 0.4 = MECHANICAL (MACHINE) LEVEL 0.5 = TOWER BASEMENT LEVEL 0.9 = BUILDING EXTERIOR 90.0 + = DETACHED BUILDINGS AND TRAILERS

RECORD NUMBER	PERCENT ASBESTOS	TYPE ASBESTOS	FRIABLE	POTENTIAL FOR DISTURBANCE	DISTURBANCE SOURCE	CONDITION	HAZARD RANK	RECOMMENDED ACTION	APPROXIMATE QUANTITY OF MATERIAL/ROOM	COST ESTIMATE	COMMENTS
137										0.00	
138										0.00	
139										0.00	
140										0.00	
141										0.00	
142										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
143	25.0	CHRY	N	LP	C	G	1	1	25 SQ FT	0.00	
144										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
145										0.00	REFLECTED BY ACTUAL SAMPLE NUMBER 4-16M
146										0.00	
147										0.00	
148										0.00	
149										0.00	
150										0.00	
151										0.00	MASTIC, ONLY, CONTAINS ASBESTIS
152	25.0	CHRY	N	LP	C	G	1	1	165 SQ FT	0.00	
153										0.00	
154										0.00	
155										0.00	
156										0.00	
157										0.00	
158										0.00	INACCESSIBLE; ASSUME ACM
159										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
160	25.0	CHRY	N	LP	C	G	1	1	25 SQ FT	0.00	MID-LANDING
161										0.00	
162										0.00	
163										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
164	25.0	CHRY	N	LP	C	G	1	1	165 SQ FT	0.00	
165										0.00	
166										0.00	
167										0.00	
168										0.00	
169										0.00	
170										0.00	

RECORD NUMBER	LOC ID	FLOOR NUMBER	ROOM DESCRIPTION	MATERIAL DESCRIPTION	SAMPLE LOCATION	ACTUAL SAMPLE	REFERENCE SAMPLE	RELATED SAMPLES
171	TRI	5.0	ELEVATOR SHAFT	SEE COMMENTS				
172	TRI	5.0	ENTRY	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
173	TRI	5.0	ENTRY	BASEBOARD MASTIC	W		1-2M	4-13M/14M
174	TRI	5.0	ENTRY	DRYWALL	W		2-11M	2-12M 4-15M
175	TRI	5.0	ENTRY	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
176	TRI	5.0	ENTRY	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
177	TRI	5.0	ENTRY	1 FT X 1 FT BGE SPCKLD FLOOR TILE	F	5-22M	5-22M	5-23M/37M
178	TRI	5.0	ENTRY	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC	F	5-22M	5-22M	5-23M/37M
179	TRI	5.0	ENTRY	1 FT X 1 FT BGE SPCKLD FLOOR TILE	F	5-23M	5-22M	5-23M/37M
180	TRI	5.0	ENTRY	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC	F	5-23M	5-22M	SEE COMMENTS
181	TRI	5.0	LAVATORY	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
182	TRI	5.0	LAVATORY	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
183	TRI	5.0	PIPE CHASE	SEE COMMENTS				
184	TRI	5.0	STAIR	DRYWALL	W		2-11M	2-12M 4-15M
185	TRI	5.0	STAIR	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
186	TRI	5.0	STAIR	1 FT X 1 FT BGE SPCKLD FLOOR TILE	F	5-37M	5-22M	5-23M/37M
187	TRI	5.0	STAIR	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC	F	5-37M	5-22M	5-23M/37M
188	TRI	5.0	TRACON	1 FT X 1 FT BLU FLOOR TILE	F		1-1M	4-16M/17M
189	TRI	5.0	TRACON	1 FT X 1 FT BLU FLOOR TILE MASTIC	F		1-1M	4-16M/17M
190	TRI	5.0	TRACON	BASEBOARD MASTIC	W		1-2M	4-13M/14M
191	TRI	5.0	TRACON	DRYWALL	W		2-11M	2-12M 4-15M
192	TRI	5.0	TRACON	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
193	TRI	5.0	TRACON	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
194	TRI	5.0	TRACON	2 FT X 4 FT ROUGH SURFACE BLK CEILING TILE	C	5- 5M	5-5M	5-6M 7-36M
195	TRI	5.0	TRACON	2 FT X 4 FT ROUGH SURFACE BLK CEILING TILE	C	5- 6M	5-5M	5-6M 7-36M
196	TRI	5.0	TRACON	1 FT X 1 FT BLK RUBBER FLOOR TILE	F	5-26M	5-26M	5-27M/28M
197	TRI	5.0	TRACON	1 FT X 1 FT BLK RUBBER FLOOR TILE	F	5-27M	5-26M	5-27M/28M
198	TRI	5.0	TRACON	1 FT X 1 FT BLK RUBBER FLOOR TILE	F	5-28M	5-26M	5-27M/28M
199	TRI	6.0	BREAKROOM	1 FT X 1 FT BLU FLOOR TILE	F		1-1M	4-16M/17M
200	TRI	6.0	BREAKROOM	1 FT X 1 FT BLU FLOOR TILE MASTIC	F		1-1M	4-16M/17M
201	TRI	6.0	BREAKROOM	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
202	TRI	6.0	BREAKROOM	BASEBOARD MASTIC	W		1-2M	4-13M/14M
203	TRI	6.0	BREAKROOM	DRYWALL	W		2-11M	2-12M 4-15M
204	TRI	6.0	BREAKROOM	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S

FOR SAMPLE LOCATION: F = FLOOR C = CEILING W = WALL R = ROOF M = MISCELLANEOUS SAMPLE NUMBERS: P = PREVIOUS INSPECTION

FLOOR NUMBERS: 0.0 = BASE BUILDING 0.4 = MECHANICAL (MACHINE) LEVEL 0.5 = TOWER BASEMENT LEVEL 0.9 = BUILDING EXTERIOR 90.0 + = DETACHED BUILDINGS AND TRAILERS

RECORD NUMBER	PERCENT ASBESTOS	TYPE ASBESTOS	FRIABLE	POTENTIAL FOR DISTURBANCE	DISTURBANCE SOURCE	CONDITION	HAZARD RANK	RECOMMENDED ACTION	APPROXIMATE QUANTITY OF MATERIAL/ROOM	COST ESTIMATE	COMMENTS
171										0.00	NO SUSPECT MATERIALS
172										0.00	
173										0.00	
174										0.00	
175										0.00	
176										0.00	
177										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
178	25.0	CHRY	N	LP	C	G	1	1	78 SQ FT	0.00	
179										0.00	MASTIC, ONLY CONTAINS ASBESTOS
180										0.00	REFLECTED BY ACTUAL SAMPLE NUMBER 5-22M
181										0.00	
182										0.00	
183										0.00	INACCESSIBLE; ASSUME ACM
184										0.00	
185										0.00	
186										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
187	25.0	CHRY	N	LP	C	G	1	1	21 SQ FT	0.00	MID-LANDING
188										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
189	25.0	CHRY	N	LP	C	G	1	1	408 SQ FT	0.00	BEHIND EQUIPMENT
190										0.00	
191										0.00	
192										0.00	
193										0.00	
194										0.00	
195										0.00	
196										0.00	
197										0.00	
198										0.00	
199										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
200	25.0	CHRY	N	LP	C	G	1	1	525 SQ FT	0.00	
201										0.00	
202										0.00	
203										0.00	
204										0.00	

RECORD NUMBER	LOC ID	FLOOR NUMBER	ROOM DESCRIPTION	MATERIAL DESCRIPTION	SAMPLE LOCATION	ACTUAL SAMPLE	REFERENCE SAMPLE	RELATED SAMPLES
205	TRI	6.0	BREAKROOM	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
206	TRI	6.0	CABLE SHAFT	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
207	TRI	6.0	ELEVATOR SHAFT	SEE COMMENTS				
208	TRI	6.0	ENTRY	1 FT X 1 FT BLU FLOOR TILE	F		1-1M	4-16M/17M
209	TRI	6.0	ENTRY	1 FT X 1 FT BLU FLOOR TILE MASTIC	F		1-1M	4-16M/17M
210	TRI	6.0	ENTRY	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
211	TRI	6.0	ENTRY	BASEBOARD MASTIC	W		1-2M	4-13M/14M
212	TRI	6.0	ENTRY	DRYWALL	W		2-11M	2-12M 4-15M
213	TRI	6.0	ENTRY	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
214	TRI	6.0	ENTRY	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
215	TRI	6.0	LAVATORY	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
216	TRI	6.0	LAVATORY	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
217	TRI	6.0	MECH EQUIPMENT & STORAGE	1 FT X 1 FT BLU FLOOR TILE	F		1-1M	4-16M/17M
218	TRI	6.0	MECH EQUIPMENT & STORAGE	1 FT X 1 FT BLU FLOOR TILE MASTIC	F		1-1M	4-16M/17M
219	TRI	6.0	MECH EQUIPMENT & STORAGE	BASEBOARD MASTIC	W		1-2M	4-13M/14M
220	TRI	6.0	MECH EQUIPMENT & STORAGE	DRYWALL	W		2-11M	2-12M 4-15M
221	TRI	6.0	MECH EQUIPMENT & STORAGE	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
222	TRI	6.0	MECH EQUIPMENT & STORAGE	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
223	TRI	6.0	PIPE CHASE	SEE COMMENTS				
224	TRI	6.0	ROOF	ROLLED ROOFING	R			SEE COMMENTS
225	TRI	6.0	ROOF	ROOF MASTIC	R			SEE COMMENTS
226	TRI	6.0	ROOF	ROOF TAR	R			SEE COMMENTS
227	TRI	6.0	ROOF	ROOF FLASHING	R	6-29M	6-29M	6-30M/31M
228	TRI	6.0	ROOF	ROOF FLASHING	R	6-30M	6-29M	SEE COMMENTS
229	TRI	6.0	ROOF	ROOF FLASHING	R	6-31M	6-29M	SEE COMMENTS
230	TRI	6.0	ROOF	STEPPING PADS	R	6-32M	6-32M	6-33M/34M
231	TRI	6.0	ROOF	STEPPING PADS	R	6-33M	6-32M	6-33M/34M
232	TRI	6.0	ROOF	STEPPING PADS	R	6-34M	6-32M	6-33M/34M
233	TRI	6.0	STAIR TO CAB	DRYWALL	W		2-11M	2-12M 4-15M
234	TRI	6.0	STAIR TO CAB	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
235	TRI	6.0	TELCO	1 FT X 1 FT BLU FLOOR TILE	F		1-1M	4-16M/17M
236	TRI	6.0	TELCO	1 FT X 1 FT BLU FLOOR TILE MASTIC	F		1-1M	4-16M/17M
237	TRI	6.0	TELCO	BASEBOARD MASTIC	W		1-2M	4-13M/14M
238	TRI	6.0	TELCO	DRYWALL	W		2-11M	2-12M 4-15M

FOR SAMPLE LOCATION: F = FLOOR C = CEILING W = WALL R = ROOF M = MISCELLANEOUS SAMPLE NUMBERS: P = PREVIOUS INSPECTION
FLOOR NUMBERS: 0.0 = BASE BUILDING 0.4 = MECHANICAL (MACHINE) LEVEL 0.5 = TOWER BASEMENT LEVEL 0.9 = BUILDING EXTERIOR 90.0 + = DETACHED BUILDINGS AND TRAILERS

RECORD NUMBER	PERCENT ASBESTOS	TYPE ASBESTOS	FRIABLE	POTENTIAL FOR DISTURBANCE	DISTURBANCE SOURCE	CONDITION	HAZARD RANK	RECOMMENDED ACTION	APPROXIMATE QUANTITY OF MATERIAL/ROOM	COST ESTIMATE	COMMENTS
205										0.00	
206										0.00	
207										0.00	NO SUSPECT MATERIALS
208										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
209	25.0	CHRY	N	LP	C	G	1	1	60 SQ FT	0.00	
210										0.00	
211										0.00	
212										0.00	
213										0.00	
214										0.00	
215										0.00	
216										0.00	
217										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
218	25.0	CHRY	N	LP	C	G	1	1	184 SQ FT	0.00	
219										0.00	
220										0.00	
221										0.00	
222										0.00	
223										0.00	INACCESSIBLE; ASSUME ACM
224										0.00	NOT SAMPLED TO AVOID DAMAGE; ASSUME ACM
225										0.00	NOT SAMPLED TO AVOID DAMAGE; ASSUME ACM
226										0.00	NOT SAMPLED TO AVOID DAMAGE; ASSUME ACM
227	30.0	CHRY	N	LP	C	G	1	1	100 LIN FT	0.00	
228										0.00	REFLECTED BY ACTUAL SAMPLE 6-29M
229										0.00	REFLECTED BY ACTUAL SAMPLE 6-29M
230										0.00	
231										0.00	
232										0.00	
233										0.00	
234										0.00	
235										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
236	25.0	CHRY	N	LP	C	G	1	1	72 SQ FT	0.00	
237										0.00	
238										0.00	

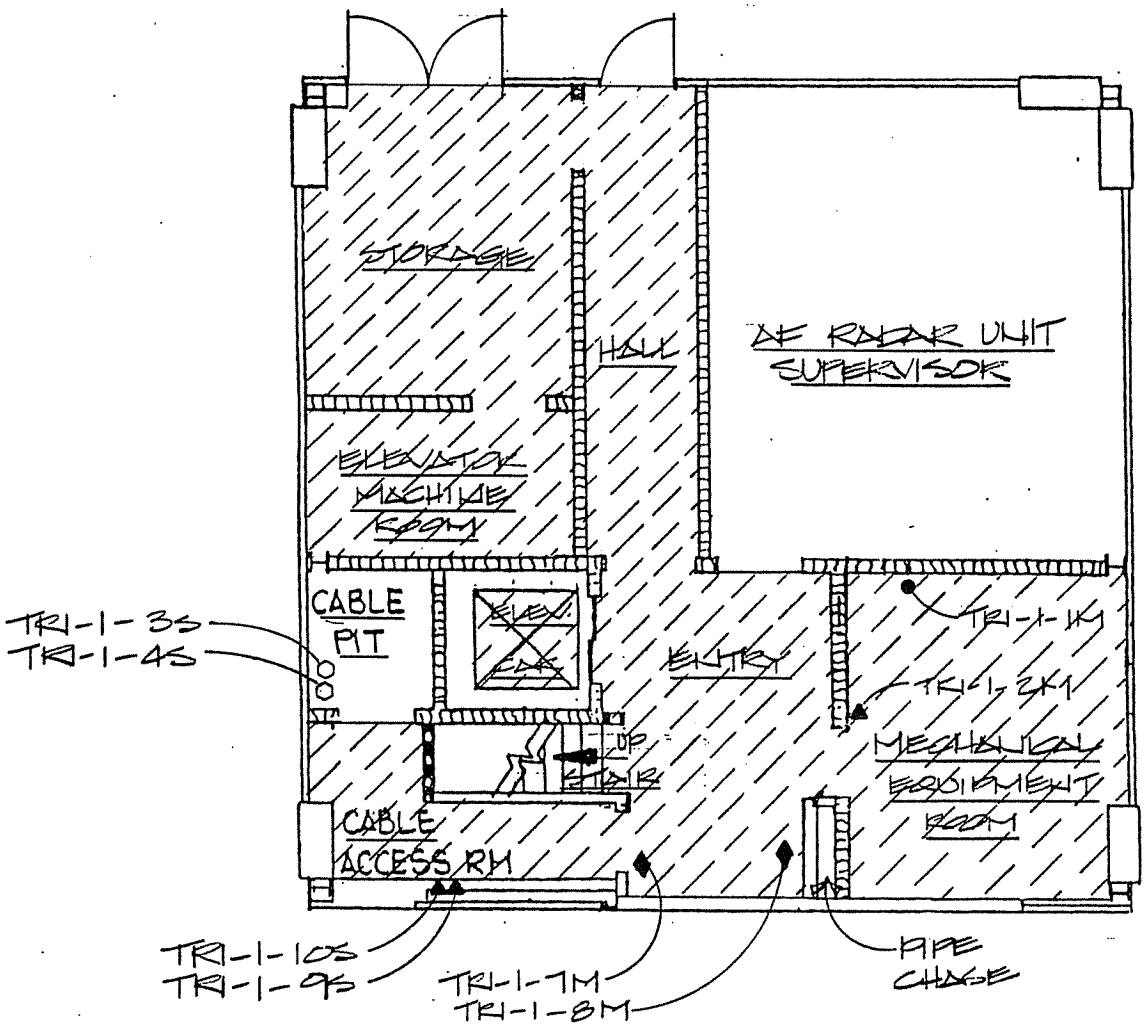
RECORD NUMBER	LOC ID	FLOOR NUMBER	ROOM DESCRIPTION	MATERIAL DESCRIPTION	SAMPLE LOCATION	ACTUAL SAMPLE	REFERENCE SAMPLE	RELATED SAMPLES
239	TRI	6.0	TELCO	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
240	TRI	6.0	TELCO	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
241	TRI	7.0	CAB	BASEBOARD MASTIC	W		1-2M	4-13M/14M
242	TRI	7.0	CAB	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
243	TRI	7.0	CAB	CEILING TILE MASTIC	C	7-35M	7-35M	
244	TRI	7.0	CAB	2 FT X 2 FT ROUGH TEXTURED BLK CEILING TILE	C	7-36M	5-5M	5-6M 7-36M
245	TRI	7.0	CAB ROOF	ROLLED ROOFING	R			SEE COMMENTS
246	TRI	7.0	CAB ROOF	ROOF FLASHING	R		6-29M	6-30M/31M
247	TRI	7.0	CAB ROOF	ROOF MASTIC	R			SEE COMMENTS
248	TRI	7.0	CAB ROOF	ROOF TAR	R			SEE COMMENTS
249	TRI	7.0	CAB ROOF	STEPPING PADS	R		6-32M	6-33M/34M
250	TRI	90.0	OUT-BLDG ENG GENERATOR RM	TSI PIPE INSULATION	M	0-38T	0-38T	0-39T/40T
251	TRI	90.0	OUT-BLDG ENG GENERATOR RM	TSI PIPE INSULATION	M	0-39T	0-38T	0-39T/40T
252	TRI	90.0	OUT-BLDG ENG GENERATOR RM	TSI PIPE INSULATION	M	0-40T	0-38T	0-39T/40T

FOR SAMPLE LOCATION: F = FLOOR C = CEILING W = WALL R = ROOF M = MISCELLANEOUS SAMPLE NUMBERS: P = PREVIOUS INSPECTION
FLOOR NUMBERS: 0.0 = BASE BUILDING 0.4 = MECHANICAL (MACHINE) LEVEL 0.5 = TOWER BASEMENT LEVEL 0.9 = BUILDING EXTERIOR 90.0 + = DETACHED BUILDINGS AND TRAILERS

RECORD NUMBER	PERCENT ASBESTOS	TYPE ASBESTOS	FRIABLE	POTENTIAL FOR DISTURBANCE	DISTURBANCE SOURCE	CONDITION	HAZARD RANK	RECOMMENDED ACTION	APPROXIMATE QUANTITY OF MATERIAL/ROOM	COST ESTIMATE	COMMENTS
239										0.00	
240										0.00	
241										0.00	
242										0.00	
243										0.00	
244										0.00	
245										0.00	NOT SAMPLED TO AVOID DAMAGE; ASSUME ACM
246	30.0	CHRY	N	LP	C	G	1	1	100 LIN FT	0.00	
247										0.00	NOT SAMPLED TO AVOID DAMAGE; ASSUME ACM
248										0.00	NOT SAMPLED TO AVOID DAMAGE; ASSUME ACM
249										0.00	
250										0.00	
251										0.00	
252										0.00	

APPENDIX B

EXHIBITS



FIRST FLOOR PLAN

1/8" = 1'-0"

NOTES:

- PIPE CHASE - INACCESSABLE; ASSUME ACM.
- STAIR-MID-LANDING, OVER CABLE ACCESS ROOM, CONTAINS 25 SQ. FT. OF ACM FLOOR TILE MASTIC.
- OUT-BUILDING ENGINE GENERATOR ROOM - NO FLOOR PLANS AVAILABLE

INDICATES AREA WITH ACM FLOOR TILE MASTIC

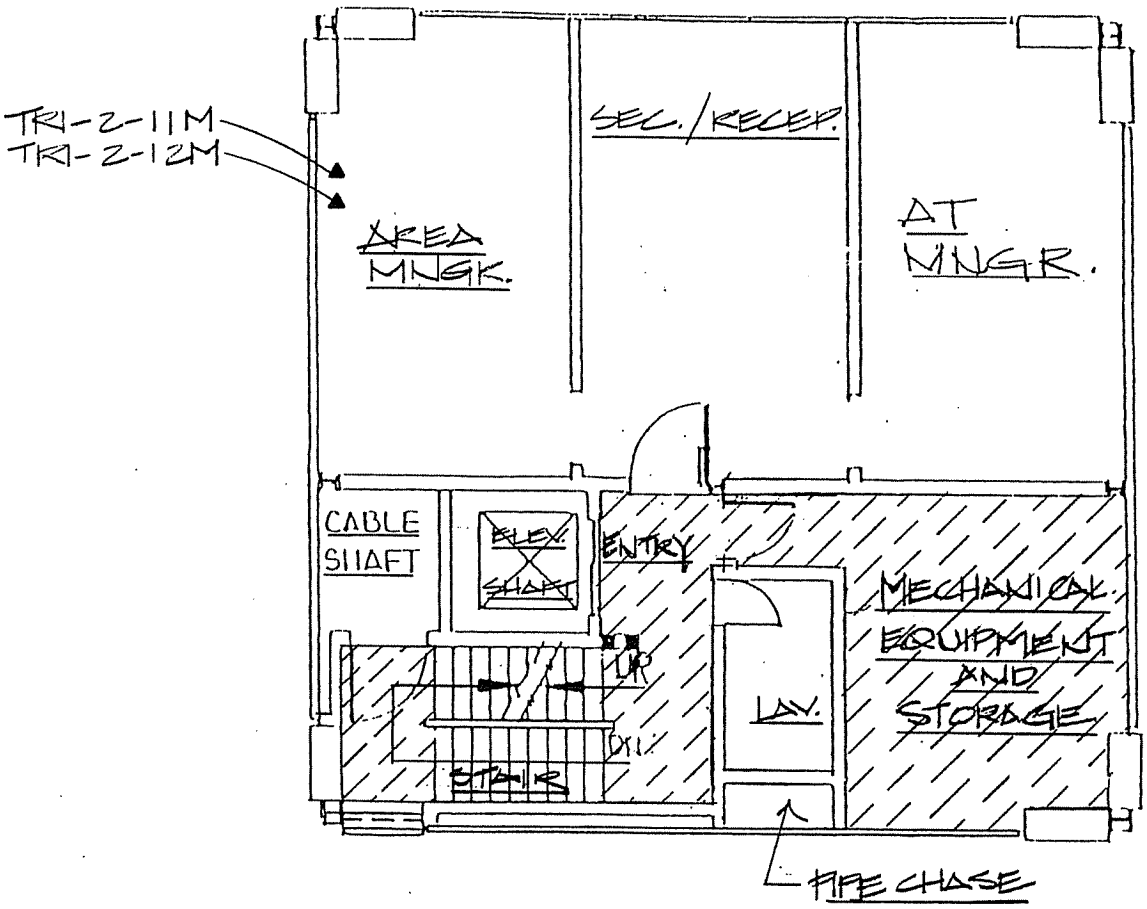
Schedule of Samples
- Floor
- Wall
- Ceiling
- Roof
- Miscellaneous

TRI-CITY REGIONAL AIRPORT BLOUNTVILLE, TENNESSEE	Date: 22 MAY 1992 Drawn by: PR	Exhibit 1

RMCI California Colorado Virginia

3190 S. Wadsworth Blvd, Suite 225
Lakewood, Colorado 80227
(303) 969-8778

A137-002



SECOND FLOOR PLAN
1/8" = 1'-0"

NOTE:
• PIPE CHASE - INACCESSABLE, ASSUME ACM.

INDICATES AREAS WITH ACM FLOOR TILE MASTIC.

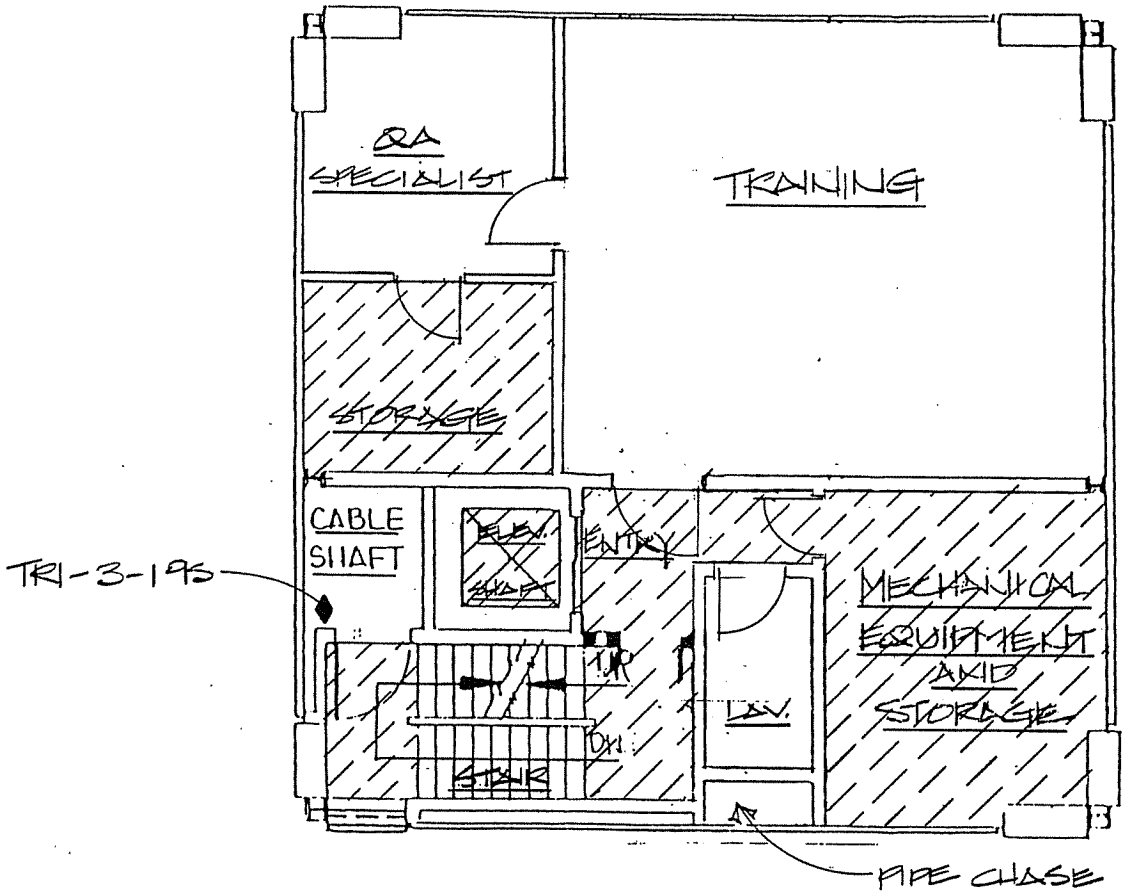
Schedule of Samples
- Floor
- Wall
- Ceiling
- Roof
- Miscellaneous

TRI-CITY REGIONAL AIRPORT BLOUNTVILLE, TENNESSEE	Date: 22 MAY 1992 Drawn by: DR	Exhibit 2

RMCI California Colorado Virginia

3190 S. Wadsworth Blvd. Suite 225
Lakewood, Colorado 80227
(303) 969-8778

A137-002



THIRD FLOOR PLAN
1/8" = 1'-0"

NOTE:

- PIPE CHASE - INACCESSABLE; ASSUME ACM.

INDICATES AREA WITH ACM FLOOR TILE AND MASTIC

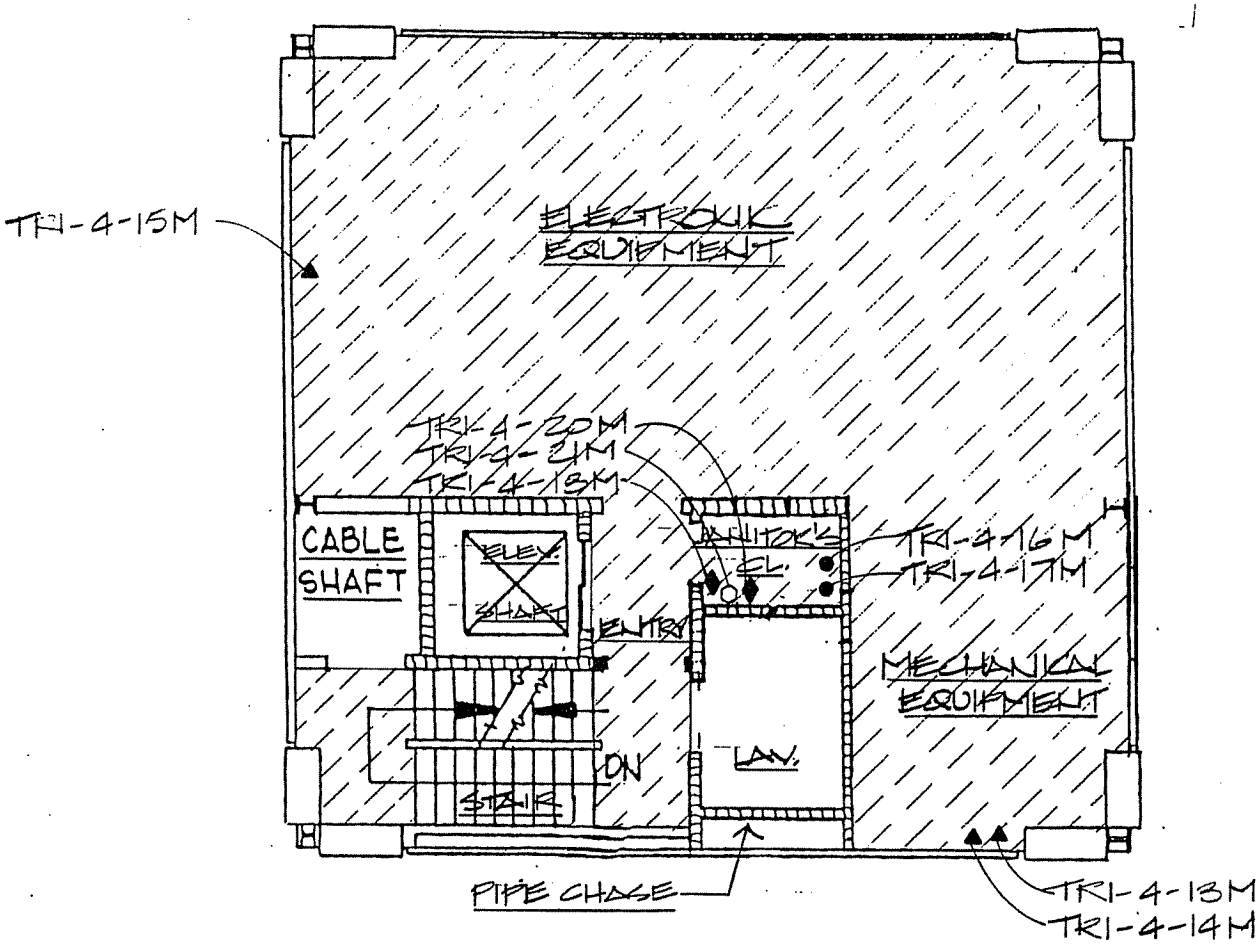
Schedule of Samples
- Floor
- Wall
- Ceiling
- Roof
- Miscellaneous

TRI-CITY REGIONAL AIRPORT BLOUNTVILLE, TENNESSEE	Date: 22 MAY 1992 Drawn by: PR	Exhibit 3

RMCI California Colorado Virginia

3190 S. Wadsworth Blvd., Suite 225
Lakewood, Colorado 80227
(303) 969-8778

A137-002



FOURTH FLOOR PLAN

1/8" = 1'-0"

NOTE:

- PIPE CHASE - INACCESSABLE; ASSUME ACM

INDICATES AREA WITH ACM FLOOR TILE MASTIC

Schedule of Samples

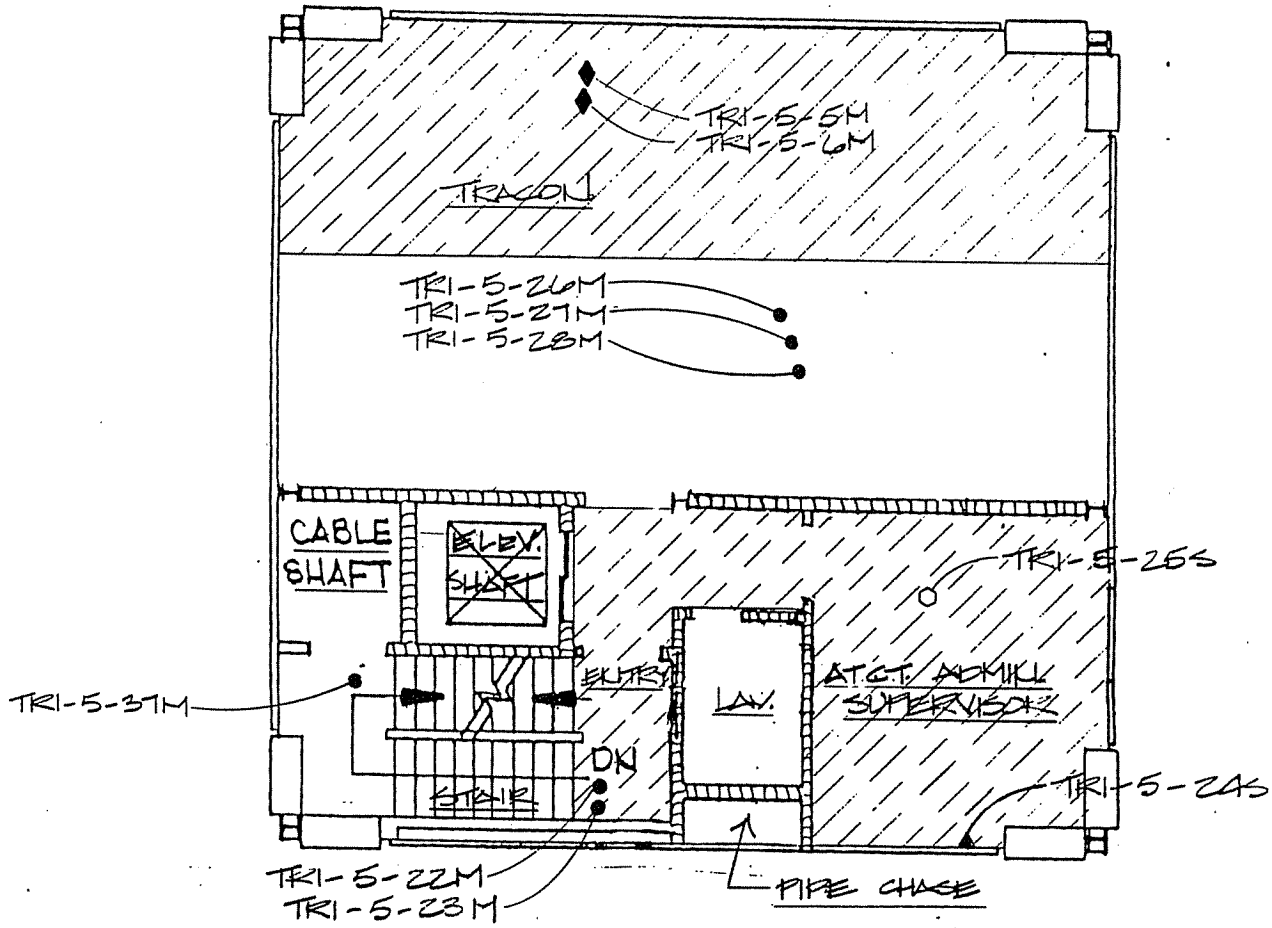
- ● Floor
- ▲ Wall
- ♦ Ceiling
- ■ Roof
- O Miscellaneous

TRI-CITY REGIONAL AIRPORT BLOUNTVILLE, TENNESSEE	Date: 22 MAY 1992 Drawn by: PR	Exhibit 4

RMCI California Colorado Virginia

3190 S. Wadsworth Blvd., Suite 225
Lakewood, Colorado 80227
(303) 969-8778

A137-002



FIFTH FLOOR PLAN

1/8" = 1'-0"

NOTE:

- PIPE CHASE - INACCESSABLE; ASSUME ACM.

INDICATES AREA WITH ACM FLOOR TILE MASTIC

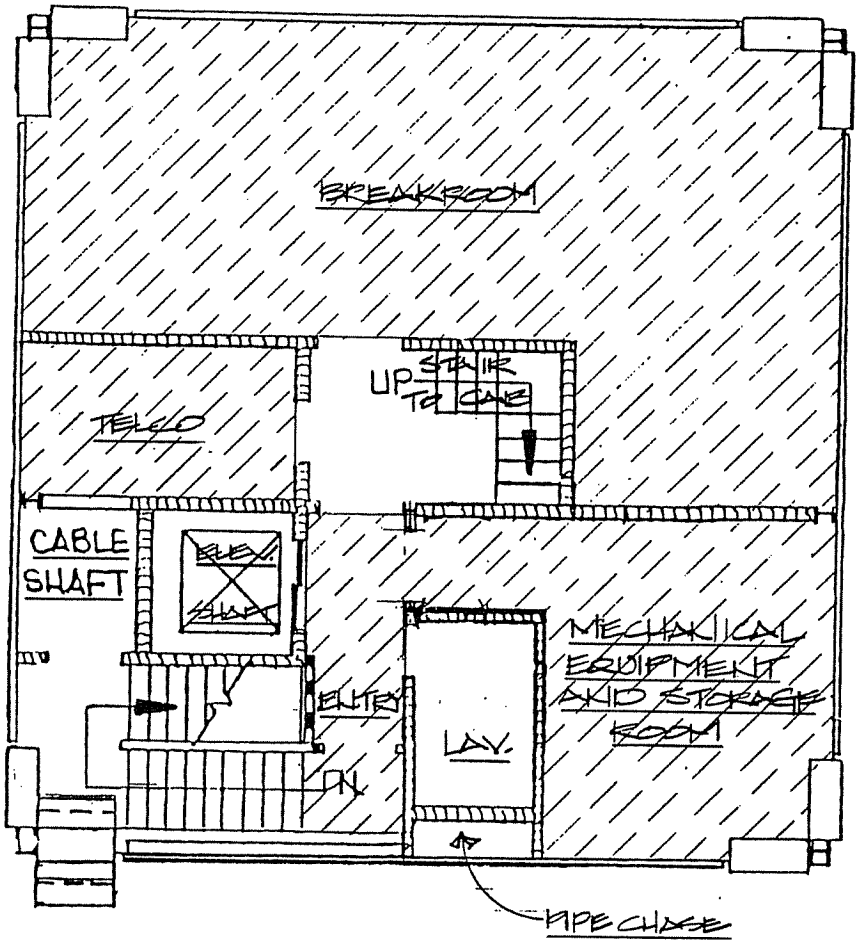
Schedule of Samples
- Floor
- Wall
- Ceiling
- Roof
- Miscellaneous

TRI-CITY REGIONAL AIRPORT BLOUNTVILLE, TENNESSEE	Date: 22 MAY 1992 Drawn by: DR	Exhibit 5

RMCI California Colorado Virginia

3190 S. Wadsworth Blvd., Suite 225
Lakewood, Colorado 80227
(303) 969-8778

A137-002



SIXTH FLOOR PLAN.
1/8" = 1'-0"

NOTES:

- PIPE CHASE - INACCESSABLE; ASSUME ACM.
- 6TH FLOOR ROOF - SAMPLES 6-29 THROUGH 6-34 LOCATED ON CAD (TM) FLOOR PLAN.

Schedule of Samples
- Floor
- Wall
- Ceiling
- Roof
- Miscellaneous

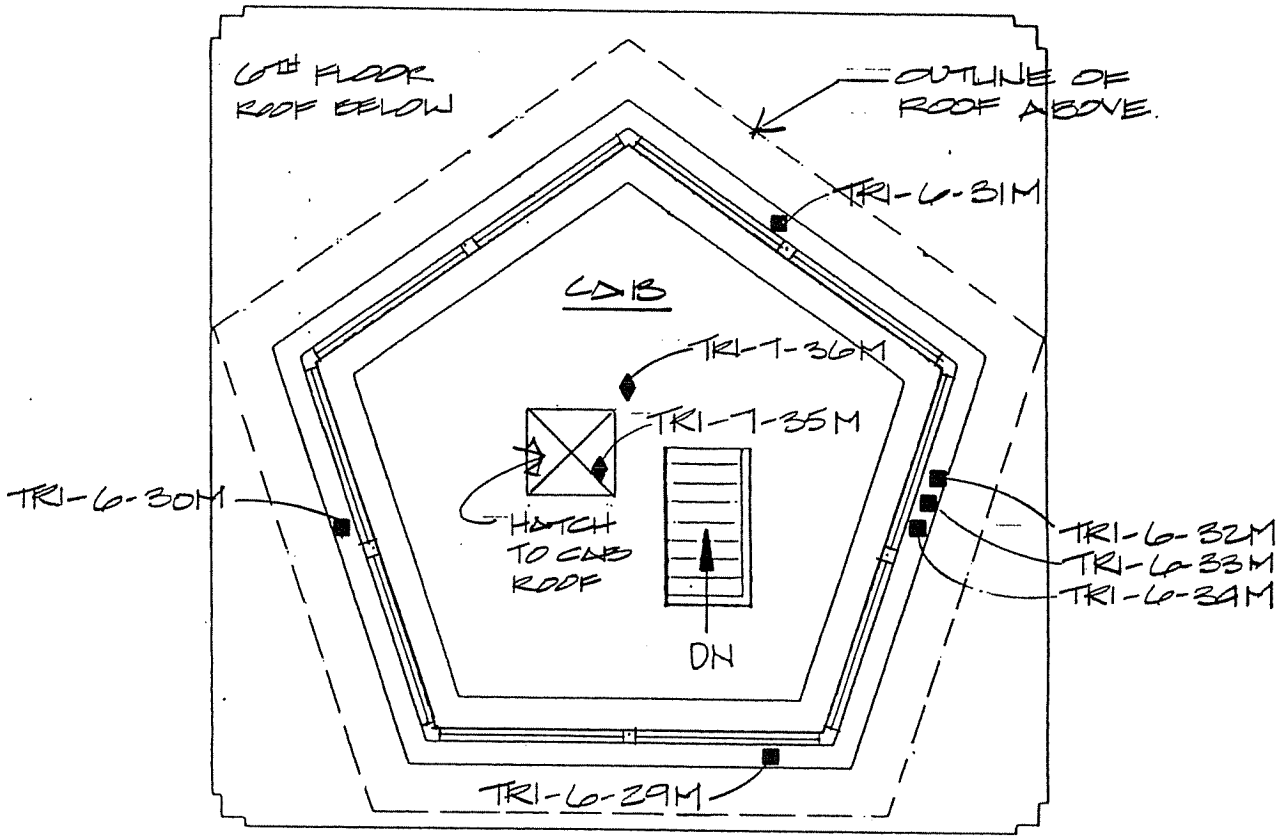
INDICATES AREA WITH ACM FLOOR TILE MASTIC.

TRI-CITY REGIONAL AIRPORT. BLOUNTVILLE, TENNESSEE	Date: 22 MAY 1992	Exhibit
	Drawn by: DR	6

RMCI California Colorado Virginia

3190 S. Wadsworth Blvd., Suite 225
Lakewood, Colorado 80227
(303) 969-8778

A137-002



CAB (7th) FLOOR

1/8" = 1'-0"

NOTE:

- SIXTH FLOOR ROOF & CAB ROOF - 100 L.F. EACH OF ACM ROOF FLASHING; ROOF MASTIC, ROOF TAR, AND ROLLED ROOFING NOT SAMPLED TO AVOID DAMAGE, ASSUME ACM.

Schedule of Samples

- ● Floor
- ▲ Wall
- ◆ Ceiling
- ■ Roof
- ○ Miscellaneous

TRI-CITY REGIONAL AIRPORT BLOUNTVILLE, TENNESSEE	Date: 22 MAY 1992 Drawn by: DR	Exhibit 7

RMCI California Colorado Virginia

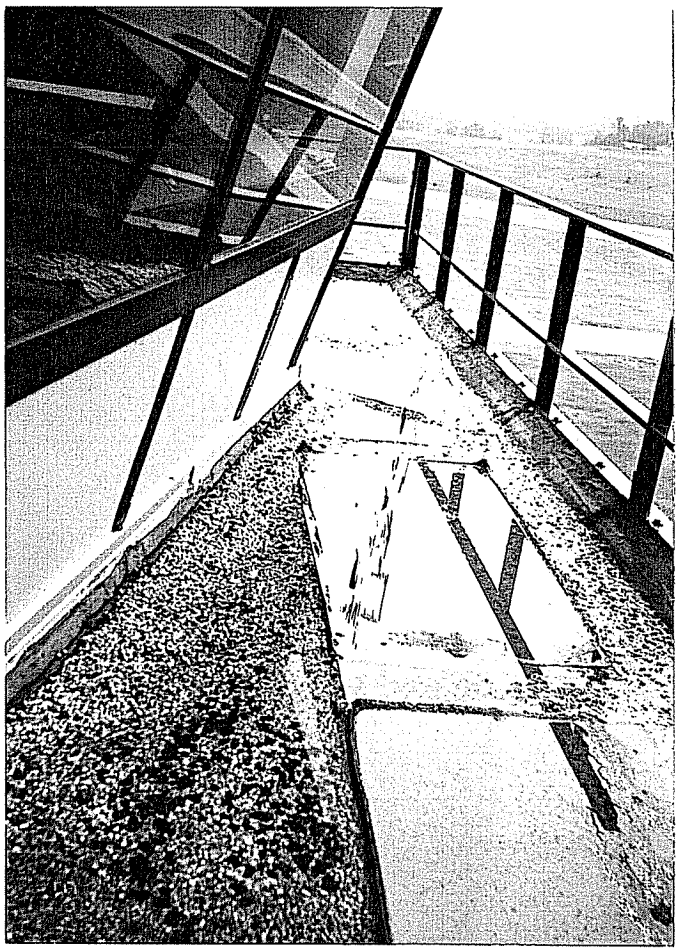
3190 S. Wadsworth Blvd. Suite 225
Lakewood, Colorado 80227
(303) 969-8778

A137-002

APPENDIX C

PHOTOGRAPHS

1) Exterior view of the Tri-City Regional Airport ATCT. May 1992.



2) Sixth floor roof. The roof flashing contains 30 percent chrysotile asbestos. The rolled roofing, roof mastic, and roof tar were not sampled to avoid damage and should be assumed ACM. May 1992.

3) Cab roof. The roof flashing contains 30 percent chrysotile asbestos. The rolled roofing, roof mastic, and roof tar were not sampled to avoid damage and should be assumed ACM. May 1992.

APPENDIX D

LABORATORY RESULTS

ATC ENVIRONMENTAL INC.

BULK SAMPLE ANALYSIS REPORT

Prepared For

Research Management Consultants, Inc.
3190 S. Wadsworth Boulevard, Suite #100
Lakewood, CO 80227

Project: A137-002-5 (TRI)
SCN: 7218-132

May 13, 1992

5031 South Ulster Street, Suite 100
Denver, Colorado 80237
(303) 793-9939
FAX (303) 793-0609

CLIENT:	Research Management Consultants, Inc.
PROJECT LOCATION:	A137-002-5 (TRI)
REPRESENTATIVE:	Jennifer Meyer
DESCRIPTION OF WORK:	Bulk Sample Analysis by Polarized Light Microscopy to establish asbestos content.
LABORATORY:	ATC ENVIRONMENTAL INC 5031 South Ulster Street, Suite 100 Denver, Colorado 80237 (303) 793-9939
ATC ENVIRONMENTAL REPRESENTATIVE:	Jeff Lomme

This report must not be used by the client to claim product endorsements by NVLAP or any agency of the U.S. Government. This test report relates only to the items stated.

PLM

POLARIZED LIGHT MICROSCOPY

PLM Analysis Methodology

PLM samples were analyzed utilizing the Environmental Protection Agency's Interim Method for the Detection of Asbestos in Bulk Insulation Samples. (EPA 600/M4-82020. December 1982) and the McCrone Research Institute's The Asbestos Particle Atlas as method references. Additional treatment and tests may be required to accurately define composition (i.e. ashing, extractions, acetone treatment, and TEM). All bulk sample reports are checked and reviewed three times. Unused portions of samples are archived for one year unless client requests special handling.

Laboratory Equipment

Laboratory analysis was accomplished utilizing an Olympus BH-2 or Meiji polarized light microscope. Both microscopes are equipped with dispersion staining lenses.

Quality Control

ATC Environmental Inc., is accredited by NVLAP (Lab Code 1081-01). ATC participates in the NVLAP and AIHA Bulk Asbestos Sample Quality Assurance Programs and maintains an in-house QC/QA program for bulk samples whereby 10% of all submitted samples are reanalyzed and documented in a Quality Control Manual. ATC also participates in a quarterly round robin QC/QA program for bulk samples with several accredited laboratories throughout the United States. Current and past QC/QA program results are available in the laboratory for inspection.

Laboratory Personnel

Samples were analyzed by Jeff Lomme, Laboratory Analyst. Mr. Lomme is a professional geologist with over two years asbestos analysis experience.

ATC ENVIRONMENTAL INC.
5031 SOUTH ULSTER STREET, SUITE 100
DENVER, COLORADO 80237
(303) 793-9939

BULK SAMPLE ANALYSIS

CLIENT: Research Management Consultants, Inc. SCN: 7218-132
PROJECT: A137-002-5 (TRI) DATE: 5-15-92

SAMPLE #	SAMPLE DATE	SAMPLE DESCRIPTION AND LOCATION	% AND TYPE OF ASBESTOS	% AND TYPE OF OTHER FIBROUS MATERIALS	% NON-FIBROUS MATERIAL
1-1m	5-13-92	Blue 1' x 1' floor tile with mastic	Trace Chryso** Mastic - 25% Chryso*	Trace Cellulose Trace Fiberglass	100%
1-2m	5-13-92	Mastic, baseboard (brown color)	ND	5% Cellulose Trace Fiberglass 5% Synthetics	90%
1-3s	5-13-92	Spray-on	Trace Tremolite/ Actinolite	20% Cellulose 15% Fiberglass 5% Vermiculite	60%
1-4s	5-13-92	Spray-on	Trace Tremolite/ Actinolite	20% Cellulose 15% Fiberglass 5% Vermiculite	60%
5-5m	5-13-92	2' x 4' Rough texture	ND	Trace Cellulose 85% Fiberglass	15%
5-6m	5-13-92	2' x 4' Rough texture	ND	Trace Cellulose 85% Fiberglass	15%
1-7m	5-13-92	2' x 4' Fissured ceiling tile (white)	ND	30% Cellulose 40% Fiberglass	30%
1-8m	5-13-92	2' x 4' Fissured ceiling tile (white)	ND	30% Cellulose 40% Fiberglass	30%
1-9s	5-13-92	Tape and joint compound	ND	Trace Cellulose Trace Fiberglass	100%
1-10s	5-13-92	Tape and joint compound	ND	Trace Cellulose Trace Fiberglass	100%

KEY:

TRACE = LESS THAN 1 PERCENT (<1%)
ND = NONE DETECTED
* = ASBESTOS CONTENT OF MASTIC IS SEPARATE FROM TOTAL % ASBESTOS AND OTHER MATERIALS.
** = NO ASBESTOS DETECTED IN FLOOR TILE; 25% CHRYSOTILE IN MASTIC

ANALYST:

Jeff Lomme

REVIEWED AND SIGNED FOR THE COMPANY BY:

Daniel M. Benecke, Regional Manager

ATC ENVIRONMENTAL INC.
5031 SOUTH ULSTER STREET, SUITE 100
DENVER, COLORADO 80237
(303) 793-9939

BULK SAMPLE ANALYSIS

CLIENT: Research Management Consultants, Inc. SCN: 7218-132
PROJECT: A137-002-5 (TRI) DATE: 5-15-92

SAMPLE #	SAMPLE DATE	SAMPLE DESCRIPTION AND LOCATION	% AND TYPE OF ASBESTOS	% AND TYPE OF OTHER FIBROUS MATERIALS	% NON-FIBROUS MATERIAL
2-11m	5-13-92	Sheetrock (drywall)	ND	10% Cellulose 5% Fiberglass	85%
2-12m	5-13-92	Sheetrock (drywall)	ND	15% Cellulose 5% Fiberglass	80%
4-13m	5-13-92	Baseboard mastic (brown)	ND	Trace Cellulose	100%
4-14m	5-13-92	Baseboard mastic (brown)	ND	Trace Cellulose Trace Fiberglass	100%
4-15m	5-13-92	Drywall	ND	15% Cellulose 5% Fiberglass	80%
4-16m	5-13-92	1' x 1' Blue tile with mastic	Trace Chryso** Mastic - 25% Chryso*	Trace Cellulose Trace Fiberglass	100%
4-17m	5-13-92	1' x 1' Blue tile with mastic	Trace Chryso** Mastic - 25% Chryso*	Trace Cellulose Trace Fiberglass	100%
4-18m	5-13-92	2' x 4' Fissured ceiling tile (white)	ND	30% Cellulose 40% Fiberglass	30%
3-19s	5-13-92	Spray-on	Trace Tremolite/ Actinolite	20% Cellulose 15% Fiberglass 5% Vermiculite	60%
4-20m	5-13-92	2' x 4' Ceiling tile fissured (white)	ND	30% Cellulose 40% Fiberglass	30%

KEY:

TRACE = LESS THAN 1 PERCENT (<1%)
ND = NONE DETECTED
* = ASBESTOS CONTENT OF MASTIC IS SEPARATE FROM TOTAL % ASBESTOS AND OTHER MATERIALS.
** = NO ASBESTOS DETECTED IN FLOOR TILE; 25% CHRYSOTILE IN MASTIC

ANALYST:

Jeff Lomme

REVIEWED AND SIGNED FOR THE COMPANY BY:

Daniel M. Benecke, Regional Manager

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BULK SAMPLE ANALYSIS

CLIENT: Research Management Consultants, Inc. SCN: 7218-132
PROJECT: A137-002-5 (TRI) DATE: 5-15-92

SAMPLE #	SAMPLE DATE	SAMPLE DESCRIPTION AND LOCATION	% AND TYPE OF ASBESTOS	% AND TYPE OF OTHER FIBROUS MATERIALS	% NON-FIBROUS MATERIAL
4-21m	5-13-92	Pipe joint compound (fire stop)	ND	ND	100%
5-22m	5-13-92	Beige 1' x 1' floor tile with mastic	Trace Chryso** Mastic - 25% Chryso*	Trace Cellulose Trace Fiberglass Trace Synthetics	100%
5-23m	5-13-92	Beige 1' x 1' floor tile (no mastic)	ND	Trace Cellulose	100%
5-24s	5-13-92	Tape and joint compound	ND	Trace Cellulose	100%
5-25s	5-13-92	Pipe sealant (caulk)	ND	Trace Cellulose 15% Wollastonite	85%
5-26m	5-13-92	1' x 1' Black rubber floor tile	ND	Trace Cellulose	100%
5-27m	5-13-92	1' x 1' Black rubber floor tile	ND	Trace Cellulose	100%
5-28m	5-13-92	1' x 1' Black rubber floor tile	ND	Trace Cellulose	100%
6-29m	5-13-92	Roof flashing (black)	30% Chrysotile	5% Cellulose Trace Fiberglass	65%
6-30m	5-13-92	Roof flashing (black)	30% Chrysotile	5% Cellulose Trace Fiberglass	65%

KEY:

TRACE = LESS THAN 1 PERCENT (<1%)
ND = NONE DETECTED
* = ASBESTOS CONTENT OF MASTIC IS SEPARATE FROM TOTAL % ASBESTOS AND OTHER MATERIALS.
** = NO ASBESTOS DETECTED IN FLOOR TILE; 25% CHRYSOTILE PRESENT IN MASTIC

ANALYST:

Jeff Lomme

REVIEWED AND SIGNED FOR THE COMPANY BY:

Daniel M. Benecke, Regional Manager

ATC ENVIRONMENTAL INC.
5031 SOUTH ULSTER STREET, SUITE 100
DENVER, COLORADO 80237
(303) 793-9939

BULK SAMPLE ANALYSIS

CLIENT: Research Management Consultants, Inc. SCN: 7218-132
PROJECT: A137-002-5 (TRI) DATE: 5-15-92

SAMPLE #	SAMPLE DATE	SAMPLE DESCRIPTION AND LOCATION	% AND TYPE OF ASBESTOS	% AND TYPE OF OTHER FIBROUS MATERIALS	% NON-FIBROUS MATERIAL
6-31m	5-13-92	Roof flashing (black)	30% Chrysotile	5% Cellulose Trace Fiberglass	65%
6-32m	5-13-92	Stepping pads	ND	25% Cellulose 5% Fiberglass	70%
6-33m	5-13-92	Stepping pads	ND	25% Cellulose 5% Fiberglass	70%
6-34m	5-13-92	Stepping pads	ND	25% Cellulose 5% Fiberglass	70%
7-35m	5-13-92	Mastic (ceiling tile)	ND	ND	100%
7-36m	5-13-92	2' x 2' Ceiling tile black (rough)	ND	Trace Cellulose 85% Fiberglass	15%
5-37m	5-13-92	1' x 1' Beige floor tile with mastic (insufficient mastic for analysis)	ND	Trace Cellulose Trace Fiberglass	100%
0-38t	5-13-92	TSI pipe insulation on generator	ND	2% Cellulose Trace Fiberglass	98%
0-39t	5-13-92	TSI pipe insulation on generator	ND	3% Cellulose Trace Fiberglass	97%
0-40t	5-13-92	TSI pipe insulation on generator	ND	2% Cellulose Trace Fiberglass	98%

KEY:

TRACE = LESS THAN 1 PERCENT (<1%)
ND = NONE DETECTED
* = ASBESTOS CONTENT OF MASTIC IS SEPARATE FROM TOTAL % ASBESTOS AND OTHER MATERIALS.

ANALYST:

Jeff Lomme

REVIEWED AND SIGNED FOR THE COMPANY BY:

Daniel M. Benecke, Regional Manager

United States Department of Commerce
National Institute of Standards and Technology

NVLAP

Certificate of Accreditation

ATC ENVIRONMENTAL, INC.
DENVER, CO

is recognized under the National Voluntary Laboratory Accreditation Program for satisfactory compliance with criteria established in Title 15, Part 7 Code of Federal Regulations. Accreditation is awarded for specific services, listed on the Scope of Accreditation, for:

BULK ASBESTOS FIBER ANALYSIS

July 1, 1993
Effective until

DEPARTMENT OF COMMERCE * UNITED STATES OF AMERICA *

For the National Institute of Standards and Technology

NVLAP LAB CODE: 1081 01

ANALYTICA
SOLUTIONS
an Analytica Group company

18000 W. Highway 72
Golden, CO 80403-8299
(303) 420-4449
(800) 873-8707
FAX: (303) 420-1434

May 20, 1992

Mr. FRANK PECK
RESEARCH MANAGEMENT
3190 S. WADSWORTH BLVD.
SUITE 225
LAKEWOOD, CO 80227

Re: LGN 300176 Project: A137-002-5 TRI

Dear Mr. PECK:

The bulk samples recently submitted to our laboratory have been analyzed by polarized light microscopy (PLM), the EPA-recommended method for determination of fibrous constituents in building materials. The results these analyses are summarized in the enclosed table.

Also enclosed is a copy of your Chain of Custody form containing your field data.

Please call if you have any questions about this work.

Sincerely,

David A. Schroeder, PhD
Data Controller

Enclosures

ANALYTICA SOLUTIONS
an Analytica Group company

18000 W. Highway 72
Golden, CO 80403-8299
(303) 420-4449
(800) 873-8707
FAX: (303) 420-1434

RESULTS OF BULK ASBESTOS SAMPLE ANALYSIS BY POLARIZED LIGHT MICROSCOPY (PLM) EPA-600/M4-82-020

Client: **RESEARCH MANAGEMENT**

LGN: **300176**

Project ID: **A137-002-5 TRI**

Sample Description:

Sample Number	Sample Date	Description
TRI 0-39T	05/13/92	TSI
TRI 1-35OC	05/13/92	Spray on

Results of PLM Analysis: Visual Area Estimation: Percentages Detected

Sample Number:	TRI 0-39T	TRI 1-35OC			
Asbestiform Minerals:					
Amosite					
Anthophyllite					
Chrysotile					
Crocidolite					
Tremolite-Actinolite					
TOTAL ASBESTOS	0	0			
Other Fibrous Materials:					
Fibrous Glass		3			
Cellulose	10	20			
Synthetics					
Other:		3 Vermiculite			
Percent Nonfibrous Material	90	74			

Analyst: Tim Bergquist
Tim Bergquist

Date: 05/19/92

ANALYTICA SOLUTIONS
18000 West Highway 72
Golden, CO 80403
(303) 420-4449

PLM

BULK SAMPLE ANALYSIS PROCEDURES

Bulk samples of construction materials are analyzed by professional mineralogists with at least a Bachelor's Degree in Geology according to the guidelines set by the Environmental Protection Agency (EPA-600/M4-82-020, December 1982). As specified in the EPA method, the total asbestos reported is the average of all components in the material analyzed, with separate layers delineated at the bottom of the report. As suggested by the EPA, our laboratory uses the preferred Becke Line Method to test the index of refraction of the materials, not the alternate method of stain dispersion. Each sample is prepared and analyzed in three different Cargille certified refractive index oils. Estimates of asbestos content are based on visual comparison using a calibrated graticule. Additional tests and treatments (see below) may also be required for certain samples.

Analytica is accredited by the National Institute for Standards and Technology (Lab Code 1086) under the National Voluntary Laboratory Accreditation Program (NVLAP) and is an AIHA accredited industrial hygiene laboratory (certificate #307). Analytica participates in the NVLAP bulk asbestos proficiency testing program (results available upon request). Analytica maintains an in-house QA/QC program whereby at least ten percent (10%) of all submitted samples are re-analyzed and documented in a quality control manual. Analytica also participates in three quarterly round robin QA/QC programs with accredited laboratories throughout the United States and the world. Unused portions of samples are archived for six months unless client requests special handling.

ASHING

Ashing is a procedure in which one half of the sample is placed in a crucible and then set in a furnace at 500°C for one hour. Most non-silicate interferants are eliminated; asbestos remains behind. The amount of the ashed material is compared to the original amount to determine the volume percent lost due to ashing. The ashed sample is analyzed by PLM for the type and percentage of asbestos present.

Unless otherwise noted, the results shown on the final report are the percentage of asbestos in the original material, not the ashed material. For example, if 50% of the original material is lost due to combustion and the ashed sample contains 10% asbestos, the final report would show 5% asbestos in the original material.

POINT COUNTING

As of November 20, 1990, National Emissions Standards for Hazardous Air Pollutants (NESHAP) established a rule that requires that friable ACM bulk samples with less than 10% asbestos be analyzed by the point count procedure described in the EPA-600/M4-82-020 method. Analytica Solutions Inc. cannot assume responsibility for client compliance with the NESHAP rule, however, the laboratory does have experienced analysts ready to perform requested point counting.

GLOSSARY

GLOSSARY

- Actinolite - one of six naturally occurring asbestos minerals. It is not normally used commercially.

- Action level - a level of airborne fibers specified by OSHA as a warning or alert level. It is 0.1 fibers per cubic centimeter (f/cc) of air, 8-hour time-weighted average, as measured by phase contract microscopy.

- AHERA - Asbestos Hazard Emergency Response Act.

- AIHA - American Industrial Hygienists' Association.

- Amosite - (brown asbestos) an asbestiform mineral of the amphibole group. It is the second most commonly used form of asbestos in the U.S.

- Amphibole - one of the two major groups of minerals from which the asbestiform minerals are derived – distinguished by their chain-like crystal structure and chemical composition. Amosite and crocidolite are examples of amphibole minerals.

- Anthophyllite - one of six naturally occurring asbestos minerals. It is of limited commercial value.

- Asbestos - a generic name given to a number of naturally occurring hydrated mineral silicates that possess a unique crystalline structure, are incombustible in air, and are separable into fibers. Asbestos includes the asbestiform varieties of chrysotile (serpentine), crocidolite (riebeckite), amosite (cummingtonite-grunerite), anthophyllite, actinolite, and tremolite.

- Asbestos-Containing Material (ACM) - any material or product which contains more than 1 percent asbestos (AHERA definition).

- Asbestosis - scarring of the lungs caused by exposure to asbestos. Continued exposure may lead to degeneration of lung function and death.

- Bulk sample - samples of bulk material; in the case of asbestos, suspect material.

- Carcinoma - a malignant tumor of epithelial origin, and in this context, referring to membranous tissues of the human body.

- Chain-of-custody - formal procedures for tracking samples and insuring their integrity.

- Chrysotile - (white asbestos) the only asbestiform mineral of the serpentine group. It is the most common form of asbestos used in buildings.

- Crocidolite - (blue asbestos) strongest of asbestos minerals. An asbestiform mineral of the amphibole group. It is of minor commercial value in the U.S.

- EPA - Environmental Protection Agency.
- Epidemiology - the study of causes, occurrence and distribution of disease throughout a population.
- Fireproofing - spray-or-trowel-applied fire-resistant materials.
- Friable - material that can be crumbled or reduced to powder by hand pressure.
- Functional spaces - spatially distinct units within a building which contain identifiable populations of building occupants.
- Heating, ventilation, and air-conditioning (HVAC) system - the system of pipes, ducts, and equipment (air conditioner, chiller, heaters, boilers, pumps, fans) used to heat, cool, move, and filter air in a building. HVAC systems are also known as mechanical systems.
- Homogeneous areas - an area which appears similar throughout in terms of color, texture, and date of material application.
- Lung cancer - a malignant growth of tissue in the lungs, specifically of the bronchial covering.
- Mesothelioma - a rare cancer of the lining around the lungs or the abdomen.
- Mesothelium - epithelium derived from mesoderm that lines the body cavity of a vertebrate embryo and gives rise to epithelia, among others.
- NESHAP - National Emission Standards for Hazardous Air Pollutants.
- NVLAP - National Voluntary Laboratory Accreditation Program.
- Personal Protective Equipment (PPE) - equipment, such as hard-toed shoes, gloves, respirator, etc., designed to protect a worker from certain workplace hazards.
- Phase contrast microscopy (PCM) - a method of analyzing air samples for fibers using a light microscope.
- Polarized light microscopy (PLM) - a method of analyzing bulk samples for asbestos in which the sample is illuminated with polarized light (light which vibrates in only one plane) and viewed under a light microscope.
- Quality assurance - a program for collecting and analyzing additional duplicate samples of suspect material to check on the reliability of procedures.
- Regulated material - in the case of ACM, a material is regulated by federal law if the asbestos content is 1 percent or greater by volume.

- Respiratory tract - the organs of the body which convey air to the blood, allow exchange of gases, and remove carbon dioxide.

- Serpentine - one of the two major groups of minerals from which the asbestiform minerals are derived -- distinguished by their tubular structure and chemical composition. Chrysotile is a serpentine mineral.

- Surfacing material - material in a building that is sprayed-on, troweled-on, or otherwise applied to surfaces, such as acoustical plaster on ceilings and fireproofing materials on structural members, or other materials on surfaces for acoustical, fireproofing, or other purposes (AHERA definition).

- Synergistic - the combination of two effects which is greater than the sum of the two independent effects.

- Thermal system insulation - means material applied to pipes, fittings, boilers, breeching, tanks, ducts, or other interior structural components to prevent heat losses or gain, or water condensation, or for other purposes.

- Transite - a trade name for asbestos cement wallboard and pipe.

- Transmission electron microscopy (TEM) - a method of analyzing air samples for asbestos fibers using a transmission electron microscope and, possibly, associated instruments for further identifying asbestos.

- Tremolite - one of six naturally occurring asbestos minerals. Tremolite has few commercial uses.

- Vinyl Asbestos Tile (VAT) - A floor tile made of plastic imbedded with asbestos.

TRI-ATCT

ASBESTOS SURVEY INVENTORY
TRI-CITY REGIONAL AIRPORT
AIR TRAFFIC CONTROL TOWER
BLOUNTVILLE, TENNESSEE

PREPARED FOR:

FEDERAL AVIATION ADMINISTRATION
NATIONAL HEADQUARTERS
ANS-204
800 INDEPENDENCE AVENUE, SW
WASHINGTON, DC 20591

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FAA CONTRACT NO. DTFA01-91-Y-01035

RMCI PROJECT NO. A137-002-S081

FLING/MEYER

DATA SUMMARY TABLE COLUMN DEFINITIONS

The Data Summary Table lists these columns in the following order:

1. RECORD NUMBER - Sequential number representing each row of data.

2. LOC ID - Location Identifier. Specific identifier unique to the facility.

3. FLOOR - Floor in which inspection, sampling, and assessment occurred.

4. ROOM DESCRIPTION - Type of room, based on use.

5. MATERIAL DESCRIPTION - Type of building material inspected and assessed.

6. SAMPLE LOCATION - Specific building component on which suspect material is found. F = Floor, W = Wall, C = Ceiling, R = Roof, M = Miscellaneous.

7. ACTUAL SAMPLE - The sample (if any) collected in the area identified by that record.

8. REFERENCE SAMPLE - Multiple samples of the same material often vary in asbestos content. This may be a reflection of manufacturing inconsistencies and/or mixing of materials such as mastics or spray-on insulation prior to application. For the purpose of discussion, one sample is chosen to represent the asbestos content of the suspect material. This is termed the reference sample.

9. RELATED SAMPLES - All samples, other than the reference sample, collected of the same suspect material.

10. PERCENT ASBESTOS - Total percentage of all forms of asbestos minerals contained in the reference sample.

11. TYPE ASBESTOS - The specific type of asbestos which is identified in the reference sample. CHRY = chrysotile, AMO = amosite, CROC = crocidolite, ANTH = anthophyllite, TREM = tremolite, ACT = actinolite.

12. FRIABLE - Material that may be crumbled or reduced to powder by hand pressure.

13. POTENTIAL FOR DISTURBANCE - Indicates the likelihood of ACM being disturbed in the future. Related to: 1) the frequency of contact between the ACM and human activity, 2) location of ACM with respect to vibration sources, and 3) the potential for air erosion. Three categories exist under AHERA: 1) "Potential for Significant Damage" (PSD), 2) "Potential for Damage" (PD), and 3) "Low Potential" (LP).

14. DISTURBANCE SOURCE - The type of condition or action which may disturb the ACM. Under AHERA, three types of disturbance exist: 1) physical contact with material (C), 2) vibration influence (V), and 3) air erosion (A).

15. CONDITION - A description of the physical condition of the ACM based on a visual inspection. AHERA defines three categories: 1) "Good Condition" (G), 2) "Damaged" (D), and 3) "Significantly Damaged" (SD).

16. HAZARD RANK - A numerical score which provides the management planner with a qualitative tool for selecting an appropriate response action. In addition, the Hazard Rank allows the FAA to compare in a relative way, the condition of different facilities in different locations. A score of "1" indicates a low hazard, while a score of "7" indicates a significant hazard. The method used to rank facilities follows the AHERA Categorizing of Assessed Material with a few notable exceptions.

Both AHERA and this ranking system evaluate material on the basis of its condition and potential for disturbance. However, AHERA only addresses friable material. The presence of non-friable ACM is documented, but it is not assessed. Non-friable ACM is included in the Hazard Rank. AHERA also categorizes on the basis of material type (surfacing, TSI, or miscellaneous). This is not appropriate for determination of the Hazard Rank since all material types present similar concerns. In summary, the Hazard Rank considers friability, condition and potential for disturbance in its calculation.

17. RECOMMENDED ACTION - Describes the type of activity recommended to respond to the presence of asbestos within the ATCT. Recommended actions are as follows:

Action 1: O&M Deferred - Maintain material in good condition. Monitor for deterioration of material.

Action 2: O&M Abatement - Remove, repair, enclose or encapsulate all damaged ACM to mitigate potential release.

Action 3: Emergency O&M Abatement - Evacuate and isolate the area. Remove, repair, enclose or encapsulate all damaged ACM. Clean all potentially contaminated areas.

Action 4: Full-Scale Emergency Abatement - Evacuate and isolate the area. Abate all damaged ACM via full-scale abatement operation. Clean all potentially contaminated areas.

18. APPROXIMATE QUANTITY OF MATERIAL/ROOM - The total estimated linear or square footage of ACM in the room.

19. COST ESTIMATE - The anticipated cost to implement recommended removal actions.

20. COMMENTS - Additional information (if any).

RECORD NUMBER	LOC ID	FLOOR NUMBER	ROOM DESCRIPTION	MATERIAL DESCRIPTION	SAMPLE LOCATION	ACTUAL SAMPLE	REFERENCE SAMPLE	RELATED SAMPLES
1	TRI	1.0	AF RADAR UNIT SUPERVISOR	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
2	TRI	1.0	AF RADAR UNIT SUPERVISOR	BASEBOARD MASTIC	W		1-2M	4-13M/14M
3	TRI	1.0	AF RADAR UNIT SUPERVISOR	DRYWALL	W		2-11M	2-12M 4-15M
4	TRI	1.0	AF RADAR UNIT SUPERVISOR	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
5	TRI	1.0	CABLE ACCESS ROOM	1 FT X 1 FT BLU FLOOR TILE	F		1- 1M	4-16M/17M
6	TRI	1.0	CABLE ACCESS ROOM	1 FT X 1 FT BLU FLOOR TILE MASTIC	F		1- 1M	4-16M/17M
7	TRI	1.0	CABLE ACCESS ROOM	BASEBOARD MASTIC	W		1-2M	4-13M/14M
8	TRI	1.0	CABLE ACCESS ROOM	DRYWALL	W		2-11M	2-12M 4-15M
9	TRI	1.0	CABLE ACCESS ROOM	DRYWALL TAPE & JOINT COMPOUND	W	1- 9S	1-9S	1-10S 5-24S
10	TRI	1.0	CABLE ACCESS ROOM	DRYWALL TAPE & JOINT COMPOUND	W	1-10S	1-9S	1-10S 5-24S
11	TRI	1.0	CABLE PIT	SPRAY-ON INSULATION	M	1- 3S	1-3S	1-4S 3-19S
12	TRI	1.0	CABLE PIT	SPRAY-ON INSULATION	M	1- 4S	1-3S	1-4S 3-19S
13	TRI	1.0	ELEVATOR CAR	1 FT X 1 FT BGE SPCKLD FLOOR TILE	F		5-22M	5-23M/37M
14	TRI	1.0	ELEVATOR CAR	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC	F		5-22M	5-23M/37M
15	TRI	1.0	ELEVATOR MACHINE ROOM	1 FT X 1 FT BLU FLOOR TILE	F		1- 1M	4-16M/17M
16	TRI	1.0	ELEVATOR MACHINE ROOM	1 FT X 1 FT BLU FLOOR TILE MASTIC	F		1-1M	4-16M/17M
17	TRI	1.0	ELEVATOR MACHINE ROOM	BASEBOARD MASTIC	W		1-2M	4-13M/14M
18	TRI	1.0	ELEVATOR MACHINE ROOM	DRYWALL	W		2-11M	2-12M 4-15M
19	TRI	1.0	ELEVATOR MACHINE ROOM	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
20	TRI	1.0	ELEVATOR MACHINE ROOM	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
21	TRI	1.0	ELEVATOR SHAFT	SEE COMMENTS				
22	TRI	1.0	ENTRY	1 FT X 1 FT BGE SPCKLD FLOOR TILE	F		5-22M	5-23M/37M
23	TRI	1.0	ENTRY	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC	F		5-22M	5-23M/37M
24	TRI	1.0	ENTRY	BASEBOARD MASTIC	W		1-2M	4-13M/14M
25	TRI	1.0	ENTRY	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
26	TRI	1.0	ENTRY	2 FT X 4 FT FISSURED CEILING TILE	C	1- 7M	1-7M	1-8M 4-18M/20M
27	TRI	1.0	ENTRY	2 FT X 4 FT FISSURED CEILING TILE	C	1- 8M	1-7M	1-8M 4-18M/20M
28	TRI	1.0	HALL	1 FT X 1 FT BGE SPCKLD FLOOR TILE	F		5-22M	5-23M/37M
29	TRI	1.0	HALL	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC	F		5-22M	5-23M/37M
30	TRI	1.0	HALL	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
31	TRI	1.0	HALL	BASEBOARD MASTIC	W		1-2M	4-13M/14M
32	TRI	1.0	MECHANICAL EQUIPMENT RM	DRYWALL	W		2-11M	2-12M 4-15M
33	TRI	1.0	MECHANICAL EQUIPMENT RM	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
34	TRI	1.0	MECHANICAL EQUIPMENT RM	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S

FOR SAMPLE LOCATION: F = FLOOR C = CEILING W = WALL R = ROOF M = MISCELLANEOUS SAMPLE NUMBERS: P = PREVIOUS INSPECTION

FLOOR NUMBERS: 0.0 = BASE BUILDING 0.4 = MECHANICAL (MACHINE) LEVEL 0.5 = TOWER BASEMENT LEVEL 0.9 = BUILDING EXTERIOR 90.0 + = DETACHED BUILDINGS AND TRAILERS

DATA SUMMARY TABLE

RECORD NUMBER	PERCENT ASBESTOS	TYPE ASBESTOS	FRIABLE	POTENTIAL FOR DISTURBANCE	DISTURBANCE SOURCE	CONDITION	HAZARD RANK	RECOMMENDED ACTION	APPROXIMATE QUANTITY OF MATERIAL/ROOM	COST ESTIMATE	COMMENTS
1										0.00	
2										0.00	
3										0.00	
4										0.00	
5										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
6	25.0	CHRY	N	LP	C	G	1	1	52 SQ FT	0.00	
7										0.00	
8										0.00	
9										0.00	
10										0.00	
11										0.00	
12										0.00	
13										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
14	25.0	CHRY	N	LP	C	G	1	1	16 SQ FT	0.00	
15										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
16	25.0	CHRY	N	LP	C	G	1	1	68 SQ FT	0.00	
17										0.00	
18										0.00	
19										0.00	
20										0.00	
21										0.00	NO SUSPECT MATERIALS
22										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
23	25.0	CHRY	N	LP	C	G	1	1	130 SQ FT	0.00	
24										0.00	
25										0.00	
26										0.00	
27										0.00	
28										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
29	25.0	CHRY	N	LP	C	G	1	1	100 SQ FT	0.00	
30										0.00	
31										0.00	
32										0.00	
33										0.00	
34										0.00	

RECORD NUMBER	LOC ID	FLOOR NUMBER	ROOM DESCRIPTION	MATERIAL DESCRIPTION	SAMPLE LOCATION	ACTUAL SAMPLE	REFERENCE SAMPLE	RELATED SAMPLES
35	TRI	1.0	MECHANICAL EQUIPMENT RM	1 FT X 1 FT BLU FLOOR TILE	F	1- 1M	1- 1M	4-16M/17M
36	TRI	1.0	MECHANICAL EQUIPMENT RM	1 FT X 1 FT BLU FLOOR TILE MASTIC	F	1- 1M	1- 1M	4-16M/17M
37	TRI	1.0	MECHANICAL EQUIPMENT RM	BASEBOARD MASTIC	W	1- 2M	1-2M	4-13M/14M
38	TRI	1.0	PIPE CHASE	SEE COMMENTS				
39	TRI	1.0	STAIR	1 FT X 1 FT BGE SPCKLD FLOOR TILE	F		5-22M	5-23M/37M
40	TRI	1.0	STAIR	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC	F		5-22M	5-23M/37M
41	TRI	1.0	STAIR	DRYWALL	W		2-11M	2-12M 4-15M
42	TRI	1.0	STAIR	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
43	TRI	1.0	STORAGE	1 FT X 1 FT BLU FLOOR TILE	F		1- 1M	4-16M/17M
44	TRI	1.0	STORAGE	1 FT X 1 FT BLU FLOOR TILE MASTIC	F		1- 1M	4-16M/17M
45	TRI	1.0	STORAGE	BASEBOARD MASTIC	W		1-2M	4-13M/14M
46	TRI	1.0	STORAGE	DRYWALL	W		2-11M	2-12M 4-15M
47	TRI	1.0	STORAGE	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
48	TRI	1.0	STORAGE	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
49	TRI	2.0	AREA MANAGER	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
50	TRI	2.0	AREA MANAGER	BASEBOARD MASTIC	W		1-2M	4-13M/14M
51	TRI	2.0	AREA MANAGER	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
52	TRI	2.0	AREA MANAGER	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
53	TRI	2.0	AREA MANAGER	DRYWALL	W	2-11M	2-11M	2-12M 4-15M
54	TRI	2.0	AREA MANAGER	DRYWALL	W	2-12M	2-11M	2-12M 4-15M
55	TRI	2.0	AT MANAGER	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
56	TRI	2.0	AT MANAGER	BASEBOARD MASTIC	W		1-2M	4-13M/14M
57	TRI	2.0	AT MANAGER	DRYWALL	W		2-11M	2-12M 4-15M
58	TRI	2.0	AT MANAGER	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
59	TRI	2.0	AT MANAGER	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
60	TRI	2.0	CABLE SHAFT	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
61	TRI	2.0	ELEVATOR SHAFT	SEE COMMENTS				
62	TRI	2.0	ENTRY	1 FT X 1 FT BGE SPCKLD FLOOR TILE	F		5-22M	5-23M/37M
63	TRI	2.0	ENTRY	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC	F		5-22M	5-23M/37M
64	TRI	2.0	ENTRY	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
65	TRI	2.0	ENTRY	DRYWALL	W		2-11M	2-12M 4-15M
66	TRI	2.0	ENTRY	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
67	TRI	2.0	ENTRY	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
68	TRI	2.0	LAVATORY	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M

FOR SAMPLE LOCATION: F = FLOOR C = CEILING W = WALL R = ROOF M = MISCELLANEOUS SAMPLE NUMBERS: P = PREVIOUS INSPECTION
FLOOR NUMBERS: 0.0 = BASE BUILDING 0.4 = MECHANICAL (MACHINE) LEVEL 0.5 = TOWER BASEMENT LEVEL 0.9 = BUILDING EXTERIOR 90.0 + = DETACHED BUILDINGS AND TRAILERS

RECORD NUMBER	PERCENT ASBESTOS	TYPE ASBESTOS	FRIABLE	POTENTIAL FOR DISTURBANCE	DISTURBANCE SOURCE	CONDITION	HAZARD RANK	RECOMMENDED ACTION	APPROXIMATE QUANTITY OF MATERIAL/ROOM	COST ESTIMATE	COMMENTS
35										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
36	25.0	CHRY	N	LP	C	G	1	1	154 SQ FT	0.00	
37										0.00	
38										0.00	INACCESSIBLE; ASSUME ACM
39										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
40	25.0	CHRY	N	LP	C	G	1	1	25 SQ FT	0.00	MID-LANDING
41										0.00	
42										0.00	
43										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
44	25.0	CHRY	N	LP	C	G	1	1	140 SQ FT	0.00	
45										0.00	
46										0.00	
47										0.00	
48										0.00	
49										0.00	
50										0.00	
51										0.00	
52										0.00	
53										0.00	
54										0.00	
55										0.00	
56										0.00	
57										0.00	
58										0.00	
59										0.00	
60										0.00	
61										0.00	NO SUSPECT MATERIALS
62										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
63	25.0	CHRY	N	LP	C	G	1	1	60 SQ FT	0.00	
64										0.00	
65										0.00	
66										0.00	
67										0.00	
68										0.00	

RECORD NUMBER	LOC ID	FLOOR NUMBER	ROOM DESCRIPTION	MATERIAL DESCRIPTION	SAMPLE LOCATION	ACTUAL SAMPLE	REFERENCE SAMPLE	RELATED SAMPLES
69	TRI	2.0	LAVATORY	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
70	TRI	2.0	MECH EQUIPMENT & STORAGE	1 FT X 1 FT BLU FLOOR TILE	F		1- 1M	4-16M/17M
71	TRI	2.0	MECH EQUIPMENT & STORAGE	1 FT X 1 FT BLU FLOOR TILE MASTIC	F		1- 1M	4-16M/17M
72	TRI	2.0	MECH EQUIPMENT & STORAGE	BASEBOARD MASTIC	W		1-2M	4-13M/14M
73	TRI	2.0	MECH EQUIPMENT & STORAGE	DRYWALL	W		2-11M	2-12M 4-15M
74	TRI	2.0	MECH EQUIPMENT & STORAGE	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
75	TRI	2.0	MECH EQUIPMENT & STORAGE	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
76	TRI	2.0	PIPE CHASE	SEE COMMENTS				
77	TRI	2.0	SECRETARY/RECEPTIONIST	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
78	TRI	2.0	SECRETARY/RECEPTIONIST	BASEBOARD MASTIC	W		1-2M	4-13M/14M
79	TRI	2.0	SECRETARY/RECEPTIONIST	DRYWALL	W		2-11M	2-12M 4-15M
80	TRI	2.0	SECRETARY/RECEPTIONIST	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
81	TRI	2.0	SECRETARY/RECEPTIONIST	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
82	TRI	2.0	STAIR	1 FT X 1 FT BGE SPCKLD FLOOR TILE	F		5-22M	5-23M/37M
83	TRI	2.0	STAIR	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC	F		5-22M	5-23M/37M
84	TRI	2.0	STAIR	DRYWALL	W		2-11M	2-12M 4-15M
85	TRI	2.0	STAIR	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
86	TRI	3.0	CABLE SHAFT	SPRAY-ON INSULATION	C	3-19S	1-3S	1-4S 3-19S
87	TRI	3.0	ELEVATOR SHAFT	SEE COMMENTS				
88	TRI	3.0	ENTRY	1 FT X 1 FT BGE SPCKLD FLOOR TILE	F		5-22M	5-23M/37M
89	TRI	3.0	ENTRY	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC	F		5-22M	5-23M/37M
90	TRI	3.0	ENTRY	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
91	TRI	3.0	ENTRY	BASEBOARD MASTIC	W		1-2M	4-13M/14M
92	TRI	3.0	ENTRY	DRYWALL	W		2-11M	2-12M 4-15M
93	TRI	3.0	ENTRY	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
94	TRI	3.0	ENTRY	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
95	TRI	3.0	LAVATORY	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
96	TRI	3.0	MECH EQUIPMENT & STORAGE	1 FT X 1 FT BLU FLOOR TILE	F		1-1M	4-16M/17M
97	TRI	3.0	MECH EQUIPMENT & STORAGE	1 FT X 1 FT BLU FLOOR TILE MASTIC	F		1-1M	4-16M/17M
98	TRI	3.0	MECH EQUIPMENT & STORAGE	BASEBOARD MASTIC	W		1-2M	4-13M/14M
99	TRI	3.0	MECH EQUIPMENT & STORAGE	DRYWALL	W		2-11M	2-12M 4-15M
100	TRI	3.0	MECH EQUIPMENT & STORAGE	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
101	TRI	3.0	MECH EQUIPMENT & STORAGE	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
102	TRI	3.0	PIPE CHASE	SEE COMMENTS				

FOR SAMPLE LOCATION: F = FLOOR C = CEILING W = WALL R = ROOF M = MISCELLANEOUS SAMPLE NUMBERS: P = PREVIOUS INSPECTION
FLOOR NUMBERS: 0.0 = BASE BUILDING 0.4 = MECHANICAL (MACHINE) LEVEL 0.5 = TOWER BASEMENT LEVEL 0.9 = BUILDING EXTERIOR 90.0 + = DETACHED BUILDINGS AND TRAILERS

RECORD NUMBER	PERCENT ASBESTOS	TYPE ASBESTOS	FRIABLE	POTENTIAL FOR DISTURBANCE	DISTURBANCE SOURCE	CONDITION	HAZARD RANK	RECOMMENDED ACTION	APPROXIMATE QUANTITY OF MATERIAL/ROOM	COST ESTIMATE	COMMENTS
69										0.00	
70										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
71	25.0	CHRY	N	LP	C	G	1	1	168 SQ FT	0.00	
72										0.00	
73										0.00	
74										0.00	
75										0.00	
76										0.00	INACCESSIBLE; ASSUME ACM
77										0.00	
78										0.00	
79										0.00	
80										0.00	
81										0.00	
82										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
83	25.0	CHRY	N	LP	C	G	1	1	25 SQ FT	0.00	MID-LANDING
84										0.00	
85										0.00	
86										0.00	
87										0.00	NO SUSPECT MATERIALS
88										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
89	25.0	CHRY	N	LP	C	G	1	1	75 SQ FT	0.00	
90										0.00	
91										0.00	
92										0.00	
93										0.00	
94										0.00	
95										0.00	
96										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
97	25.0	CHRY	N	LP	C	G	1	1	154 SQ FT	0.00	
98										0.00	
99										0.00	
100										0.00	
101										0.00	
102										0.00	INACCESSIBLE; ASSUME ACM

RECORD NUMBER	LOC ID	FLOOR NUMBER	ROOM DESCRIPTION	MATERIAL DESCRIPTION	SAMPLE LOCATION	ACTUAL SAMPLE	REFERENCE SAMPLE	RELATED SAMPLES
103	TRI	3.0	QA SPECIALIST	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
104	TRI	3.0	QA SPECIALIST	BASEBOARD MASTIC	W		1-2M	4-13M/14M
105	TRI	3.0	QA SPECIALIST	DRYWALL	W		2-11M	2-12M 4-15M
106	TRI	3.0	QA SPECIALIST	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
107	TRI	3.0	QA SPECIALIST	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
108	TRI	3.0	STAIR	1 FT X 1 FT BGE SPCKLD FLOOR TILE	F		5-22M	5-23M/37M
109	TRI	3.0	STAIR	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC	F		5-22M	5-23M/37M
110	TRI	3.0	STAIR	DRYWALL	W		2-11M	2-12M 4-15M
111	TRI	3.0	STAIR	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
112	TRI	3.0	STORAGE	1 FT X 1 FT BLU FLOOR TILE	F		1-1M	4-16M/17M
113	TRI	3.0	STORAGE	1 FT X 1 FT BLU FLOOR TILE MASTIC	F		1-1M	4-16M/17M
114	TRI	3.0	STORAGE	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
115	TRI	3.0	STORAGE	BASEBOARD MASTIC	W		1-2M	4-13M/14M
116	TRI	3.0	STORAGE	DRYWALL	W		2-11M	2-12M 4-15M
117	TRI	3.0	STORAGE	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
118	TRI	3.0	STORAGE	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
119	TRI	3.0	TRAINING	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
120	TRI	3.0	TRAINING	BASEBOARD MASTIC	W		1-2M	4-13M/14M
121	TRI	3.0	TRAINING	DRYWALL	W		2-11M	2-12M 4-15M
122	TRI	3.0	TRAINING	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
123	TRI	3.0	TRAINING	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
124	TRI	4.0	CABLE SHAFT	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
125	TRI	4.0	ELECTRONIC EQUIPMENT RM	1 FT X 1 FT BLU FLOOR TILE	F		1-1M	4-16M/17M
126	TRI	4.0	ELECTRONIC EQUIPMENT RM	1 FT X 1 FT BLU FLOOR TILE MASTIC	F		1-1M	4-16M/17M
127	TRI	4.0	ELECTRONIC EQUIPMENT RM	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
128	TRI	4.0	ELECTRONIC EQUIPMENT RM	BASEBOARD MASTIC	W		1-2M	4-13M/14M
129	TRI	4.0	ELECTRONIC EQUIPMENT RM	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
130	TRI	4.0	ELECTRONIC EQUIPMENT RM	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
131	TRI	4.0	ELECTRONIC EQUIPMENT RM	DRYWALL	W	4-15M	2-11M	2-12M 4-15M
132	TRI	4.0	ELEVATOR SHAFT	SEE COMMENTS				
133	TRI	4.0	ENTRY	1 FT X 1 FT BLU FLOOR TILE	F		1-1M	4-16M/17M
134	TRI	4.0	ENTRY	1 FT X 1 FT BLU FLOOR TILE MASTIC	F		1-1M	4-16M/17M
135	TRI	4.0	ENTRY	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
136	TRI	4.0	ENTRY	BASEBOARD MASTIC	W		1-2M	4-13M/14M

FOR SAMPLE LOCATION: F = FLOOR C = CEILING W = WALL R = ROOF M = MISCELLANEOUS SAMPLE NUMBERS: P = PREVIOUS INSPECTION
FLOOR NUMBERS: 0.0 = BASE BUILDING 0.4 = MECHANICAL (MACHINE) LEVEL 0.5 = TOWER BASEMENT LEVEL 0.9 = BUILDING EXTERIOR 91.0 + = DETACHED BUILDINGS AND TRAILERS

RECORD NUMBER	PERCENT ASBESTOS	TYPE ASBESTOS	FRIABLE	POTENTIAL FOR DISTURBANCE	DISTURBANCE SOURCE	CONDITION	HAZARD RANK	RECOMMENDED ACTION	APPROXIMATE QUANTITY OF MATERIAL/ROOM	COST ESTIMATE	COMMENTS
103										0.00	
104										0.00	
105										0.00	
106										0.00	
107										0.00	
108										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
109	25.0	CHRY	N	LP	C	G	1	1	25 SQ FT	0.00	MID-LANDING
110										0.00	
111										0.00	
112										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
113	25.0	CHRY	N	LP	C	G	1	1	85 SQ FT	0.00	
114										0.00	
115										0.00	
116										0.00	
117										0.00	
118										0.00	
119										0.00	
120										0.00	
121										0.00	
122										0.00	
123										0.00	
124										0.00	
125										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
126	25.0	CHRY	N	LP	C	G	1	1	650 SQ FT	0.00	
127										0.00	
128										0.00	
129										0.00	
130										0.00	
131										0.00	
132										0.00	NO SUSPECT MATERIALS
133										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
134	25.0	CHRY	N	LP	C	G	1	1	60 SQ FT	0.00	
135										0.00	
136										0.00	

RECORD NUMBER	LOC ID	FLOOR NUMBER	ROOM DESCRIPTION	MATERIAL DESCRIPTION	SAMPLE LOCATION	ACTUAL SAMPLE	REFERENCE SAMPLE	RELATED SAMPLES
137	TRI	4.0	ENTRY	DRYWALL	W		2-11M	2-12M 4-15M
138	TRI	4.0	ENTRY	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
139	TRI	4.0	ENTRY	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
140	TRI	4.0	JANITOR'S CLOSET	BASEBOARD MASTIC	W		1-2M	4-13M/14M
141	TRI	4.0	JANITOR'S CLOSET	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
142	TRI	4.0	JANITOR'S CLOSET	1 FT X 1 FT BLU FLOOR TILE	F	4-16M	1-1M	4-16M/17M
143	TRI	4.0	JANITOR'S CLOSET	1 FT X 1 FT BLU FLOOR TILE MASTIC	F	4-16M	1-1M	4-16M/17M
144	TRI	4.0	JANITOR'S CLOSET	1 FT X 1 FT BLU FLOOR TILE	F	4-17M	1-1M	4-16M/17M
145	TRI	4.0	JANITOR'S CLOSET	1 FT X 1 FT BLU FLOOR TILE MASTIC	F	4-17M	1-1M	SEE COMMENTS
146	TRI	4.0	JANITOR'S CLOSET	2 FT X 4 FT FISSURED CEILING TILE	C	4-18M	1-7M	1-8M 4-18M/20M
147	TRI	4.0	JANITOR'S CLOSET	2 FT X 4 FT FISSURED CEILING TILE	C	4-20M	1-7M	1-8M 4-18M/20M
148	TRI	4.0	JANITOR'S CLOSET	PIPE JOINT COMPOUND	M	4-21M	4-21M	
149	TRI	4.0	LAVATORY	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
150	TRI	4.0	LAVATORY	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
151	TRI	4.0	MECHANICAL EQUIPMENT RM	1 FT X 1 FT BLU FLOOR TILE	F		1-1M	4-16M/17M
152	TRI	4.0	MECHANICAL EQUIPMENT RM	1 FT X 1 FT BLU FLOOR TILE MASTIC	F		1-1M	4-16M/17M
153	TRI	4.0	MECHANICAL EQUIPMENT RM	DRYWALL	W		2-11M	2-12M 4-15M
154	TRI	4.0	MECHANICAL EQUIPMENT RM	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
155	TRI	4.0	MECHANICAL EQUIPMENT RM	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
156	TRI	4.0	MECHANICAL EQUIPMENT RM	BASEBOARD MASTIC	W	4-13M	1-2M	4-13M/14M
157	TRI	4.0	MECHANICAL EQUIPMENT RM	BASEBOARD MASTIC	W	4-14M	1-2M	4-13M/14M
158	TRI	4.0	PIPE CHASE	SEE COMMENTS				
159	TRI	4.0	STAIR	1 FT X 1 FT BGE SPCKLD FLOOR TILE	F		5-22M	5-23M/37M
160	TRI	4.0	STAIR	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC	F		5-22M	5-23M/37M
161	TRI	4.0	STAIR	DRYWALL	W		2-11M	2-12M 4-15M
162	TRI	4.0	STAIR	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
163	TRI	5.0	ATCT ADMIN SUPERVISOR	1 FT X 1 FT BLU FLOOR TILE	F		1-1M	4-16M/17M
164	TRI	5.0	ATCT ADMIN SUPERVISOR	1 FT X 1 FT BLU FLOOR TILE MASTIC	F		1-1M	4-16M/17M
165	TRI	5.0	ATCT ADMIN SUPERVISOR	BASEBOARD MASTIC	W		1-2M	4-13M/14M
166	TRI	5.0	ATCT ADMIN SUPERVISOR	DRYWALL	W		2-11M	2-12M 4-15M
167	TRI	5.0	ATCT ADMIN SUPERVISOR	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
168	TRI	5.0	ATCT ADMIN SUPERVISOR	DRYWALL TAPE & JOINT COMPOUND	W	5-24S	1-9S	1-10S 5-24S
169	TRI	5.0	ATCT ADMIN SUPERVISOR	PIPE SEALANT CAULK	M	5-25S	5-25S	
170	TRI	5.0	CABLE SHAFT	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S

FOR SAMPLE LOCATION: F = FLOOR = CEILING W = WALL R = ROOF M = MISCELLANEOUS SAMPLE NUMBERS: P = PREVIOUS INSPECTION
FLOOR NUMBERS: 0.0 = BASE BUILDIN: 0.4 = MECHANICAL (MACHINE) LEVEL 0.5 = TOWER BASEMENT LEVEL 0.9 = BUILDING EXTERIOR 90.0 + = DETACHED BUILDINGS AN(TRAILERS

RECORD NUMBER	PERCENT ASBESTOS	TYPE ASBESTOS	FRIABLE	POTENTIAL FOR DISTURBANCE	DISTURBANCE SOURCE	CONDITION	HAZARD RANK	RECOMMENDED ACTION	APPROXIMATE QUANTITY OF MATERIAL/ROOM	COST ESTIMATE	COMMENTS
137										0.00	
138										0.00	
139										0.00	
140										0.00	
141										0.00	
142										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
143	25.0	CHRY	N	LP	C	G	1	1	25 SQ FT	0.00	
144										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
145										0.00	REFLECTED BY ACTUAL SAMPLE NUMBER 4-16M
146										0.00	
147										0.00	
148										0.00	
149										0.00	
150										0.00	
151										0.00	MASTIC, ONLY, CONTAINS ASBESTIS
152	25.0	CHRY	N	LP	C	G	1	1	165 SQ FT	0.00	
153										0.00	
154										0.00	
155										0.00	
156										0.00	
157										0.00	
158										0.00	INACCESSIBLE; ASSUME ACM
159										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
160	25.0	CHRY	N	LP	C	G	1	1	25 SQ FT	0.00	MID-LANDING
161										0.00	
162										0.00	
163										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
164	25.0	CHRY	N	LP	C	G	1	1	165 SQ FT	0.00	
165										0.00	
166										0.00	
167										0.00	
168										0.00	
169										0.00	
170										0.00	

RECORD NUMBER	LOC ID	FLOOR NUMBER	ROOM DESCRIPTION	MATERIAL DESCRIPTION	SAMPLE LOCATION	ACTUAL SAMPLE	REFERENCE SAMPLE	RELATED SAMPLES
171	TRI	5.0	ELEVATOR SHAFT	SEE COMMENTS				
172	TRI	5.0	ENTRY	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
173	TRI	5.0	ENTRY	BASEBOARD MASTIC	W		1-2M	4-13M/14M
174	TRI	5.0	ENTRY	DRYWALL	W		2-11M	2-12M 4-15M
175	TRI	5.0	ENTRY	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
176	TRI	5.0	ENTRY	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
177	TRI	5.0	ENTRY	1 FT X 1 FT BGE SPCKLD FLOOR TILE	F	5-22M	5-22M	5-23M/37M
178	TRI	5.0	ENTRY	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC	F	5-22M	5-22M	5-23M/37M
179	TRI	5.0	ENTRY	1 FT X 1 FT BGE SPCKLD FLOOR TILE	F	5-23M	5-22M	5-23M/37M
180	TRI	5.0	ENTRY	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC	F	5-23M	5-22M	SEE COMMENTS
181	TRI	5.0	LAVATORY	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
182	TRI	5.0	LAVATORY	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
183	TRI	5.0	PIPE CHASE	SEE COMMENTS				
184	TRI	5.0	STAIR	DRYWALL	W		2-11M	2-12M 4-15M
185	TRI	5.0	STAIR	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
186	TRI	5.0	STAIR	1 FT X 1 FT BGE SPCKLD FLOOR TILE	F	5-37M	5-22M	5-23M/37M
187	TRI	5.0	STAIR	1 FT X 1 FT BGE SPCKLD FLOOR TILE MASTIC	F	5-37M	5-22M	5-23M/37M
188	TRI	5.0	TRACON	1 FT X 1 FT BLU FLOOR TILE	F		1-1M	4-16M/17M
189	TRI	5.0	TRACON	1 FT X 1 FT BLU FLOOR TILE MASTIC	F		1-1M	4-16M/17M
190	TRI	5.0	TRACON	BASEBOARD MASTIC	W		1-2M	4-13M/14M
191	TRI	5.0	TRACON	DRYWALL	W		2-11M	2-12M 4-15M
192	TRI	5.0	TRACON	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
193	TRI	5.0	TRACON	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
194	TRI	5.0	TRACON	2 FT X 4 FT ROUGH SURFACE BLK CEILING TILE	C	5- 5M	5-5M	5-6M 7-36M
195	TRI	5.0	TRACON	2 FT X 4 FT ROUGH SURFACE BLK CEILING TILE	C	5- 6M	5-5M	5-6M 7-36M
196	TRI	5.0	TRACON	1 FT X 1 FT BLK RUBBER FLOOR TILE	F	5-26M	5-26M	5-27M/28M
197	TRI	5.0	TRACON	1 FT X 1 FT BLK RUBBER FLOOR TILE	F	5-27M	5-26M	5-27M/28M
198	TRI	5.0	TRACON	1 FT X 1 FT BLK RUBBER FLOOR TILE	F	5-28M	5-26M	5-27M/28M
199	TRI	6.0	BREAKROOM	1 FT X 1 FT BLU FLOOR TILE	F		1-1M	4-16M/17M
200	TRI	6.0	BREAKROOM	1 FT X 1 FT BLU FLOOR TILE MASTIC	F		1-1M	4-16M/17M
201	TRI	6.0	BREAKROOM	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
202	TRI	6.0	BREAKROOM	BASEBOARD MASTIC	W		1-2M	4-13M/14M
203	TRI	6.0	BREAKROOM	DRYWALL	W		2-11M	2-12M 4-15M
204	TRI	6.0	BREAKROOM	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S

FOR SAMPLE LOCATION: F = FLOOR C = CEILING W = WALL R = ROOF M = MISCELLANEOUS SAMPLE NUMBERS: P = PREVIOUS INSPECTION
FLOOR NUMBERS: 0.0 = BASE BUILDING 0.4 = MECHANICAL (MACHINE) LEVEL 0.5 = TOWER BASEMENT LEVEL 0.9 = BUILDING EXTERIOR 90.0 + = DETACHED BUILDINGS AND TRAILERS

RECORD NUMBER	PERCENT ASBESTOS	TYPE ASBESTOS	FRIABLE	POTENTIAL FOR DISTURBANCE	DISTURBANCE SOURCE	CONDITION	HAZARD RANK	RECOMMENDED ACTION	APPROXIMATE QUANTITY OF MATERIAL/ROOM	COST ESTIMATE	COMMENTS
171										0.00	NO SUSPECT MATERIALS
172										0.00	
173										0.00	
174										0.00	
175										0.00	
176										0.00	
177										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
178	25.0	CHRY	N	LP	C	G	1	1	78 SQ FT	0.00	
179										0.00	MASTIC, ONLY CONTAINS ASBESTOS
180										0.00	REFLECTED BY ACTUAL SAMPLE NUMBER 5-22M
181										0.00	
182										0.00	
183										0.00	INACCESSIBLE; ASSUME ACM
184										0.00	
185										0.00	
186										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
187	25.0	CHRY	N	LP	C	G	1	1	21 SQ FT	0.00	MID-LANDING
188										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
189	25.0	CHRY	N	LP	C	G	1	1	408 SQ FT	0.00	BEHIND EQUIPMENT
190										0.00	
191										0.00	
192										0.00	
193										0.00	
194										0.00	
195										0.00	
196										0.00	
197										0.00	
198										0.00	
199										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
200	25.0	CHRY	N	LP	C	G	1	1	525 SQ FT	0.00	
201										0.00	
202										0.00	
203										0.00	
204										0.00	

RECORD NUMBER	LOC ID	FLOOR NUMBER	ROOM DESCRIPTION	MATERIAL DESCRIPTION	SAMPLE LOCATION	ACTUAL SAMPLE	REFERENCE SAMPLE	RELATED SAMPLES
205	TRI	6.0	BREAKROOM	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
206	TRI	6.0	CABLE SHAFT	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
207	TRI	6.0	ELEVATOR SHAFT	SEE COMMENTS				
208	TRI	6.0	ENTRY	1 FT X 1 FT BLU FLOOR TILE	F		1-1M	4-16M/17M
209	TRI	6.0	ENTRY	1 FT X 1 FT BLU FLOOR TILE MASTIC	F		1-1M	4-16M/17M
210	TRI	6.0	ENTRY	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
211	TRI	6.0	ENTRY	BASEBOARD MASTIC	W		1-2M	4-13M/14M
212	TRI	6.0	ENTRY	DRYWALL	W		2-11M	2-12M 4-15M
213	TRI	6.0	ENTRY	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
214	TRI	6.0	ENTRY	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
215	TRI	6.0	LAVATORY	2 FT X 4 FT FISSURED CEILING TILE	C		1-7M	1-8M 4-18M/20M
216	TRI	6.0	LAVATORY	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
217	TRI	6.0	MECH EQUIPMENT & STORAGE	1 FT X 1 FT BLU FLOOR TILE	F		1-1M	4-16M/17M
218	TRI	6.0	MECH EQUIPMENT & STORAGE	1 FT X 1 FT BLU FLOOR TILE MASTIC	F		1-1M	4-16M/17M
219	TRI	6.0	MECH EQUIPMENT & STORAGE	BASEBOARD MASTIC	W		1-2M	4-13M/14M
220	TRI	6.0	MECH EQUIPMENT & STORAGE	DRYWALL	W		2-11M	2-12M 4-15M
221	TRI	6.0	MECH EQUIPMENT & STORAGE	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
222	TRI	6.0	MECH EQUIPMENT & STORAGE	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
223	TRI	6.0	PIPE CHASE	SEE COMMENTS				
224	TRI	6.0	ROOF	ROLLED ROOFING	R			SEE COMMENTS
225	TRI	6.0	ROOF	ROOF MASTIC	R			SEE COMMENTS
226	TRI	6.0	ROOF	ROOF TAR	R			SEE COMMENTS
227	TRI	6.0	ROOF	ROOF FLASHING	R	6-29M	6-29M	6-30M/31M
228	TRI	6.0	ROOF	ROOF FLASHING	R	6-30M	6-29M	SEE COMMENTS
229	TRI	6.0	ROOF	ROOF FLASHING	R	6-31M	6-29M	SEE COMMENTS
230	TRI	6.0	ROOF	STEPPING PADS	R	6-32M	6-32M	6-33M/34M
231	TRI	6.0	ROOF	STEPPING PADS	R	6-33M	6-32M	6-33M/34M
232	TRI	6.0	ROOF	STEPPING PADS	R	6-34M	6-32M	6-33M/34M
233	TRI	6.0	STAIR TO CAB	DRYWALL	W		2-11M	2-12M 4-15M
234	TRI	6.0	STAIR TO CAB	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
235	TRI	6.0	TELCO	1 FT X 1 FT BLU FLOOR TILE	F		1-1M	4-16M/17M
236	TRI	6.0	TELCO	1 FT X 1 FT BLU FLOOR TILE MASTIC	F		1-1M	4-16M/17M
237	TRI	6.0	TELCO	BASEBOARD MASTIC	W		1-2M	4-13M/14M
238	TRI	6.0	TELCO	DRYWALL	W		2-11M	2-12M 4-15M

FOR SAMPLE LOCATION: F = FLOOR C = CEILING W = WALL R = ROOF M = MISCELLANEOUS SAMPLE NUMBERS: P = PREVIOUS INSPECTION

FLOOR NUMBERS: 0.0 = BASE BUILDING 0.4 = MECHANICAL (MACHINE) LEVEL 0.5 = TOWER BASEMENT LEVEL 0.9 = BUILDING EXTERIOR 90.0 + = DETACHED BUILDINGS AND TRAILERS

11/16/92

TRI CITY REGIONAL AIRPORT
DATA SUMMARY TABLE

RECORD NUMBER	PERCENT ASBESTOS	TYPE ASBESTOS	FRIABLE	POTENTIAL FOR DISTURBANCE	DISTURBANCE SOURCE	CONDITION	HAZARD RANK	RECOMMENDED ACTION	APPROXIMATE QUANTITY OF MATERIAL/ROOM	COST ESTIMATE	COMMENTS
205										0.00	
206										0.00	
207										0.00	NO SUSPECT MATERIALS
208										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
209	25.0	CHRY	N	LP	C	G	1	1	60 SQ FT	0.00	
210										0.00	
211										0.00	
212										0.00	
213										0.00	
214										0.00	
215										0.00	
216										0.00	
217										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
218	25.0	CHRY	N	LP	C	G	1	1	184 SQ FT	0.00	
219										0.00	
220										0.00	
221										0.00	
222										0.00	
223										0.00	INACCESSIBLE; ASSUME ACM
224										0.00	NOT SAMPLED TO AVOID DAMAGE; ASSUME ACM
225										0.00	NOT SAMPLED TO AVOID DAMAGE; ASSUME ACM
226										0.00	NOT SAMPLED TO AVOID DAMAGE; ASSUME ACM
227	30.0	CHRY	N	LP	C	G	1	1	100 LIN FT	0.00	
228										0.00	REFLECTED BY ACTUAL SAMPLE 6-29M
229										0.00	REFLECTED BY ACTUAL SAMPLE 6-29M
230										0.00	
231										0.00	
232										0.00	
233										0.00	
234										0.00	
235										0.00	MASTIC, ONLY, CONTAINS ASBESTOS
236	25.0	CHRY	N	LP	C	G	1	1	72 SQ FT	0.00	
237										0.00	
238										0.00	

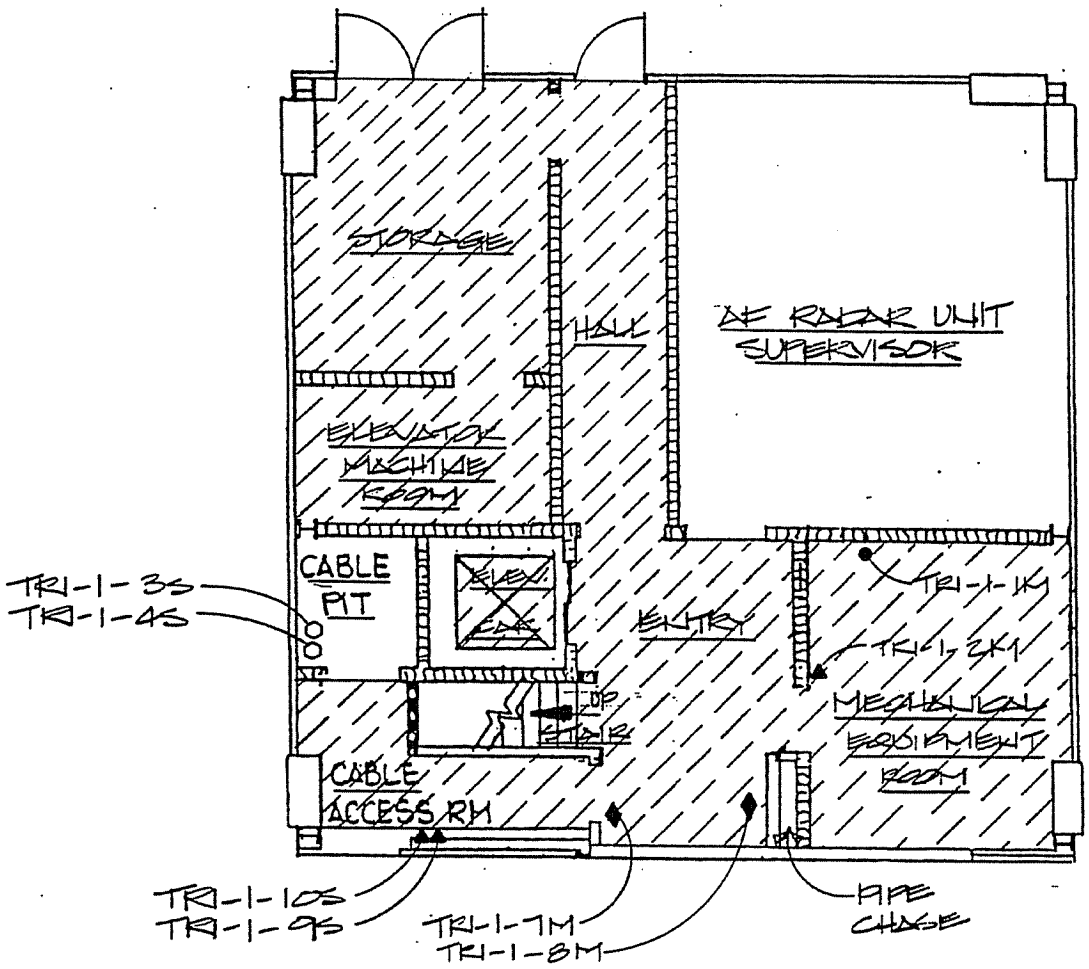
RECORD NUMBER	LOC ID	FLOOR NUMBER	ROOM DESCRIPTION	MATERIAL DESCRIPTION	SAMPLE LOCATION	ACTUAL SAMPLE	REFERENCE SAMPLE	RELATED SAMPLES
239	TRI	6.0	TELCO	DRYWALL TAPE & JOINT COMPOUND	W		1-9S	1-10S 5-24S
240	TRI	6.0	TELCO	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
241	TRI	7.0	CAB	BASEBOARD MASTIC	W		1-2M	4-13M/14M
242	TRI	7.0	CAB	SPRAY-ON INSULATION	C		1-3S	1-4S 3-19S
243	TRI	7.0	CAB	CEILING TILE MASTIC	C	7-35M	7-35M	
244	TRI	7.0	CAB	2 FT X 2 FT ROUGH TEXTURED BLK CEILING TILE	C	7-36M	5-5M	5-6M 7-36M
245	TRI	7.0	CAB ROOF	ROLLED ROOFING	R			SEE COMMENTS
246	TRI	7.0	CAB ROOF	ROOF FLASHING	R		6-29M	6-30M/31M
247	TRI	7.0	CAB ROOF	ROOF MASTIC	R			SEE COMMENTS
248	TRI	7.0	CAB ROOF	ROOF TAR	R			SEE COMMENTS
249	TRI	7.0	CAB ROOF	STEPPING PADS	R		6-32M	6-33M/34M
250	TRI	90.0	OUT-BLDG ENG GENERATOR RM	TSI PIPE INSULATION	M	0-38T	0-38T	0-39T/40T
251	TRI	90.0	OUT-BLDG ENG GENERATOR RM	TSI PIPE INSULATION	M	0-39T	0-38T	0-39T/40T
252	TRI	90.0	OUT-BLDG ENG GENERATOR RM	TSI PIPE INSULATION	M	0-40T	0-38T	0-39T/40T

FOR SAMPLE LOCATION: F = FLOOR C = CEILING W = WALL R = ROOF M = MISCELLANEOUS SAMPLE NUMBERS: P = PREVIOUS INSPECTION
FLOOR NUMBERS: 0.0 = BASE BUILDING 0.4 = MECHANICAL (MACHINE) LEVEL 0.5 = TOWER BASEMENT LEVEL 0.9 = BUILDING EXTERIOR 90.0 + = DETACHED BUILDINGS AND TRAILERS

RECORD NUMBER	PERCENT ASBESTOS	TYPE ASBESTOS	FRIABLE	POTENTIAL FOR DISTURBANCE	DISTURBANCE SOURCE	CONDITION	HAZARD RANK	RECOMMENDED ACTION	APPROXIMATE QUANTITY OF MATERIAL/ROOM	COST ESTIMATE	COMMENTS
239										0.00	
240										0.00	
241										0.00	
242										0.00	
243										0.00	
244										0.00	
245										0.00	NOT SAMPLED TO AVOID DAMAGE; ASSUME ACM
246	30.0	CHRY	N	LP	C	G	1	1	100 LIN FT	0.00	
247										0.00	NOT SAMPLED TO AVOID DAMAGE; ASSUME ACM
248										0.00	NOT SAMPLED TO AVOID DAMAGE; ASSUME ACM
249										0.00	
250										0.00	
251										0.00	
252										0.00	

APPENDIX B

EXHIBITS



FIRST FLOOR PLAN

1/8" = 1'-0"

NOTES:

- PIPE CHASE - INACCESSIBLE; ASSUME ACM.
- STAIR-MID-LANDING, OVER CABLE ACCESS ROOM, CONTAINS 25 SQ. FT. OF ACM FLOOR TILE MASTIC.
- OUT-BUILDING ENGINE GENERATOR ROOM - NO FLOOR PLANS AVAILABLE

INDICATES AREA WITH ACM FLOOR TILE MASTIC

Schedule of Samples

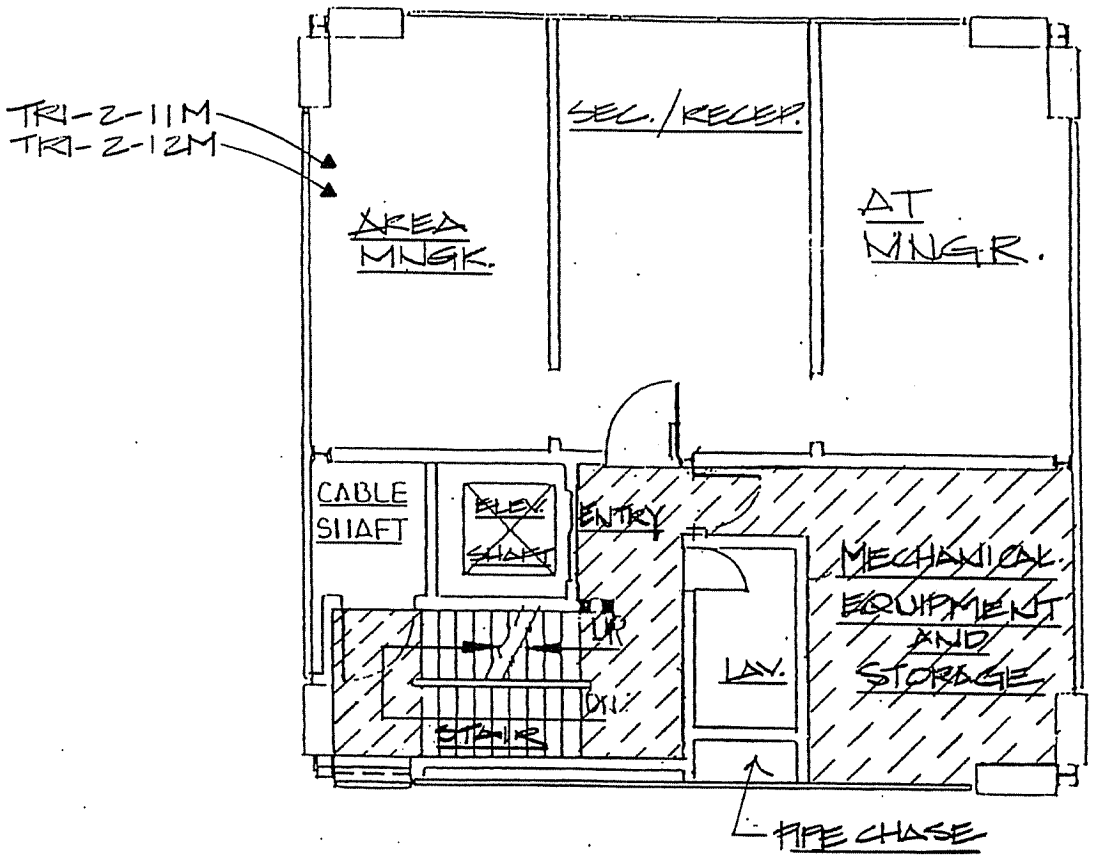
- ● Floor
- ▲ Wall
- ◆ Ceiling
- ■ Roof
- O Miscellaneous

TRI-CITY REGIONAL AIRPORT. BLOUNTVILLE, TENNESSEE	Date: 22 MAY 1992	Exhibit
	Drawn by: PR	1

RMCI California Colorado Virginia

3190 S. Wadsworth Blvd, Suite 225
Lakewood, Colorado 80227
(303) 969-8778

A137-002



SECOND FLOOR PLAN
1/8" = 1'-0"

NOTE:
• PIPE CHASE - INACCESSABLE, ASSUME ACM.

INDICATES AREAS WITH ACM FLOOR TILE MASTIC.

Schedule of Samples
- Floor
- Wall
- Ceiling
- Roof
- Miscellaneous

TRI-CITY REGIONAL AIRPORT. BLOUNTVILLE, TENNESSEE	Date: 22 MAY 1992	Exhibit
	Drawn by: PR	2

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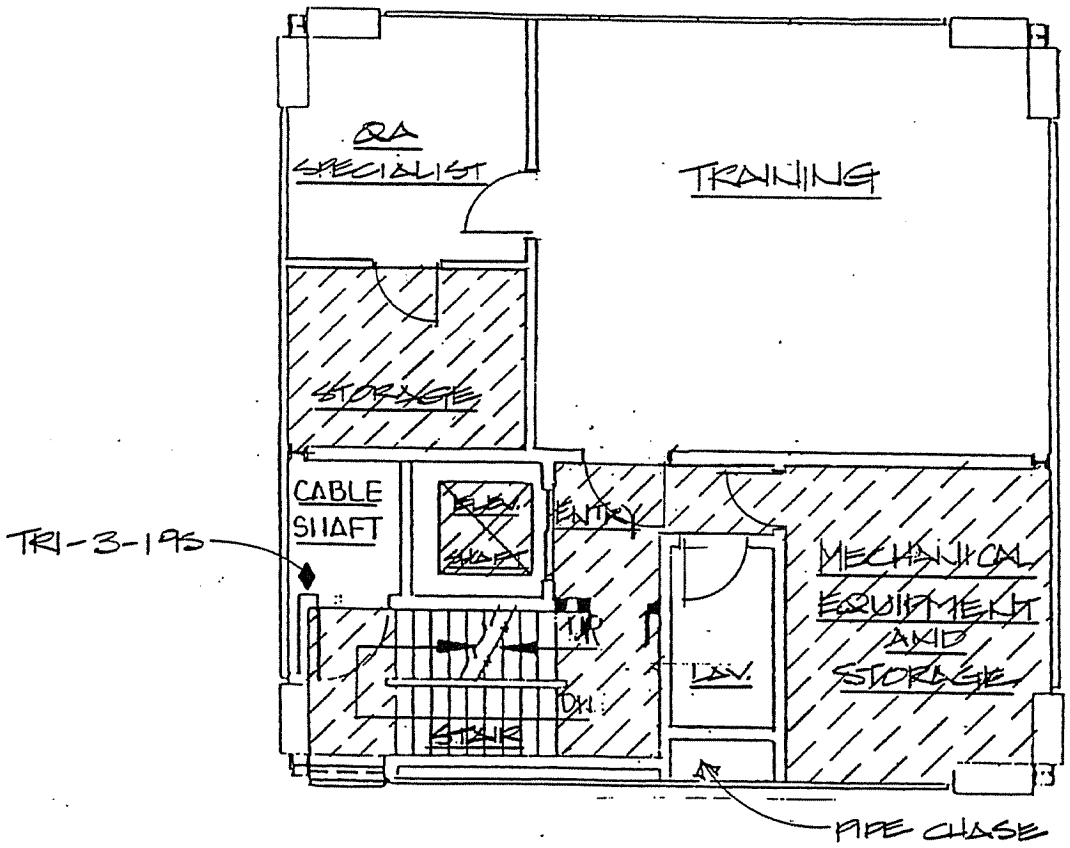

THIRD FLOOR PLAN
1/8" = 1'-0"

NOTE:

• PIPE CHASE - INACCESSABLE; ASSUME ACM.

INDICATES AREA WITH ACM FLOOR TILE AND MASTIC

Schedule of Samples
- ● Floor
- ▲ Wall
- ♦ Ceiling
- ■ Roof
- O Miscellaneous

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	Drawn by: PR	3

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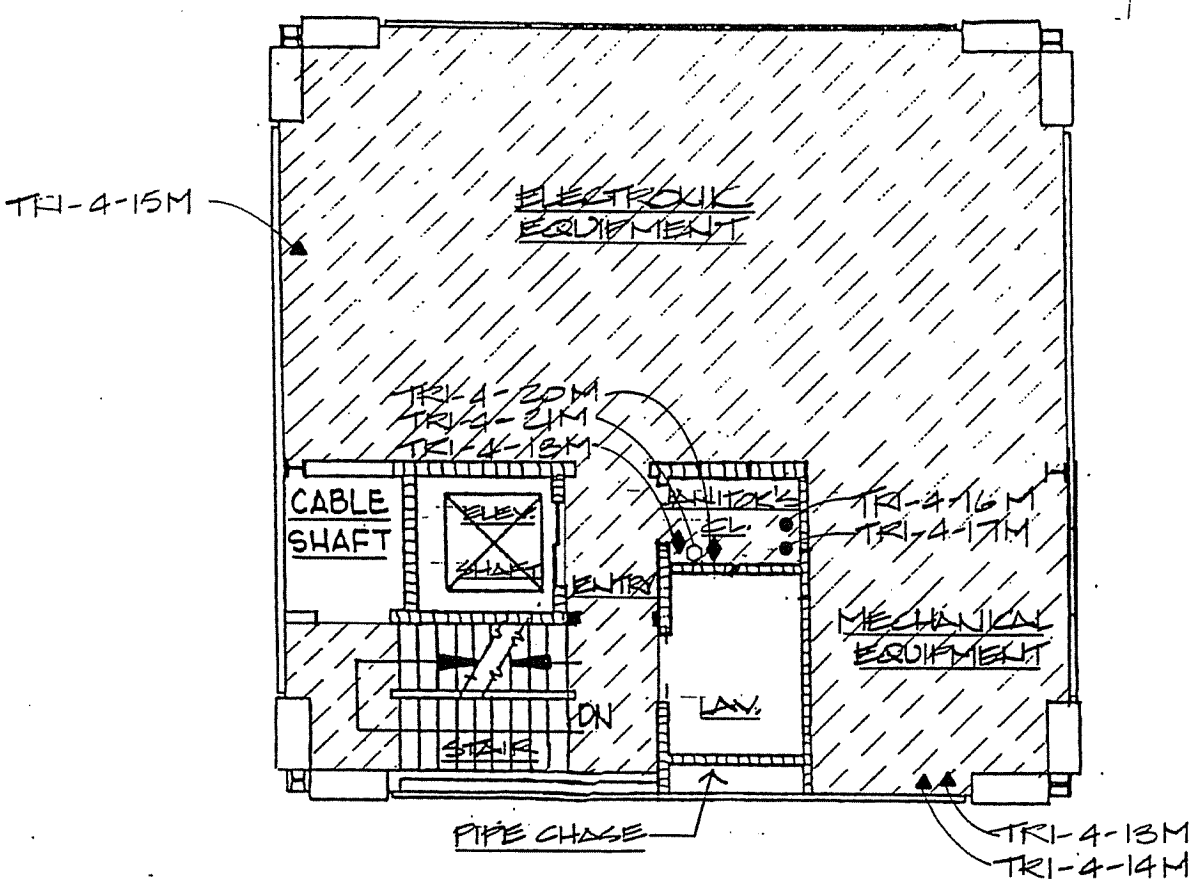

FOURTH FLOOR PLAN

1/8" = 1'-0"

NOTE:

- PIPE CHASE - INACCESSABLE; ASSUME ACM

INDICATES AREA WITH ACM FLOOR TILE MASTIC

Schedule of Samples

- ● Floor
- ▲ Wall
- ◆ Ceiling
- ■ Roof
- ○ Miscellaneous

TRI-CITY REGIONAL AIRPORT BLOUNTVILLE, TENNESSEE	Date: 22 MAY 1992 Drawn by: DR	Exhibit 4

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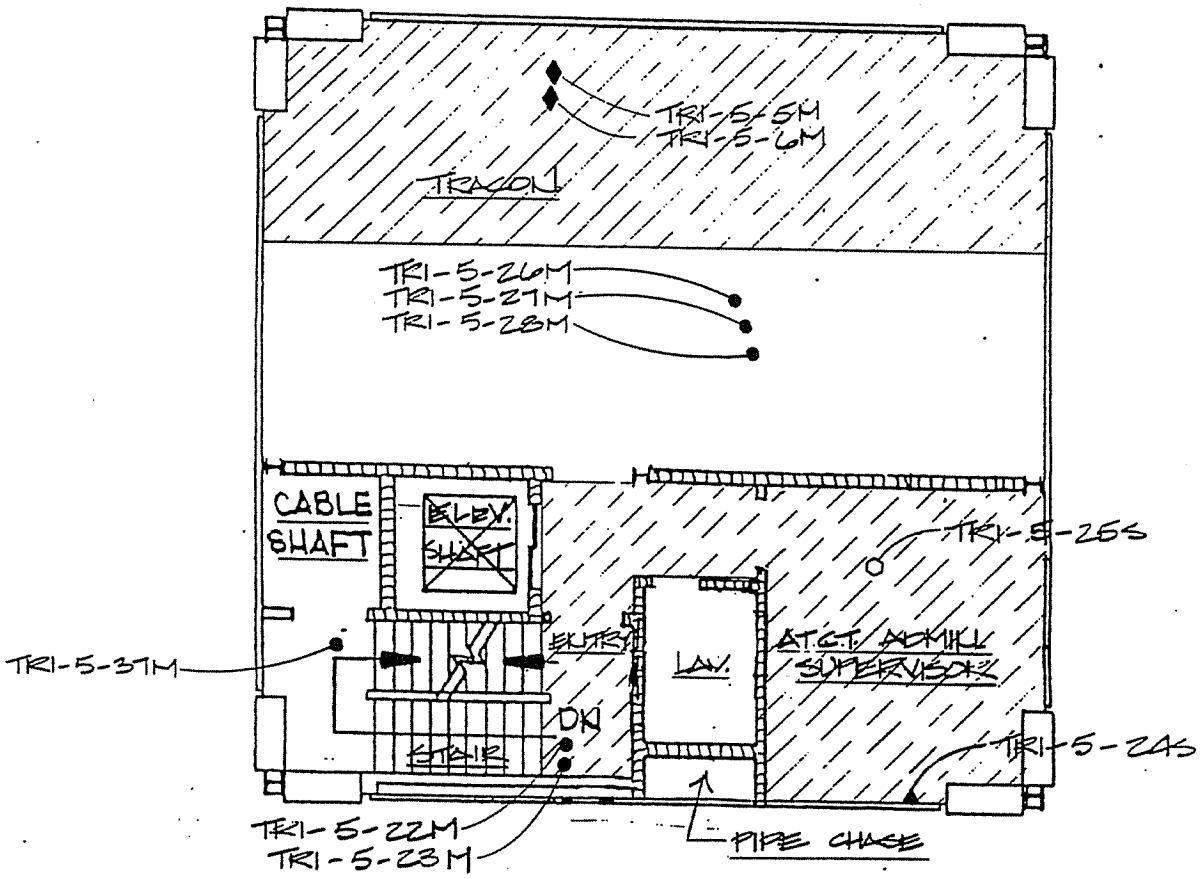

FIFTH FLOOR PLAN

1/8" = 1'-0"

NOTE:

- PIPE CHASE - INACCESSABLE; ASSUME ACM.

INDICATES AREA WITH ACM FLOOR TILE MASTIC

Schedule of Samples
- Floor
- Wall
- Ceiling
- Roof
- Miscellaneous

TRI-CITY REGIONAL AIRPORT. BLOUNTVILLE, TENNESSEE	Date: 22 MAY 1992	Exhibit
	Drawn by: DR	5

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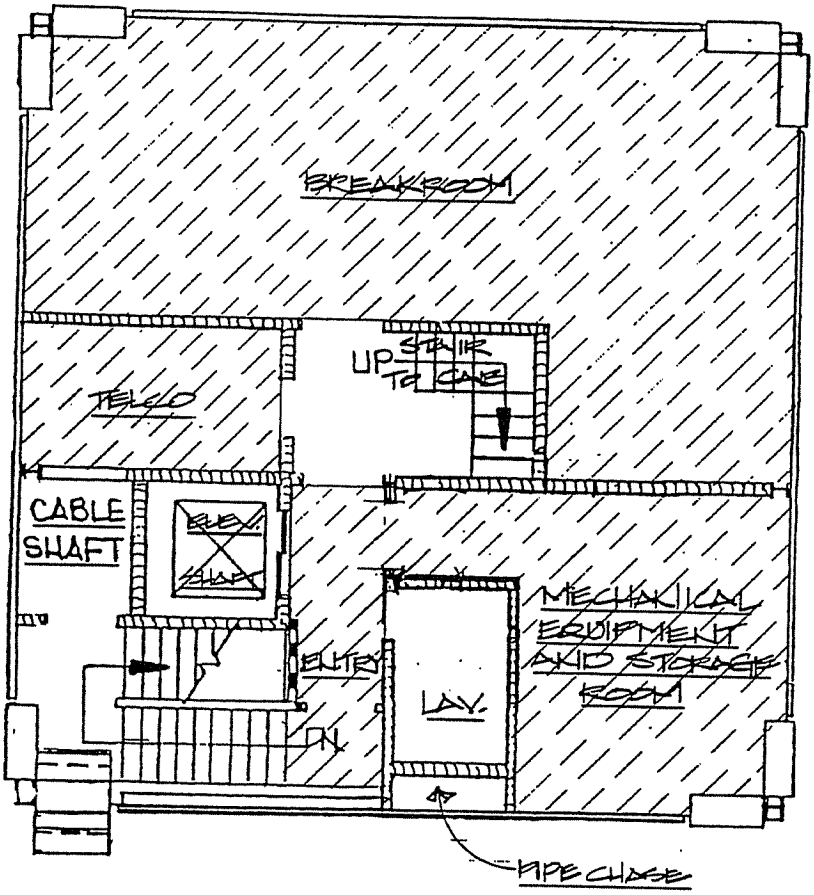

SIXTH FLOOR PLAN.
1/8" = 1'-0"

NOTES:

- PIPE CHASE - INACCESSABLE; ASSUME ACM.
- 6TH FLOOR ROOF - SAMPLES 6-29 THROUGH 6-34 LOCATED ON CAD (TE) FLOOR PLAN.

INDICATES AREA WITH ACM FLOOR TILE MASTIC.

N

Schedule of Samples
- ● Floor
- ▲ Wall
- ♦ Ceiling
- ■ Roof
- O Miscellaneous

TRI-CITY REGIONAL AIRPORT. BLOUNTVILLE, TENNESSEE	Date: 22 MAY 1992	Exhibit
	Drawn by: DR	6

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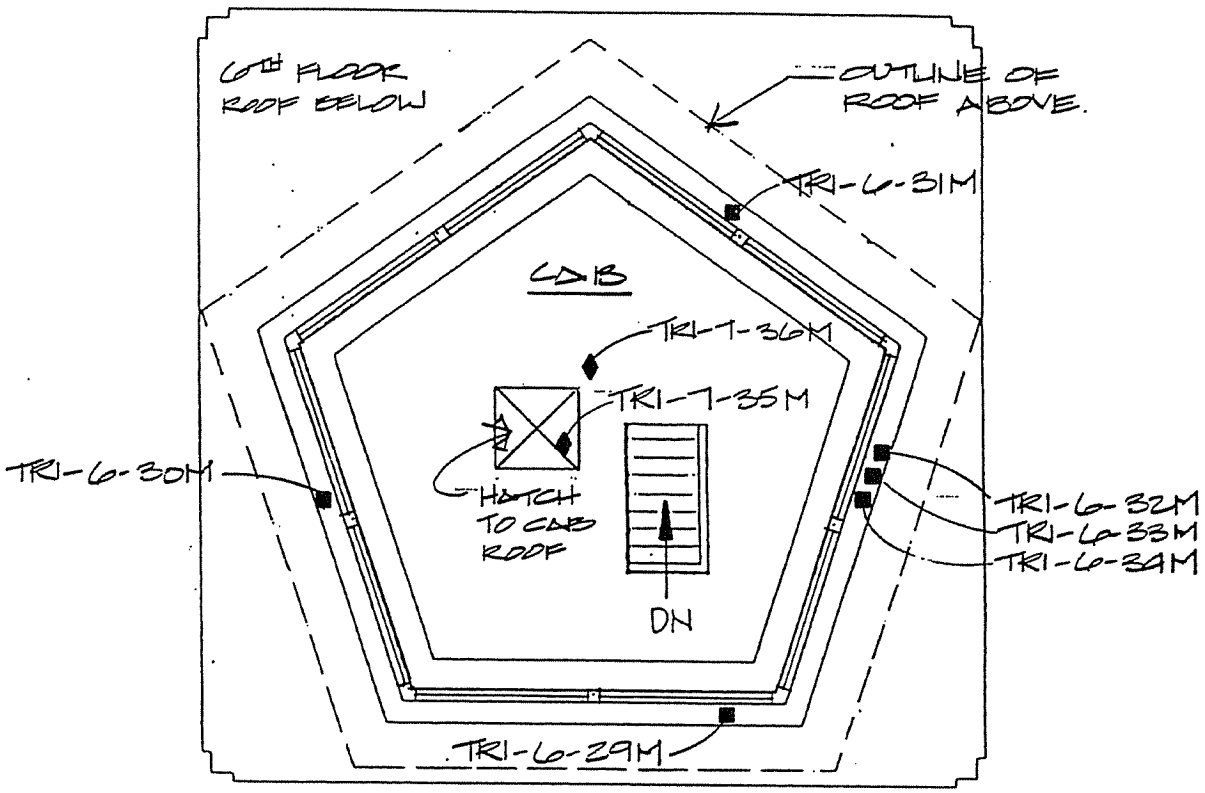

CAB (7th) FLOOR
1/8" = 1'-0"

NOTE:

- SIXTH FLOOR ROOF & CAB ROOF - 100 L.F. EACH OF ACM ROOF FLASHING; ROOF MASTIC, ROOF TAR, AND ROLLED ROOFING NOT SAMPLED TO AVOID DAMAGE, ASSUME ACM.

Schedule of Samples
- ● Floor
- ▲ Wall
- ◆ Ceiling
- ■ Roof
- ○ Miscellaneous

TRI-CITY REGIONAL AIRPORT. BLOUNTVILLE, TENNESSEE	Date: 22 MAY 1992	Exhibit
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