SECTION 20 1000

GENERAL MECHANICAL PROVISIONS

PART 1 - GENERAL

1.01 CONTRACT CONDITIONS

A. Work of this Division is bound by the Provisions of Division 1 bound herewith, in addition to these Specifications and accompanying Drawings.

1.02 SECTION INCLUDES

A. General requirements specifically applicable to Division 20, 21, 22 and 23 sections, which apply in addition to Division 1 - General Requirements.

1.03 DRAWINGS AND SPECIFICATIONS

A. The Drawings and Specifications are complimentary, and what is called for by one shall be as binding as if called for by both.

B. Use of the word "Provide" shall be equivalent to "Furnish and Install."

C. Use of singular or plural in article, paragraph, and subparagraph headings does not indicate numbers of products required. Example: The heading "Chiller" does not necessarily mean there is only one chiller required.

D. Abbreviations:
   1. ADA: Americans with Disabilities Act
   2. AASHTO: American Association of State Highway and Transportation Officials
   3. ASTM: American Society for Testing and Materials
   4. AWWA: American Water Works Association
   5. ANSI: American National Standards Institute
   6. NEMA: National Electrical Manufacturers' Association
   7. ASME: American Society of Mechanical Engineers
   8. UL: Underwriters' Laboratories
   9. IAPMO: International Association of Plumbing and Mechanical Officials
   10. Fed. Spec.: Federal Specifications
   11. MSS: Manufacturers' Standardization Society of the Valve and Fitting Industry
   12. WOG: Non-shock Water-Oil-Gas maximum working pressure rating
   13. NFPA: National Fire Prevention Association
   14. FM: Factory Mutual
   15. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association
   16. ARI: Air Conditioning and Refrigeration Institute
   17. AMCA: Air Movement and Control Association
   18. TIMA: Thermal Insulation Manufacturers' Association
   19. ASHRAE: American Society of Heating, Refrigerating, and Air Conditioning Engineers
   20. AABC: Associated Air Balance Council
   21. NEBB: National Environmental Balancing Bureau

E. For products specified by listing one or more manufacturers, followed by "Similar to" and one manufacturer's model number, the following requirements apply:
   1. Approval of each listed manufacturer is contingent upon that manufacturer having a product which meets the specification, fits the available space, and is comparable to the listed model.
   2. Electrical requirements, duct connections, pipe connections, and space requirements indicated on Drawings are based on the listed model. Provide revisions required to accommodate the model actually furnished.

F. For products specified by listing one or more manufacturers, followed by a model number for each manufacturer, the following requirements apply:
   1. Provide one of the listed model numbers or an approved substitution.
   2. Electrical requirements, duct connections, pipe connections, and space requirements indicated on Drawings are based on one of the listed models, and may not be suitable for

all models listed. Provide revisions required to accommodate the model actually furnished.

1.04 PERMITS, FEES, AND GOVERNING AGENCIES

A. Obtain permits and pay fees required by governing agencies.

B. Minimum requirements not otherwise stated herein shall meet governing codes and standards.

C. Arrange and pay for inspections and tests required by applicable codes and ordinances.

1.05 SITE VISITATION AND FIELD MEASUREMENTS

A. Examine site of proposed Work to verify conditions. Beginning of Work means acceptance of conditions.

B. If conditions differ substantially from conditions indicated on Drawings, notify Architect before commencing Work.

1.06 SUBSTITUTIONS

A. Substitution requests will not be considered unless they are submitted in writing, in accordance with Division 0 and Division 1.

B. Substitution requests will not be considered unless they include the following:
   1. Model numbers of proposed substitutions.
   2. Options that are required to make the proposed substitution comply with Specifications.
   3. Summary of modifications of the Work that are required to accommodate the proposed substitution.

1.07 OWNER FURNISHED ITEMS

A. Refer to Division 1.

1.08 ALTERNATES

A. Refer to Division 1.

1.09 PROJECT MANAGEMENT AND COORDINATION

A. Provide coordination for the Work of Divisions 20, 21, 22 and 23 in accordance with Division 1.

B. Locations shown on Drawings are approximate and are not intended to fully coordinate the Work of all Sections. Plan exact locations based on field measurements of field conditions and the Work of other Sections.

C. Drawings do not show all required duct and pipe offsets and fittings. Provide offsets and fittings as required to coordinate with the Work of other Sections and with field conditions.

D. Locate equipment, piping, valves, dampers, etc. to provide adequate space for normal operating and maintenance activities.

1.10 CUTTING AND PATCHING

A. Provide cutting and patching for the Work of Divisions 20, 21, 22 and 23 in accordance with Division 1.

1.11 SHOP DRAWINGS AND PRODUCT DATA

A. Provide shop drawings and product data for the Work of Divisions 20, 21, 22 and 23 in accordance with Division 1. Refer to each Section for required shop drawings and product data submittals.

B. Acceptable Submittal Formats: Hard-Copy, or Electronic. If Electronic format is selected, at least one Hard-Copy of the information must be submitted with the Electronic copies to the Engineer (the Hard-Copy will not be returned).

C. Submittal formats shall conform with the following requirements:
   1. Each hard-copy Submittal package shall be formatted as follows:
      a. Use three-ring loose leaf binders.
      b. Provide index referencing specification section and page.
      c. Tab individual sections.

2. Each Electronic Submittal package shall be formatted as follows:
    a. The full extent of the submitted data shall be presented in a single electronic file on a CD-ROM.
    b. File Format Type: Adobe pdf, or universally readable equivalent.
    c. Scanned information: Minimum 400 dpi.
    d. Provide index referencing specification section and page.
    e. Bookmark individual sections.
    f. One file per CD-ROM.
        1) Format CD-ROM for use in PC compatible hardware
        2) Format CD-ROM so that additional files may be written to it (read-write).

D. Contractor may provide one (1) early submittal for items with long lead times as determined by the Contractor. The submittal shall be clearly identified as “Long Lead Time Item Submittal”.

E. The remainder of the shop drawings and product data shall be submitted as a single Project Submittal, except:
1. Control system shop drawings and product data may be provided as a single, separate submittal package prior to beginning of control work on site.
2. Fire Sprinkler Shop Drawings and Product Data may be provided as a single, separate submittal package before or after the project submittal.
3. Seismic Restraint Shop Drawings, and Product Data may be provided as a single, separate submittal package before or after the Project Submittal.

F. The Project Submittal must be submitted no more than three (3) weeks after the Long Lead Time Item Submittal. If the Project Submittal is found to be incomplete, it will be rejected and returned. The Project Submittal shall then be completed by the Contractor and resubmitted in its entirety.

G. Definitions of comments used in submittal review:
1. "No Exception Taken" The meaning and intent of this statement is that the Engineer finds no objection (except those noted thereon or in correspondence) to inclusion of items or Work indicated in construction provided that it:
    a. Complies with Contract Drawings and Specifications as to quantities, space requirements, and dimensions.
    b. Does not interfere with other trades.
    c. Is not the cause of union tradesmen disputes.
    d. Does not infringe on patent rights.
    e. Is not the cause of injury or damage to persons or property.
    f. Complies with OSHA regulations.
2. "Rejected" The meaning and intent of this statement is that the submitted material does not conform to plans and specifications. Resubmittal of a different product or shop drawing is required.
3. "Revise and Resubmit" This statement is used when the general product line is acceptable, but the submitted material varies in dimension, accessories, etc. from what is required. Resubmittal is required.
4. "Make Corrections Noted" This statement is used as an alternative to "Revise and Resubmit" when resubmittal is not required.
5. Said review does not relieve Contractor of any Contractual responsibilities.

1.12 TEMPORARY FACILITIES AND CONTROLS

A. Refer to Division 1.

B. Use of Project equipment for temporary service during construction is not allowed.

1.13 SCHEDULING

A. Schedule the Work of Divisions 20, 21, 22 and 23 in accordance with Division 1.

B. Schedule Work at such a time, and in such a manner, to minimize interference and inconvenience to the Owner.

C. Work that causes disruptions of existing services shall be coordinated with the Owner. Provide a minimum of 24 hour notice prior to any shutdown of existing services.

1.14 OPERATION AND MAINTENANCE MANUALS

A. Provide operation and maintenance manuals for the Work of this Division in accordance with Division 1 and Section 20 2000.

1.15 MATERIAL AND EQUIPMENT

A. Comply with Division 1.

B. Similar products shall be of the same manufacturer.

C. Comply with manufacturer's printed instructions, in addition to requirements of the Contract Documents, regarding storage, handling, installation, operation, and adjustment of materials and equipment.

D. Protect ductwork, piping, outlets/inlets, equipment, and mechanical appurtenances from damage. Provide temporary covers as necessary to prevent accumulation of dust and debris.

E. Notify the Architect (or authorized representative) immediately of conflicts between manufacturer's instructions and Contract Documents. Resolve such conflicts before proceeding with the work.

1.16 CONTRACT CLOSEOUT

A. Comply with Division 1.

1.17 FINAL CLEANING

A. Provide cleaning for the Work of Divisions 20, 21, 22 and 23 in accordance with Division 1.

1.18 RECORD DOCUMENTS

A. Provide Record Documents for the Work of this Division in accordance with Division 1.

B. Record Drawings shall include:
   1. Contract Drawings
   2. Fire Suppression System Shop Drawings
   3. Seismic Restraint Shop Drawings

1.19 INSTRUCTION OF OPERATING PERSONNEL

A. Provide instruction of Owner's operating personnel associated with the Work of Divisions 20, 21, 22 and 23 in accordance with Division 1.

B. Instruct Owner's designated operating personnel in the operation and maintenance of all systems.

C. Submit written certificate from Owner that Instruction of Operating Personnel has been performed.

1.20 WARRANTIES

A. Provide and document warranties applicable to the Work of Divisions 20, 21, 22 and 23 in accordance with Division 1 and Section 20 2000.

1.21 SELECTIVE STRUCTURE DEMOLITION

A. Provide demolition for the Work of this Division in accordance with Division 2.

B. Where items are to be salvaged for relocation or retained by the Owner, removal shall cause no damage to these items. Move in accordance with manufacturer's instructions.

1.22 EXCAVATION AND BACKFILLING

A. Provide trenching, excavation, and backfilling for the Work of Divisions 20, 21, 22 and 23 in accordance with Section 31 3233.

1.23 PAINTING

A. Provide painting for the Work of Divisions 20, 21, 22 and 23 in accordance with Division 9.

B. Provide cleaning and surface preparation for products specified in Divisions 20, 21, 22 and 23 that have finishes specified in Division 9.

C. Paint the following items with one coat of primer and two coats of oil-based enamel:
   1. Uninsulated black steel pipe which is not concealed within walls or above ceilings.
   2. Steel supports, stands, and brackets which are not galvanized or factory painted.
   3. Pipe rollers, hangers, and hanger rods which are not galvanized.
   4. Additional items noted on Drawings or in Divisions 20, 21, 22 and 23.

D. Colors shall be approved by Architect.

1.24 SUSTAINABLE BUILDING REQUIREMENTS

A. Provide work to support the project LEED® requirements for Division 20, 21, 22, and 23 in accordance with Division 1.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 20 2000

MECHANICAL OPERATION AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. General and specific requirements for Operation and Maintenance Manuals applicable to Division 20, 21, 22 and 23 sections. Requirements apply in addition to Division 1 requirements. Contractor shall provide Operation and Maintenance Manual for the Work of this Division.

1.02 SHOP DRAWINGS AND PRODUCT DATA

A. Submittals required for the following, in accordance with Section 20 1000:
   1. Table of Contents (TOC) for the Operation and Maintenance Manual. Provide one complete TOC with Project Submittal.

1.03 CONTRACT CLOSEOUT

A. Submittals required for the following, in accordance with Section 20 1000:
   1. Operation and Maintenance Manual. Provide 3 complete sets.

PART 2 - PRODUCTS

2.01 GENERAL

A. The requirements listed herein apply to one full set of the Operation and Maintenance Manual. Provide multiple copies of the set in accordance with requirements listed under Part 1 of this Section.

B. Information provided in the Operation and Maintenance Manuals shall be customized for the specific equipment provided for, and as applied to, this Project.

2.02 PRESENTATION

A. Format:
   1. Manufacturer's literature shall be pre-printed.
   2. Documents generated specifically for this project shall be machine printed on white paper, or typed.
   3. Hand written material is not acceptable unless specifically noted herein.
   4. Internally subdivide binder contents with permanent page dividers in accordance with the organizational format described herein. Tab titles shall, as a minimum, be legibly printed and inserted into reinforced laminated plastic tabs.

B. Binding:
   1. In three-ring (D-side ring style) loose leaf plastic or cloth side binders. Paper report binders, or bend-tab thesis covers are not acceptable.
   2. 8-1/2 inch x 11 inch format.
   3. Ring size as necessary to contain the information for this project. Minimum ring size: 1 inch. Maximum ring size: 4 inch.
   4. Provide sheet lifters, front and back, in each notebook.
   5. Provide multiple binders where required to accommodate the data. Each binder maximum 80% full.
   6. Label each binder with typed, permanently adhered, labels on the front cover and the spine. Minimum Label information:
      a. Project Name
      b. Project Location
      c. Project Owner
      d. Project Engineer
      e. Volume (notebook no.) of (number of notebooks in one set of O&M Manuals)

C. Provide a plastic page cover for each occurrence of the following pages:
   1. Cover Sheet
   2. Table of Contents
   3. Nameplate Directory

4. Valve Directory
5. Service and Dealer Directory

2.03 ORGANIZATION AND CONTENT OF MANUAL

A. Include in the front of EACH Notebook of the Operation and Maintenance Manual:
   1. Cover Sheet
   2. Table of Contents:
      a. List the contents of the full manual.
      b. List full extent of major and minor divisions (tabs).

B. Include the following information in the Project Operation and Maintenance Manual:
   1. Directories, including:
      a. Equipment and Nameplate Directory
      b. Itemized Service and Maintenance Directory
      c. Service and Dealer Directory
      d. Warranties Directory
   2. Material and Equipment Information (with Individual Tabs by Divisions 20, 21, 22 and 23 Section Number and Name), including:
      a. Shop Drawings and Product Data
      b. Manufacturer's Printed Operation and Maintenance Manuals
      c. Service Contracts and Field Start-up Reports
   3. Cleaning, Certification, and Test Reports:
      a. Domestic water system disinfections report and test results
      b. Combination Fire/Smoke Damper Operational Certification
      c. Air and Water Balance Report
   4. System Information (with Individual Tabs by Divisions 20, 21, 22 and 23 Section Number and Name), including:
      a. Operation instructions
      b. Record drawings (reduced size set)
      c. Controls operation and maintenance Information
      d. DESCRIPTION OF MANUAL CONTENT

C. Cover Sheet, listing:
   1. Project name and location
   2. Architect
   3. Engineer
   4. General Contractor
   5. Mechanical Contractor
   6. Electrical Contractor

D. Table of Contents, listing:
   1. Volume number.
   2. Section title
   3. Items included under each section (e.g., equipment name and number, parts list, service instructions, etc.)

E. Directories (with Individual Directory Specific Tab):
   1. “Equipment Nameplate Directory”. This is a summary of the equipment included in the Project with a nameplate designation (code), such as “AHU-1", including:
      a. Mechanical equipment type
      b. Nameplate designation
      c. Manufacturer's nameplate data
         1) Data as read from the nameplate for the actual equipment provided
      d. Installed location
         1) List room name and number
      e. Area served
      f. Control switch normal position

2. “Itemized Service and Maintenance Directory”. Obtain information from the manufacturer. This is an itemized summary listing of service and inspection requirements. Itemize by Nameplate Designation (i.e.; AHU-1, CH-1, etc.). include:
    a. Service and lubrication schedule:
        1) Filter, size, number of, performance, clean pressure drop, and recommended change-out.
        2) Bearing type, recommended lubricant, and frequency.
    b. Inspection Requirements:
        1) Inspection type (e.g., belt wear, refrigerant charge, etc.), frequency, recommended actions.
3. “Service and Dealer Directory”. This is a summary of the equipment and material suppliers for the Project, including:
    a. Company name for authorized service and parts
    b. Physical address
    c. Phone number, fax number, e-mail, and web site address (if available)
    d. Summary listing of applicable equipment and materials
4. “Warranties”. In addition to the warranty statement, include:
    a. Project name as shown on the Project Manual
    b. The equipment (nameplate designation and description) and/or system to which the warranty applies
    c. Effective date of the warranty
    d. Expiration date of the warranty
    e. Extent of the warranty
    f. Company name, address, telephone number, and contact person for the issuer of the warranty
5. “Valve Directory”. This is a sequential, ascending, summary of the numbered valves in the Project, separated by system, including:
    a. Valve number
    b. Valve Type
    c. Valve Size
    d. Installed location
    e. Valve function
    f. Valve normal position

F. Material and Equipment Information (under individual material or equipment specification specific tabs):
1. Shop Drawings and Product Data for items reviewed, approved, and provided for this Project
2. Manufacturer's Printed Operation and Maintenance Manuals, including:
    a. Manufacturer's parts list
    b. Information for starting, adjusting, and maintaining each item in continuous operation for long periods of time
    c. Dismantling and reassembling of the complete units and sub-assembly components with illustrations including “exploded” views showing and identifying each separate item
    d. Identification of special tools and instrument requirements
    e. Detailed explanation of function and control of each piece of equipment, component, or accessory
    f. Precautions for operation of equipment and reason for each precaution
    g. Troubleshooting guide
3. Service Contracts and Field Start-up Reports:
    a. Provide for boilers, chillers, etc.
    b. Include list of inspection requirements to be completed prior to end of warranty.

G. Cleaning, Certification, and Test Reports:
1. Backflow Prevention Devices Inspection and Testing. Coordinate with requirements listed in Section 22 4100.

2. Piping Systems Cleaning, Disinfection, and Chemical Treatment Report. Coordinate with requirements listed in Section 22 5400.
3. Written certification of combination fire/smoke damper testing. Coordinate with requirements listed in Section 20 9100.
4. Air and Water Balance Report. Coordinate with requirements listed in Section 20 9100.
    a. When an Air and Water Balance Report is provided in a separate notebook (three-ring binder), reference the notebook as a volume of the Project Operation and Maintenance Manual set. Label the notebook accordingly.
5. Seismic restraint system installation report certifying that seismic restraints are installed in conformance with approved shop drawings and no additional restraints are necessary based on field conditions. Include the written authorization, from seismic restraint system Engineer, of the designated representative.

H. System Information:
1. Operation Instructions. Under individual system specific tab. Provide complete, detailed guidance for the operation of each system (e.g., Hydronic System, etc.)
    a. Information shall include:
        1) Start-up
        2) Routine and normal operation
        3) Adjustment and regulation
        4) Chemical treatment
        5) Testing
        6) Detection of malfunction
        7) Shut-down
        8) Cleaning
        9) Summer and winter operations
        10) Emergency operation
2. Record Drawings. Provide an 11 inch by 17 inch set (print-to-fit) bound in a separate pressboard report cover with reinforced top hinges. Label front of report cover in accordance with previously listed notebook labeling requirements.
3. Controls Operation and Maintenance Information. Coordinate with controls requirements listed in Division 23.
    a. Where controls information is provided in separate notebook(s) (three-ring binder), reference the notebook(s) as volume(s) of the Project Operation and Maintenance Manual set. Label the notebook(s) accordingly.

PART 3 - EXECUTION

3.01 GENERAL

A. Information provided in the Operation and Maintenance Manuals shall be specific to actual equipment, materials, and systems provided under the Work of this project.

B. Pre-printed Parts lists, service instructions, equipment data manuals, etc., shall be marked to indicate the model number of the corresponding item provided under the Work of this project.
1. Use an arrow stamp to designate the pre-printed model numbers for Products applicable to this Project. Arrow shall be of a reproducible color (i.e.; red or black).
2. Where the corresponding model number is not shown on a pre-printed sheet, hand write the model number, and associated data, in ink using legible block style lettering.

END OF SECTION

SECTION 20 4100

VIBRATION ISOLATION

PART 1 - GENERAL

1.01 RELATED SECTIONS

A. Section 20 1000 - General Mechanical Provisions

B. Section 20 2000 - Mechanical Operation and Maintenance Manuals

C. Section 20 4200 - Seismic Restraints

1.02 SCOPE OF WORK

A. Provide vibration isolation for equipment as specified herein.

B. Vibration Isolator Selection:
   1. Determine vibration isolator sizes and locations including anchor bolt design.
   2. Verify that the type of isolators and deflections shown in the vibration isolation schedule are correct for the application.

C. Provide shop drawings and installation instructions for vibration isolators.

D. At completion of installation, perform final inspection of project and provide report certifying vibration isolators are installed as shown in shop drawings and in accordance with manufacturer's recommendations.

1.03 SHOP DRAWINGS, PRODUCT DATA, OPERATION & MAINTENANCE DATA

A. Submit the following in accordance with Section 20 1000 (reference isolated equipment as numbered in Contract Documents). Operation & Maintenance information required as indicated in Section 20 2000:
   1. Isolator type as numbered in Contract Documents.
   2. Manufacturer's isolator model numbers.
   3. Drawings of individual isolators selected for each support point, details of mounting brackets for isolators, location for all equipment mounting bolts, and size and locations of concrete piers supporting the isolators.
   4. Detailed calculations showing the weight distribution for each equipment support point (as calculated, not averaged), calculations showing the loads at each isolator, anticipated expansion, calculations showing the loads at restraints, spring deflections, initial and final loads on the building structure. Calculations are to be included for all connections to the structure, considering localized effects on the structural elements.

B. At project completion, submit three (3) copies of report certifying that vibration isolators are installed as shown on shop drawings and in accordance with manufacturer's recommendations.

1.04 DEFINITIONS AND ABBREVIATIONS

A. Equipment: Includes (but not limited to) pumps, fans, air handling units, water heaters, boilers, chillers, heat exchangers, tanks, air separators, terminal units, duct coils, etc. Equipment referred to by type is typical. Equipment not specifically listed here is still subject to the requirements listed in this specification.

B. Equipment Weight: Installed operating weight of equipment as reported by equipment manufacturer.

C. Integral Isolation: Isolators furnished as an integral part of the equipment.

D. Roof-Mounted Equipment: Equipment located above and attached to roof.

1.05 PROJECT DESIGN CRITERIA

A. Systems and components shall be designed and installed in accordance with the vibration Isolator manufacturer's instructions.

B. Isolators for a single piece of equipment shall have equal deflections when loaded with the equipment.

C. A minimum of four isolators shall be used to support each piece of equipment.

D. See Seismic Design Criteria of Section 20 4200 for application of seismically restrained isolators.

PART 2 - PRODUCTS

2.01 ROOFTOP CURB MOUNTED EQUIPMENT

A. Type RC-1 (Restrained Isolator Roof Curb): Complete isolation curb with integral seismically restrained spring isolators.
   1. Curb mounted rooftop equipment mounted on spring isolation curbs.
   2. The lower member to consist of a continuous support section containing adjustable and removable steel springs that support the upper floating section.
   3. The upper frame must provide continuous support for the equipment and must be captive to resiliently resist wind and seismic forces.
   4. Limit stops to be located below the upper spring attachment to limit horizontal displacement due to angular spring misalignment.
   5. All directional neoprene snubber bushings to be a minimum of 1/4 inch thick.
   6. Steel springs to be laterally stable and rest on 1/4 inch neoprene acoustical pads.
   7. Spring adjustment must use a level lift mechanism to reduce side sway and limit short circuits.
   8. Hardware must be cadmium plated and the springs plated or provided with an approved rust-resistant finish.
   9. The curb's waterproofing to consist of continuous galvanized flexible counter-flashing nailed over the lower curb's waterproofing and joined at the corners by EPDM bellows.
   10. All spring locations to have access ports with removable waterproof covers.
   11. Lower curbs to have provisions for two inch insulation.
   12. Roof curb assembly to be designed and built to compensate for roof pitch.
   13. Manufacturers: Mason Industries, Kinetics, Korfund, Amber Booth, or approved. Similar to Mason Industries type RSC.

PART 3 - EXECUTION

3.01 GENERAL

A. Vibration isolators shall be installed in strict accordance with the manufacturer’s written instructions and certified submittal data.

B. Coordinate selection of supports with equipment support points to provide isolation without creating excessive stresses at equipment connections or in piping.

C. Review equipment manufacturer's literature to ensure that procedures for setting and adjusting all isolation devices are in accordance with the recommendations.

D. Conflicts with other trades that result in rigid contact with the equipment or piping due to inadequate space or other conditions shall be corrected.

E. Provide supplementary support steel for equipment, piping, and ductwork required for the work of this Section.

PART 4 - APPLICATION TO SYSTEMS

4.01 EQUIPMENT

A. Air Conditioning Units, Roof Mounted (RTU-1 & RTU-2):
   1. Supporting Structure: See Drawings.
   2. Isolator/Restraint Type: RC-1.
   3. Isolator Deflection (ins.): 1.5 inch.

END OF SECTION

SECTION 20 4200

SEISMIC RESTRAINTS

PART 1 - GENERAL

1.01 RELATED SECTIONS

A. Section 20 1000 - General Mechanical Provisions

B. Section 20 2000 - Mechanical Operation and Maintenance Manuals

C. Section 20 4100 - Vibration Isolation

1.02 SCOPE OF WORK

A. Provide seismic restraints in accordance with ASCE Standard 7 requirements for piping, ductwork, and mechanical equipment.

B. Provide engineering for seismic restraint system, assemblies, and components.

C. Provide shop drawings and installation instructions for seismic restraint system.

D. Provide final inspection and report for installed restraint system acceptance.

1.03 DEFINITIONS AND STANDARDS

A. Referenced Standards:
   1. ASCE Standard 7: American Society of Civil Engineers / Structural Engineering Institute, Standard 7, Minimum Design Loads for Buildings and Other Structures

B. Design Criteria:
   1. Occupancy Category: ASCE 7 Occupancy Category designation, Table 1.5-1
   2. Site Classification: ASCE 7 Site Classification designation, Table 20.3-1
   3. Peak Spectral Response Acceleration (S_S): ASCE 7 Figure 22-1 - Maximum Considered Earthquake Ground Motion of 0.2s spectral response acceleration, Site Class B
   4. Design Spectral Response Acceleration (S_{DS}): ASCE 7, Eqs. 11.4-3 and 11.4-4
   5. Seismic Design Category: ASCE 7 Seismic Design Category designation, Tables 11.6-1 and 11.6-2.
   6. Component Importance Factor (I_P): ASCE 7, Section 13.1.3

C. Custom Engineered Assembly: Anchorage and seismic restraint assembly, comprised of standard or proprietary components, designed and applied to system by the Seismic Engineer.

D. Pre-Engineered Assembly: Previously designed anchorage and seismic restraint assembly selected and applied to system by the Seismic Restraint System Engineer.

E. Seismic Restraint System Engineer: Registered Professional Engineer currently licensed in Oregon as a structural, civil, or mechanical engineer. Responsible for designing, applying, and inspecting pre-engineered seismic restraint assemblies and components in accordance with applicable codes and component manufacturer's published recommendations.

F. Seismic Engineer: Professional engineer currently licensed in Oregon as a structural, civil, or mechanical engineer. Responsible for designing, applying, and inspecting custom seismic restraint components in accordance with applicable codes.

G. Equipment:
   1. Includes (but not limited to) pumps, fans, air handling units, heat exchangers, etc. Equipment referred to by type is typical. Equipment not specifically listed here is still subject to the requirements listed herein.
   2. Weight: Installed operating weight of equipment as reported by equipment manufacturer.
   3. Integral Isolation: Isolators which are furnished as an integral part of the equipment.
   4. Roof-Mounted: Equipment located above and attached to roof.
   5. Floor-Mounted: Equipment located on and attached to floor.

H. Ductwork and Piping:
   1. Duct Run: A length of duct without change in direction.
   2. Piping Run: A length of pipe without change in direction.
   3. Component Weight: Calculated installed (operating) weight of component.

4. Longitudinal Bracing: Restraints applied to limit motion parallel to the centerline of the pipe or duct.
5. Transverse Bracing: Restraints applied to limit motion perpendicular to the centerline of the pipe or duct.

1.04 PROJECT DESIGN CRITERIA

A. Restraint system, assemblies, and components shall be designed and installed to resist lateral loads in accordance with the current adopted State of Oregon Structural Specialty Code.

B. Seismic Design Criteria:
1. Occupancy Category: II.
2. Site Classification: D.
3. Peak Spectral Response Acceleration (S_S): 0.78.
4. Design Spectral Response Acceleration (S_{DS}): 0.62.
5. Seismic Design Category: E.
6. Maximum Allowable Lateral Loads and Anchorage Requirements: See Structural Drawings.
7. Component Importance Factors (I_P): 1.0.

1.05 SYSTEM ENGINEERING AND QUALITY ASSURANCE

A. Seismic restraint system shall be engineered to comply with criteria stated and referenced herein.

B. Seismic restraints and related engineering for HVAC, plumbing, and piping systems to be provided by a single vendor.

C. Application of Pre-engineered Assemblies by Seismic Restraint System Engineer:
1. Application of Custom Engineered and/or Pre-Engineered Assemblies, as applicable to this project, and as follows:
   a. Application of restraints for floor or roof-mounted equipment.
   b. Application of restraints for curb mounted equipment including unit-to-curb and curb-to-structure attachments.
   c. Application of seismic restraint assemblies for vibration isolated and suspended equipment.
   d. Application of seismic restraint assemblies for piping and ductwork.
2. Submittal packages shall bear the stamp of only the responsible Seismic Restraint System Engineer.
3. Approved Pre-engineered Assembly and Application Services: Mason Industries, Kinetics, or an independent professional engineer meeting qualifications listed herein as Seismic Restraint System Engineer.

D. Custom Engineered Assemblies:
1. System engineering shall include design and Application of Custom Engineered Assemblies, as applicable to this project, and as follows:
   a. Design and Application of restraints for floor or roof-mounted equipment.
   b. Design and Application of restraints for curb mounted equipment including unit-to-curb and curb-to-structure attachments.
   c. Design and Application of seismic restraint assemblies for vibration isolated and suspended equipment.
   d. Design and Application of seismic restraint assemblies for piping and ductwork.
2. Engineering shall be performed by, or under the direct supervision of, a Seismic Engineer meeting the qualifications listed herein. Submittal packages shall bear the signed seal of only the Seismic Engineer.

E. Lateral loads and anchorage requirements at attachment to building structural system to be coordinated with project Structural Engineer.

F. For anchorage requirements and allowable lateral loads at attachment to building structural system, provide structural analysis and report from an independent Registered Structural Engineer currently licensed in the State of Oregon.

1.06 SHOP DRAWINGS, PRODUCT DATA, OPERATION & MAINTENANCE DATA

A. Pre-submittal:
   1. Included within project Mechanical Submittals, submit attached letter outlining how the seismic requirements for this project will be met (i.e., Pre-engineered Assemblies, Custom Assemblies). In the letter state what companies will be providing the services and the qualifications of the responsible individuals.

B. Shop drawings shall be submitted as one complete package inclusive of all mechanical systems and equipment.

C. Submit the following in accordance with Section 20 1000 (Reference isolated equipment as numbered in Contract Documents):
   1. Seismic Restraint Location Plan: Full or half size copies of ductwork and piping plans from the Contract Documents, showing locations and type of seismic restraint assemblies to be used.
      a. Drawings shall consist of mechanically reproduced copies of the Contract Documents, or custom drafted specifically for the Work of this Project and bear only the seal of the Seismic Restraint System Engineer or Seismic Engineer. All other seals shall be eradicated from drawings prior to submittal.
      b. Provide separate drawings for ductwork and piping systems.
      c. Each drawing shall be printed on a single sheet. Drawings pieced together from multiple copies are not acceptable.
   2. Seismic Restraint Assembly Installation Details: Pre-Engineered or Custom Engineered assembly details showing required components, dimensions, and method of connection to supporting structure.
   3. Calculations For System Application: Calculations shall indicate maximum forces anticipated at each restraint assembly, method of determining forces, and selection of restraint assemblies.
      a. For Pre-Engineered Assemblies, include documentation of design conditions, maximum load capacity of assembly, and maximum forces at anchorage points.
      b. For Custom Engineered Assemblies, submit calculations identifying maximum load capacity of assembly, maximum forces on each component, sizing/selection of each component, and maximum forces at anchorage points.

D. The entire submittal package comprised of drawings, details, and calculations for mechanical ductwork, piping, and equipment shall be stamped and signed in accordance with the requirements listed under 1.05 SYSTEM ENGINEERING AND QUALITY ASSURANCE in this specification section.

E. At seismic restraint system installation completion, submit three (3) copies of report from seismic restraint system Engineer, or the Engineer's representative, certifying that seismic restraints are installed in conformance with approved shop drawings and no additional restraints are necessary based on field conditions. Include written authorization, from Seismic Restraint System Engineer, of the designated representative.

F. Prior to Contract Closeout submit Operation and Maintenance information required as indicated in Section 20 2000.

PART 2 - PRODUCTS

2.01 PRE-ENGINEERED ASSEMBLIES

A. Anchorage and seismic restraint assemblies, comprised of standard or proprietary components, capable of application to restraint system and supporting structure.

B. Acceptable Proprietary Manufacturers: Mason Industries, Kinetics, Tolco, B-Line, or approved.

PART 3 - EXECUTION

3.01 GENERAL

A. Seismic restraint system shall be installed in strict accordance with the manufacturer's written instructions and certified submittal data.

B. Conflicts with other trades that result in rigid contact with the equipment or piping due to inadequate space or other conditions shall be coordinated with the Seismic Restraint Engineer and corrected.

C. Attach restraints and anchors to a common structural element plane and within a common structural system.

D. Provide supplementary support steel for equipment, piping, and ductwork required for the work of this Section.

3.02 EQUIPMENT SEISMIC RESTRAINT

A. Coordinate size of housekeeping pads and/or concrete piers to ensure adequate space for required bases, isolators, restraints, and attachment thereto.

3.03 DUCTWORK AND PIPING SEISMIC RESTRAINT

A. Provide minimum of two transverse supports and one longitudinal support on each pipe or duct run. Transverse bracing shall be installed at each turn and at each end of a run with a minimum of one brace at each end. Where a pipe or duct run is shorter than the minimum interval between braces, provide braces at each end.

B. Where restraints are attached to clevis style pipe hangers, the cross bolt must be reinforced.

3.04 EQUIPMENT WITH VIBRATION ISOLATION SUPPORTS

A. Anchor isolator to structural system in accordance with details on Drawings and isolator manufacturer's instructions.

END OF SECTION

SECTION 20 4200 - SEISMIC RESTRAINT SYSTEM ENGINEERING PRE-SUBMITTAL

PROJECT:_____

(Project Title)

The Undersigned states the following:

- Seismic restraints for the work of Divisions 22 and 23 for this project will be provided as required in Section 20 4200.
- Application of Pre-Engineered Restraint Assemblies will be provided by Seismic Restraint System Engineer meeting qualifications of Section 20 4200.

  Seismic Restraint System Engineer: _____

  Firm Name: _____

  Authorized Representative: _____

  (Name of representative authorized to act on Engineer's behalf)

- Design for Custom Engineered Restraint Assemblies will be provided by Seismic Engineer meeting qualifications of Section 20 4200.

  Seismic Engineer: _____

  Firm Name: _____

  Authorized Representative: _____

  (Name of representative authorized to act on Engineer's behalf)

- Upon completion of seismic restraint system installation the Engineers listed above, or the designated representative listed, will inspect and certify that seismic restraints are installed in conformance with approved shop drawings and, based on actual field conditions, no additional restraints are necessary to comply with applicable codes.

Submitted by: _____ Signature: _____

Firm: _____

Address: _____

Telephone: _____ E-mail:_____

Date: _____

SECTION 20 6000

MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.01 RELATED SECTIONS

A. Section 20 1000 - General Mechanical Provisions

1.02 SHOP DRAWINGS, PRODUCT DATA, OPERATION & MAINTENANCE DATA

A. Submittals required for the products listed in the Product Table, in accordance with Section 20 1000. Operation & Maintenance Information required as indicated in the Product Table in accordance with Section 20 2000.

B. Operation & Maintenance Information requirements indicated by number designation as follows. Refer to Section 20 2000 for a description of each type of information.
   1. Shop Drawings (submittal data)
   2. Product Data (submittal data)
   3. Manufacturer's Operation Manuals
   4. Manufacturer's Service and Lubrication Requirements
   5. Service Contracts and Field Start-up Reports
   6. Cleaning, Certification, and Test Reports
   7. System Information
   8. Warranties

	Operation & Maintenance Information							
PRODUCT TABLE	1	2	3	4	5	6	7	8
Pipe Labels		X						
Valve Tags		X						
Control and Equipment Nameplates		X						
Ceiling Tacks		X						
Damper Locator Labels	X	X						
Pipe Union Labels	X	X						

1.03 REFERENCES

A. ANSI A13.1 (American National Standards Institute) - Scheme for the Identification of Piping Systems, latest edition.

PART 2 - PRODUCTS

2.01 PIPE LABELS

A. Pipe Labels:
   1. Type: Preformed plastic or adhesive-backed vinyl, with factory printed legend on colored background.
   2. Letter Size: Conform to ANSI A13.1 1981.
   3. Background Color: Conform to ANSI A13.1 1981.
   4. Flow Direction Arrow: At each pipe label.
   5. Legend Wording: Match the pipe description shown in Symbols List on Drawings.
   6. Manufacturer: Seton, Brady, MSI, or approved.

2.02 VALVE TAGS

A. Valve Tags:
   1. Type: Brass or aluminum disc, 1-1/2 inch diameter, with stamped legend.
   2. Letter Size:

a. System Type: 1/4 inch.
b. Valve Number: 1/2 inch.

3. Legend Wording:
   a. System Type: Match pipe abbreviation shown in Symbols List on Drawings.
   b. Valve Number: Sequential numbers by system designation. Coordinate with Owner to determine the starting number for each system type.
4. Manufacturer: Seton, Hanson, MSI, or approved.

2.03 CONTROL AND EQUIPMENT NAMEPLATES

A. Nameplates:
   1. Type: Laminated plastic, with engraved white letters on black background.
   2. Letter Size: 1/2 inch tall.

2.04 EILING TACKS

A. Description: Steel with 3/4 inch (19 mm) diameter color-coded head.

B. Color code as follows:
   1. HVAC equipment: Yellow
   2. Fire dampers/smoke dampers: Red
   3. Plumbing valves: Green

C. Manufacturer: Seton, Hanson, MSI, or approved.

2.05 MISCELLANEOUS LABELS

A. Damper Locator Labels:
   1. Material: White vinyl, self-adhesive, permanent.
   2. Red lettering, minimum 1/2 inch tall.
   3. Labels at fire dampers read “FIRE DAMPER ACCESS”.
   4. Manufacturer: Seton, Brady, MSI, or approved.

B. Pipe Union Labels
   1. Material: White vinyl, self-adhesive, permanent.
   2. Red lettering, minimum 1/2 inch tall.
   3. Labels at unions and die-electric unions read “UNION”.
   4. Manufacturer: Seton, Brady, MSI, or approved.

PART 3 - EXECUTION

3.01 PIPE LABELS

A. Provide labels for piping.

B. Labels shall be oriented to be visible from the normal access side of the pipe.

C. Locate pipe labels as follows:
   1. Within 3 feet of each valve.
   2. Within 3 feet of each equipment connection.
   3. Within 3 feet of each wall, floor, or ceiling penetration.
   4. Within 3 feet of each branch.
   5. At intervals along the pipe, not to exceed 20 feet on center.

D. Prior to label installation, clean pipe or insulation surfaces according to label manufacturer's recommendations.

3.02 VALVE TAGS

A. Provide tags for valves, except as follows:
   1. Tags not required for:
      a. Stop valves at plumbing fixtures
      b. Relief valves
      c. Check valves
      d. Pressure reducing valves
      e. Balancing valves
      f. Automatic flow control valves

g. Equipment isolation valves within 5 feet of equipment served

B. Secure tag to valve with corrosion-resistant metal chain, S-hook, or meter seal.

3.03 CONTROL AND EQUIPMENT NAMEPLATES

A. Provide nameplates for mechanical equipment -- including air handling units, fans, pumps, terminal units, reheat coils, furnaces, unit heaters, chillers, boilers, heat exchangers, storage tanks, expansion tanks, radiant piping manifolds, etc. Wording to match equipment designations on Drawings

B. Provide nameplates for variable frequency drives. Wording to indicate equipment served, followed by the letters “VFD”. For instance, label for a VFD serving an air handling unit supply fan would read: AHU-XX SF VFD

C. Provide nameplates for control panels and major control components.

D. Attach nameplates with rivets or screws; adhesive only fastening not permitted. Provide weather-proof sealant for outdoor applications where screws penetrate casing.

E. At room thermostats and temperature sensors, write the name of the unit served on the inside of cover in permanent ink.

3.04 CEILING TACKS

A. Provide ceiling tacks to locate equipment, valves, or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

3.05 DAMPER LOCATOR LABELS

A. Provide label for each fire damper and each combination fire/smoke damper. Coordination final locations for labels with Architect and Owner’s Representative.

B. Provide locator label at access from occupied space to each fire damper and combination fire/smoke damper. Mount label on ceiling grid for dampers located above lay-in ceilings. Mount labels on the wall access door and the duct access door for dampers located behind walls.

C. Prior to label installation, clean surfaces in accordance with label manufacturer’s instructions.

3.06 PIPE UNION LABELS

A. Provide label for each union and die-electric union concealed inside pipe insulation. Orient label parallel with pipe run and position to be visible from the normal access side of the pipe.

B. Prior to label installation, clean surfaces in accordance with label manufacturer’s instructions.

END OF SECTION

SECTION 20 9100

TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.01 RELATED SECTIONS

A. Section 20 1000 – General Mechanical Provisions

B. Section 20 2000 – Mechanical Operation and Maintenance Manuals

1.02 SECTION INCLUDES

A. Testing, adjusting, and balancing (TAB) of air systems.

B. Measurement of final operating conditions of HVAC equipment.

1.03 QUALIFICATIONS

A. Work of this Section shall be performed by a firm currently certified by the National Environmental Balancing Bureau (NEBB) in the following categories:
   1. Certification for Performance of both Air and Hydronic TAB

B. Work of this section shall be accomplished under the on-site supervision of a NEBB Certified supervisor assigned full time to an office in the State of Oregon. The NEBB certified person designated in writing to NEBB (for the purpose of NEBB Certification of the firm) shall be the supervisor who will represent the firm. The NEBB certified supervisor shall be responsible for the supervision of on-site TAB work and the setup/review of the balancing report.

C. Approved Firms: Northwest Engineering Service, Inc., Air Introduction and Regulation, Inc., Southern Oregon Engineering Services, Neudorfer Engineers, Inc., Air Balancing Specialty, or approved.

1.04 QUALITY ASSURANCE

A. Work of this Section shall be done in accordance with the current edition of the NEBB Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

B. Maintain and calibrate measuring instruments in accordance with NEBB standards.

1.05 SUBMITTALS

A. Submittals required for the following, in accordance with Division 1 requirements, Section 20 1000 and Section 20 2000:
   1. Preliminary Balancing Report
      a. Submittal timing: Include with “Long Lead Time Item Submittal” if provided. Otherwise, include with “Project Submittal”
      b. Copies: Submit three (3) copies, of which one copy will be retained by Engineer.
      c. Binding: Bind report in 3 ring binder with indexed tabs.
      d. Content:
         1) Cover sheet: Provide cover sheet with each report containing:
            a) Project name and location
            b) Architect
            c) Engineer
            d) Mechanical Contractor
            e) Testing, Adjusting and Balancing Firm
         2) Table of Contents: Indexed to tabs.
         3) Proposed Forms: Copies of proposed field test log forms to be used during actual field balancing. Forms similar to and containing data indicated in example logs in NEBB Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems. Logs to also include (as a minimum) spaces for all data as required elsewhere in this Section. See sample forms immediately following this Section.
   2. Final Balancing Report:
      a. Submittal timing: Provide Final Report prior to Contractor’s application for substantial completion.

b. Copies: Provide 3 copies of report. Provide one copy directly to Mechanical Engineer. Insert remaining copies into Mechanical Operation and Maintenance Manuals submitted per Section 20 1000.
c. Binding: Bind report in 3-ring binder with indexed tabs.
d. Content:
    1) Cover sheet: Provide cover sheet with each report containing:
        a) Project name and location
        b) Architect
        c) Engineer
        d) Mechanical Contractor
        e) Testing, Adjusting and Balancing Firm
    2) Table of Contents: Indexed to tabs.
    3) Content:
        a) Data required by this Section on forms approved by the Engineer.
        b) Reduced copies of Drawings relating reference points to outlet logs, including room numbers.
        c) Written discussion describing any discrepancies between design and actual data including description of required corrective actions necessary to meet specified flow tolerances.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.01 GENERAL

A. Check the following and report to Contractor for necessary corrections:
    1. Drafts, noise and vibration.
    2. Building pressure under normal operating conditions.

3.02 ADJUSTMENT AND BALANCING

A. Mechanical Equipment:
    1. Provide unit designation and area served.
    2. Provide motor design data including HP, volts, phase, and speed (RPM).
    3. Provide motor nameplate data including manufacturer, frame, HP, volts, phase, FLA, RPM, service factor, and nameplate efficiency (Energy Efficient or Premium Efficiency).
    4. Provide motor measured data including volts and amps each phase, RPM, installed starter manufacturer and size, and installed thermal overcurrent protection size and adjustment.
    5. List fan design data including CFM, SP, HP, BHP, RPM.
    6. Provide fan nameplate data including manufacturer, model, size, type, and serial number.
    7. After final adjustments, provide data on installed belt drives including fan motor base position, shaft center-to-center measurement, sheave manufacturer, size, and turns open for adjustable sheaves.
    8. Provide belt manufacturer, size, and model number.
    9. List sizes and quantities of air filters.
    10. Partly blank off air filters with temporary material such as cardboard or sheet metal. Simulate partial loading of air filters by adjusting the amount area which is blanked off. For partial loading use the measured pressure drop of clean filters plus 80% of the difference between the clean pressure drop and the scheduled "change out" air pressure drop. Fill condensate trap with water. Inspect trap with fan operating and record in the Final Report whether or not the traps hold water. Filters shall remain partially blanked off while measuring fan test data.
    11. Measure and report actual fan test data including FLA, fan rpm, ESP, TSP, supply CFM, return CFM, exhaust CFM, outside air CFM, EAT, LAT.
    12. Measure and report pressure drops across AHU components including louvers, hoods, dampers, filters, and coils.

13. Measure and report pressure drops across gravity backdraft dampers. Adjust counterbalance weights at gravity backdraft dampers to achieve specified pressure drops.
14. Adjust fan speed, providing belt and sheave changes as needed to meet air outlet flow tolerances at minimum fan amperage draw.
15. Test and balance systems and record data in specified modes of operation (Refer to Section 23 0900), including the following:
    a. Measure and record total outside air flow. Measure by traverse, except when approved by Engineer where damper configuration prevents traverse (such as single blade OSA minimum damper), measure by temperature differential when air temperatures provide a minimum 20 deg. F air temperature delta. Provide log of traverse or description of procedure and data for measurement by temperature differential. For outside air economizer systems measure and record flow at minimum and 100% outside air. For variable volume systems record flow at minimum and maximum flows. Measure outside air with all terminal units at minimum flows, all at maximum flows, and with terminal units under automatic control. For systems with occupancy-based control including occupancy sensors and CO2 sensors, measure flows with no occupancy and simulated full occupancy.
    b. Verify smoke dampers and minimum outside air damper open/close at unit startup/shutdown.
    c. On activation of smoke detector or receipt of building fire alarm system, verify fans shut down, operate in smoke control mode, or operate in smoke purge mode, per Section 23 0900.
    d. Coordinate with Division 26 testing to verify smoke dampers close on receipt of building fire alarm signal. Verify smoke dampers begin to close subject to delay subsequent to receipt of fire alarm. Minimum delay is 10 seconds.
    e. For engineered smoke control systems, coordinate with Division 26 testing to verify smoke dampers open/close per sequences in Section 23 0900.

B. Air Terminal Units:
1. Measure actual air flow at outlets served by each device and compare sum to total CFM reported by DDC controller in Section 23 0900. For series fan powered terminal units traverse or measure pressure drop across primary air inlets. Compute calibration factor and coordinate with Section 23 0900 to input factor into the controller software. Provide schedule in each report to include the following for each device:
    a. Terminal Unit Inlet Size
    b. Cooling/Maximum Design CFM
    c. Heating/Minimum Design CFM
    d. Cooling/Maximum Computer Indicated CFM
    e. Heating/Minimum Computer Indicated CFM
    f. Cooling/Maximum Actual CFM
    g. Heating/Minimum Actual CFM
    h. Calibration Factor

C. System Supply, Return, Exhaust outlets:
1. Measure airflow with Shortridge Diffuser Hood or for oversized outlets measure by traverse.
2. List method of measurement.
3. List required design cfm, velocity, AK.
4. List initial velocity, cfm, and percent of design flow at each inlet and outlet.
5. Coordinate with controls installer in Section 23 0900 to command variable air volume (VAV) devices fully open. Where fan total is less than terminal unit totals due to load diversity (verify), open VAV devices in groups of zones per NEBB procedures.
6. Measure supply outlet flows at minimum and 100% outside air.
7. Measure supply outlets served by variable volume terminal units at minimum and maximum flows.

8. Proportion flow between outlets. Report outlet and inlet flows as actual CFM and as percent of required. Adjust and list, or re-adjust fan speed, until volumes are within specified flow tolerances.
9. Adjust diffuser patterns to minimize drafts.
10. Mark final positions of balancing dampers.

D. System flow tolerances at maximum flow:
1. Air handling unit, supply air flow 5,000 cfm or larger: -5 percent to +5 percent.
2. Air handling unit, outside air flow: -0 percent to +10 percent at minimum setting.
3. All other fans, air flow: -0 percent to +10 percent.
4. VAV terminal units, air flow: -5 percent to +10 percent at maximum and minimum settings.
5. Individual room air outlets and inlets, and air flow rates not mentioned above: -10 percent to +10 percent.

E. Room Thermostats:
1. Check and report thermostat settings and room temperature after all adjustments have been made, with HVAC system(s) operating under automatic control.

F. Repair:
1. Provide plastic plugs to seal holes drilled in ductwork for test purposes.
2. Repair or replace insulation removed or damaged for TAB work. Refer to requirements for insulation in Sections 22 1410, 22 4120, and 23 0700.

G. Final Adjustments and Fine Tuning:
1. For a period of one year after final acceptance, provide call back site visits as requested by the Engineer at no additional cost to the project.

END OF SECTION

FAN EQUIPMENT TEST LOG

Project: _____ Company Name: _____

Fan System: _____ Technician: _____

Area Served: _____ NEBB Certified Supervisor:: _____

Date: _____ NEBB Certifications (Circle): Air / Hydronic / Cleanroom / Sound & Vibration

DESIGN SUMMARY

Unit	CFM	TSP	Size - Type	Wheel RPM	BHP	Efficiency	Volts/Phases
Supply Fan							
Return Fan							

SF Motor: Horsepower _____ Speed (RPM): _____ Volts/Phases: _____ Efficiency (%): _____

RF Motor: Horsepower _____ Speed (RPM): _____ Volts/Phases: _____ Efficiency (%): _____

EQUIPMENT DATA

Unit	Manufacturer	Model	Type	Diameter	Discharge	Class	Max RPM
Supply Fan							
Return Fan							

SUPPLY FAN MOTOR

Horsepower _____ Speed (RPM): _____ Volts/Phases: _____ Efficiency (%): _____
Starter Type (VFD / Mag) _____ Manufacturer: _____ Model:_____ Size:_____
Thermals: Size: _____ Amps: _____ / _____ / _____
Drive Belts: Number: _____ Manufacturer: _____ Size:_____
Motor Sheave: Manufacturer/Model: _____ Size: _____ Turns Open: _____
Driven Sheave: Manufacturer/Model: _____ Size: _____ C-C (Inches): _____
Frame Size: _____ Motor Base: Min: _____ Max: _____ Set: _____

RETURN FAN MOTOR

Horsepower _____ Speed (RPM): _____ Volts/Phases: _____ Efficiency (%): _____
Starter Type (VFD / Mag) _____ Manufacturer: _____ Model:_____ Size:_____
Thermals: Size: _____ Amps: _____ / _____ / _____
Drive Belts: Number: _____ Manufacturer: _____ Size:_____
Motor Sheave: Manufacturer/Model: _____ Size: _____ Turns Open: _____
Driven Sheave: Manufacturer/Model: _____ Size: _____ C-C (Inches): _____
Frame Size: _____ Motor Base: Min: _____ Max: _____ Set: _____

AIR FILTERS

No. of Sets: _____ Manufacturer: _____ Efficiency % / MERV:_____
Size: _____ Quantity: _____ Size: _____ Quantity: _____
Clean Pressure Drop (In. w.g.): _____ Changeout Pressure Drop (In. w.g.): _____

OPERATIONAL TEST DATA

HTG COIL GPM: _____ EAT: _____ LAT: _____ EWT: _____ LWT: _____

CLG COIL GPM: _____ EAT: _____ LAT: _____ EWT: _____ LWT: _____

Condensate Drain Trap: _____ Holds pressure _____ Draws water _____ Expels water (Check one)

Pressure Drops: OSA Intake: _____ RA Damper: _____ Filters: _____ Heating Coil: _____ Cooling Coil: _____

TEST	Fan RPM	AMPS 1 2 3	Fan TSP (In. w.g.)	Supply CFM	Return CFM	Relief CFM	Outside Air CFM
As Installed:							
100% OSA, VAV at Min.							
100% OSA, VAV at Max.							
Min. OSA, VAV at Min.							
Min. OSA, VAV at Max.							
System Under Auto Control							

AIR INLET AND OUTLET TEST LOG

Project: _____
Fan System: _____
Area Served: _____
Date: _____

Company Name: _____
Technician: _____
Test Apparatus: _____
NEBB Certified Supervisor:: _____

SUPPLY AIR OUTLETS

ROOM	OUTLET				FLOW (CFM)				PERCENT	NOTES
	NO.	TAG	SIZE	AK	DESIGN	INITIAL	ADJUSTED	FINAL	OF DESIGN	

NOTES: