SECTION 210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe, fittings, valves, and connections for wet sprinkler systems.

1.2 SCOPE OF THE WORK

A. Modify existing wet sprinkler system and add sprinkler heads for remodeled configuration of the Douglas Island Center Building project area. Contractor shall perform site visits to as-built system for connection points.

1.2 RELATED REQUIREMENTS

A. Section 07 9200 – Joint Sealants, for Firestopping requirements.

B. Section 09 9123 – Interior Paint: Preparation and painting of fire protection piping systems.

C. Section 21 1300 - Fire-Suppression Sprinkler Systems: Sprinkler systems design.

1.3 REFERENCE STANDARDS

A. ASME (BPV IX) - Boiler and Pressure Vessel Code, Section IX - Welding and Brazing Qualifications; The American Society of Mechanical Engineers; 2010.

B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; The American Society of Mechanical Engineers; 2005.

C. ASME B16.3 - Malleable Iron Threaded Fittings; The American Society of Mechanical Engineers; 1998 (R2006).

D. ASME B16.4 - Gray Iron Threaded Fittings; The American Society of Mechanical Engineers; 1998 (R2006).

E. ASME B16.5 - Pipe Flanges and Flanged Fittings; The American Society of Mechanical Engineers; 2009 (ANSI/ASME B16.5).

F. ASME B16.9 - Factory-made Wrought Steel Buttwelding Fittings; The American Society of Mechanical Engineers; 2007.

G. ASME B36.10M - Welded and Seamless Wrought Steel Pipe; The American Society of Mechanical Engineers; 2004.

SECTION 211300 - FIRE SUPPRESSION SPRINKLERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Wet-pipe sprinkler system.

B. System design, installation, and certification.

1.2 RELATED REQUIREMENTS

A. Section 07 9200 – Joint Sealants for Firestopping.

B. Section 21 0500 - Common Work Results for Fire Suppression: Pipe, fittings, and valves.

1.3 REFERENCE STANDARDS

A. NFPA 13 - Standard for the Installation of Sprinkler Systems; National Fire Protection Association; 2010.

B. UL (FPED) - Fire Protection Equipment Directory; Underwriters Laboratories Inc.; current edition.

1.4 SUMMARY OF WORK

A. Modify and extend an existing wet sprinkler system to provide coverage for remodeled spaces of the Douglas Island Center Building. Contractor shall perform site visits to as-built system for connection points.

1. All areas without exposed structural ceilings shall have concealed sprinkler piping with recessed heads.

2. Provide recessed heads in all finished ceilings.

3. Contractor shall provide connections to the existing sprinkler system as required hereunder to maintain continuity for reasonable down periods coordinated with Owner.

1.5 WORK INCLUDED

A. The Mechanical Work is governed by the entire Specifications and not just Division 21. The entire Specifications must be examined for requirements relating to the Work hereunder. The Work covered by this and all other Mechanical sections consists of furnishing labor, equipment, and materials in accordance with the Specifications or Drawings, or both, together with any incidental items not shown or specified which can be reasonably inferred or taken as belonging

to the Work and necessary in good practice to provide a complete system described or shown as intended.

B. Coordinate shutdown of systems with State of Alaska Maintenance Personnel. Contact name and phone number will be available through ARCHITECT.

C. Continuity of Mechanical Systems for the Building: Continuity of Mechanical systems for building sprinkler, plumbing, heating, and ventilation systems during demolition and new work shall be the responsibility of the CONTRACTOR. Building sprinkler, plumbing, heating, and ventilation systems shall be operational during occupied periods. Shutdown of systems shall not affect Occupied portions of the building except when coordinated with the State of Alaska and the ARCHITECT. Sprinkler, plumbing, heating, and ventilation systems shall be active at all times in Occupied areas. Shutdown to Occupied portions of the building to occur after hours upon approval of the State of Alaska.

D. Demolition of and Connection to Existing Material, Equipment, and Systems:

1. Where select piping and ductwork systems are shown to be partially removed for connection, prepare and protect the connection points appropriately to ensure later continuity of Work. CONTRACTOR shall provide all temporary supports as required and completely replace material and equipment that are not suitably protected during construction and becomes damaged.
2. CONTRACTOR shall provide all temporary caps for ductwork and piping as required. CONTRACTOR shall provide all temporary partitions such as air-tight air plenum separations as required to maintain continuity of systems and to not contaminate existing systems or finishes. CONTRACTOR shall remove all temporary provisions when the phase of Work is completed or earlier if required.
3. All material and equipment that are to be removed for relocation is the CONTRACTORS responsibility to suitably protect and store in a location that protects from damage. CONTRACTOR shall completely replace all relocated material and equipment that are damaged from storage and other misuse between demolition and reinstallation.
4. Where items are shown to be removed such as piping or ductwork it is to be assumed that this includes the removal of the respective system including but not limited to pipe and duct hangers, supports, conduit, wiring, valves, and other related trim and appurtenances. Piping to be removed through a floor assumes that the piping is to be capped below floor and the floor finished smooth.

1.6 SUBMITTALS

A. General: Provide submittals according to Conditions of Contract, Division 01 Specifications Sections, and as required hereunder. Drawings and general provisions of the contract including General, Supplementary Conditions, and all Division 01 Specification Sections, apply to this Section. Approval of the data shall not eliminate responsibility for compliance with the Drawings or Specifications unless specific attention has been called in writing to proposed deviations at the time of transmittal of the data and such deviations have been approved, not shall it eliminate the responsibility for freedom of errors of any sort in the data. All Mechanical submittal data for Project construction is to be turned in for approval at the same time in order for an efficient review process. Partial submittals may be rejected until the full submittal is received.

B. See Division 01 - Submittals, for submittal procedures.

C. Specific Products: Trade names and catalog numbers of manufactured products included herein are intended to indicate the type, size and grade of quality of equipment and materials required and such equipment and materials are approved for installation subject to full compliance with the Specifications. Except where single manufacture is specified for standardization, requires for approval of other manufacturers than those specified must be accompanied by complete descriptions including overall dimensions, performance data, and, if catalog material, identification of specific products or items proposed.

D. Shop Drawings:

1. Submit coordinated shop drawings of the sprinkler system. Provide shop drawings of entire project area including all features, piping, heads, valves, hangers, bracing, accessories, and systems connections. Include separate ceiling plans detailing head locations, lighting, diffusers, grilles, speakers, and other ceiling obstructions.
2. Indicate pipe material used, joint methods, supports, and floor and wall penetrations seals. Indicate installation, layout, heights, weights, mounting and support details, and piping connections. Show all related systems in light format for coordination such as ductwork, lights, etc.
3. Indicate hydraulic calculations if needed, detailed pipe layout, hangers and supports, sprinklers, components and accessories.
4. Submit shop drawings to ARCHITECT and then approved shop drawings to authority having jurisdiction for code official approval.

E. Submittal Format: All data shall be submitted at one time in neatly bound loose-leaf three ring binders with pockets and tabulated in order of Specification Division 21. All data shall be typed, minimum 10 point font, not exceptions. Data submitted that is not conforming to these specification requirements will be returned without reviewing and will need to be resubmitted at Contractors sole complete cost.

