	1 2	3	4 5	6
	SECTION 23 05 00 COMMON WORK RESULTS FOR HVAC	B. Electric controls, contactors, starters, pilot lights, push buttons, etc., shall be provided complete as part of the motor, heater or other equipment which it operates. All electrical components shall be in conformance with the	1.10 CORE DRILLING A. Cutting of holes through concrete and masonry shall be by diamond core or	B. All materials utilized for the hanging an be manufactured products, which are sp hanging piping systems. The use of wire
	1.0 GENERAL 1.01 DESCRIPTION	requirements of the National Electrical Code and Division 26. Starters shall be wye-delta, closed transition type. Reference Division 26 and the electrical engineering drawings for those motor starters provided under that Division 26. All starters not shown shall be provided under this Division 23. Unless specified otherwise under other individual equipment Sections, motor starters	concrete saw. Pneumatic hammer, impact electric and hand or manual hammer type drills will not be allowed, except as permitted by the Architect where required by limited working space. Locate holes such that they will not affect structural sections such as ribs or beams. Holes shall be laid out well in advance of the installation. These layout locations shall be approved by the	strictly prohibited. C. Supports and hangers shall be selected unless otherwise specified herein) and p expansion of the piping systems. Ancho
Н	A. This Division 23 and the accompanying drawings cover the provision of all labor, equipment, appliances, and materials and performing all operations in connection with the construction of the air conditioning, ventilating, heating, fire suppression and plumbing systems as specified herein and as shown.	shall conform to the following minimum requirements: 1. Starters for motors 1/3 horsepower or smaller shall be manual unless remote or automatic starting is required, in which case the starters	Architect prior to drilling. 1.11 IDENTIFICATION OF PIPING	control such movement within offsets a D. All hangers and supports shall be selec five based on the ultimate tensile stren
	B. The General Provisions and Division 01, including the general, supplementary and other conditions and other Divisions, as appropriate, apply to work specified in this Division.	 shall be magnetic, full voltage, non-reversing, single-speed, unless otherwise indicated. All other starters shall be magnetic. 2. Each starter for a three-phase motor shall be furnished with three (3) overload relays sized for the full load running current of the motor 	A. All aboveground HVAC piping sized 3/4" and larger which is installed in accessible locations (including piping above removable ceilings and behind access panels) shall be identified in strict conformance with the "Scheme for the Identification of Piping Systems" (ANSI A13.1-2015).	E. Intermediate pipe supports shall be prov members so as not to exceed maximum be structural steel angles (minimum 2
	1.02EXISTING CONDITIONS A. Attention is called to the fact that the work is to be performed within an existing operational facility. Prior to the submission of bids, each bidder shall	actually provided. Provide an external "HAND-OFF-AUTO" selector switch with red "RUNNING" light. Provide a green pilot light to indicate motor "STOPPED". Each pilot light shall have a legend plate indicating	 B. Piping labels in exposed areas shall be oriented and located in coordination with the Architect. 	F. For suspending pipes from concrete beck beam bracket utilizing bolts in sleeves
	visit the project site, thoroughly investigate and be familiar with all existing conditions which will affect their work; especially the work to be performed above the existing ceilings.	 Each overload relay shall have a normally open alarm contact which will close only when actuated by an overload (not to be confused with N.O. or N.C. auviliary contacts). These contacts shall be properly wired 	 C. Specific system names shall be subject to Owner approval. System names shall, at minimum, uniquely identify the system and performance category — i.e. Base Building Condenser Water Supply, Cooling Tower Make—up, etc. D. Each identification marker shall include to the following: 	Where sleeves are not used, provide exp fasteners. G. Hanger rods for pipe hangers shall be a
	B. Connect new work to existing work in a neat and workmanlike manner. Where an existing structure must be cut or existing utilities interfere, such obstructions shall be bypassed, removed, replaced or relocated, patched and repaired. Work disturbed or damaged shall be replaced or repaired to its prior	to their respective blue pilot light provided on the starter front cover and having a "TRIPPED" legend plate. 4. Individually mounted motor starters shall be in a NEMA Type 1 general	 Proper color-coded background Proper color of legend in relation to background color 	1. $3/8$ " hanger rod – 2" nominal pi 2. $1/2$ " hanger rod – 2 $\frac{1}{2}$ " and 3"
G	condition. 1.03INTENT OF DRAWINGS AND SPECIFICATIONS A The implied and stated intent of the drawings and specifications is to	purpose enclosure in unfinished areas and shall be flush mounted in all finished areas. All starters mounted in exterior areas shall have a NEMA 3R enclosure. Each starter shall have a laminated nameplate to indicate equipment unit number, function and circuit number.	3. Proper legend letter size 4. Proper marker length	3. 5/8" hanger rod — 4" and 5" no 4. 3/4" hanger rod — 6" nominal p
	establish minimum acceptable standards for materials, equipment and workmanship, and to provide operable mechanical systems complete in every respect.	5. All motor starters, push buttons and pilot lights shall be of the same Manufacturer as the switchboard and shall be General Electric, Square D, Siemens I.T.E., or Westinghouse.	5. Direction of flow arrows shall be included on each marker E. Locations for pipe markers shall be as follows:	5. 7/8" hanger rod - 8" through 16 H. Pipe hangers selected for supporting ho
	B. The engineering drawings are diagrammatic, intended to show general arrangement and sizes of system components, and shall not be scaled. Rather, the architectural and structural drawings shall govern space constraints, dimensions and finishes. All offsets and fittings which will be	 Motor starters for the following equipment shall be provided under this Division 23 by the Manufacturer of the equipment: 1. Packaged air conditioning equipment 	 Adjacent to each valve and fitting At each branch and riser take off 	1. Hot water supply and return pipi related piping sized 2" and smal
	additional cost or increase in the Contract. 1.04SPACE PRIORITY	2. Water chillers	3. At each pipe passage through walls, floors or ceilings 4. On all straight pipe runs every 25 feet	I. Provide pipe saddles, inserts and shields below:
	A. Ensure optimum use of available space for materials and equipment installed above ceilings. Allocate space in the order of priority as listed below except as otherwise detailed. Items are listed in the order of priority, with items of	D. Unless otherwise noted or specified in individual Sections, all 3-phase motors	 F. Identification markers may be stenciled or shall be Setmark Pipe Markers, as manufactured by Seton Name Plate Corporation. 	 Hot water supply and return pipin condensate return piping over 2" welded to pipe. Insulation shall b
F	equal importance listed under a single priority number. 1. Gravity flow piping systems	shall be standard NEMA continuous duty "B" type, with Class B insulation, open drip—proof frame for indoor service, TEFC for outdoor service and a service factor of 1.15. All motors 5 HP and larger shall be U.S. Motors Hi—Efficiency Model or Reliance XE Hi—Efficiency Model.	number with brass valve tags. Each valve tag shall be 19 gauge brass with 1/4" black-filled letters over 1/2" black-filled numbers. Tags shall be fastened to valves with brass "S" hooks or brass jack chain. Brass tags and fasteners shall be as manufactured by Seton Name Plate Corporation.	2. All other insulated piping shall be inserts and galvanized shields, ex piping sized less than 2". Foamg
	 Vent piping systems Recessed lighting fixtures 	 E. All power wiring and final connections to equipment shall be provided under Division 26. E. Control components all interlocks (VAVs actuators smoke dampers) 	H. Provide charts of all valves. Valve charts shall include the following items:	a. Shields shall be as follows:
	 Concealed HVAC terminals and equipment Air duct systems 	fire/smoke dampers, motor-operated dampers, fire alarm motors, etc.) and control wiring (277 volt, single phase and less) shall be provided under this Division 23 as required to achieve the specified control sequences. All	2. Location	 Pipes 2 and smaller: 18 Pipes 2 1/2" and larger:
	6. Sprinkler piping systems 7. Pressurized piping systems	electrical connections shall be specifically coordinated with Division 26 and any necessary scope included as part of Division 23. G. All control wiring over 30 volts shall be installed by a licensed Electrician	2.0 PRODUCTS	b. Shields and inserts shall be 180 pipe at all pipe hangers, except and floor supported horizontal ground the entire pipe
	8. Electrical conduit, wiring, control air tubing B. Order of space priority does not dictate installation sequence. Installation	working under this Division 23. 1.08 SLEEVES, SEALS AND ESCUTCHEONS	2.01 BID BASIS AND SUBSTITUTION PROCEDURES A. Manufacturer names, series and model numbers, as noted or specified, are	<u>3.0 EXECUTION</u>
E	sequence shall be as required to install all affected trades. C. The work of this Division 23 shall not obstruct access for installation, operation and maintenance of the work of any other Division.	A. Sleeves shall be provided through all pipe and ductwork penetrations of concrete or masonry walls, elevated floors and roofs, except those piping penetrations for equipment, etc.	materials and products to be used. Unless "or equal" is specifically stated, bids shall be based only on the specified "basis of design" Manufacturer. The listing of a particular manufacturer as an "equal" or "acceptable substitute"	3.01 SUBMITTALS A. Before preparing submittals, study all C detail, obtain manufacturer's recommen [,]
	D. All major items of equipment shall be arranged so as to provide a minimum of 28" clear aisle space. Additional space shall be provided between and around equipment for maintenance and proper operation as shown in the Equipment Manufacturer's literature.	B. Sleeves shall be fabricated from Schedule 40 steel pipe through 10" and Standard Wall steel pipe for sleeve sizes 12" and larger. All sleeves penetrating exterior walls, underground walls, pit or vault walls shall be provided with a 3" x 3/8" thick waterstop ring welded completely to the midpoint of the sleeve.	substitution of that Manufacturer's standard product in place of the basis of design. No consideration will be given to a product, which would require dimensional, spatial or aesthetic changes to the project. "Acceptable substitute" and "equal" manufacturers shall only bid those products, which exactly match the size and other characteristics of the specified basis of	prepared based on specific equipment a An officer of the Contracting Firm shall conformance with plans and specificatio or releasing to the field. B. The submittal process shall not be utili
	 1.05 COORDINATION A. Coordinate all work under this Division 23 with work under all other Divisions, providing adjustment as necessary. 	 C. All sleeves penetrating exterior walls, underground walls, pit or vault walls and elevated floors shall be packed and sealed watertight. D. Sleeves through roofs shall extend above the roof surface and be flashed 	design. Any changes to other disciplines and trades of work required by an "or equal" or "substitute" product shall be duly considered and priced accordingly prior to bidding or pricing. The decision as to whether or not a proposed substitute or "equal" product is actually equal to that specified shall	products after the execution of the con unequal product be submitted, it will be substitution is made during the resubmi more reviews of that product will be pe
	 B. Coordination of space requirements with respect to Division 26 shall be performed such that: 1. No equipment piping or ductwork other than electrical shall be 	watertight. E. Sleeves through walls shall be cut and finished flush with each surface of the	 B. Requests to provide "equal" products in lieu of those specified shall be submitted to the Architect in writing at least ten (10) days prior to final 	c. All submittals shall be submitted and re
	 2. No piping or ductwork which ever operates at a temperature in excess of 120°F shall be installed within 3" of any electrical conductor. 	F. Sleeves through floors in mechanical rooms or other back of house spaces shall be installed with the top no less than 1/2" above the finished floor to allow for leak protection. Space between the top of the fire-stopping and top	pricing and execution of the Contract. No consideration will be given to substitute products after final pricing and execution of the Contract. C. Any "or equal" product or proposed product substitution which will cause a	D. Submittals will not be accepted for revi1. Comply with the requirements of
D	C. All items mounted in or below the ceiling, and all items penetrating the ceiling, shall be coordinated with the architectural reflected ceiling plans. If any items are not shown on these plans, or any items need to be relocated for coordination purposes, prepare a reflected ceiling plan and submit it to	of the sleeve shall be packed with mineral wool and caulked to not allow water ponding within the sleeve. G. Sleeves shall be sized to provide a minimum of 1/2" clearance between the inside surface of the sleeve and the outside finished surface of the pipe plus	it structure, electrical system or any other engineered systems shall be accompanied by a scaled drawing and written description of the required change(s) for approval by the Architect. If deemed necessary by the Architect, Owner, or AHJ, design changes shall be signed and sealed by a registered Professional Engineer, currently licensed in this State. This shall be	 Include complete information per- accessories Are submitted as complete pack- in Division 23. Separate package:
	the Architect for approval. D. Variable—Frequency Drives shall be provided under Division 23 and installed by Division 26. See specification 26 29 23 Variable — Frequency Motor Controllers.	any insulation specified. H. Fire—stops shall be provided as specified herein. All annular spaces between piping and sleeves, which do not require fire—stops, shall be packed with mineral wool and caulked.	D. Any and all changes due to a substitution of basis of design equipment including but not limited to electrical connection, physical size, access, duct	a. All HVAC equipment and compo b. The automatic controls and EM
	E. Fused disconnects shall be provided under this Division 23 for all equipment connected directly to bus duct, and rating shall match bus duct rating. Coordinate with Division 26.	I. Provide round, chrome-plated escutcheons on all exposed piping and ductwork penetrations passing through walls, floors, partitions and ceilings. Escutcheons shall be painted and caulked in coordination with Architect. Note that	or piping connections, controls, etc. shall be solely the responsibility of substituting Contractor. 2.02 MINIMUM STANDARDS	 Are properly marked with equipm as related to the project and ar paragraph number Submit catalog information factory ass
	 1.06 CODE COMPLIANCE A. All workmanship and materials provided under this Division 23 shall comply with all laws, ordinances, codes and regulations of all Federal, State and Local 	nove slightly during operation.	A. Every piece of energy consuming equipment, all fire suppression products and life safety equipment shall comply with the following standards as applicable; especially in regard to prevailing codes:	drawings and certifications as required to description of all items of equipment. T unquestionable compliance with the Con
C	Authorities Having Jurisdiction. B. All fire suppression, plumbing, heating, ventilating, and air conditioning materials and workmanship shall comply with the following codes and standards as minimum requirements:	A. Where piping, conduit, etc. pass through fire partitions, fire walls and floors, a firestop shall be provided that will ensure an effective barrier against the spread of fire, smoke and gases. Firestop material shall be packed tight and completely fill gaps between the ductwork, piping, conduit, etc. and the parimeter of their rough openings.	 Factory Mutual Laboratories (FM) Industrial Risk Insurers (IRI) Underwriters Laboratories Inc. (III.) 	F. Review of submittals shall not be const from the plans and specifications unless and separately submitted in the form o submittals.
0	1. NFPA 70, National Electrical Code, 2017 Edition	 B. All penetrations shall be in accordance with UL 1479 or ASTM E 814 listed systems, and products used shall be specifically applicable for the appropriate 	4. ADC: Air Diffusion Council	G. Submittals are required on all manufact consuming equipment. Submittals shall following items of equipment:
	2. Life Safety Code (NFPA 101) — 2015 Edition 3. All other NFPA Codes and Standards — Applicable Editions	Installation conditions. Assemblies shall provide a minimum rating equal to the construction penetrated. Products shall be by HILTI, 3M, or ProSet. C. Installation shall be by a Qualified Installer. Installer shall be certified,	5. AGA: American Gas Association 6. AMCA: Air Moving and Conditioning Association, Inc.	5. Ductwork and Piping Insulation 6. Terminal Units
	4. North Carolina State Building Code — 2018 Edition 5. North Carolina State Energy Code — 2018 Edition	licensed, or otherwise qualified by the Firestopping Manufacturer as having the necessary training to install the Manufacturer's specific product. A Manufacturer or Vendor's willingness to sell the firestopping product to the	7. ANSI: American National Standards Institute 8. API: American Petroleum Institute	7. Split Systems 8. Packaged Roofton Units including
	6. North Carolina State Fire Prevention Code — 2018 Edition 7. North Carolina State Mechanical Code — 2018 Edition	Contractor or Installer does not in itself confer qualification. D. Installer shall have at least one of the following qualifications:	9. AHRI: Air Conditioning, Heating, and Refrigeration Institute 10.ASHRAE: American Society of Heating, Refrigerating and Air	9. Air Distribution Devices
	8. North Carolina State Plumbing Code - 2018 Edition	1. FM 4991 Approved Contractor 2. UL Approved Contractor	Conditioning Engineers 11. ASME: American Society of Mechanical Engineers	10.Ductwork Accessories (Including A
B	9. North Carolina Accessibility Code — 2018 Edition 10.American with Disabilities Act, January 26, 1992	3. HILTI, 3M, or ProSet Accredited Fire Stop Specialty Contractor E. Installing Firm shall have no less than 3 years of experience with firestop installation	12.ASTM: American Society of Testing and Materials 13.AWWA: American Water Works Association	12.Unit, Wall, Ceiling, Duct, Etc. Hea 13.T&B Company Certifications and
D	11. American National Standard Handicapped Code, A117.1 — 1986 Edition 12. ASME A17.1 Safety Code Elevators and Escalators, 2013 Edition	F. A Manufacturer's direct Representative (not Distributor or Agent) shall be on site during initial installation of firestop systems to train appropriate	14.IBR: Institute of Boiler and Radiator Manufacturers	14.Ductwork and Piping Shop Drawin
	C. Secure and pay all fees associated with all permits and licenses required for execution of the Contract. Arrange for all inspections required by City, County, State and other Authorities Having Jurisdiction, and deliver certificates	Contractor personnel in proper selection and installation procedures. G. The firestop Contractor or Installer shall supply As-Built documentation of each individual penetration location on the project. Documentation shall	15.MSS: Manufacturers Standardization Society 16.NBBPVI: National Board of Boiler and Pressure Vessel Inspectors	A. All equipment shall be installed in strict recommendations of the Equipment Mar
	of approval to the Architect. D. The code requirements are strictly a minimum and shall be met without incurring additions to the Contract. Where requirements of the drawings or	include a sequential location number, detailed description of the penetration location, size, and type, tested system number, type of assembly penetrated, and rating to be achieved. As-Built documentation shall be included with the	17.NEMA: National Electrical Manufacturer's Association 18.OSHA: Occupational Safety & Health Administration	Drawings and as specified. B. Provide installation manuals for each pi- bound volumes after review of submitte
	specifications exceed the code requirements, the work shall be provided in accordance with these drawings or specifications. In the event of conflict or ambiguity between the various codes, the most stringent requirement shall	H. Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach label permanently on both sides	19.PDI: Plumbing Drainage Institute 20. PPI: Plastic Pipe Institute	C. Provide supplementary steel framing and stands as required for proper hanging of
	1.07 ELECTRICAL REQUIREMENTS AND INTERFACE	ot penetrated construction in a visible location. The label shall include the following: 1. The words "Warning — Through Penetration Firestop System—Do Not	21.SMACNA: Sheet Metal and Air Conditioning Contractors National Association, Inc.	systems. Steer angles, channels and tub selected for a maximum deflection of 1 D. All roof curbs shall be a minimum of 1
A	A. All electrical equipment and wiring provided under this Division 23 shall comply with the electrical system characteristics indicated on the electrical drawings and specified in Division 26.	Disturb" 2. Through Penetration firestop system designation and Manufacturer	 2.03 PIPE HANGERS AND SUPPORTS A. Pipe hangers, trapeze hangers, upper attachments, rods and other supports shall be selected based on pipe size and material contained therein. Provide all hangers, rods, turnbuckles, angles, shappels, and other supports. 	roof pitches. Curbs installed on roofs he per foot may be standard curbs shimm provide suitable support and flashing su
		J. Date of Installation	securely support the piping systems from the building structure.	A. The exterior surfaces of all mechanical etc., shall be cleaned and free of all di other construction debris.

support of the piping systems shall cifically intended for the purpose of steel straps, plastic ties, etc. is	B. Ducts, plenums, and air unit casings shall be cleaned of all debris and either vacuumed or blown free of all rubbish, dirt, and dust before installing grilles,	
p fit around the pipe (and insulation	C. Bearings that require lubrication shall be lubricated in strict accordance with	
vide adequate movement for shall be provided to restrict and expansion loops.	D. All control equipment shall be adjusted to the settings required for the performance specified.	Н
d at a minimum factor of safety of h of the material. ed between building structural	E. Fans shall be adjusted to the speed indicated by the Manufacturer to meet the installed final system pressure at the airflows indicated. Any additional sheaves and belts required for final adjustments shall be provided with no increase in the Contract amount	
support spacing specified and shall 2" x 2 1/2" x 1/4"). In steel be securely clamped to steel beams supports be attached to roof decks.	F. Any fans operated during construction shall have temporary filters. Temporary filters shall be changed regularly to minimize contamination of the equipment and duct systems. Permanent filters shall be installed prior to final inspection.	
s, upper attachments shall be side t in top portions of the beams. asion shields or power—actuated	G. All coils shall be thoroughly cleaned and combed prior to final inspection.	
follows:	water etc. to be installed or utilized for the project shall be fully protected. This is inclusive of piping and duct openings and internal fan ventilation intakes and discharges. This Division's scope includes protection and	
e and smaller	remediation of any and all Division materials, etc. including cleaning, vacuuming, dusting, etc. required for a clean system and operation. Insulation and equipment with electrical connections subject to water shall be replaced	
ominal pipe inal pipe	in their entirety. Coordinate with all other trades and schedules. 3.05 PAINTING	G
	A. All uncoated and uninsulated steel surfaces exposed to sight inside the building, such as piping, equipment hangers and supports which are not provided with factory prime cost or advanising, shall be cleaned and pointed	
nominal pipe contal insulated piping shall be sized	with one coat of rust inhibiting primer. In addition, all surfaces in finished spaces shall also be painted with two coats of finish paint in a colour selected by the Architect.	
d the pipe and under the insulation:	B. All ductwork surfaces, piping, supports, etc. visible through grilles, registers and diffusers in finished areas shall be painted flat black. All ductwork,	
on all insulated piping as outlined	equipment, piping, supports, air distribution, etc. visible in exposed finished areas shall be painted a colour selected by the Architect, except that nameplates shall not be painted.	
and associated steam and	C. Steel items exposed outside the building, such as equipment supports, uninsulated piping and hangers, which are not factory painted or galvanized, shall be cleaned and painted with one coat of rust inhibiting primer and two	
hall be supported by steel saddles continuous through the saddle. supported on Foamalas insulation	coats of asphaltic base aluminum paint. Insulated steel pipes outside the building shall be cleaned and painted with one coat of rust inhibiting primer before installing insulation.	E
ept that no inserts are required on s inserts shall extend at least 2"	D. Factory painted equipment that has been scratched or marred shall be repainted to match the original factory color.	
uge x 12" long	3.06 DUCTWORK AND PIPING LEAK TESTING A. Insulated, underground, and concealed ductwork and piping shall be tested for	
gauge x 18" long	conducted in the presence of the Architect or their designated Representative.	
degrees around the lower half of the hat on trapeze hangers, pipe racks ses, shields shall be 360 degrees	C. All medium and high pressure ductwork (operating pressure of more than 1.0"	
	WC ESP) shall be tested at 1.5 times the design operating pressure of the system to which it is connected, or at the total fan pressure at shut—off, whichever is greater, up to the maximum pressure classification of the associated ductwork system.	
tract Drawings and specifications in d instructions, and have submittals	 D. All visible and audible air leaks from the ductwork systems shall be repaired. E. See specification section 23 11 23 for testing requirements of natural gas 	E
ign all shop drawings (certifying) before submitting to the Architect	unless otherwise arranged within the Contract. Coordinate with Division 22.	
d as an avenue to substitute act. Should an unspecified or	be hydrostatically tested at a pressure of not less than the greater of 1.5 times the operating pressure or 100 psig, whichever is greater, for a minimum of one hour. No loss in pressure shall be permitted.	
ejected. If a second attempt at al of the same product, then no prmed without direct compensation	G. **Steam and condensate return piping shall be tested at a test pressure of 100 psig minimum but not less than 1.25 times the system operating	
nal services required for the third	pressure for a minimum of one hour. No loss of pressure shall be permitted. H. All refrigerant piping shall be 100% tested with the applicable ASHRAE	
unless they:	I. All leaks shall be repaired by tightening, remaking joints, or replacing pipe and fittings. Caulking of joints shall not be permitted.	
ivision 1 ning to all appurtenances and	3.07 RECORD (AS-BUILT) DRAWINGS	
es which pertain to all related items shall be submitted as follows: ents	A. At the completion of the project, provide a set of reproducible prints to the Architect which reflects all changes, deviations and revisions made to the original design documents. Locations of all underground piping and utilities shall be clearly shown and dimensioned from permanent reference points such as building column lines. Record drawings shall be produced in electronic format compatible with AUTOCAD. Furnish electronic copies of all drawings in dwg. format, and two (2) bond copies of all drawing sheets. **As-Builts for electronic incorporation by the Design Team, as applicable, shall be redline	D
t, service, or function identification marked with pertinent specification	mark-ups of the Construction Documents. 3.08 OPERATING AND MAINTENANCE MANUALS AND INSTRUCTIONS	
ably drawings, field installation complete explanation and submittal data shall provide ample, act Documents.	A. Complete operating and maintenance manuals shall be provided to the Owner. Four copies shall be provided. Each copy shall be bound in a separate 3-ring, loose-leaf notebook. Operating instructions shall be provided for each mechanical system, and shall each include a brief system description, a simple schematic and a sequence of operation. Operating and maintenance	
ed as authorizing any deviations such deviations are clearly identified a letter that is enclosed with the	instructions shall be provided for each piece of equipment. A control system wiring diagram shall be included in each operating and maintenance manual. B. Prior to final acceptance or beneficial occupancy, provide the services of a	
ed equipment, especially energy	Competent Technician for not less than one (1)**two (2) days** to instruct the Owner in the operation of the mechanical systems.	C
nude, but are not minited to, the	3.09 TESTING AND BALANCING A. Testing and balancing of the HVAC system shall be performed **in	
	direct supervision of a Certified Test and Balance Engineer** as specified in Section 23 05 93. Note that this work is to be performed under a separate Contract directly under the General Contractor. Submit four (4) copies of the	
proposed controller and points list	test and balance report directly to the Architect. 3.10PIPING SUPPORTS	
Dampers)	A. Pipe hangers or supports shall be provided within 18" of each horizontal fitting, equipment connection, valve, etc. and within 18" of the centerline of horizontal or vertical changes in direction summing to 90° or more. Specific attention is called to vertical turns into risers.	
rs	B. Piping supports shall be provided, at a minimum, in accordance with the greater of the below or at code minimum. Where the below or code does not	
nal Report	address support for specific piping, supports shall be in accordance with manufacturer's requirements.	В
	Capper pipe 12' 10'	
conformance with the acturer, as indicated on the	Copper tubing $\leq 1-1/4$ " dia. 6' 10'	
e of equipment. Submit in separately	Copper tubing $\geq 1-1/2$ " dia. 10' 10' PVC pipe 4' 10'*	
welded steel equipment support d support of the mechanical g utilized for such framing shall be 360th of the span.	*Midstory guide required for piping 2" diameter and smaller C. Riser clamps shall be provided at each floor penetration. For pressurized piping systems except refrigerant suction and liquid service, provide vibration	
high and selected for the various ing pitches of not more than 1/4" level with steel channels or Zs to aces.	isolation at all riser clamps with two (2) pad-type mountings consisting of a minimum 3/8" thick ribbed or waffled elastomeric pads bonded between minimum 16-gauge galvanized steel separator plates. Pads shall be sized for a deflection of 0.12" to 0.16". Pads shall be minimum 3" x 3" square.	A
juipment, piping, ductwork, conduit, grease, oil, paint splatter, and	3.11 WARRANTY	



	A. All work provided under this Division 23 shall be subject to a minimum one year warranty. The warranty shall include prompt repair or replacement of equipment or system failures and shall include all parts, refrigerant, and labor. In addition, all compressors shall carry an additional four year parts, only warranty. Extended warrantias shall be provided on all other	 Addenda Change orders Deviawed outpretituels
	equipment so specified in other Sections. 3.14SHOP DRAWINGS	 5. Reviewed submittals B. The General Contractor shall start-up and maintain the shall continue the operation of the HVAC systems during
Н	A. Shop drawings per the submittal requirements shall be submit to the Design Team with adequate time for multiple rounds of review. Shop drawings shall show "As-Built" conditions including elevations, offsets, transitions, and accessories. Shop drawings shall indicate all code and manufacturer's recommended clearances, access, and coordinate the clearance and access	and balancing. Start-up and operation shall include, as following: 1. All equipment operable and in safe condition. 2. Temperature control system complete.
	requirements with all other trades. B. Shop drawings that use keynotes direct from the Design Documents shall not be acceptable as they do not demonstrate coordination with all other trades,	 3. Proper thermal overload protection in place for election 4. Ductwork leakage rates not exceeding those specified
	necessary transitions, etc. C. Shop drawings shall be provided as complete packages in parallel with all	systems clean of debris. 5. Air transfer systems shall have:
	drawings are generally not acceptable.	a. Correct fan rotation and RPM.
	A. The Contractor shall include all systems, equipment and accessories shown on the plans and specifications.	c. Filters clean and in place.
G	 B. The Contractor is responsible for providing all design documents to all SubContractors. All systems, equipment and accessories shall be included in 	d. Access doors closed.e. All dampers in place and open.
	the bid, whether shown on the SubContractor applicable plans or other design documents.	f. All grilles, registers and diffusers installed.
	C. Should any discrepancy occur in the Design Documents, the Contractor shall provide a request for clarification prior to bid or note the discrepancy in the bid and provide an appropriate cost allowance in the bid.	C. Provide sufficient time before final completion date so to balancing can be accomplished. Coordinate the submitte
	D. The Contractor shall acknowledge that the Design Documents are diagrammatic and shall provide all systems, equipment and accessories required for a complete facility. Any areas that appear to be void of systems	without undue delay. E. The General Contractor and his SubContractors shall con
	or inappropriate systems shall be noted in the bid. No post bid change order shall be considered for areas or discrepancies not noted in the bid.	Agency to provide the following: 1. Access to HVAC system components.
	E. All installation coordination and means and methods and labor and materials required for proper system installation shall be included.	2. The right to adjust the systems. F. Any conditions which prevent a proper HVAC Test and F
_	RFP or general specifications.	reported by the Agency to the General Contractor and a of their discovery.
F	SECTION 23 05 93	G. If it is determined by the Agency and confirmed by the changes or additional balancing dampers are required, to obtain and install all necessary components.
	TESTING, ADJUSTING, AND BALANCING FOR HVAC	H. The Agency shall cooperate with the Architect and the SubContractors to perform the work in such a manner
	1.01 DESCRIPTION	I. The Agency shall verify that all system components are proper working order prior to legving the project
	A. All work specified in this Section is governed by the Common Work Results for HVAC Section 23 05 00.	J. All reported and recorded data shall represent true med
	B. This Section 23 05 93 and the accompanying drawings cover the provision of all labor, equipment, appliances, and materials and performing all operations in connection with the testing and balancing (T&B) of the heating, ventilating and air conditioning (HVAC) systems as specified herein and as shown. These systems include, but are not limited to, the following:	 K. Where equipment uses variable speed drives, and where used as the primary balancing method prior to adjustment valves, dampers, etc. END OF SECTION
Е	1. Supply distribution systems 2. Return and exhaust air systems	SECTION 23 07 13
L	3. Heating, ventilating and air conditioning equipment (all scheduled equipment as a minimum)	1.0 GENERAL
	4. Hydronic systems	1.01 DESCRIPTION A. All work specified in this Section is governed by the Con
	1.02INTENT A. It is the intent of this Section of the specifications to provide a complete	for HVAC Section 23 05 00. B. This Section 23 07 13 and the accompanying drawings
	operable and balanced HVAC system as shown and specified which is reasonably airtight, comfortable and free of objectionable noise and vibration.	all labor, equipment, appliances, and materials and perform in connection with the construction of the ductwork systems include, but are not herein and as shown. These systems include, but are not following:
	A. HVAC test and balance shall be performed by an Independent Agency certified by the Associated Air Balance Council (AABC) or National Environmental	1. Insulation for typical ductwork
	Balancing Bureau (NEBB) under direct contract to the General Contractor. All work performed by this Agency shall be performed by qualified Technicians under the direct supervision of an AABC or NEBB Certified Test and Balance	2. Duct liner 1.02INTENT
D	Engineer. The Agency shall be independent and shall not be associated in any way with the installing HVAC SubContractor.	A. It is the intent of this Section of the specifications to operable duct system as shown and specified which is r
	of the AABC National Standards, 2016 for Total System Balance or the NEBB Procedural Standards for TAB of Environmental Systems, 8th Edition, 2015	space allotted and to exhibit a minimum resistance to 2.0 PRODUCTS
	 D. The final Test and Balance report shall serve to substantiate compliance with the intent of the Contract Documents, specifically the HVAC systems. 	2.01 DUCT LINER
	E. HVAC Test and Balance shall not begin until the systems are substantially complete.	A. Duct liner shall be one inch thick, 1 ½ lb. density (3 lb and high-pressure supply air systems except that 1 ½ acceptable if the liner is at least R \ge 4.2 and NRC \ge 0
	F. Upon the completion of the Test and Balance work, the Agency shall submit four (4) copies of the complete HVAC Test and Balance Report directly to	one face coated with a black fire retardant compound. composite fire and smoke hazard rating of the liner sho liner face and shall be:
	G. The Agency, as a part of its contract with the General Contractor, shall act as an Authorized Inspection Agency, responsible to the General Contractor	 Maximum Flame Spread 25 Maximum Smoke Developed 50
C	and the Architect and shall, during the test and balance, list those items which require correction or have not been installed in accordance with the Contract Documents.	2.02 TYPICAL DUCT INSULATION
C	H. The Agency shall plainly mark the settings of all valves, dampers and other adjustable devices. If a balancing device is provided with a memory stop, it shall be set locked and marked	A. Duct insulation shall be 2" thick, minimum $3/4$ lb. dens FSKL 0.00035" thick aluminum foil jacket, reinforced wit Thermal conductivity shall be a maximum of K = 0.29
	 The Agency shall record all of the final set points on all variable speed drives. 	B. Insulation adhesive shall be Benjamin Foster 85-20. Tap
	1.04 SUBMITTALS	C. The composite NFPA 90A and 90B, ASTM E84, UL rating insulation shall not exceed 25/50.
	A. The name and certification of the Agency, along with the name and certification of the Certified Test and Balance Engineer, shall be submitted to the Architect for review within 30 days after the award of the General Contract	D. The grease exhaust ductwork shall have zero-clearance from the hood connection to discharge termination. Coo
	B. The selected Agency shall submit to the Owner:	with all required access panels, drains, etc. as required <u>3.0 EXECUTION</u>
	5. Procedural Manual 6. Report Forms	3.01 INSTALLATION
В	7. AABC or NEBB Performance Guaranty	B. Duct liner shall be provided throughout all return air, tr
	9. Schedule	Duct liner shall also be provided for the following minim through the first elbow(s), or as otherwise indicated on whichever is greater, downstream of each unit indicated
	10.Floorplans as Needed to Uniquely Identify Device Locations C. A reviewed copy of each of the above shall be returned to the Agency before	1. Packaged rooftop unit - 25 ft
	the HVAC Test and Balance begins. D. If a complete submittal in accordance with these requirements is not received	 Spirt system air nandling unit - 5 ft Terminal unit - 5 ft
	אונחוח שם aays from award of the General Contract, then the Architect reserves the right to select the Agency. 2.0 PRODUCTS	C. Straight runs only shall be factored into the above disto Elbows, etc. within the length shall be lined but shall no length requirement.
	2.01 (Not applicable).	D. Duct liner shall not be installed within six inches of a c and/or smoke dampers. Metal nosings are required on t
^	3.0 EXECUTION 3.01 GENERAL CONTRACTOR'S DUTIES	or the exposed insulation. Where lining has been interrup insulation is required.
	A. The General Contractor shall provide the following, within 10 days after his receipt, to the Agency:	corner joints. Liner shall be installed with the coated su stream. Duct liner shall be adhered to the ductwork wit the sheet metal surfaces using a fire retardant adhesive
	1. Contract applicable specification Division 23 (others as applicable)	Coat all exposed leading edges and all transverse joints adhesive. The liner shall be additionally secured using m the duct and speed washers. All leading edges shall be
	2. contract applicable specification Division 25 (others as applicable)	metal airfoils.

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	F. Inside the vapor barrier	of the building all supply air ductwork which is not	
iintain the HVAC systems and	lined shall be insulated. downstream of a PIU s exterior door shall be in Insulation shall be cut thickness at corners. A Insulation shall be adhe be applied so that insu	All supply air ductwork which is on the top floor, erving an exterior exposure or is within 25 feet of an nsulated. All outside air ductwork shall be insulated. slightly longer than circumference of duct to insure full all insulation shall be applied with edges tightly banded. ered to duct with fire resistant adhesive. Adhesive shall all the surfaces uniformly and firmly	SECTION 23 21 00 HYDRONIC PIPING <u>1.0 GENERAL</u> 1.01 DESCRIPTION
ms during each day of testing clude, as a minimum, the on.	In addition to the adhe bottom of all ducts 18' The protruding end of have been applied. The tape where the pins ha wide SMACNA tape. Any	esive, the insulation shall be additionally secured to the "or wider by means of welded pins and speed clips. the pins shall be cut off flush after the speed clips vapor barrier facing shall be thoroughly sealed with ave pierced through. All joints shall be sealed with 2" y cuts or tears shall be sealed with SMACNA tape.	 A. All work specified in this Section is governed for HVAC Section 23 05 00. B. This Section 23 21 00 and the accompanyin all labor, equipment, appliances, and materia in connection with the construction of the p and as shown for the beating, ventilating and as shown for the beating.
e for electrical equipment. e specified and all duct	 G. All outside air ductwork shall be externally insul H. All conditioned air duct ventilator outside air su 	k located in conditioned or semi-conditioned spaces lated similar to supply ductwork. work, including partially conditioned energy recovery upply to the building and exhaust ductwork, installed in	 Refrigerant suction and liquid (RS&RL) Drains (DR)
	spaces that are ventila END OF SECTION	ted only, i.e. penthouses, shall be insulated. SECTION 23 07 19	3. Valves and Accessories
	<u>1.0 GENERAL</u>	HVAC PIPING INSULATION	A. It is the intent of this Section of the specie operable piping systems as shown and specie properly vented, free of noise, vibration and fit the space allotted and to exhibit a minin
led. date so that testing and	A. All work specified in th for HVAC Section 23 0	is Section is governed by the Common Work Results 5 00.	B. The word "piping" is defined to mean all pip coatings, valves, cocks, test and sensor wel the HVAC piping systems described, shown o
submitted T&B schedule. Juired corrections and repairs shall cooperate fully with the	B. This Section 23 07 19 all labor, equipment, ap in connection with the herein and as shown for systems. These insulate following:	and the accompanying drawings cover the provisions of opliances, and materials and performing all operations insulation of the HVAC piping systems as specified or the heating, ventilating and air conditioning (HVAC) ed piping systems include, but are not limited to, the	 1.03GENERAL REQUIREMENTS A. Provide all reducing fittings, flanges, coupling type of material to match the piping to each accessory. B. Union joints or flanges shall be provided in
	 Refrigerant suction Condensate drains 	and liquid (RS&L) (indoors only)	piece of equipment and elsewhere as indicat match the piping system in which they are 1. Unions or flanges shall be provided betw connections in water-carrying piping. Th
est and Balance shall be tor and Architect within 7 days d by the Architect that drive	 C. All insulation products requirements for Flame D. Inserts for all piping where shall be provided at such as the second shall be provided shall be provided at such as the second shall be provided shall be provided at such as the second shall be provided shall	installed indoors shall meet NFPA 90A, 90B and 255 Spread Rating 25 and Smoke Developed Rating 50. hich is specified to have hangers outside the insulation ch hangers and supports for all piping 2" and larger.	insulating type. C. All changes in direction and branches shall fittings. D. In all water piping systems, changes in horiz
equired, the Contractor shall and the Contractor and all his manner as to meet the job	1.02INTENT A It is the intent of this	Section of the specifications to provide a complete	with eccentric reducers installed flat on top tees, reducing elbows and concentric reduce changing pipe sizes in vertical risers and for equipment and accessories from vertical rise
ients are in place and in ct. true measured conditions	piping insulation system finished, free of sweatir to exhibit a negligible h B. The word "piping" is de	which is free of gaps and tears, properly fitted and ng, and fabricated so as to fit the space allotted and neat transfer.	E. In refrigerant, drain, steam and condensate shall be installed with the flat side on botto pipe flush for proper condensate and oil dro elbows and concentric reducers shall only be in vertical risers and for making connections
nd where feasible, VFDs shall be adjustment or balancing of	coatings, valves, cocks, the HVAC piping system 1.03ACCEPTABLE MANUFACTURE	test and sensor wells and accessories necessary for ns described, shown and specified. RS	F. All pipe joints shall be cut square and all b G. All butt-weld pipe elbows shall be long radi
	A. Insulation products shal Manville, Certainteed, Do <u>2.0 PRODUCTS</u> 2.01 PIPING INSULATION	ll be as manufactured by Owens Corning, Knauf, ow, Armacell, or Armstrong.	 H. Fabrication of a bullhead tee connection is I. Each pump shall be provided with a straight a length not less than five (5) times the su shall be equipped with a suction diffuser. St
y the Common Work Results	 A. Piping insulation installe and liquid service, shall all-service jacket/vapor BTU/In/Hr/SF/°F, at a 1.5", 2" thick insulation 1.5" thick insulation shall 	ed inside the building, except for the refrigerant suction be fiberglass preformed pipe insulation with a white r barrier. Insulation shall have a maximum K of 0.27 mean temperature of 75°F. For pipe sizes larger than shall be used; and for pipe sizes 1.5" and smaller,	whenever feasible. J. Open ends of pipelines not currently being h installation to keep dirt, water and foreign r K. Horizontal water supply and return piping sh space permits, slope up in the direction of
drawings cover the provisions of and performing all operations twork systems as specified ut are not limited to, the	 B. Piping insulation installer suction service, shall be insulation (Trymer 2000 glass fiber jacket finish caulk joints and seams 0.19 BTU/In/Hr/SF/*F opiping 1.5" and smaller piping 1.5" and smaller 	ed outside the building, except for the refrigerant e prefabricated 2 lb/ft ³ density polyisocyanurate) XP or approved equal) with waterproof mastic and ned with an aluminum jacket with waterproof silicone 5. Outside the building, insulation with a maximum K of at a mean temperature of 75°F shall be used. Outdoor shall be insulated with 1.5" thick insulation; outdoor	 run. L. Horizontal **steam, condensate return, refriged own in the direction of flow at a minimum M. All Welders employed at this project shall be of ANSI Specification B31.1.0, Section 127.5. shall be submitted before any welds are made 2.0. PRODUCTS
tions to provide a complete vhich is reasonably airtight,	C. Piping insulation installer shall be prefabricated 2 2000 XP or approved e	ed underground, either inside or outside the building, 2 lb/ft ³ density polyisocyanurate insulation (Tymer equal) with HDPE jacket. Jacket shall conform to ASTM	2.01 PIPE AND FITTINGS A. All pipe and fittings shall be products of a
cated so as to fit into the ance to airflow.	D. Closed-cell insulation s other services as speci 1-1/2" thick 25/50 Ar products of the same l	shall be provided over all refrigerant suction piping and fied or noted. Closed—cell piping insulation shall be maflex or Rubatex. All glues and coatings shall be Manufacturer as the insulation.	 B. Pipe and fittings shall be as listed and outl 2. Refrigerant Suction and Liquid, All Sizes 3. All other drains, All Sizes: Material 6
sity (3 lb. density on medium- hat 1 $\frac{1}{2}$ lb. density is NRC \geq 0.65) fibrous glass with	E. Insulation shall be cont penetrations. Do not in gauges, valve handwhee	inuous over all valve bodies, fittings, and wall and floor sulate unions on hot water piping; nor instruments, els, etc. on any piping.	 C. The pipe, fittings and joints shall be as out 1. Material Type 4: a. Pipe - Type I hard drawn copper t
liner shall be stenciled on the	F. All piping insulation cov weather and subject to oversized insulation to G. Provide a continuous w	vering water—carrying piping which is exposed to the bursting from freezing temperatures shall have accommodate heating cable. See Section 23 05 33. atertight aluminum jacket and fitting covers for all	 b. Fittings - Wrought copper meeting c. Joints - Silver brazed with sil-fos
- lb. density fiberalass with an	3.0 EXECUTION 3.01INSTALLATION OF PREFORME	Ton piping exposed to the weather. ED PIPE INSULATION	6. Material Type 6: a. Pipe — Copper drainage tube DWV r
orced with fiberglass scrim. = 0.29 at 75°F mean compression.	A. Indoors 1. Preformed pipe insu longitudinal joints l	ulation with all-service jackets shall have all apped by a minimum of 2" and sealed with fire	b. Fittings — Wrought copper solder—jo B16.29. c. Joints — Soldered with a solder me
UL rating of the installed	2. All elbows shall be thickness specified	apor barrier jacket and secured with 5 wide tape similar insulated with preformed fitted insulation equal to the for the adjacent piping insulation. As an alternative,	2.02 VALVES A. All valves shall have the Manufacturer's nam pressure cast or stamped on the valve body
clearance to combustibles wrap Ition. Coordinate the insulation required by NFPA 96.	with fiberglass insu insulation. B. Outdoors	ers meeting NFPA/UL 25/50 ratings; stuff all covers lation having characteristics equal to adjacent pipe	 B. All valves utilizing packing shall be designed repacking while under pressure. C. All valves shall be provided by a domestic M
with SMACNA, UL, and NFPA	 Preformed pipe insu insulation secured of the insulation. Over thickness and draw aluminum jacket wi 	ulation for exterior water—carrying pipe shall have on with copper wire with ends twisted and turned into r the insulation, apply mastic to a minimum 1/4" r in, while mastic is wet, glass fiber cloth. Finish with ith waterproof silicone caulk joints and seams. All	 All valves 374 and smaller shall be full-por may be "reduced-port" type. E. Valves on insulated lines shall be provided w clearance for specified pipe insulation. Provided valve assembly in insulated piping systems.
rn air, transfer and plenums. ng minimum distances, cated on the drawings, indicated below:	seams shall be ove 2. All elbows shall be thickness specified 3. All water-carrying self-regulating elec 05 33.	erlapped in the direction of rainfall, as practical. insulated with preformed fitted insulation equal to the for the adjacent piping insulation. piping subject to freezing weather shall have etric heat tracing installed as specified in Section 23	 F. Valves shall be suitable for 125 psig and 40 operating conditions, whichever is greater, U J. Check Valves: 1. Check valves 2-1/2" and larger shall be suitable because the suitable for 125 psig and 40 operating conditions, which ever is greater, U
pove distance requirements. t shall not count towards the	3.02 CLOSED-CELL PIPING INSU A. Insulation shall be provi condensate drain lines. method; slitting of the rejection. All elbows sha	LATION INSTALLATION ided on all refrigerant suction and indoor cooling coil The insulation shall be installed by the slip—on insulation is prohibited and shall be cause for all be mitered and all such joints and butt joints shall	grove-type silent checks with bronze the flanged end connections. Flow area thro cross sectional area of the pipe in whice less than 10%. Valves shall be Apollo Vo and under, 169T up to 600 psi or equa Globe Style Silent Check Valve, Hammon grooved piping systems, valves shall be
es of a damper, including fire lired on the downstream side n interrupted, external	be tightly made and glue B. All insulation installed of protective coating appli	ued. outdoors shall be coated with a glossy white, ultraviolet ied in two coats.	2. Check valves 2" and smaller shall be y- body, renewable bronze seat disc, and b Valves shall be Apollo Valves 164T for u
nd compressed longitudinal coated surface facing the air twork with a 100% coverage of t adhesive applied by spraying.	3.03 MISCELLANEOUS REQUIREM A. Where insulation is inst barrier at all penetration termination by bevel cu	ENTS alled over pipe hangers, supports, etc., seal vapor ons. Also seal all end joints at unions and points of utting the end and drawing jacket over until secured at	up to 400 psi CWP or equal by Hammo 3. All check valves on pump discharges sh 4. All check valves shall be installed in an manufacturer's recommendations

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0	L. Control valves shall meet the requirements of the appropriate valve sections. Control valves shall be provided with electric operator/actuators which shall provide full modulation from closed to open and positive closure. Operators/actuators and all components shall be plenum-rated in return air		
	plenums. M. Relief valves shall be sized to have the pressure and temperature relief capacities indicated by their service, including any piped discharge sizes and lengths. Relief valves shall be ASME rated and labeled.		
ed by the Common Work Results	2.03 FLEXIBLE PIPE CONNECTIONS		н
ng drawings cover the provisions of ials and performing all operations piping systems as specified herein and air conditioning (HVAC) are not limited to, the following:	N. Flexible piping connections for individual small HVAC units such as fan coil units, water-source heat pumps, and water coils shall be provided with each unit or coil. Flexible supply and return hoses shall be a minimum of 24" and complete with service shut-off valves. Hose assembly shall be stainless steel outer braid and EPDM inner tube. Hoses shall have insulation to match insulation specification requirements. Hoses shall be rated for the system pressure and temperature in which they are installed and not less than 40°F to 250°F, 300 psig.	-	
	 Flexible piping connections are for vibration isolation only and shall not be used to align piping connections, for thermal expansion, or any other purpose. 2.08 THERMOMETERS AND PRESSURE GAUGES 		
ifications to provide complete and cified which are free of leaks, d sweating, and fabricated so as to imum resistance to fluid flow.	A. Thermometers and pressure gauges shall be products of Trerice, Weksler or Weiss. Select all devices to operate within 20% of the midpoint of their scales under normal operating conditions. Gauges provided on pumps shall be compound type.		G
ping, fittings, joints, hangers, Ils and accessories necessary for and specified.	2.09 PRESSURE AND TEMPERATURE (P&T) TEST PLUGSA. Plugs shall be constructed of brass with two (2) self-closing Nordel cores and be complete with cap and gasket.		U
ngs and unions of the size and ach piece of equipment, valve and	 B. Plugs shall be as manufactured by Peterson or Lancaster. C. Provide a complete test kit to the Owner at the time of final inspection. Test kit shall be complete with pressure gauge, thermometer, probes and carrying 		
each pipeline connected to each Ited and specified. Unions shall installed.	case. <u>3.0 EXECUTION</u>	-	
ween all copper to steel hese unions shall be dielectric,	3.01 ARRANGEMENT A. Follow the general piping layout, arrangement, schematics, and details. Provide		
be made with manufactured	all offsets, air vents, drains and connections necessary to accomplish the installation. Automatic air vents shall be provided at all high points. Manual air vents shall be installed as required for system fill, troubleshooting, and testing. Fabricate piping accurately to measurements established at the project Site to avoid interference with ductwork, other piping, equipment,		F
o for proper air venting. Reducing ers shall only be allowed for or making connections to sers.	openings, electrical conduits and light fixtures. B. Make suitable provision for expansion and contraction with expansion loops and offsets. With Engineer approval, Victaulic Style 177, 77, or W77, as appropriate, flexible couplings or Style 155 expansion joint may be used to accommodate expansion and contraction. **Victaulic shall be consulted to		-
com to maintain the bottom of the rainage. Reducing tees, reducing be allowed for changing pipe sizes as to equipment and accessories	ensure proper application and design. Victaulic shall provide details and calculations where required. C. Pressure gauges and thermometers called to be permanently installed shall be easily visible from a standing position on the ground.	-	
burrs shall be removed.	3.02 UNDERGROUND PIPING		
ius type. strictly prohibited.	 A. All underground piping shall have a minimum cover of 3-0. B. Provide concrete thrust blocks at all changes of direction and secure all joints. 		
nt run of piping into the suction of suction pipe size indicated and/or Straight runs shall be provided	C. All underground water lines shall be protected from corrosion with a continuous plastic sheathing or coating and wrapping. This sheathing or coating and wrapping shall be extended 6" to 12" above finished floor. See Section 23 07 19 for HVAC piping insulation.		E
handled shall be plugged during material out of the system.	3.03 REFRIGERANT PIPING INSTALLATION		
hall be installed level or, where flow at 1/2 to 1 percent of the	A. All refrigerant piping shall be sized in accordance with the Air Conditioning Equipment Manufacturer's written instructions. Provide charging ports, solenoid valves, service valves, dryers, etc. at each piece of equipment.		
igerant and drain piping shall slope n slope of 1/8" per foot of run.	 B. All brazing shall be done while the line is being flushed with carbon dioxide, nitrogen, or other inert gases. 	_	
be qualified under the requirements 5. Evidence of Welders' qualifications ade.	C. The inside of all tubing shall be thoroughly cleaned and internally wiped with a lintless, dry cloth. D. Suction lines shall drop below their coils before any horizontal run.		
	E. Provide oil traps at least every ten feet for extended vertical risers.F. All oil traps shall be constructed from close-radius type fittings.		
domestic Manufacturer.	G. Dryer cores shall be installed to remove horizontally or downward.		D
s: Material 4	 H. Install external equalizer downstream of its expansion valve sensing bulb. I. Install expansion sensing valve bulb on top centerline of piping up to 5/8" size; install 45 degrees down from the horizontal centerline on pipe sizes 		
tlined below:	7/8" and larger. END OF SECTION		
tubing meeting ASTM B88 or ASTM	SECTION 23 31 00	-	
ANSI B16.22. or silver solder.	HVAC DUCTS, ACCESSORIES, AND CASINGS <u>1.0 GENERAL</u> 1.01 DESCRIPTION		
meeting ACTN D706	A. All work specified in this Section is governed by the Common Work Results		
joint drainage fittings meeting ANSI	B. This Section 23 31 00 and the accompanying drawings cover the provisions of		С
eeting ASTM B32.	all labor, equipment, appliances, and materials and performing all operations in connection with the construction of the ductwork systems as specified herein and as shown. These systems include, but are not limited to, the following:		
me or trademark and the working Jy.	 Supply air ductwork Return, transfer and relief air ductwork 		
d and constructed to allow	 3. Exhaust ductwork 4. Ductwork accessories 	-	
Manufacturer. rt" type, and greater than 3/4"	1.02INTENT A. It is the intent of this Section of the specifications to provide a complete		
with stem extensions to provide ide preformed insulation to encase	operable duct system as shown and specified which is reasonably airtight, free of noise, vibration and sweating, and fabricated so as to fit into the space allotted and to exhibit a minimum resistance to airflow.		В
0°F to 250°F or the system JON.	 A. Ductwork shall be provided in strict accordance with the third edition - 2005 - of the SMACNA HVAC Duct Construction Standards - Metal and Flexible, NFPA No. 90A, 90B, 91 and 96, and UL 181. Where SMACNA tables have an option between different aguages and supports, the begivier aguage shall be 		
e non-slam type with iron body, rim, stainless steel spring and ough the valve shall exceed the ch the valve is installed by not	 B. Ductwork dimensions shown are net, clear, inside dimensions with no allowance shown for duct liner. All ductwork specified to be lined shall be 2" 	-	
Alves 910F up to 200 psi or 2" al by Mueller Co., APCO, Metraflex nd IR 9354, or Milwaukee 1800. In Victaulic 716, 779, or W715 as	larger than shown in each dimension to compensate for the liner. Ductwork shall be square, rectangular, round, spiral or flat oval as noted. Conversion of duct shapes and sizes shown shall be accomplished without increasing air velocities or friction losses and is subject to prior approval by the Architect and Engineer.		
-pattern, swing-type with brass be MSS SP-80 factory-tested. up to 200 psi CWP and 168T for	C. Elbows shall be either full radius type (inside radius equal to duct width), five-gore radiused flat-oval type or, in low pressure systems only, mitered with double-thickness turning vanes.		
ona, or млwauкee. hall be non-slam type. n orientation allowed by the	D. Abrupt changes in duct sizes and shapes shall not be permitted. The total angle of diverging transitions shall be not more than 15 degrees; converging transitions shall be not more than 30 degrees unless otherwise noted or required due to structural constraints.		A
iping systems shall have the check outside of the insulation.	E. Offsets, transitions, rises and drops are not individually called out on the Design Drawings. They shall be provided as required to fit the ductwork into the allocated spaces.		

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	ductwork level and as high as possible.
G.	"Medium pressure ductwork" shall be constructed for 3" WC static pressure class at 4000 FPM velocity with Class A seals. Applications shall include: 1. All supply air ductwork between the VAV self-contained air handling, packaged rooftop unit, and the terminal units
	2. All ductwork between central ventilation fans (such as outside air, toilet exhaust, pressure relief, energy recovery units, 100% outdoor air units) and their terminal units.
	3. All ductwork in systems subject to more than 1" WC.
Н.	All other ductwork shall be constructed for standard 1" WC static pressure class at 2500 FPM with Class C seals and is herein defined as "low pressure ductwork".
Ι.	Provide the following types of ductwork material for the services indicated:1. Galvanized sheetmetal: supply, return, exhaust, and relief of conditioned and outside air
2.0 PRO	DUCTS VANIZED SHEETMETAL
A.	Galvanized sheetmetal shall be lock—forming grade G90—ASTM A 525 hot dip galvanized steel sheets. Sheetmetal shall be galvanized on each side with not less than 1.25 ounces of zinc per square foot.
В.	Galvanized sheetmetal installed outside the building and subject to weather shall be soldered or welded. See Section 23 07 13 for additional information about covering and insulation.
C.	Galvanized sheetmetal installed outside the building and not exposed to weather, such as in covered loading docks and parking decks, may match the construction of ductwork inside the building.
D.	Galvanized sheetmetal ductwork outside the building within 20 miles of the seacoast shall have corrosion coating appropriate to the installation location.
2.02 SF	PIRAL DUCT
Α.	Spiral duct shall be utilized for all flat—oval and round ductwork in medium and high—pressure systems.
В.	Spiral duct shall be the product of United McGill Corporation, R.V. Money, Eastern Sheet Metal, or an approved equal.
C.	Spiral duct with internal ribs is not acceptable.
D.	spiral auct shall conform to SMAUNA 2005 Standards. Lighter gauges, etc. due to standing ribs are not acceptable.
2.03 D(DUBLE-WALL DUCTWORK
2.08 D	two (2) layers of sheetmetal in accordance with SMACNA standards. All joints shall be permanently sealed airtight.
A.	Manual Volume Dampers
	 Single blade butterfly dampers are acceptable up to 12" round or 12" x 12" square. Dampers larger than these dimensions shall be multi-blade type. Single blade dampers shall be constructed of 16 gauge or heavier advanized sheetmetal
	 No multi-blade damper blade shall exceed 8" in width. All multiple blade dampers shall be constructed of 16 gauge galvanized steel or heavier. The damper frame shall be 16 gauge or heavier. The damper action shall be opposed-blade type.
	3. Each blade shall pivot on a 1/2" cadmium plated, cold-rolled steel axle
	 4. The top and bottom edges of each rectangular damper blade shall be crimped for stiffness.
	 The operating rod for all dampers shall be extended outside the damper frame for attachment of an operator. Each operator shall have a position indicator and locking quadrant.
	6. All dampers utilized for introduction of outside air shall have flexible, gasketed edge and end seals. The leakage rate shall be less than 4 CFM per SF of face area against a 1" WC differential pressure, based on a nominal 48" x 48" damper size.
	7. All dampers utilized for exhaust or relief air shall have flexible, gasketed edge and end seals. The leakage rate shall be less than 4 CFM per SF of face area against a 1" WC differential pressure, based on a nominal 48" x 48" damper size.
	8. Dampers to be installed in insulated ductwork shall have standoffs sufficient to allow for insulation and vapor barrier integrity.
	9. Manual volume dampers shall be as manufactured by Louvers & Dampers, Inc., Pottorff, Greenheck, Nailor, Ruskin, or an approved equal.
В.	Control Dampers
	1. Control dampers shall be of the same construction as manual volume dampers, except that no manual operator and quadrant is required. The operating rod shall be suitable for operation by an automatic pneumatic or electric operator.
C.	Fire Dampers
	1. Fire dampers shall be UL-listed and labeled for 1 1/2 or 3 hours, in accordance with the installation location, and shall be provided with 160°F links or linkages appropriate for the service. Dampers installed within ducts shall be Type B or Type C with the blades out of the air stream. Areas indicated shall be net, clear, open areas.
	 Fire dampers shall be appropriate for the installation location and application. All fire dampers in supply, return, exhaust, etc. shall be dynamic-type.
	 Fire dampers shall be as manufactured by Louvers & Dampers, Inc., Pottorff, Greenheck, Nailor, Ruskin, or an approved equal.
D.	Smoke Dampers
	 Smoke dampers shall be UL-listed as Class 1 low-leakage smoke dampers. Smoke dampers shall be 24V and wired under this Division.
	 Smoke dampers shall be appropriate for the installation location and application. All fire dampers in supply, return, exhaust, etc. shall be dynamic-type.
	3. Smoke dampers shall be as manufactured by Prefco, Louvers & Dampers, Inc., Pottorff, Greenheck, Nailor, Ruskin, or an approved equal.
E.	Fire/Smoke Dampers
F	 Fire/smoke dampers may be combined into a combination fire/smoke dampers. All provisions of the above shall apply. Fire/smoke dampers shall be UL-listed.
г.	 Backdraft dampers shall be sized according to their installation location and noted pressure setting. Damper pressure setting shall be adjustable and shall be accessible from outside ductwork or via access hatch, as
2.09 10	applicable. DW-PRESSURE DUCT BRANCHES
A.	Splitter dampers shall be provided at all low-pressure ductwork branches. All low-pressure ductwork branches shall be radiused or 45 degree take-offs;

G

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Β.	The internal duct surface shall be acoustically rated, coated steel wire helix. The external jacket shall be a bi-directionally reinforced, metallized vapor barrier wir seam. Fiberglass insulation shall be provided between the jacket to achieve a maximum thermal conductan ft./°F at 75°F mean.

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- C. Flexible ductwork shall be suitable for 10" W.G. positive negative pressure in sizes 4" through 12" ID, and 6" W.G and 0.5" W.G. negative pressure in sizes 14-16" ID.
- D. Flexible ductwork, insulation and insulation cover shall b return air plenum installation and shall comply with all standards regarding such ceiling plenum installations.
- E. Flexible duct shall be Thermaflex M-KE or an approved e
 F. The maximum allowable installed length of flexible ductwork
 follows:
- 8'-0" on low-pressure supply air systems limited to end of runs connected to round neck supply diffuse
- 4'-0" on medium and high-pressure supply air systern runouts from the sheetmetal ductwork to each term
- 2'-0" on connections from round neck grilles to she return, exhaust and transfer ductwork.
- G. Provide a spin-in fitting with integral scoop and volume run-out connections in low-pressure supply air ductwork locations where spin-in fittings would project more than projecting ductwork dimension. **Adhesive fittings are ac they are also screwed to the ductwork and sealed with r
- H. Flexible ductwork shall not pass through wall, floors, or a 2.11 TERMINAL UNIT RUNOUTS
- A. Medium and high—pressure runouts to terminal units sha the trunk duct with factory—welded laterals, conical tees abrupt round to rectangular taps are strictly prohibited of
- B. Terminal unit runouts shall be the larger of the associat size or the size noted on the drawings.
- 2.12 FLEXIBLE CONNECTIONS
- A. Provide flexible duct connections at the inlet and outlet fan, indoor unit, fan coil unit, air handling unit, etc., and locations indicated. Flexible connections shall be fabricate fabric coated on both sides with neoprene. Minimum weig per sq. yard. Flexible connections shall be used for vibra shall not be used to correct connection misalignment.
- 2.13DUCT HARDWARE
- A. Duct hardware shall be as manufactured by Young Regul equal.
- 2.14 ACCESS DOORS
- A. A duct access door shall be provided at each fire and s doors shall be designed for 1.5 times the pressure of th are mounted. Access doors shall be of sufficient size to the dampers for resetting the blades and replacing the I medium and high-pressure ductwork shall be installed do dampers and shall be implosion type. Where access is pr gypsum board walls or ceilings, furnish access door for i Division 09. Coordinate with Division 09 and Architect. Ec the fire-rating of the wall or ceiling indicated.
- B. Access shall be provided to duct-mounted smoke detec shall allow inspection and maintenance of all aspects of doors shall meet the requirements of A, above, as need
- 3.0 EXECUTION
- 3.01 INSTALLATION
- A. Ductwork shall be installed in strict accordance with SMA standards.
- B. All ductwork installed outside the building shall be secure Coordinate with the Structural Engineer as needed. It is responsibility to design and coordinate all supports. All s designed to withstand all code-required wind and seismic
- C. Flexible ducts utilized in the low-pressure ductwork syste without kinks or bends which are less than a centerline greater than twice the diameter of the flexible duct bein the runouts from the medium or high-pressure ductwork units, the flexible ducts shall be installed with a variance per foot of installed length off a straight and level line the sheetmetal ductwork runout or tap to the centerline inlet. The size of the flexible ductwork connected to each be the equivalent size of the larger of the following:
- The inlet size of the terminal unit
 The runout size indicated on the drawings
- Should the runout size indicated on the drawings differ f the terminal unit, or where the inlet to the terminal unit transition shall be made with sheetmetal and shall occur terminal unit.
- D. All low pressure ductwork downstream of VAV units shall balancing until tenant fit-up affects the units.
- E. All intersections (crossing) of low-pressure and mediumshall be made with offsets in the low-pressure ductwork pressure ductwork shall be ran straight and level.
- F. Electric duct heaters shall be installed as indicated and the manufacturer's recommendations. Coordinate the act provided with all trades. The heater shall be tested and installation to provide the capacities indicated.
- G. Ductwork labels, including factory labels, tags, etc. excep nameplates shall be removed to the satisfaction of the exposed areas.

END OF SECTION

SECTION 23 34 00

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HVAC FANS
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<u>1.0 GENERAL</u>

- 1.01 DESCRIPTION A. All work specified in this Section is
- A. All work specified in this Section is governed by the Corr for HVAC Section 23 05 00.
- B. This Section 23 34 00 and the accompanying drawings all labor, equipment, appliances and materials, and perfor in connection with the construction and installation of the herein and as shown. These fans include, but are not line
- 1. Roof-mounted centrifugal exhaust fans
- 2. Inline fans
- 3. Ceiling/cabinet fans
- 1.02INTENT
- A. It is the intent of this Section of the specifications to operable, adjusted fans as shown and specified which a noise, vibration and airflow fluctuations.
 0.3BASIS OF DESIGN
- 1.03BASIS OF DESIGN
- A. The basis of design is as scheduled. Any proposed subst proven equal in all aspects to the equipment specified of Particular attention is called to the requirements of Sec

1.04 ACCEPTABLE SUBSTITUTE MANUFACTURERS

A. Acceptable substitute manufacturers are Carnes, Cook, City, Price, and Greenheck. Acceptable manufacturers for exhaust fans are Captive—Aire, Viking, and Greenheck.

90B Standards.

A. Flexible ductwork shall be Class 1, UL 181 air duct and meet NFPA 90A and

 M. Hanner Hanner		4 5	6
 Alternation of the second of th	ack CPE bonded to a fiberglass,	2.0 PRODUCTS	 An acoustically lined sheetmetal housing wheel.
 Pathema C. 200 Pathema C. 200<td>a standing, triple ply ne duct surface and of 0.24 BTU/Hr./sq.</td><td>A. All non-filtered fans shall be factory tested, rated and certified in accordance with the requirements of AMCA Standard No. 210 and shall be labeled accordingly. Filtered fans may be non-labeled but must be rated in an AMCA</td><td> Resiliently mounted, vibration-isolated, p motor of the voltage shown on the elec Backdraft damper to prevent reverse flow </td>	a standing, triple ply ne duct surface and of 0.24 BTU/Hr./sq.	A. All non-filtered fans shall be factory tested, rated and certified in accordance with the requirements of AMCA Standard No. 210 and shall be labeled accordingly. Filtered fans may be non-labeled but must be rated in an AMCA	 Resiliently mounted, vibration-isolated, p motor of the voltage shown on the elec Backdraft damper to prevent reverse flow
 Alter Ale Alter A	pressure and 1"W.G. G. positive pressure be suitable for ceiling	 B. All roof-mounted fans shall be constructed such that water cannot enter the building through the fan regardless of whether or not the fan is operating. Fans shall be provided with drain connection and piped to the nearest roof drain can provided with drain connection. 	H. The plenum section shall be acoustically line either the primary VAV unit or the induction through the low pressure duct system. Paral
 M. M. L. S. M. M.	applicable codes and equal.	C. Fans installed outside or otherwise subject to weather shall have a weatherproof enclosure over the motor compartment. All components, including VFDs, shall have enclosures and be appropriate for the installation	I. Each PIU, when operating in the fan powered be selected to operate against a minimum e with a maximum NC level of 35 at the disch condition, the radiated poise shall be a max
 Markamer and Same And Same	work shall be as to short runouts and ers and registers	D. All roof-mounted fans shall be provided complete with roof curbs. Roof curbs shall be of aluminum construction, insulated, canted and complete with wood nailer strips. Insulation shall meet NFPA 25/50 flame spread/smoke developed	J. The PIUs shall have intermittent fan operation J. The Dius shall have intermittent fan operation
 Martin Lander, M. B. 1999 and Lander, M. 1999 and La	stems limited to the minal unit.	ratings. E. All belt—drive assemblies shall be mounted on vibration isolators. F. All motors on belt—drive assemblies shall be mounted on slide bases to	K. There shall be <u>only one</u> electrical power conr assembly to provide electrical power to both *Unit shall operate on 460-volt, 3-phase ur a separate fused wiring for the fan motor o
 A. Social Sociel Social Sociel Social Sociel Social Sociel Social Sociel Social Sociel	e damper at all flexible rk only, except n 50% into the	G. All belts in belt drives shall be rated for not less than 150% of the connected motor horsepower.	L. There shall be <u>only one</u> electrical power con
 A can share to be a can share to be a can be can be a can be can be a can be a can be a can be a c	moord into the acceptable provided mastic. ceilings.	 All belt-drives ariver by a 3 HP or larger motor shall be multiple belt arrangements. All belt-drives shall be adjustable to a minimum speed variation of plus or minus 20% of the design RPM. 	applicable. Unit connection shall be 24-volt. compliance with this item.
 A. Company and A. S. Company and Company and Company and Company and Co	all be connected to	J. All centrifugal fan wheels shall be statically and dynamically balanced.	3.01 INSTALLATION
 Handback and Alexandrowski strandski strand	and shall be rejected.	 All electric motors and equipment shall be of labeled. L. Refer to Division 26 of these specifications and to the electrical Contract Drawings for electrical characteristics and connections to all equipment. Coordinate all electric motors and other equipment with these electrical desuments. 	 B. The wiring of all VAVs shall be performed by
 If a data part of the second part of t		M. Fans with variable-frequency drives (VFDs) shall have shaft grounding ring and	3.02 ADJUSTMENT
 	t of each belt—driven nd at all other ited from a glass eight shall be 30 oz. ration isolation only and	 N. All exposed motors and belts shall be protected with enclosures or guards in accordance with OSHA requirements. O. Life safety fans (i.e. stair pressurization, elevator hoistway pressurization) 	 A. The units shall be tested and adjusted after capacities indicated. END OF SECTION
sets Stroke Access is also stroke Access is a stroke Access	ulator or an approved	 Since safety fails (i.e. stall pressurf action, elevator holstway pressurf action, smoke control, etc. shall have 1.5 times the number of belts necessary for the scheduled performance with no less than two (2) belts. 2.02 ROOF-MOUNTED CENTRIFUGAL EXHAUST FANS 	
 Martin Marken Markan Marken Marken Marken Marken Marken Marken Marken Marken Mar	smoke damper. Access	A. Roof—mounted centrifugal exhaust fans shall be Greenheck Model G for direct drive fans and Greenheck Model GB for belt—drive fans, or an approved equal, as scheduled.	SECTION 23 37 1
 Tradition Control Control	the duct in which they to provide access to the links. Access doors in downstream of fire provided through	2.05 CEILING/CABINET EXHAUST FANS A. Ceiling/cabinet exhaust fans shall be Greenheck Model CSP (inline/cabinet) or Greenheck Model SP (ceiling) with integral grille, or an approved equal.	DIFFUSERS, REGISTERS, AN <u>1.0 GENERAL</u> 1.01 DESCRIPTION
 A. Fore while is defined as believed on the variance of the second of the variance of the second of the variance of the variance	installation under Each door shall match	3.0 EXECUTION 3.01 INSTALLATION	A. All work specified in this Section is governed for HVAC Section 23 05 00.
 1.2.2 - 2.0000000 A. The took shall be scalar and adjusted clar instaliation or parale the concelline inflated. 2.8.0 - 2.5 GETOR 3.8.0 - 2.5 GETOR 3.8.1 - 2.5 GETOR 3.9.2 - 2.5 GETOR 3.9.	ctor locations. Access if the detector. Access ded.	A. Fans shall be installed as indicated and in conformance with the manufacturer's recommendations. Coordinate the actual units to be provided with all trades.	B. This Section 23 37 13 and the accompanyi all labor, equipment, appliances and materic in connection with the construction and ins as specified herein and as shown. These un
FOR OF SECTION 2. Control Section 4. Performance with the interfactor as spectral to the control of the control o	IACNA, UL, and NFPA	3.02 ADJUSTMENT A. The fans shall be tested and adjusted after installation to provide the capacities indicated.	the following: 1. Ceiling Diffusers (CD) 2. Return Air Grilles (RAG)
100 AP ETRIVAL LURS H. Ellistic of B 100	red to the structure. s the Contractor's supports shall be	END OF SECTION SECTION 23 36 00	3. Curved Supply Register (CSR) 1.02INTENT
 In Figher on to arrive the Tight of the Difference of Difference of the Difference of Difference	items shall be installed	AIR TERMINAL UNITS	H. It is the intent of this Section of the spec operable, adjusted air distribution devices a free of excessive noise, vibration and airflo
 A. Mill gost grantfed in this Section is governed by the Common Work Rends on the forehold of the	e radius equal to or ing installed. Also, in rk to the terminal	1.01 DESCRIPTION	1.03 SELECTION CRITERIA
 and whith direct and a second party gravity access the previous of the second party of the se	ce of no more than 1" e from the centerline of ne of the terminal unit	A. All work specified in this Section is governed by the Common Work Results for HVAC Section 23 05 00.	A. All air distribution devices shall be selected minimum criteria unless otherwise noted be
Inform The Niels size of intermediation of the intermediation of the object o	ich termindi unit shali	B. This Section 23 36 00 and the accompanying drawings cover the provisions of all labor, equipment, appliances and materials, and performing all operations in connection with the construction and installation of the terminal units as specified herein and as shown. These units include, but are not limited to the following:	1. Method of mounting shall be compatible surface which it mounts on or in; i.e. frame, duct collar, etc. The architectur determine the mounting method for ea mounted devices shall be provided with
all be left: unequeed for 1.02 NEX1 1.02 NEX1 A secolated control systems 1.02 NEX1 A is to finand of this section of the specifications to provide complete, objected to mind of the Section of the specifications to provide complete, objected to secolar on all specifications to provide complete, specifications of the specification of the specifications of the specification of the s	from the inlet size of nit is rectangular, the ur at the inlet to the	 Variable air volume (VAV) units Powered induction units (PIU) 	 Finish of all ceiling mounted devices sh of the adjacent ceiling. Finish of all wa which is compatible with the finish coa finish coat will be applied under Division
 The presure ducteork is only. The medium A. It is the intent of this Section of the specifications to provide complete, operated, edgisted terminal units as shown and specified, which are free of society in the component is incommon. Work feed to a society in the specification of the specification	all be left uncapped for	3. Associated control systems	1.04 BASIS OF DESIGN
In Conformance with a rubitated after a capitated capitate a capitated after a capitated capitate a capitated after a capitated capitate a capitated capaitate a capitated capitate a capitated ca	n-pressure ductwork rk only. The medium	A. It is the intent of this Section of the specifications to provide complete, operable, adjusted terminal units as shown and specified, which are free of excessive noise, vibration and airflow fluctuations.	A. The basis of design is Nailor. Any proposed equal in all respects to the equipment spec modifications to ductwork, controls, ceilings result from any substitution shall be coordi coordination shall occur before delivery of
pit equipment Architect in all 1.04ACCEPTABLE SUBSITUTE NANUFACTURERS Interactive sections and known of the substitute menufacturers are Trane, Naller, Price, Carrier, Titus, and, Kneeger. Interactive sections and kneeger. 2.0 PRODUCTS 2.0 PRODUCTS 2.0 DESCRPTION A. Veriable air volume units (VAV) shall consist of primary air domper, attenuator section and noise shroud (if required to meet listed sound pressure levels), primary air domper actuator, primary air controller and any other items required to perform as indicating and is 3 or 10° inicit satistic pressure; the maximum acceptable NC at the VAV unit discharage is 40 of 10° inicit satistic pressure; the maximum acceptable NC at the VAV and is 35 or 10° inicit satistic pressure; the maximum acceptable NC at the VAV unit discharage is 40 of 10° inicit satistic pressure; the maximum acceptable and round hall be constructed of galvanized steel sheets, referered to a static pressure; the maximum acceptable NC at the VAV unit discharage is 40 of 10° inicit satistic pressure; the maximum acceptable NC at the VAV and the ablock fire reformed to a direct field S ⁻⁰ from the requirements of Section 23 Of 13. Service to internal ports shall be thorough an access and few, housing shall be constructed of galvanized steel sheets, referered to reported according to the housing. B. Return Air Grilles (RAG) provide complete, ref free of excessive C. A pressure independent pressure schon, fup powerd induction section, disposable filter, backdrich dumper for in section, consider shall control the supply arguments while be 24-woit. B. Return Air Grilles (RAG) provide complete, ref free of excessive F. Powere induction units (PUIs) shall be factory fabricated complete with dire	d in conformance with ctual units to be d adjusted after	 1.03BASIS OF DESIGN A. The basis of design is Trane or as scheduled. Any proposed substitutions shall be proven equal in all aspects to the equipment specified as the basis of design. 	A. Acceptable manufacturers are Price, Carnes
2.0 PRODUCTS 2.0 IDESCRIPTION 2.0 IDESCRIPTION A. Variable air volume units (VAV) shall consist of primary air damper, attenuator section and noise shroud (if required to meet listed sound pressure levels), primary air damper ocluator, primary air controller and any other items required to perform as indicated and specified. A. Ceiling Diffusers (CD) ammon Work Results B. The maximum acceptable KC at the VAV unit discharge is 40 at 1.0° inlet static pressure; the maximum acceptable rolated KO is 35 at 1.0° inlet static pressure; the maximum static pressure drop through the unit shall be immed to the following: B. The maximum acceptable KC at the VAV unit discharge is 40 at 1.0° inlet static pressure; the maximum static pressure drop through the unit shall be admini at dotter field 5-0° from the based on AkIR 880. B. Return Air Oriles (AGC) C. The unit housing shall be constructed of galvanized steel sheets, reinforced to eliminate excessive fiexing. Housing, shall be internal parts shall be through an access dorn in the bottom or side of the housing. B. Return Air Oriles shall be following: in a direct field 5-0° from the requirements of Section 23 OT 13. Service to internal parts shall be through an access dorn in the bottom or side of the housing. B. Return Air Oriles shall be follow selected to match the CDS; Nai the boals of doesign. provide complete, re free of excessive F. Powered induction units (PUs) shall be factory tabricated complete with as the boals of design. Nacet, PengBarry, Twin ar kitchen grease F. Powered induction units (PUs) shall be factory fabricated complete with accepting design. Nacet, PengBarry, Twin ar kitchen grease S. Intermittent operatin fundation davian	ept equipment Architect in all	 1.04 ACCEPTABLE SUBSTITUTE MANUFACTURERS A. Acceptable substitute manufacturers are Trane, Nailor, Price, Carrier, Titus, and Krueger 	characteristics are equal in all respects for <u>2.0 PRODUCTS</u>
 2.01 DESCRIPTION 2.01 DESCRIPTION A. Variable air volume units (VAV) shall consist of primary air damper, attenuator section and noise shroud (if required to meet listed sound pressure levels), primary oir damper actuator, primary oir controller and ony other items required to perform as indicated and specified. B. The maximum acceptable NC at the VAV unit discharge is 40 at 1.0° inlet static pressure. The maximum acceptable radiated NC is 35 at 1.0° inlet static pressure. The maximum acceptable radiated NC is 35 at 1.0° inlet static pressure. The maximum acceptable radiated NC is 35 at 1.0° inlet static pressure. The maximum acceptable radiated NC is 35 at 1.0° inlet static pressure. The maximum intervelocity shall be 2200 FPM. All NC ratings are based on AHR 880. C. The unit housing shall be internally lined with accustical fibrous glass liner with exposed face costed with a black fire retardant compound, conforming to NPA requirements. Liner shall meet the requirements of Section 23 OT 13. Service to internal parts shall be through an access door in the bottom or side of the housing. D. Controls shall be low-voltage electronic type with electrical actuators. All actuators shall be access door in the bottom or side of the housing. D. Controls shall be low-voltage electronic type with electrical actuators. All actuators shall be acton, the oward induction section, disposable filter, backdraft domper for moximum and minimum CfM. The VAV valves shall be normally closed on a close of control power. F. Powered induction units (PM) for primary air with for discharge perpendicular to the "No" and all electrical contactors, P.E. switches and controls. PIU shall have variable filter, backdraft domper for fans celling diffusers. C. Curved registers shall be duct m to mact the exterior insulation douts the installed down access door in the doset may with for discharge perpendicular to the WAV with is a co		2.0 PRODUCTS	2.01 DESCRIPTION A. Ceiling Diffusers (CD)
 ather items required to perform as indicated and specified. barmon Work Results cover the provision of cover the provision of forming all operations specified. B. The maximum acceptable NC at the VAV unit discharge is 40 at 1.0" inlet static pressure. The maximum acceptable rodiated NC is 35 at 1.0" inlet static pressure. The maximum inlet velocity shall be 2200 FPM. All NC ratings are based on AHRI 880. C. The unit housing shall be constructed of galvanized steel sheets, reinforced to eliminate excessive flexing. Housing shall be internal/purities that back adapted to the following: D. The unit housing shall be constructed of galvanized steel sheets, reinforced to eliminate excessive flexing. Housing shall be internal/purities shall be through an access door in the bottom or side of the housing. D. Controls shall be low-voltage electronic type with electrical actuators. All actuators shall be low-voltage electronic type with electrical actuators. All actuators shall be low-voltage electronic type with electrical actuators. All actuators shall be ad-volt. E. A pressure independent primary air volume controller shall control the supply ar quantity within 5% of the air volume required to satisfy the thermostat, regardless of charges in system static pressure. Full shall be factory set for moximum and minimum CFM. The VAV values shall be normally closed on a loss of control power. F. Powered induction units (PIUs) shall be factory fabricated complete with variable air volume section, fao powered induction section, disposable filter, backfordf damper for fon section, accustical plexum section, fao reverim, PL, switches and controls. PL switches and controls actuators shall be factory as of flex roty are volume expliced to actions, fao reverim and minimum CFM. The VAV values shall be normally closed on a loss of control power. <l< td=""><td></td><td> 2.01 DESCRIPTION A. Variable air volume units (VAV) shall consist of primary air damper, attenuator section and noise shroud (if required to meet listed sound pressure levels), primary air damper actuator, primary air controller and any </td><td> CD Ceiling diffusers (CD) shall be squar providing one-way, two-way, two-way air patterns; Nailor UNI with directional a 22 gauge steel face panel that capte The face panel shall be removable by r </td></l<>		 2.01 DESCRIPTION A. Variable air volume units (VAV) shall consist of primary air damper, attenuator section and noise shroud (if required to meet listed sound pressure levels), primary air damper actuator, primary air controller and any 	 CD Ceiling diffusers (CD) shall be squar providing one-way, two-way, two-way air patterns; Nailor UNI with directional a 22 gauge steel face panel that capte The face panel shall be removable by r
 0.45° WC. The maximum inlet velocity shall be 2200 FPM. All NC ratings are based on AHRI 880. 0.45° WC. The maximum inlet velocity shall be 2200 FPM. All NC ratings are based on AHRI 880. 0.45° WC. The maximum inlet velocity shall be 2200 FPM. All NC ratings are based on AHRI 880. 0.45° WC. The maximum inlet velocity shall be 2200 FPM. All NC ratings are based on AHRI 880. 0.45° WC. The maximum inlet velocity shall be 2200 FPM. All NC ratings are based on AHRI 880. 0.45° WC. The maximum inlet velocity shall be 2200 FPM. All NC ratings are based on AHRI 880. 0.45° WC. The maximum inlet velocity shall be internal parts shall be internal parts shall be through an occess door in the bottom or side of the housing. 0. Controls shall be low-voltage electronic type with electrical actuators. All actuators shall be low-voltage electronic type with electrical actuators. All actuators shall be 24-volt. E. A pressure independent primary air volume controller shall control the supply ar quantity within 5% of the air volume required to satisfy the thermostat, regardless of changes in system static pressure. Each unit shall be factory set for maximum and minimum CFM. The VAV valves shall be normally closed on a loss of control power. F. Powered induction units (PIUs) shall be factory fabricated complete with ar scoop damper set of affection blades shall be CSR and the intermost shall be as the basis of design. ction 23 05 00. Acme, PennBarry, Twin or kitchen grease G. Intermittent operation fan powered induction section shall consist of: 3.0 EXECUTION 	ommon Work Results	other items required to perform as indicated and specified. B. The maximum acceptable NC at the VAV unit discharge is 40 at 1.0" inlet static pressure; the maximum acceptable radiated NC is 35 at 1.0" inlet static pressure. The maximum static pressure drop through the unit shall be	exposed surface of the face panel shall visible fasteners. The back pan shall be and shall be constructed of 22-guage shall be in accordance with ANSI/ASHR maximum NC level at design girflow sha
 fibrous glass liner with exposed face coated with a black fire retardant compound, conforming to NFPA requirements. Liner shall meet the requirements of Section 23 07 13. Service to internal parts shall be through an access door in the bottom or side of the housing. D. Controls shall be low-voltage electronic type with electrical actuators. All actuators shall be 24-volt. E. A pressure independent primary air volume controller shall control the supply air quantity within 5% of the air volume required to satisfy the thermostat, regardless of changes in system static pressure. Each unit shall be factory set for maximum and minimum CFM. The VAV valves shall be normally closed on a loss of control power. F. Powered induction units (PIUs) shall be factory fabricated complete with air scoop damper set of deflection blades shall be CSR. The register shall have foa in accordance with ADC standarn adirflow at a maximum NC of 35 mounted directly to the duct wi the exterior insulation, as applic or volume unit (VAV) for primary air with fan discharge perpendicular to the VAV units. G. Intermittent operation fan powered induction section shall consist of: 	forming all operations the fans as specified imited to the following:	0.45" WC. The maximum inlet velocity shall be 2200 FPM. All NC ratings are based on AHRI 880. C. The unit housing shall be constructed of galvanized steel sheets, reinforced to eliminate excessive flexing. Housing shall be internally lined with acoustical	in a direct field $5'-0"$ from the face of 24"x24" unless noted on drawings. The white, unless directed otherwise by the and round neck damper (operable from installed in hard opilings)
provide complete, pre free of excessiveD. Controls shall be low-voltage electronic type with electrical actuators. All actuators shall be 24-volt.selected to match the CDs; Nail the plenum for return. All other ceiling diffusers.provide complete, pre free of excessiveE. A pressure independent primary air volume controller shall control the supply air quantity within 5% of the air volume required to satisfy the thermostat, regardless of changes in system static pressure. Each unit shall be factory set for maximum and minimum CFM. The VAV valves shall be normally closed on a loss of control power.G. Curved Supply Registers (CSR)stitutions shall be as the basis of design. ction 23 05 00.F. Powered induction units (PIUs) shall be factory fabricated complete with variable air volume section, acoustically lined plenum section, factory-mounted heating coil (installed downstream of the fan section) and all electrical contactors, P.E. switches and controls. PIU shall have variable air volume unit (VAV) for primary air with fan discharge perpendicular to the VAV unit. See Paragraphs 2.01 A through E for VAV units.3.0 EXECUTION		fibrous glass liner with exposed face coated with a black fire retardant compound, conforming to NFPA requirements. Liner shall meet the requirements of Section 23 07 13. Service to internal parts shall be through an access door in the bottom or side of the housing.	B. Return Air Grilles (RAG) 2. Retun air grilles shall be hollow core, 2
 stitutions shall be as the basis of design. Acme, PennBarry, Twin or kitchen grease Acme, PennBarry, Twin C. Intermittent operation fan powered induction section shall consist of: C. Intermittent operation fan powered induction section shall consist of: C. Intermittent operation fan powered induction section shall consist of: C. Intermittent operation fan powered induction section shall consist of: 	provide complete, are free of excessive	 D. Controls shall be low-voltage electronic type with electrical actuators. All actuators shall be 24-volt. E. A pressure independent primary air volume controller shall control the supply air quantity within 5% of the air volume required to satisfy the thermostat 	selected to match the CDs; Nailor UNI. the plenum for return. All other charac ceiling diffusers. G. Curved Supply Registers (CSR)
 as the basis of design. action 23 05 00. Acme, PennBarry, Twin por kitchen grease Carmittent operation fan powered induction section shall consist of: CSR and the innermost shall be CSR. The register shall have for an accordance with ADC standard in accordance with ADC standard in accordance with ADC standard airflow at a maximum NC of 35 mounted directly to the duct when the exterior insulation, as applications. Intermittent operation fan powered induction section shall consist of: 	stitutions shall be	regardless of changes in system static pressure. Each unit shall be factory set for maximum and minimum CFM. The VAV valves shall be normally closed on a loss of control power. F. Powered induction units (PIUs) shall be factory fabricated complete with	 Curved registers shall be duct mounted to match the installation duct system, complete with air scoop dampers for b set of deflection blades shall be paralle
bor kitchen grease the exterior insulation, as applic G. Intermittent operation fan powered induction section shall consist of: <u>3.0 EXECUTION</u>	as the basis of design. Action 23 05 00.	variable air volume section, fan powered induction section, disposable filter, backdraft damper for fan section, acoustically lined plenum section, factory-mounted heating coil (installed downstream of the fan section) and all electrical contactors, P.E. switches and controls. PIU shall have variable air volume unit (VAV) for primary air with fan discharge perpendicular to the VAV	CSR and the innermost shall be paralle CSR. The register shall have foam gask in accordance with ADC standards and airflow at a maximum NC of 35. CSRs mounted directly to the duct where no
	or kitchen grease	unit. See Paragraphs 2.01 A through E for VAV units. G. Intermittent operation fan powered induction section shall consist of:	the exterior insulation, as applicable. <u>3.0 EXECUTION</u>

6

7		8		9	
g and centrifugal direct drive fan	3.01 INSTALLAT	10N			
permanently lubricated, ECM fan ctrical drawings. ow through blower.	L. Air di the n be cc in the	stribution devices shall be installed as indicated and in c nanufacturer's recommendations. The color, frame, and bo ordinated with Architectural requirements and shall be se e finished surface indicated.	onformance with order types shall lected to install		
ed and shall receive air from n fan, and distribute the air Illel (side by side) discharge is	M. All ai indicc modif	r distributions devices to be reused shall be installed the ted for new devices. All existing color, frame, and border ied as required to match new device requirements.	same way as types shall		н
ed, 100% induced air mode, shall external static pressure of 0.35" charge. At the same operating ximum NC level of 35. All NC	N. All ai Archii incluc 3.02 ADJUSTM	r distribution devices with blade orientations shall be coor ect. Specific attention is called to devices in exposed ce ing wall—mounted. IENT	rdinated with iling areas,		
on except those serving toilets, e constant volume units.	A. Grilles sched	, registers, diffusers, etc. shall be tested and adjusted to uled air flow capacities.	o provide the		
nection required to each PIU n the fan and the electric heater. Inless otherwise scheduled. Provide only. The fan motor shall draw not connected to 277 volts, single	B. All de damp instal Adjus with damp	evices shall have adjustable and accessible volume damped ers are not or will not be accessible without access pane remote balancing cable control system, Young Regulator tment shall be from the face of the air distribution devic the Air Distribution Manufacturer. Coordinate the location er with the installation.	rs. Where els, provide and or equal. ee, coordinated and size of the		
s to be connected to (A, B, or C) nection required to each VAV	C. In all finish These sectio	slot diffuser applications, the inactive sections of the slo ed with perforated steel, painted flat black, selected to m sections shall be open to the plenum as a return air po ons shall have an insulated light shield	ot shall be natch the SDs. ath. Inactive		G
n the actuator and controls, as . Submittal shall indicate specific	END OF SECTI	ON SECTION 23 81 26			
		SPLIT-SYSTEM AIR-CONDITIONERS			
conformance with the e the actual units to be provided	1.01 DESCRIPTION	DN			
y the Installer of the VAVs under	A. All wo for H'	rk specified in this Section is governed by the Common ' /AC Section 23 05 00.	Work Results		
r installation to provide the	B. This S all lab in cor specif follow	Section 23 81 26 and the accompanying drawings cover t for, equipment, appliances and materials, and performing mection with the construction and installation of the split ied herein and as shown. This work includes, but is not ling ng:	he provision of all operations t systems as imited to, the		F
	1. S 2. C	ontrol system (interlocked to all split system components)		
	C. Split units with c R-410	system units shall be self—contained, automatic, packaged shall be completely factory—assembled as unitary package operating controls, internal wiring and piping and fully cha DA refrigerant. Only one electrical power connection shall	d units. These es complete rged with be required for		
13 ND GRILLES	each D. Units with /	unit. shall be UL listed and cooling capacities shall be certified NSI/AHRI 210/240.	d in accordance		
	1.02INTENT	he intent of this Section of the specifications to provide	complete		
ed by the Common Work Results	operal efficie	ole, adjusted split systems, as shown and specified, which ntly and automatically, and are free of excessive noise a	operate nd vibration.		
ing drawings cover the provisions of ials, and performing all operations stallation of air distribution devices nits include, but are not limited to	A. The b includ excep Carrie propo appro	asis of design is as scheduled. Acceptable alternate man e Trane, Carrier, Mitsubishi, Lennox, and Daikin for ducted t that Liebert systems are also acceptable for Server/IT r, Mitsubishi, LG, Hitachi, and Daikin for ductless mini-spl sed substitutions shall be submitted in accordance with t val requirements.	ufactures I systems spaces, and its. Any he prior		E
	2.0 PRODUCTS 2.01UNIT CASI	- NGS			
cifications to provide complete, as shown and specified which are ow fluctuations.	A. Unit a assem baked compo Fan c NFPA	casings shall be formed, galvanized steel construction with ably. Galvanized steel surfaces shall be bonderized and pa acrylic enamel for complete weather protection. Accesso onents shall match and interlock with all other split syste oil unit casings shall be fully internally insulated with line 25/50 flame spread/smoke developed ratings.	n welded inted with ries and em components. r which meets		
d in accordance with the following elow or on the drawings:	2.02 CONDENS	SING UNITS	and ready for		
le with the ceiling, wall or duct lay—in, surface mounting, plaster ral drawings shall be referenced to ach device. All flanges on surface n a gasket.	opera provid be dir pump have vibrat	tion. All units with capacities greater than five (5) tons s ed with minimum 2-stage (50% and 100%) cooling. Comp ect drive, 3600 RPM, hermetic reciprocating type with ce crankcase heater and internal pressure relief valve. Com internal spring isolation and sound muffling and exhibit m on transmission and noise. Anti-recycle timers shall be p	shall be pressor(s) shall ntrifugal oil pressor(s) shall inimum provided to		D
hall be selected to match the color all mounted devices shall be primer ating specified for the adjacent wall; on 9.	prever (5) m shutd	nt excessive cycling of compressors thru utilization of a r inute time shutdown of unit on interruption of power or own.	ninimum five controlled		
d substitutions shall be proven	B. Conde Conde	nsing unit condenser fans shall be direct—driven, propelle nsing unit heat rejection shall be vertically upward.	r blade type.		
ecified as the basis of design. Any s, building structure, etc., that linated with all trades. This equipment and any modifications	A. