

**Anderson Mikos Architects, ltd.**

RENOVATE CARDIOLOGY DEPARTMENT, BLDG 200

EDWARD HINES, JR. V.A. HOSPITAL

HINES, ILLINOIS

SECTION 20 05 00

STANDARD TECHNICAL PROVISIONS FOR ALL MECHANICAL,  
PLUMBING & FIRE PROTECTION WORK

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Work under this section is subject to requirements of the Contract Documents, including General Conditions and Supplementary Conditions and applicable portions of Division 1 - General Requirements.

1.2 WORK INCLUDED

- A. The work of the Contract shall consist of furnishing all labor, tools, equipment, services, transportation and all items necessary to complete the Mechanical Trades Work as indicated on drawings and as described in the applicable Sections of the Specifications.
- B. The Drawings and Specifications shall be understood to cover according to their intent and meaning, complete operating systems as shown on the Drawings and specified under appropriate Sections of the Specifications.
- C. Items and accessories or devices necessary to the complete a proper operation of any system shall be provided by the Contractor and Subcontractor for such system whether or not they are specifically called for by the Specifications and Drawings.
- D. Additional work includes, but is not limited to the following:
  - 1. Site visit to examine the existing conditions that may affect the performance of the work specified.
  - 2. It shall be the responsibility of each mechanical contractor to field inspect this project, prior to submitting their bid.
  - 3. It shall be understood by submitting a base bid that any item required, even if not indicated in construction documents, to complete the intent of drawings and specification is included in base bid.
  - 4. No additional compensation shall be rendered to the contractor for any item if visual confirmation of discrepancy(s) can be made by field verification.
  - 5. Obtain and pay for all permits, licenses, approvals, reviews, utility shut-downs, tests and inspections.
  - 6. Pipe sleeves through floors, walls, and structural elements of the building, set in coordinated locations.
  - 7. All cutting, coring and patching of general construction as necessary for installation of the work specified. Smoke/fire stopping of all penetrations created by Mechanical and Plumbing contracts. Provide a 2-part minimum fire stopping system complying with fire department approved, UL listed details, which establish a smoke or fire resistance rating equal to or greater than the wall or floor penetrated.
  - 8. Provide demolition work as noted on the contract drawings.
  - 9. Coordinated shop drawings and calculations; submit and obtain approval by the Architect and Engineer.
  - 10. Clean-up, on a daily basis, of all debris associated with the installation of this work, as necessary to maintain the premises in a broom swept condition.
  - 11. Testing, adjusting, retesting re-adjusting as may be required to obtain system acceptance by the Chicago Bureau of Inspectional Services, Owner's Insurance Underwriter, and Owner's Representative. Contractors shall remain responsible for their respective systems until all approvals are obtained.
  - 12. Provide equipment manuals, record drawings, valve tag schedules, testing certificates and personnel instruction, prior to system turn-over to the Owner.

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- E. The work in this Division includes providing all labor, materials, specialty products, and services for, and reasonably incidental to, the satisfactory completion of the Mechanical, Plumbing, Fire Protection and/or Medical Gas systems, as indicated on the Contract Drawings, in the Specification Sections, and/or required by codes and referenced standards.

1.3 CODES AND REGULATIONS

- A. The work under the Mechanical Sections shall comply with the latest edition of the applicable standards and codes of the following:

ASME American Society of Mechanical Engineers  
ASHRAE American Society of Heating, Refrigeration and Air  
Conditioning Engineers  
ARI Air Conditioning and Refrigeration Institute  
ASTM American Society for Testing Materials  
AGA American Gas Association  
AWWA American Water Works Association  
TABIC Testing & Balancing Institute for Certification.  
IBR Institute of Boiler & Radiator Manufacturers  
ANSI American National Standards Institute  
UL Underwriters Laboratories, Inc.  
NEMA National Electrical Manufacturer's Association  
AWS American Welding Society  
NFPA National Fire Protection Association  
SMACNA Sheet Metal and Air Conditioning Contractors' National  
Association, Inc.  
OSHA Occupational Safety and Health Act  
Safety Standard Code Applying to the Trades as Required by Federal and  
State Agencies.  
Standard Specifications for Facilities for the Handicapped.  
Local and State Building Codes.  
Governing Federal Standards.

1.4 COORDINATION OF WORK BETWEEN VARIOUS TRADES

- A. Each mechanical trade shall be responsible for obtaining information regarding the extent of work which is to be performed by the General Contractor, by other Mechanical trades and by the Electrical trades, and perform his contractual obligations in full coordination with aforementioned trades. Prior to ordering of any mechanical equipment requiring electrical services, he shall verify current characteristics and other interrelated items with the Electrical trades and inform the Engineer in writing of any discrepancies he may discover. Claim for additional compensation will be denied due to failure to comply with the foregoing requirements.

1.5 SCHEDULING OF WORK

- A. Each mechanical trade will perform their work without affecting or disrupting normal hospital operations under any circumstances. Any shutdowns of systems or areas shall be done with authorization of Hospital Engineering, and shall be done during periods the foregoing authorities deem most advantageous to hospital operations. In case of any authorized shut-down of any system, portion of system or areas, the contractor shall be fully responsible to provide immediate restoration of this system, portion of system or area into full service, if necessary.
- B. Contractor shall also coordinate their work with other mechanical, electrical and general trades in order not to cause any delays in project progress schedule.

1.6 DEFINITIONS AND INTERPRETATIONS

- A. Specific terminology used in the Drawings and Specifications shall have the following meanings;
1. "Piping" includes pipe, fittings, flanges, valves, controls, hangers, supports, vents, drains and other customarily required items required in connection with the transfer of gases and fluids.
  2. "Install" includes unloading at the delivery point for the project and performing all tasks necessary to establish a secure mounting and correct operation, for items and assemblies furnished by other trades or the Owner.
  3. "Furnish" includes purchase and delivery to the project site, of items and assemblies, complete with necessary appurtenance.
  4. "Provide" shall mean "Furnish and Install".
  5. "Concealed" when used in connection with the installation of piping, shall mean hidden from view behind chases, furred spaces, pipe shafts, or above suspended ceilings.
  6. "Contractor" shall mean the Mechanical and Plumbing Contractors and their vendors, fabricators or subcontractors.
  7. "Design Drawings" or "Contract Documents" shall mean documents, including drawings and written specifications, prepared by the Architects and Engineers, to obtain building permits and competitive bid proposals from contractors, for construction of the specified mechanical and plumbing systems.
  8. "Shop Drawings" shall mean documents, including calculations, drawings and material specifications prepared by the Mechanical and Plumbing Contractors, obtaining approval from the authority having jurisdiction, Owner's Insurance Underwriter, Architect/Engineer.
  9. "NPS" shall mean nominal pipe size.
- B. The following are industry abbreviations for plastic materials:
1. PVC: Polyvinyl chloride plastic.
- C. The following are industry abbreviations for rubber materials:
1. EPDM: Ethylene-propylene-diene terpolymer rubber.
  2. NBR: Acrylonitrile-butadiene rubber.
- D. The use of the Design Drawings and Specifications by the contractor, for Bid Proposal and Working Drawing preparation, shall include the following understanding:
1. The information included in the drawings and specifications is given as a guide only, to indicate general feasibility and to show an acceptable arrangement of systems, system zones, piping ductwork and equipment.
  2. The design drawings utilize symbols and diagrams to indicate required work, representing only the sequence of items to be installed, which have no dimensional significance and do not indicate every required item to be provided. The work shall be installed in accordance with the diagrammatic intent expressed on the drawings, in conformity with the dimensions indicated on the final architectural and structural working drawings, and final equipment shop drawings. Information regarding general construction shall be derived only from the architectural and structural drawings and specifications.

3. The drawings and specifications are complementary and are to be utilized together for a complete interpretation of the work intended. The higher capacity or standard shall be provided, where conflicts between the drawings and specifications, or conflicts within themselves, occur.
4. The limitations of the language used on the drawings and specifications shall not be interpreted as meaning that accessories and appurtenances, required for completion of work, are to be excluded. The description of any item, on the drawings or in the specifications or both, requires the installation of all its necessary components for approved, satisfactory operation.
5. Submission of a bid proposal requires the contractor to review all project documents and visit the construction site, to be thoroughly familiar with all requirements for the project, and identify in his bid, conditions that may affect the efficient and satisfactory performance of the work. Claims for additional compensation shall be denied if the above procedures are not followed and the disputed conditions would have been identified by the completion of these required tasks.
6. The information shown on the design drawings and written in the specifications shall not be interpreted as to instruct the contractor to not follow the applicable codes or local amendments. Where the information provided for guidance is believed not to be in conformance with the code requirements and referenced standards, the contractor shall notify the Architect and Engineer for clarification prior to the submission of his bid proposal.

1.7 DRAWINGS AND SPECIFICATIONS

- A. Each Mechanical trade shall be responsible for obtaining information regarding any and all peculiarities and limitations of spaces available for installation of all materials and work furnished and installed under this Contract. Although the location of equipment may be shown on the drawings in certain positions, each mechanical trade shall be guided by the Architectural details, conditions of the job, correlating his work with that of other sections.
- B. The Drawings for this work accompanying these Specifications are to be considered as important and integral parts of same, and anything omitted from one and embodied in the other is to be considered as essential to the requirement of the Contract and must be furnished and installed by the Contractor. The Drawings indicate required size and points of termination of piping and ducts, and suggest proper routes of piping and ducts to conform to structures, avoid obstruction and preserve clearances. However, it is not the intention of the Drawings to indicate all necessary offsets, and it shall be the responsibility of each trade to install piping and ductwork in such a manner as to preserve head room and keep all openings and passageways clear without further construction or cost.
- C. It is intended that apparatus shall be located symmetrically with architectural elements, notwithstanding the fact that locations indicated on the Drawings may be distorted for clearness in presentation.

1.8 INTENT OF MECHANICAL DRAWINGS

- A. The Mechanical drawings shall serve as working drawings for the general layout of the various items of equipment. However, layout of equipment, accessories, specialties, ductwork, and piping systems, are diagrammatic unless specifically dimensioned, and do not necessarily indicate every required valve, fitting, trap, duct, elbow, transition, turning vane, switch, damper, etc. necessary to conform to project conditions.

1.9 SUBMITTALS

- A. Submit under provisions of Section 01 3300.
- B. Shop Drawings submittal shall have a coordination sign-off signature from all disciplines.
- C. No material or equipment shall be purchased or installed without approved submittal.
- D. Mechanical and Plumbing contractors shall obtain written approval from electrical contractor on product submittals.
- E. "As-Built" drawings shall include all the revisions done during the construction period.
- F. Electronic Equipment Submittals
  - 1. Electronic submittals are preferred, but hard copy submittals will be accepted for review.
  - 2. Electronic submittals shall consist of pertinent information only, so as to minimize size of electronic files. Information that is not specific to the project will not be reviewed.
  - 3. Each category of product shall be submitted individually and shall be submitted in a separate email.
  - 4. Provide cover sheet with space for engineers stamp.
  - 5. Provide transmittal sheet (attached to shop drawing) indicating section, title, and tag number as per table of contents of these specifications.
  - 6. All reviewed electronic submittals will be posted to K&A's ftp site (and architect's at their request)
  - 7. Shop drawings larger than 1 mb shall not be submitted by email.
  - 8. Installation manuals shall be distributed through the contractor and shall not be submitted for engineers review.
  - 9. Operation and maintenance manuals shall be submitted with project close out documents.
- G. Such submittals shall contain outline dimensions, operating and maintenance clearances and sufficient engineering data to indicate compliance with Specifications. Each submittal shall be clearly labeled with:
  - 1. Name of the job.
  - 2. Contractor's name and trade.
  - 3. The function of the item on which approval is required.
  - 4. Manufacturer's name.
  - 5. Subcontractor's name (if any).
  - 6. Number of specification that item is being submitted under (i.e., Section 23 3416-2.08-A-4).
- H. Shop Drawings covering work to be performed by Subcontract, or material or equipment to be delivered to site by manufacturer shall bear stamped or written evidence that:
  - 1. Contractor has inspected such Drawings, cuts or schedules.
  - 2. Material or equipment covered will meet Specification requirements.
  - 3. Material or equipment will fit properly in the building and with work of other trades.
  - 4. Each item is complete or that the missing elements have been provided from another source.

- I. Detailed dimensioned shop drawings for the installation of the work shall be prepared and submitted for review by the Engineer. These drawings shall be new drawings and not reproduced from the Engineer's drawings.
- J. In preparation of shop drawings, contractor may, at his option, obtain from the engineer electronic drawing files in autocad format on a CD-ROM disk for shipping and handling fee of \$150.00 per request. Contractor shall contact the architect and engineer for written authorization and necessary release authorization form and to specify shipping method. In addition to payment, architect's written authorization and engineer's release agreement form must be received before the electronic drawing files will be sent.
- K. Shop Drawings shall be drawn to a minimum scale of 1/8" = 1'-0", showing all equipment; with Mechanical Rooms to a minimum scale of 1/4" = 1'-0, showing all equipment, ductwork and piping to be installed under the Mechanical Sections. For critical areas, provide section drawings to a minimum scale of 1/4" = 1'-0". Layouts shall show clearances of piping, ducts, etc., above floor. SHOP DRAWINGS SHALL BE REVIEWED AND SIGNED OFF BY ALL OTHER TRADES BEFORE SUBMITTAL. Any installation of equipment/material without approved shop drawings is prohibited.
- L. Manufacturers' data sheets shall be submitted indicating the necessary installation dimensions, weights, materials and performance information. The performance shall include capacities, RPM, BHP, pressure drop, design and operating pressure, temperatures, acoustical performance, and similar data. Complete electrical data, including power conditions and identifying types and numbers, shall be included. Where pertinent, electrical diagrams and/or control diagrams shall be provided.
- M. Review of Shop Drawings is rendered as a service only, and shall not be considered as a guarantee of measurements or building conditions, nor shall it be construed as relieving the Contractor of basic responsibility under the Contract.

#### 1.10 SUBSTITUTIONS

- A. Architect/Engineer will consider requests for substitutions for products made during the bidding period by submitting completed substitution request form a minimum of 10 days prior to Bid Date. Those submitted ten days prior to Bid Date will be included in an addendum if acceptable. Any substitutions not submitted at least ten (10) days prior to bid date will be rejected.
- B. Substitutes may be considered after the end of the bidding period, in case of product unavailability or other conditions beyond the control of Contractor.
- C. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Support each request as follows:
  - 1. Identify product by Specifications section and Article numbers.
  - 2. Complete data substantiating compliance of proposed substitution with requirements stated in Contract Documents:
    - a. Product identification, including manufacturer's name and address.
    - b. Manufacturer's literature; identify:
      - 1) Product description
      - 2) Reference standards
      - 3) Performance and test data.

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- c. Samples, as applicable.
      - d. Name and address of similar projects on which product has been used, and date of each installation.
    3. Provide itemized comparison of the proposed substitution with product specified; list significant variations.
    4. Data relating to changes in construction schedule.
    5. Any effect of substitution on separate contracts.
    6. List of changes required in other work or products.
    7. Accurate cost data comparing proposed substitution with product specified.
      - a. Amount of any net change to Contract Sum.
    8. Designation of availability of maintenance services, sources of replacement materials.
  - D. A request constitutes a representation that the Bidder and/or Contractor:
    1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
    2. Will provide the same warranty for the Substitution as for the specified product.
    3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
    4. Waives claims for additional costs or time extension which may subsequently become apparent.
    5. Will reimburse Owner for review or redesign services associated with re-approval by authorities.
  - E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals; without separate written request, or when acceptance will require revision to the Contract Documents.
  - F. Substitution Submittal Procedure:
    1. Submit three copies of Request for Substitution for consideration. Limit each request to one proposed Substitution.
    2. Submit shop drawings, Product data, and certified test results attesting to the proposed Product equivalence.
    3. The Architect/Engineer will notify Contractor, in writing, of decision to accept or reject request.
- 1.11 RECORD DRAWINGS
- A. The Contractor shall submit letter of certification with pay request indicating that the record drawings on site are up to date and reflect true "as-built" conditions at that time. No pay request will be approved without this letter.
  - B. The Contractor or Subcontractor shall keep at the project site one complete set of the Contract Working Drawings on which he shall record any deviations or changes from such Drawings made during construction. Record Drawings shall show change in size, type, capacity, etc., or material, device or piece of equipment, location of any outlet or source in building service system, rerouting any piping, sewers or other building services.
  - C. These Drawings shall also record the location of all concealed services, piping, sewers, wastes, vents and other equipment by indication of measured dimensions to each such line from readily identifiable and accessible walls or corners of the building. Drawings shall show invert

elevations of sewers and top of water mains, runs, gas services, etc.

- D. After the project is completed, three copies of these Drawings shall be delivered to the Owner in good condition as a permanent record of the installation as actually constructed, as a precedent to final payment.

1.12 STANDARDS FOR MATERIAL WORKMANSHIP

- A. Workmanship shall be in accordance with Division 1.
- B. All materials shall be new and shall conform with the standards of the Underwriters' Laboratories, Inc., in every case where such standards have been established for the particular material in question. All work shall present a neat, mechanical appearance when completed.
- C. Materials, the style, make or quality of which is specifically designated, shall be as specified. Should any substitution of material or item of equipment or apparatus be made, the Engineer's written approval must be obtained prior to installation.
- D. Furnish necessary materials in ample quantities and as frequently as required to avoid delay in the progress of the work, and so store them as to prevent interference with other work.
- E. All piping and ductwork shall be run parallel to lines of the building unless otherwise distinctly shown or noted in the Drawings.
- F. Heating, piping, air conditioning and ventilation ducts, shall be concealed.
- G. Hangers for all piping shall be clevis or split ring type, unless otherwise specified or indicated, with provision for vertical adjustments, except that hangers supporting copper tubing shall be copper or bronze. Hangers shall be supported from rods fastened to building construction. Wire or perforated strap iron will not be permitted.
- H. Where head room requirements or physical space limitations necessitate, consideration shall be given to altering of building structural elements such as penetrating beams, webs, notching of joists, etc., which shall be kept to an absolute minimum, and shall be done only after written permission is issued by the Architect and/or Structural Engineer. Any damage done to structural or architectural elements shall be restored and/or repaired to the satisfaction of the Engineer at the expense of the installer. Refer to Section 01045 Cutting and Patching.
- I. All piping, equipment, devices, ducts, hangers, etc., shall be securely and permanently hung from supporting walls, roof or floor construction etc., in a manner satisfactory to the Architect and Engineer.
- J. All material or work found to be defective or not in strict conformity with the Drawings or different from the requirements of the Drawings and Specifications, or defaced or injured through negligence of the Contractor or his employees, or through the action of fire or weather or any other cause, will be rejected and shall be immediately removed from the premises by the Contractor and satisfactory material and work substituted therein without delay.
- K. Any defective material or work which may be discovered shall be corrected immediately on notice from the Engineer. No previous inspection or certificate on account shall be held to relieve the Contractor from his obligation to furnish sound material and to perform

good and satisfactory work.

1.13 MANUFACTURER'S NAMEPLATES

- A. Each major component of equipment shall have the manufacturer's name, address, model number and rating on a plate securely affixed in a conspicuous place. The nameplate of a distributing agent will not be acceptable. ASME Code Ratings, or other data which are die-stamped into the surface of the equipment shall be stamped in an easily visible location.

1.14 LINES AND LEVELS

- A. Each Mechanical Contractor shall be responsible for the lines and levels of the ductwork and piping, lighting fixtures, panels and conduit, based on reference lines and bench marks established by the Contractor for the general work.

1.15 RULES AND REGULATIONS

- A. All workmanship and materials shall conform with the requirements of the building and ordinances and rules and regulations of all departments and bureaus of the County, City and State having lawful jurisdiction, irrespective of any statements herein to the contrary.

1.16 ORDINANCES

- A. The work shall be in accordance with the governing State and Local ordinances, codes and regulations; including fire rating and inspection bureaus and the N.F.P.A. regulation, all of which are hereby made a part of these Specifications.

1.17 GUARANTEES

- A. The Contractor shall guarantee all work performed and materials and equipment furnished under the contract, against defects in materials and workmanship, for a period of one year from the date of substantial completion of the work, in accordance with Section "General Conditions". Repairs or replacements made under the guarantee shall bear an additional twelve (12) month guarantee from date of repair or replacement. Provide all service necessary and incidental to the proper performance of the system for a period of one (1) year from the date of substantial completion of the contract at no additional charge to the Owner.
- B. Each Mechanical Trade shall submit product warranties on all equipment and include all extended warranties beyond one year and identify them with specification section number and equipment identification number.

1.18 HOUSEKEEPING

- A. Each Mechanical trade shall be responsible for keeping stocks of materials and equipment stored on the premises in a neat and orderly manner.
- B. Each Mechanical trade shall clean and maintain its portion of the work as specified.
- C. The exposed surfaces of piping, ductwork or equipment which have become covered with dirt, plaster, or other material during handling and construction, shall be thoroughly cleaned by the erecting trade before such surfaces are covered with insulation, prepared for painting, or enclosed within the building structure.

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1.19 QUALITY ASSURANCE

- A. All materials, specialty products, equipment, methods of installation, and the application of materials and products in specific situations, shall be in strict accordance with the applicable requirements of Chicago Code and referenced standards, and have the prior approval of the authority having jurisdiction. All materials and equipment shall be UL labeled, and installed in accordance with their listing.
- B. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- C. 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 Series, "Code for Pressure Piping."
  - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- D. Electrical Characteristics for Mechanical 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.

1.20 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, and protect materials and equipment under provisions of Division 01.
- B. Each Mechanical trade shall keep all its respective pipe and duct openings closed by means of plugs or caps to prevent the entrance of foreign matter, and cover all fixtures, equipment and apparatus as required to protect them against dirt, water, chemical or mechanical damage both before and after installation.
- C. Any such fixtures, equipment or apparatus damaged prior to final acceptance of the work shall be restored to its original condition or replaced by the respective Mechanical trade.
- D. Any fixtures, equipment or apparatus delivered to the project and stored on the project exposed to the weather, shall be completely covered with minimum 6 mil white polyethylene sheets.

1.21 ACCESS PANELS

- A. Ceiling, duct chase, and pipe chase access panels will be installed by General Contractor where indicated and as required for access to valves, dampers, apparatus, etc. Where in the opinion of the respective Mechanical trades, access panels are required, but are not shown on the drawings, their omission shall be brought to the attention of the Architect/ Engineer, and coordinated with other trades for quantity, size, location and installation of additional panels as approved by the Architect/Engineer.

1.22 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical 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 mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."

1.22 CHANGE PROPOSAL REQUESTS

- A. All Change Proposal Requests for work additional to the base bid contract shall be based on material, labor, overhead and profit costs as published in the latest edition of "Means Mechanical, Electrical, Plumbing, and Building Construction Cost Data". All change requests must be broken down in the following manor:  
Material cost: (ie. Equipment, sheet metal per pound and piping per lineal foot/fitting).  
Labor cost: (Number of hours at current labor rate per hour)  
Overhead and profit: (Indicating percentages)  
Total change order price: (Material + labor = O&P)  
Pricing for all items of work which are to be credited to the project shall be broken down in a similar manor to the added costs.  
The associated cost for drafting changes (including three dimensional modeling) shall not exceed 10% of the cost of material and labor for the change.

1.23 OPERATION AND MAINTENANCE INSTRUCTIONS

- A. Furnish to the Owner three (3) manuals covering model, type, serial numbers, capacities, flow, operation and maintenance of each major item of equipment or apparatus. Operation instructions shall cover all phases of control.
- B. The operation and maintenance instructions shall contain the following minimum items:
  - 1. Flow sheets showing sizes and quantities of all systems, including shut-off valves, centrifugal pumps, fans, air handling equipment, control valves, filters, etc.
  - 2. Flow sheets of all automatic controls showing automatic controls superimposed on physical systems, and showing devices which require manual resetting.
  - 3. Maintenance and operation instructions inclusive of maintenance and operation instructions furnished by the manufacturers.
  - 4. For each section of the specification as applicable, furnish a competent engineer or qualified supervisor for a period of not less than one (1) day to instruct representatives of the Owner in the operation and routine maintenance of the equipment included.

1.23 FINAL PAYMENT

- A. Final payment shall be withheld until all items of deficiency are corrected and accepted, and complete sets of reproducible "as-built" record drawings are received from each sub-contractor for their work.

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PART 2 PRODUCTS

Not used

PART 3 EXECUTION

3.1 INSTALLATION

- A. Give careful consideration to clearances under beams, over windows, etc., to provide maximum headroom in all cases, and to the locations of lines and type of fittings used to obtain these clearances. Ascertain from the drawings the heights of all suspended ceilings and the size of all shafts in which piping and ductwork is to be concealed, and the location and size of structural members in and adjacent to all shafts. Coordinate the piping, ductwork and lighting trades with each other, and with all other equipment. In any case, where insufficient room is provided for piping above suspended ceilings, or in vertical shafts, obtain clarification from the Engineer before any work is installed.
- B. Fabricate pipe and ductwork accurately to measurements established at the building, work into place without springing or forcing, and properly clear all windows, doors and other openings. Cutting or other weakening of the building structure to facilitate piping and ductwork installation will not be permitted unless approved by the Engineer.

3.2 LOCATION OF EQUIPMENT AND DEVICES

- A. Locations of mechanical equipment and devices are approximate. Where equipment and devices are exposed to public view the exact locations are as shown on the Architectural drawings, approved coordination drawings, approved shop drawings, and as installed in the approved mock-up. In all cases, consult with the Architect when the exact location is in doubt.
- B. Relocate equipment or devices when directed by Architect/Engineer without cost, providing new location is not greater than 20 feet from original location shown.

3.3 CONTRACTOR'S NOTES

- A. Refer to architectural documents for exact locations of walls and ceiling type/outlets. Provide necessary labor, material and engineering, etc. to accommodate necessary adjustments to mechanical systems.
- B. Commissioning of the systems shall meet the functional criteria and satisfaction of the Owner.

END OF SECTION