1. Each binder shall have a set of separators with index tabs A to Z. Tabs are to be printed type. Slip in tabs not acceptable.
2. The first page shall be a cover sheet with project name, address, data, submittal product name, all applicable contractors and contact information, and all applicable consultants and contact information.
3. Second page shall be a submittal manual index of all project Specification sections with respective tab numbers, and respective book number, if applicable.
4. The first page of each manuals section shall be an index of the respective project Specification section and number with each product name, manufacturer name and model number.
5. Each manuals section shall be labeled and certified by mechanical Subcontractor that the data presented is in accordance with project Specifications. Index sheet in front of completed diner listing each piece of equipment or material submitted.
6. Product Data to be utilized shall be flagged and noted and all other data shall be crossed out or otherwise flagged that it is not in the project.
7. Data shall be inserted in binders in order of Specification number. Specification number shall be clearly labeled on the each submittal page.

F. As-Built Drawings: As-Built drawings shall be required at a minimum to two times during the

project and at final submittal. Interim as-builts are to provide project manager updated information as to the systems is required. As-builts shall accurately show all changes for Contract Document for piping, ductwork, and equipment. As-Built drawings shall be updated daily and available for inspection on-site by the ARCHITECT.

G. Maintenance Materials: Furnish the following for OWNER's use in maintenance of project.
   1. Extra Sprinklers: Type and size matching those installed, in quantity required by referenced NFPA design and installation standard.
   2. Sprinkler Wrenches: For each sprinkler type.

F. Operation and Maintenance Data: Not required.

H. Shop Drawings: Verify on-site as-built conditions during demolition of construction if required where system is concealed. Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections. Shop drawings shall be coordinated and corrected with all other disciplines for interference and location of existing and new conditions prior to submittal to ARCHITECT.

I. Submit prior to Substantial Completion Inspection and Final Inspection a detailed list of equipment and systems that will NOT be completed for the completion date. Include status and information of deficiencies from all previous inspection reports.

J. Submit prior to Re-inspections of Substantial Completion Inspections, if applicable, and the Final Inspection a marked copy of the previous Engineers Inspection Reports detailing all items that have been completed and all items that have not been completed with reasons thereof. Re-inspection or Final Inspection will not occur until receipt of this list.

1.7 COOPERATIVE WORK

A. The Work hereunder shall be coordinated between various mechanical Sections and with the Work specified under other divisions or contracts toward rapid completion of the entire Project. If any cooperative Work must be altered due to lack of proper supervision hereunder, or failure to make proper provisions in time, then the Work hereunder shall include all expense of such changes as are necessary to be made in the Work under other divisions and contracts, and such changes shall be directly supervised by the ARCHITECT and shall be made to the satisfaction of the ARCHITECT.

B. In general pitched piping and ductwork shall take preference in location within the Project area. Coordination of all drain valves, duct access doors, and other equipment requiring access and maintenance procedures is required with all building components during construction for maximum accessibility and proper location as intended. In many portions of the building, piping mains, piping branches, and sprinkler piping, as well as some duct branches will need to be installed in the joist space to allow for installation of duct mains. Coordinate closely with all other Contractors.

C. Protection of existing mechanical material and equipment during selective demolition shall be the responsibility of the CONTRACTOR and coordinated with the respective Contractors. The CONTRACTOR shall provide temporary supports for all material and equipment. The CONTRACTOR at no cost to the Owner shall replace any existing material or equipment damaged during selective demolition due to insufficient protection. Coordination with all

disciplines is required.

D. Temporary Utilities: In addition to requirements hereunder see Division 01. Continuity of Mechanical systems for building sprinkler, plumbing, heating, and ventilation systems during demolition and new Work shall be the responsibility of the CONTRACTOR. The CONTRACTOR shall be responsible for providing and maintaining the Mechanical Systems serving occupied areas of the building throughout Construction. Shutdown of systems shall not affect Occupied portions of the building except when coordinated with State of Alaska and Maintenance. Sprinkler, plumbing, heating, and ventilation systems shall be active at all times in Occupied areas.

1. Protection of existing mechanical material and equipment during selective demolition shall be the responsibility of the CONTRACTOR and coordinated with the respective Sub Contractor. The CONTRACTOR shall provide temporary supports for all material and equipment. The CONTRACTOR at no cost to Owner shall replace any existing materials or equipment damaged during selective demolition due to insufficient protection. Coordinate with all disciplines and phasing plans are required.
2. The CONTRACTOR shall be responsible for providing and maintaining the Mechanical Systems serving occupied areas of the building installed or modified under this Project throughout the Construction period including during the Phases.

1.8 QUALITY ASSURANCE

A. Maintain one copy of referenced design and installation standard on site.

B. Conform to UL requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

D. Installer Qualifications: Company specializing in performing the work of this section with minimum three years experience approved by manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Sprinklers, Valves, and Equipment:

1. Tyco Fire Suppression & Building Products
2. Viking Corporation
3. Grinnell

2.2 SPRINKLER SYSTEM

A. Sprinkler System: Modify entire existing system in the Project Area for proper coverage remodel areas.

B. Occupancy: Light hazard; comply with NFPA 13.

C. Water Supply: Determine volume and pressure from water flow test data. Contractor shall obtain water flow test data on-site from the nearest fire hydrant station from the City and Borough of Juneau, if available. Otherwise Contractor shall provide test and measurement flow data. All expenses obtaining the information shall be borne by the Contractor.

D. Pipe Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:

1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
5. Other Types: As required.

2.3 SPRINKLERS

A. Suspended Ceiling Type: Recessed pendant type with matching push on escutcheon plate.

1. Response Type: Standard.
2. Coverage Type: Extended.
3. Finish: Chrome plated.
4. Escutcheon Plate Finish: Chrome plated.
5. Fusible Link: Glass bulb type temperature rated for specific area hazard.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with referenced NFPA design and installation standard.

B. Install equipment in accordance with manufacturer's instructions.

C. Place pipe runs to minimize obstruction to other work.

D. Place piping in concealed spaces above finished ceilings.

E. Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.

F. Center sprinklers in one direction only in ceiling tile with location in other direction variable, dependent upon spacing and coordination with ceiling elements. Recessed heads shall have all

deflectors at same location below ceiling, with tolerance of plus or minus 0.5 inch.

G. Submit required test certificates to Fire Marshall and to Owner.

END OF SECTION 211300

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems.

1.2 REFERENCE STANDARDS

A. AABC MN-1 - AABC National Standards for Total System Balance; Associated Air Balance Council; 2002.

B. ASHRAE Std 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 1988, with 1997 Errata.

C. NEBB (TAB) - Procedural Standards for Testing Adjusting Balancing of Environmental Systems; National Environmental Balancing Bureau; 2005, Seventh Edition.

D. SMACNA (TAB) - HVAC Systems Testing, Adjusting, and Balancing; Sheet Metal and Air Conditioning Contractors' National Association; 2002.

1.3 SUMMARY

A. Scope of Work: Adjust and balance all building air systems in Project Area. Air volumes are located on the diffuser and grille schedules. Coordinate with contract document requirements.

1. Ventilation and Exhaust Systems:

a. HRV (5) System.

1.5 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.

C. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.

1. Submit to ARCHITECT.
2. Submit six weeks prior to starting the testing, adjusting, and balancing work.

3. Include certification that the plan developer has reviewed the contract documents, the equipment and systems, and the control system with the ARCHITECT and other installers to sufficiently understand the design intent for each system.
4. Include at least the following in the plan:

    a. List of all air flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
    b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
    c. Identification and types of measurement instruments to be used and their most recent calibration date.
    d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
    e. Final test report forms to be used.
    f. Expected problems and solutions, etc.
    g. Details of how TOTAL flow will be determined; for example:

        1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations, displacement diffusers.
        2) Water: Pump curves, circuit setter, flow station, etc.

    i. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and methods to verify this.
    j. Confirmation of understanding of the outside air ventilation criteria under all conditions.
    k. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).
    l. Method of checking building static and exhaust fan and/or relief damper capacity.
    m. Proposed selection points for sound measurements and sound measurement methods.
    n. Time schedule for TAB work to be done in phases (by Season, floor, etc.).
    o. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.
    p. Procedures for formal deficiency reports, including scope, frequency and distribution.

D. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

1. Revise TAB plan to reflect actual procedures and submit as part of final report.
2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for ARCHITECT and for inclusion in operating and maintenance manuals.
3. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

4. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
5. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
6. Units of Measure: Report data in both I-P (inch-pound) units.
7. Include the following on the title page of each report:

    a. Name of Testing, Adjusting, and Balancing Agency.
    b. Address of Testing, Adjusting, and Balancing Agency.
    c. Telephone number of Testing, Adjusting, and Balancing Agency.
    d. Project name.
    e. Project location.
    f. Project ARCHITECT.
    g. Project Engineer.
    h. Project CONTRACTOR.
    i. Project altitude.
    j. Report date.

H. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:

1. AABC MN-1, AABC National Standards for Total System Balance.
2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
3. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
4. SMACNA HVAC Systems Testing, Adjusting, and Balancing.
5. Maintain at least one copy of the standard to be used at project site at all times.

B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.

D. TAB Agency Qualifications:

1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
2. Having minimum of three years documented experience.
3. Certified by one of the following:

    a. AABC, Associated Air Balance Council: www.aabchq.com; upon completion submit AABC National Performance Guaranty.
    b. NEBB, National Environmental Balancing Bureau: www.nebb.org.
    c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org.
    d. Professional mechanical engineer with documented TAB experience within the last five years.

E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.2 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:

1. Systems are started and operating in a safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Filters have been replaced immediately prior to adjustment of air system.
5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Fire and volume dampers are in place and open.
8. Air coil fins are cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage is minimized.
12. Hydronic systems are flushed, filled, and vented.
13. Pumps are rotating correctly.
14. Proper strainer baskets are clean and in place.
15. Service and balance valves are open.

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

C. Beginning of work means acceptance of existing conditions.

3.3 ADJUSTMENT TOLERANCES

A. HRV Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

3.4 RECORDING AND ADJUSTING

A. Field Logs: Maintain written logs including:

1. Running log of events and issues.
2. Discrepancies, deficient or uncompleted work by others.
3. Contract interpretation requests.
4. Lists of completed tests.

B. Ensure recorded data represents actual measured or observed conditions.

C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. Mark on the drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.

E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

G. Adjust diffuser and grille blades for proper air diffusion throughout. Adjust horizontal to vertical projection cones for proper air diffusion for round diffusers.

3.5 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.

B. Measure air quantities at air inlets and outlets.

C Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

D. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

M. HRV Adjustment: Perform in the following sequence.

1. Achieve the design flow rates for all outlets.

3.7 SCOPE

A. Test, adjust, and balance the following:

1. HRV units
2. Air Inlets and Outlets

3.8 MINIMUM DATA TO BE REPORTED

A. Electric Motors:

1. Manufacturer
2. Model/Frame
3. HP/BHP
4. Phase, voltage, amperage; nameplate, actual, no load
5. RPM
6. Service factor
7. Starter size, rating, heater elements
8. Sheave Make/Size/Bore

B. Air Moving Equipment:

1. Location
2. Manufacturer
3. Model number
4. Serial number
5. Arrangement/Class/Discharge
6. Air flow, specified and actual
7. Return air flow, specified and actual
8. Outside air flow, specified and actual
9. Total static pressure (total external), specified and actual
10. Inlet pressure
11. Discharge pressure
12. Sheave Make/Size/Bore
13. Number of Belts/Make/Size
14. Fan RPM

C. Return Air/Outside Air:

1. Identification/location
2. Design air flow
3. Actual air flow
4. Design return air flow
5. Actual return air flow
6. Design outside air flow
7. Actual outside air flow
8. Return air temperature

9. Outside air temperature
10. Required mixed air temperature
11. Actual mixed air temperature
12. Design outside/return air ratio
13. Actual outside/return air ratio

K. Air Distribution Tests:

1. Air terminal number
2. Room number/location
3. Terminal type
4. Terminal size
5. Area factor
6. Design velocity
7. Design air flow
8. Test (final) velocity
9. Test (final) air flow
10. Percent of design air flow

END OF SECTION 23 0593

SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Duct insulation.

1.2 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2010.

B. ASTM C553 - Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2008.

C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2010.

D. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 1985 (Reapproved 2007).

E. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts; 2011.

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2010b.

G. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2010.

H. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.

I. SMACNA (DCS) - HVAC Duct Construction Standards - Metal and Flexible; Sheet Metal and Air Conditioning Contractors' National Association; 2005.

J. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.3 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable

workmanship and that installation standards will be achieved.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section, with minimum 3 years of experience and approved by manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.6 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 - PRODUCTS

2.1 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.

2.2 GLASS FIBER, FLEXIBLE

A. Manufacturer:

1. Knauf Insulation.
2. Johns Manville Corporation.
3. Owens Corning Corp.
4. CertainTeed Corporation.

B. Insulation: ASTM C553; flexible, noncombustible blanket.

1. 'K' value: 0.36 at 75 degrees F, when tested in accordance with ASTM C518.
2. Maximum Service Temperature: 1200 degrees F.

3. Maximum Water Vapor Sorption: 5.0 percent by weight.

C. Vapor Barrier Jacket:

1. Kraft paper with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
3. Secure with pressure sensitive tape.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that ducts have been tested before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Insulated ducts conveying air below ambient temperature:

1. Provide insulation with vapor barrier jackets.
2. Finish with tape and vapor barrier jacket.
3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

D. Insulated ducts conveying air above ambient temperature:

1. Provide with or without standard vapor barrier jacket.
2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

E. Do not insulate ductwork exposed in finished spaces.

3.3 SCHEDULES

A. Duct System Insulation: Supply air ducts located downstream of booster coils: Mineral Fiber Blanket Insulation 1-1/2 inches thick.

END OF SECTION 23 0713

SECTION 230926 - BUILDING AUTOMATION SYSTEM AND AUTOMATIC CONTROLS

PART 1 - GENERAL

1.1 OVERVIEW

A. Furnish all labor materials, equipment, and service necessary for a renovation and replacement of the HVAC control system for the Douglas Island Building Renovation. Work includes a relocation of room thermostats in Project Area. All building controllers, application controllers, and all input/output devices shall communicate using the protocols and network standards as defined by ANSI/ASHRAE Standard 135-2008, BACNet.

1.2 QUALITY ASSURANCE

A. The control Subcontractor shall maintain an office in Juneau or Anchorage with repair parts and maintenance personnel to ensure prompt response to an emergency call during the warranty period. The contractor shall maintain a complete sales, engineering, installation, and service organization.

B. All WORK described in this section shall be installed, wired, circuit tested and calibrated by factory trained electricians and mechanics qualified for this WORK. The installing office shall have a minimum of five years of installation experience with the manufacturer and shall provide documentation in submittal package verifying that installation experience. Installation shall not be subcontracted. Supervision, calibration and checkout of the system shall be by personnel with documented experience with specified manufacturer.

C. All materials and equipment used shall be standard components, of regular manufacture for this application. All systems and components shall have been thoroughly tested and proven in actual use.

D. The automatic control system shall be installed by trained, qualified personnel and commissioned by factory-trained technicians.

E. Perform work in accordance with NFPA 70.

F. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.3 SYSTEM DESCRIPTION

A. Scope of WORK:

1. This specification describes the primary products and performance of the automatic control system.
2. All control equipment abandoned or no longer required due to this renovation shall be

removed.

3. All wiring serving new or replaced control systems shall be new. Do not reuse existing control wiring. All existing control wiring shall be removed.
4. Provide as-built documentation, operator's terminal software, diagrams, and all other associated project operational documentation including technical manuals, on approved media, the sum total of which accurately represents the final system.

1.4 COORDINATION

A. Equipment: Control Subcontractor shall supply control equipment for installation by equipment suppliers and mechanical Subcontractor where required. This includes all control equipment installed in piping systems such as thermostat wells and automatic valves. Control Subcontractor shall also coordinate locations of control equipment, including, but not limited to, thermostats, and valve actuators, thermostat bulbs and averaging elements.

1.5 ACCEPTABLE MANUFACTURERS

A. Siemens for Standardization.

1.6 SUBMITTALS

A. Submittal of the entire control system design shall be provided. Submittal shall consist of shop drawings, a complete list of equipment and materials, manufacturer's catalog data sheets, and installation instructions. Terminal identification for all control wiring shall be shown on the shop drawings. Prior to installing the automatic control systems, submit the following for review and approval:

B. Shop Drawings: Not required.

C. Product data/specification sheets for control system components and field devices. Not required.

D. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.

1.7 OPERATION AND MAINTENANCE MANUALS

A. Operation and maintenance manuals shall be submitted for review and approved before the final inspection and Owner training. Not required.

1.8 WARRANTY

A. A warranty period of one year shall commence upon acceptance of the systems by the OWNER. The warranty shall consist of providing parts and labor as required to repair or replace parts of

the control system that prove to be faulty due to defective materials or improper installation practices or troubleshooting control sequences that are not operating as specified. Included is reprogramming of the system software to include changes in the point descriptions as requested by the Owner. This warranty excludes normal routine maintenance.

1.9 ACCEPTANCE TESTING

A. Point Verification:

1. All control points shall be tested and included in point-to-point testing report provided to Engineer prior to inspection. To verify end-to-end operation of the system, the Subcontractor shall provide a hard copy of an All Points Summary Listing to the Owner of each part or system and verify that each point has been successfully tested. Successful testing report must be received prior to being placed in warranty by the Owner. For CHS systems, the Subcontractor shall additionally provide a print screen of the process display showing real time dynamic point information for all points on the subsystem(s) to be accepted.

1.11 TRAINING

A. After substantial completion and prior to final completion of the installation, operating personnel of the Maintenance shall be instructed on site in the sequence of operation and maintenance of the system hardware and software by the Subcontractor's qualified representative.

B. Subcontractor is to provide minimum of 7 days notice to the Maintenance Director prior to training and warranty visits.

C. Provide application engineer to instruct owner in operation of systems and equipment.

PART 2 - PRODUCTS

2.1 BUILDING AUTOMATION SYSTEM (BAS) COMMUNICATIONS

A. Work includes relocation of existing room thermostats. Utlize equipment and methods that are standard for State of Alaska Buildings

2.2 WIRING

A. Includes all control wiring to complete the system and provide control arrangements specified or shown on the drawings. Power or interlock wiring shall be run in separate conduits from sensor and communications wiring.

1. Low-voltage Control Wiring (12-24v): Protected in exposed locations including, but not

limited to, mechanical rooms and storage rooms. Plenum rated cable installed in ceiling plenums above accessible ceilings only. Motor disconnect switch shall also disconnect control circuit. Indicating lights wired from the motor terminals or from the last controlling device to the motor to show actual operation. All low voltage control wiring 18 AWG minimum.

2. 110-volt and larger Control Wiring: 12 AWG minimum if directly operating a motor, and 14 AWG minimum if controlling relays and holding coils.

2.3 FIRE STOP SYSTEMS

A. Manufacturers

1. Hilti
2. Dow Corning
3. Fyre Putty

B. General purpose Vibration Resistant Fire Stopping Sealant: Silicone based, non-slumping premixed sealant with intumescent properties, vibration and moisture resistant, rated for 3 hours per ASTM E814 and UL 1479.

C. Fire rated Stuffing: Non-combustible mineral wool insulation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify conditions before starting work.

B. Verify that systems are ready to receive work.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Check and verify location of thermostats with plans and room details before installation. Locate 48 inches centerline above floor. Align with lighting switches.

3.3 WIRING AND RACEWAYS

A. General:

1. Provide wiring, conduits and raceway complying with the National Electrical Code, Division 26, 27, 28, State and Local Codes and Ordinances.
2. Unenclosed low voltage wiring shall be plenum rated cabling type and shall be acceptable for installation only above accessible suspended ceilings. All other

wiring/cabling shall be installed in conduit.

3. Remove all existing controls.
4. All thermostats/sensors shall be installed at 46-inch height centerline.
5. Use EMT, metal duct, IMC, rigid conduit, surface metal raceways, or totally enclosed metal through with flexible metal tubing as required by Division 16. Paint all exposed conduit in occupied areas two coats of enamel paint selected by ARCHITECT.
6. Provide wire with copper stranded conductors. Provide color or number coded jackets.
7. Provide 20 gauge minimum foil-shielded cable rated 100 VDC at 80 C. for input/output wiring.
8. Provide communications network wiring meeting the gauge, impedance, capacitance, resistance and shielding requirements specified by the manufacturer of the connected devices.
9. Install wiring in a neat an orderly manner generally running piping and wiring along building lines.
10. Seal conduit penetrations at rated walls with fire-stopping installed in accordance with fire-stopping manufacturers UL listed installation requirements.
11. Wire all electrical controls and switches furnished under this section of the Specifications.
12. Support and conceal wiring in finished areas.

3.4 COORDINATION

A. Coordinate this WORK with the WORK of other trades, and make arrangements for the complete and proper accomplishment of all related WORK. Coordinate required control interlocks with HVAC manufacturers or local representatives as necessary.

3.5 TESTING AND ADJUSTING

A. Upon completion of the control installation, start up the system, perform necessary testing, and adjust the system to ensure proper operation.

3.6 WARRANTY ACCESS

A. The Owner shall grant to the Subcontractor, reasonable access to the BAS system during the warranty period. The owner shall provide, at no cost to the Subcontractor, a dedicated voice grade telephone extension for remote telecommunications during this period.

3.7 SEQUENCE OF OPERATIONS

A. FINNED PIPE CONTROL (FP): Existing control, verify sequence. Respective room thermostat, set at an adjustable 68°F to open finned pipe or convector automatic valves to supply heat to individual rooms as needed. Normally open automatic valves open on failure of control power. Local Control is NOT acceptable. Thermostat sensor value displayed on floor plan graphic with Alarm sent to BAS when temperature drops below adjustable 50F.
   1. Night Setback: During Unoccupied schedule heating units room set point to change to an

adjustable 62F.

END OF SECTION 23 0926

SECTION 233100 - HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Metal ductwork.

1.2 RELATED REQUIREMENTS

A. Section 07 9200 – Joint Sealants: Firestopping.

B. Section 09 9123 – Interior Paint: Weld priming, weather resistant, paint or coating.

C. Section 23 0713 - Duct Insulation: External insulation.

D. Section 23 3300 - Air Duct Accessories.

E. Section 23 3700 - Air Outlets and Inlets.

F. Section 23 0593 - Testing, Adjusting, and Balancing for HVAC.

1.3 REFERENCE STANDARDS

A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; 2009.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2008.

C. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and General Applications; 2011a.

D. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip; 2011a.

E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2010.

F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength, Low Alloy, and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2011.

G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low Alloy, High-Strength Low-Alloy With Improved Formability, and Ultra-High Strength; 2010.

H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2010b.

I. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association; 2009.

J. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems; National Fire Protection Association; 2009.

K. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; National Fire Protection Association; 2011.

L. SMACNA (DCS) - HVAC Duct Construction Standards - Metal and Flexible; Sheet Metal and Air Conditioning Contractors' National Association; 2005.

M. SMACNA (KVS) - Kitchen Ventilation Systems and Food Service Equipment Fabrication & Installation Guidelines; 2001.

N. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data for duct materials.

C. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of documented experience.

1.6 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A standards.

1.7 FIELD CONDITIONS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 - PRODUCTS

2.1 DUCT ASSEMBLIES

A. All Ducts: Galvanized steel, minimum 24 gage, unless otherwise indicated.

B. HRV Supply: 2 inch w.g. pressure class, galvanized steel.

C. General Exhaust: 2 inch w.g. pressure class, galvanized steel.

2.2 MATERIALS

A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.

B. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.

1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
2. Surface Burning Characteristics: Flame spread of zero, smoke developed of zero, when tested in accordance with ASTM E84.
3. For Use With Flexible Ducts: UL labeled.

C. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.3 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

B. No variation of duct configuration or size permitted except by written permission. Size round duct installed in place of rectangular ducts in accordance with ASHRAE Handbook - Fundamentals.

C. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

D. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes of perforated metal with glass fiber insulation.

E. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.

F. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

G. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

H. Fittings shall be spot welded two gages heavier than indicated in SMACNA Standard. Prime coat welded joints. All round ductwork shall be spiral type. Utilize manufactured duct fittings for all branch take-offs unless indicated otherwise.

I. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

J. Provide standard 45-degree lateral wye takeoffs unless otherwise indicated where 90-degree conical tee connections may be used.

K. Pleated 90 degree round elbows may be used only on duct 8-inch diameter and under. Use segmented 5 piece elbows on 90 degree elbows 10 inches and over. 90 degree adjustable elbows are not acceptable unless approved on a case by case basis by the ARCHITECT.

L. Flanged closures must be SMACNA "J" rated with minimum 1-3/8 inch flange. Flange shall be gasketed. Corners bolted. Metal cleat for application around perimeter of transverse joint.

M. Transverse joints: Ductmate proprietary duct connections will be accepted. Ductwork constructed using these systems will refer to manufacturers guidelines for sheet gage, intermediate reinforcement size and spacing, and joint reinforcement. TDF shall be constructed in accordance with SMACNA – HVAC Duct Construction Standards Manuals T-24 flange. Basis for evaluating a substitution shall be Ductmate Joining System, all steel construction. Ductmate system shall utilize minimum 20 gage steel companion angles, 12 gage steel corner pieces, and an integral polymer mastic seal. Acceptable joining systems: Ductmate 35, Nexus, Accuduct, or TDF. TDC is not acceptable.

N. Longitudinal seams and fitting: Pittsburgh lock or snap lock shall be used on all longitudinal seams. Use Pittsburgh only on fittings, snap lock is not acceptable.

2.4 INSULATED FLEXIBLE DUCTS

A. Manufacturers:

1. Thermaflex
2. Thermoid
3. Wiremold

A. Two ply vinyl film supported by helical wound spring steel wire; fiberglass insulation; polyethylene vapor barrier film.

1. Pressure Rating: 10 inches wg positive and 1.0 inches wg negative.
2. Maximum Velocity: 4000 fpm.
3. Temperature Range: -10 degrees F to 160 degrees F.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify sizes of equipment connections before fabricating transitions.

3.2 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. Install in accordance with manufacturer's instructions.

D. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system. Check daily or more frequently that sealing of ducts is intact.

E. Flexible Ducts: Connect to metal ducts with draw bands.

F. Duct sizes indicated are inside clear dimensions.

G. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

I. Connect flexible ducts to metal ducts with adhesive and draw bands.

M. Duct Sealing:

1. Seal all longitudinal and latitudinal joints of metal ducts with two coats of sealant. Apply sealant in accordance with manufacturer’s recommendations. Apply second coat of sealant after first coat has completely cured. Inspect seams with ductwork pressurized and reapply as required for an airtight application.

N. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system. Check daily or more frequently that sealing of ducts is intact.

3.3 CLEANING

A. If supply, exhaust, or return air ductwork is found to be dirty during construction due to inadequately capped/sealed ductwork or operating fans without filters, the CONTRACTOR shall clean all affected duct systems with high power vacuum machines to the satisfaction of the ARCHITECTProtect equipment that may be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes. All construction debris is to be removed by CONTRACTOR prior to cleaning.

END OF SECTION 23 3100

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Volume Control Dampers.

1.2 RELATED REQUIREMENTS

A. Section 07 9200 – Joint Sealants: Firestopping.

B. Section 09 9123 – Interior Paint: Weld priming, weather resistant, paint or coating.

C. Section 23 0713 - Duct Insulation: External insulation.

1.3 REFERENCE STANDARDS

A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association; 2009.

B. NFPA 92A - Standard for Smoke-Control Systems Utilizing Barriers and Pressure Differences; 2009.

C. SMACNA (DCS) - HVAC Duct Construction Standards - Metal and Flexible; Sheet Metal and Air Conditioning Contractors' National Association; 2005.

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide for shop fabricated assemblies including volume control dampers.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect dampers from damage to operating linkages and blades.

PART 2 - PRODUCTS

2.1 VOLUME CONTROL DAMPERS

A. Manufacturers:

1. Ventlock
2. Nailor Industries Inc
3. Ruskin Company
4. Durodyne
5. Rossi, www.rossihardware.com

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. For stainless steel duct manual dampers constructed of stainless steel material and rods painted two coats of rust preventive paint or constructed of stainless steel material.

C. Single Blade Dampers: Fabricate for duct sizes up to 6 x 30 inch.

1. Fabricate for duct sizes up to 6 x 30 inch.
2. Blade: 24 gage, minimum.

D. End Bearings: Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings. Provide closed end bearings on all ducts having a pressure classification over 2 inches wg; Ventlock Model 607 or 609. Similar Durodyne or Young

E. Regulators:

1. Provide self-locking, indicating regulators with heavy steel stamped handle on single and multi-blade dampers.
2. On insulated ducts mount regulators on standoff mounting brackets, bases, or adapters.
3. Where rod lengths exceed 30 inches provide regulator at both ends.
4. Ventlock Model 641. Similar Durodyne or Young.
5. For concealed damper locations use concealed damper regulator type for installation in ceilings. Ventlock Model 666. Similar Durodyne or Young.
6. Regulators with wing nuts are not acceptable.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

B. Verify ducts and equipment installations are ready for accessories.

3.2 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 3100 for duct construction and pressure class.

B. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.

C. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION 23 3300

SECTION 233700 - AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Diffusers.

B. Registers/grilles.

1.2 RELATED REQUIREMENTS

A. Section 09 9000 - Painting and Coating: Painting of ducts visible behind outlets and inlets.

1.3 REFERENCE STANDARDS

A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; Air Movement and Control Association International, Inc.; 2007.

B. ASHRAE Std 70 - Method of Testing for Rating the Performance of Air Outlets and Inlets; American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.; 2006.

C. SMACNA (DCS) - HVAC Duct Construction Standards - Metal and Flexible; Sheet Metal and Air Conditioning Contractors' National Association; 2005.

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

C. Project Record Documents: Record actual locations of air outlets and inlets.

1.5 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.

B. Test and rate louver performance in accordance with AMCA 500-L.

C. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

PART 2 - PRODUCTS

2.1 CEILING SUPPLY DIFFUSERS (SG-1)

A. Manufacturers:

1. Titus TDCA-AA
2. Krueger
3. Price

B. Type: Square 24x24 inch module size for lay-in type. Louver size as shown on plans. Round neck with size as shown on drawings.

C. Diffusers: Movable vanes, accessible from face to adjust discharge from horizontal to vertical. Core for discharge pattern of four-way corner blow. Diffusers are four-way blow unless otherwise shown on schedule.

D. Frame: 24"x24" Lay-in type border for all T-bar ceilings. Coordinate with ceiling plans for border type.

E. Fabrication: Aluminum with white baked enamel finish.

2.2 EXHAUST GRILLES (EG-1)

A. Manufacturers:

1. Titus PAR
2. Krueger
3. Carnes
4. Price

B. Type: Square 24x24 inch diffuser for use in lay-in ceilings. Perforated face of 3/16 inch holes. Neck size as shown on drawings.

C. Frame: Lay-in type border.

D. Fabrication: Aluminum with white baked enamel finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify inlet/outlet locations.

B. Verify ceiling and wall systems are ready for installation.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.

C. Install diffusers to ductwork with air tight connection.

D. Provide balancing dampers on branch duct to diffusers and grilles whether shown or not.

E. Paint ductwork visible behind air outlets and inlets matte black. Refer to Section 09 9123.

F. Modify ceiling and ceiling lay-in panels as required for diffuser installation.

END OF SECTION 233700

SECTION 23 8129 - VARIABLE REFRIGERANT VOLUME (VRV) HVAC SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Variable refrigerant volume HVAC system includes:
   1. Outdoor/condensing unit(s).
   2. Indoor/evaporator units.
   3. Branch selector units (if required).
   4. Refrigerant piping.
   5. Control panels.
   6. Control wiring.
   7. Design drawings, calculations, and submittal data.

1.2 RELATED REQUIREMENTS

A. Section 26 2717 - Equipment Wiring: Power connections to equipment.

B. Section 23 8130 - Basis of Design VRV Equipment.

1.3 REFERENCE STANDARDS

A. AHRI 210/240 - Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; Air-Conditioning, Heating, and Refrigeration Institute; 2008, Including All Addenda.

B. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; 2013.

C. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; 2013, Including All Amendments and Errata (ANSI/ASHRAE/IES Std 90.1).

D. ITS (DIR) - Directory of Listed Products; current edition.

E. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 1995 - Heating and Cooling Equipment; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Pre-Bid Submittals: For proposed substitute systems/products, as defined in PART 2, and alternate systems/products, as defined above, proposer shall submit all data described in this article, under the terms given for substitutions stated in PART 2 and/or the best equivalent system equipment/products.

C. Product Data: Submit manufacturer's standard data sheets showing the following for each item of equipment, marked to correlate to equipment item markings shown in the contract documents:
   1. Outdoor/Central Units:
      a. Refrigerant Type and Size of Charge.
      b. Cooling Capacity: Btu/h.
      c. Heating Capacity: Btu/h.
      d. Cooling Input Power: Btu/h.
      e. Heating Input Power: Btu/h.
      f. Operating Temperature Range, Cooling and Heating.
      g. Air Flow: Cubic feet per minute.

h. Fan Curves.
i. External Static Pressure (ESP): Inches WG.
j. Sound Pressure Level: dB(A).
k. Electrical Data:
1) Maximum Circuit Amps (MCA).
2) Maximum Fuse Amps (MFA).
3) Maximum Starting Current (MSC).
4) Full Load Amps (FLA).
5) Total Over Current Amps (TOCA).
6) Fan Motor: HP.
l. Weight and Dimensions.
m. Maximum number of indoor units that can be served.
n. Maximum refrigerant piping run from outdoor/condenser unit to indoor/evaporator unit.
o. Maximum height difference between outdoor/condenser unit to indoor/evaporator unit, both above and below.
p. Control Options.

2. Indoor/Evaporator Units:
a. Cooling Capacity: Btu/h.
b. Heating Capacity: Btu/h.
c. Cooling Input Power: Btu/h.
d. Heating Input Power: Btu/h.
e. Air Flow: Cubic feet per minute.
f. Fan Curves.
g. External Static Pressure (ESP): Inches WG.
h. Sound Pressure level: dB(A).
i. Electrical Data:
1) Maximum Circuit Amps (MCA).
2) Maximum Fuse Amps (MFA).
3) Maximum Starting Current (MSC).
4) Full Load Amps (FLA).
5) Total Over Current Amps (TOCA).
6) Fan Motor: HP.
j. Maximum Lift of Built-in Condensate Pump.
k. Weight and Dimensions.
l. Control Options.

3. Control Panels: Complete description of options, control points, zones/groups.

D. Shop Drawings: Installation drawings custom-made for this project; include as-designed HVAC layouts, locations of equipment items, refrigerant piping sizes and locations, condensate piping sizes and locations, remote sensing devices, control components, electrical connections, control wiring connections. Include:
1. Detailed piping diagrams, with branch balancing devices.
2. Condensate piping routing, size, and pump connections.
3. Detailed power wiring diagrams.
4. Detailed control wiring diagrams.
5. Locations of required access through fixed construction.
6. Drawings required by manufacturer.
7. In addition to paper copies, submit shop drawings as CAD files in DXF format.
8. Architect will furnish CAD files for use in preparing shop drawings.

E. Design Data:
   1. Provide design calculations showing that system will achieve performance specified.
   2. Provide design data required by ASHRAE Std 90.1 I-P.
   3. Provide design drawings for the air-conditioning system similar to the drawings provided in bid documents. Drawings shall show all ductwork, piping, electrical, and control features suitable for review, construction, and as-built purposes.

F. Operating and Maintenance Data:
   1. Manufacturer's complete standard instructions for each unit of equipment and control panel.
   2. Custom-prepared system operation, troubleshooting, and maintenance instructions and recommendations.
   3. Identification of replaceable parts and local source of supply.

G. Warranty: Executed warranty, made out in Owner's name.

H. Project Record Documents: Record the following:
   1. As-installed routing of refrigerant piping and condensate piping.
   2. Locations of access panels.
   3. Locations of control panels.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. Company that has been manufacturing variable refrigerant volume heat pump equipment for at least 5 years.

B. Installer Qualifications: Trained and approved by manufacturer of equipment.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, and handle equipment and refrigerant piping according to manufacturer's recommendations.

1.7 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Compressors: Provide manufacturer's warranty for six (6) years from date of installation. During the stated period, should any part fail due to defects in material and workmanship, it shall be repaired or replaced at the discretion of Daikin AC (Americas), Inc. according to Daikin's terms and conditions. All warranty service work shall be preformed by a Daikin factory trained service professional.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: The system design shown in the contract documents is based on equipment and system designed by Daikin AC; www.daikinac.com.

B. Systems designed and manufactured by other manufacturers will be considered by Owner under the terms described for substitutions with the following exceptions:
   1. Substitution requests will be considered only if received at least 10 days prior to the bid date.
   2. Substitution requests will be considered only if required submittal data is complete; see article SUBMITTALS above.
   3. Contractor (not equipment supplier) shall certify that the use of the substitute system and equipment will not require changes to other work or re-design by Architect.

4. Do not assume substitution has been accepted until formal written notice has been issued by Architect.

2.2 HVAC SYSTEM DESIGN

A. System Operation: Cooling and heating.
   1. Provide a complete functional system that achieves the specified performance based on the specified design conditions and that is designed and constructed according to the equipment manufacturer's requirements.
   2. Conditioned spaces are shown on the drawings.
   3. Outdoor/Condenser unit locations are shown on the drawings.
   4. Indoor/Evaporator unit locations are shown on the drawings.
   5. Required equipment unit capacities are shown on the drawings.
   6. Refrigerant piping sizes are not shown on the drawings.
   7. Connect equipment to condensate piping provided by others; condensate piping is shown on the drawings.
   8. Initial Equipment Sizing:

B. Cooling Mode Interior Performance:
   1. Daytime Setpoint: 74 degrees F, plus or minus 2 degrees F.
   2. Setpoint Range: 60 degrees F to 80 degrees F.
   3. Night Setback: 78 degrees F.
   4. Interior Relative Humidity: 20 percent, maximum.

C. Heating Mode Interior Performance:
   1. Daytime Setpoint: 68 degrees F, plus or minus 2 degrees F.
   2. Setpoint Range: 57 degrees F to 77 degrees F.
   3. Night Setback: 78 degrees F.
   4. Interior Relative Humidity: 20 percent, maximum.

D. Outside Air Design Conditions:
   1. Summer Outside Air Design Temperature: 0.4 percent cooling design condition listed in ASHRAE Fundamentals Handbook - ASHRAE (FUND).
   2. Winter Outside Air Design Temperature: 99.6 percent heating design condition listed in ASHRAE Fundamentals Handbook - ASHRAE (FUND).

E. Energy Design Wind Speed: 25 mph.

F. Operating Temperature Ranges:
   1. Cooling Mode Operating Range: 23 degrees F to 122 degrees F dry bulb.
   2. Heating Mode Operating Range: -4 degrees F to 60 degrees F dry bulb; minus 4 degrees F to 60 degrees F wet bulb; without low ambient controls or auxiliary heat source.

G. Refrigerant Piping Lengths: Provide equipment capable of serving system with following piping lengths without any oil traps:
   1. Minimum Piping Length from Outdoor/Central Unit(s) to Furthest Terminal Unit: 984 feet, equivalent.

H. Controls: Provide the following control interfaces:
   1. One central remote control panel for entire system; locate where accessible.
   2. Wireless room thermostats for zone control.
   3. BACNet gateways compatibility for future DDC connection.

2.3 EQUIPMENT

A. All Units: Factory assembled, wired, and piped and factory tested for function and safety.
   1. Performance Certification: AHRI Certified; www.ahrinet.org.

2. Safety Certification: Tested to UL 1995 by UL or Intertek-ETL, listed in ITS (DIR), and bearing the certification label.
3. Provide outdoor/condensing units capable of serving indoor unit capacity up to 200 percent of the capacity of the outdoor/condensing unit.
4. Provide units capable of serving the zones indicated.
5. Thermal Performance: Provide heating and cooling capacity as indicated, based on the following nominal operating conditions:
   a. Cooling: Indoor air temperature of 80 degrees F dry bulb, 67 degrees F wet bulb; outdoor air temperature of 95 degrees F dry bulb; and 25 feet.
6. Outdoor Units: Units and their supports designed and installed to resist wind pressures defined in ASCE 7.

B. Electrical Characteristics:
1. Power - Condensing Units: 208 to 230 Volts, 3-phase, 60 Hz.
2. Power - Indoor Units: 208 to 230 Volts, single phase, 60 Hz.
3. 208-230 Voltage Range: 187 to 253 volts.
4. Control: 16 volts DC.

C. System Controls:
1. Include self diagnostic, auto-check functions to detect malfunctions and display the type and location.

D. Unit Controls: As required to perform input functions necessary to operate system; provided by manufacturer of units.
1. Provide interfaces to remote control and building automation systems as specified.

E. Wiring:
1. Control Wiring: 18 AWG, 2-conductor, non-shielded, non-polarized, stranded cable.

F. Refrigerant Piping:
1. Refrigerant Flow Balancing: Provide refrigerant piping joints and headers specifically designed to ensure proper refrigerant balance and flow for optimum system capacity and performance; T-style joints are prohibited.
2. Insulate each refrigerant line individually between the condensing and indoor units.

2.4 OUTDOOR/CONDENSING UNITS

A. Outdoor/Condensing Units: Air-cooled DX refrigeration units, designed specifically for use with indoor/evaporator units; factory assembled and wired with all necessary electronic and refrigerant controls; modular design for ganging multiple units.
1. Refrigeration Circuit: Scroll compressors, motors, fans, condenser coil, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports and refrigerant regulator.
2. Refrigerant: Factory charged.
3. Variable Volume Control: Modulate compressor capacity automatically to maintain constant suction and condensing pressures while varying refrigerant volume to suit heating/cooling loads.
4. Capable of being installed with wiring and piping to the left, right, rear or bottom.
5. Capable of heating operation at low end of operating range as specified, without additional low ambient controls or auxiliary heat source; during heating operation, reverse cycle (cooling mode) oil return or defrost is not permitted, due to potential reduction in space temperature.
6. Sound Pressure Level: As specified, measured at 3 feet from front of unit; provide night setback sound control as a standard feature; three selectable sound level steps of 55 dB, 50 dB, and 45 dB, maximum.

7. Power Failure Mode: Automatically restart operation after power failure without loss of programmed settings.
8. Safety Devices: High pressure sensor and switch, low pressure sensor/switch, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers.
9. Provide refrigerant sub-cooling to ensure the liquid refrigerant does not flash when supplying to us indoor units.
10. Oil Recovery Cycle: Automatic, occurring 2 hours after start of operation and then every 8 hours of operation; maintain continuous heating during oil return operation.
11. Controls: Provide contacts for electrical demand shedding.
12. Product:
    a. Daikin RXTQ Series.

B. Unit Cabinet: Weatherproof and corrosion resistant; rust-proofed mild steel panels coated with baked enamel finish.
1. Designed to allow side-by-side installation with minimum spacing.

C. Fans: One or more direct-drive propeller type, vertical discharge, with multiple speed operation via DC (digitally commutating) inverter.
1. External Static Pressure: Factory set at 0.12 in WG, minimum.
2. Fan Motors: Factory installed; permanently lubricated bearings; inherent protection; fan guard; output as indicated for specific equipment.

D. Condenser Coils: Copper tubes expanded into aluminum fins to form mechanical bond; waffle louver fin and rifled bore tube design to ensure high efficiency performance.

E. Compressors: Scroll type, hermetically sealed, variable speed inverter-driven and fixed speed in combination to suit total capacity; minimum of one variable speed, inverter driven compressor per condenser unit; minimum of two compressors per condenser unit; capable of controlling capacity within range of 6 percent to 100 percent of total capacity.
1. Provide each compressor with crankcase heater, high pressure safety switch, and internal thermal overload protector.
2. Provide oil separators and intelligent oil management system.
3. Provide spring mounted vibration isolators.

2.5 INDOOR/EVAPORATOR UNITS

A. All Indoor/Evaporator Units: Factory assembled and tested DX fan-coil units, with electronic proportional expansion valve, control circuit board, factory wiring and piping, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.
1. Refrigerant: Refrigerant circuits factory-charged with dehydrated air, for field charging.
2. Temperature Control Mechanism: Return air thermistor and computerized Proportional-Integral-Derivative (PID) control of superheat.
3. Coils: Direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond; waffle louver fin and high heat exchange, rifled bore tube design; factory tested.
    a. Provide thermistor on liquid and gas lines.
4. Fans: Direct-drive, with statically and dynamically balanced impellers; high and low speeds unless otherwise indicated; motor thermally protected.
5. Return Air Filter: Washable long-life net filter with mildew proof resin, unless otherwise indicated.
6. Condensate Drainage: Built-in condensate drain pan with PVC drain connection.

a. Units With Built-In Condensate Pumps: Provide condensate safety shutoff and alarm.
b. Units Without Built-In Condensate Pump: Provide built-in condensate float switch and wiring connections.

7. Cabinet Insulation: Sound absorbing foamed polystyrene and polyethylene insulation.

B. Concealed-In-Ceiling Units: Ducted horizontal discharge and return; galvanized steel cabinet.
1. Return Air Filter: Manufacturer's standard.
2. Sound Pressure: Measured at low speed at 5 feet below unit.
3. Provide external static pressure switch adjustable for high efficiency filter operation
4. Condensate Pump: Built-in, with lift of 9 inches, minimum.
5. Switch box accessible from side or bottom.
6. Product(s):
a. Daikin FXMQ_P Series; three-speed direct-drive DC (ECM) type fan with automatic airflow adjustment; external static pressure selectable during commissioning.

C. Manufactured Duct Zone Box for In-Ceiling Indoor Unit: Multiple individually controlled duct zones for connection to indoor fan coil. Integral dampers and actuators. Manual setting for maximum and minimum flow for each damper. Provide spare actuator for each ducted unit.
1. Product(s):
a. Daikin DZK030E Series Zoning Box.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that required electrical services have been installed and are in the proper locations prior to starting installation.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install refrigerant piping in accordance with equipment manufacturer's instructions.

C. Perform wiring in accordance with NFPA 70, National Electric Code (NEC).

D. Coordinate with installers of systems and equipment connecting to this system.

3.3 SYSTEM STARTUP

A. Prepare and start equipment and system in accordance with manufacturer's instructions and recommendations.

B. Adjust equipment for proper operation within manufacturer's published tolerances.

3.4 CLOSEOUT ACTIVITIES

A. Demonstrate proper operation of equipment to Owner's designated representative.

END OF SECTION – 23 8129

H. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2010.

I. ASTM A135/A135M - Standard Specification for Electric-Resistance Welded Steel Pipe; 2009.

J. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use; 2008.

K. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; American Water Works Association; 2007 (ANSI/AWWA C111/A21.11).

L. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast, for Water; American Water Works Association; 2009 (ANSI/AWWA C151/A21.51).

M. NFPA 13 - Standard for the Installation of Sprinkler Systems; National Fire Protection Association; 2010.

N. UL (FPED) - Fire Protection Equipment Directory; Underwriters Laboratories Inc.; current edition.

O. UL 262 - Gate Valves for Fire-Protection Service; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

P. UL 312 - Check Valves for Fire-Protection Service; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturers catalogue information. Indicate valve data and ratings.

C. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections. See 21 1300 for additional requirements.

D. Project Record Documents: Record actual locations of components and tag numbering.

E. Operation and Maintenance Data: Include installation instructions and spare parts lists.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store valves in shipping containers, with labeling in place.

B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

PART 2 - PRODUCTS

2.1 FIRE PROTECTION SYSTEMS

A. Sprinkler Systems: Conform work to NFPA 13.

B. Welding Materials and Procedures: Conform to ASME Code.

2.2 ABOVE GROUND PIPING

A. Steel Pipe: ASTM A795 Schedule 10 (3-inches and over only) or ASTM A53 Schedule 40, black.

1. Steel Fittings: ASME B16.9, wrought steel, buttwelded.
2. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings and ASME B16.4, threaded fittings.
3. Malleable Iron Fittings: ASME B16.3, threaded fittings.
4. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe. Couplings to fully encircle pipe and not U-bolt type. Similar to Victaulic Style 75 or 77. Rolled groove type. Cut groove not acceptable.
5. Exterior piping and fittings shall be galvanized schedule 40.
6. Piping over 3-inch size may be electrically welded, using backing rings and coated rods.

2.3 PIPE HANGERS AND SUPPORTS

A. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.

B. Hangers for Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.

C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

D. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.

E. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.

F. Vertical Support: Steel riser clamp.

G. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

H. Galvanized: Pipe hangers and supports shall be galvanized where in contact with galvanized piping or installed outside of the building.

I. Accessories: Hanger Rod: Mild steel continuous threads.

2.4 DRAIN VALVES

A. Ball Valve:

1. Brass with cap and chain, 3/4 inch hose thread.
2. Compression Stops: Bronze with hose thread nipple and cap.

PART 3 - EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and foreign material, from inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

A. Install sprinkler system and service main piping, hangers, and supports in accordance with NFPA 13.

B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

C. Install piping to conserve building space, to not interfere with use of space and other work.

D. Group piping whenever practical at common elevations.

E. Sleeve pipes passing through partitions, walls, and floors.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Pipe Hangers and Supports:

1. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
2. Place hangers within 12 inches of each horizontal elbow.

3. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
4. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
6. Prime coat exposed steel hangers and supports. Refer to Section 09 9000. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

H. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.

I. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding. Refer to Section 09 9123.

J. Do not penetrate building structural members unless indicated.

K. Provide sleeves when penetrating footings, floors, and walls. Seal pipe and sleeve penetrations to achieve fire resistance equivalent to fire separation required.

L. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

M. Die cut threaded joints with full cut standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.

N. Provide drain valves at main shut-off valves, low points of piping and apparatus.

O. Coordinate closely with all other Contractors. In general, pitched waste and vent piping and ductwork shall take preference in location within the Project area. Sprinkler piping shall be installed in structural joist space throughout, except where conflicts with ductwork and piping will not occur. Coordinate required beam penetrations with Structural Engineer and Architect. Coordination of all drain valves, and other equipment requiring access and maintenance procedures is required with all building components during construction for maximum accessibility and proper location as intended.

END OF SECTION 210500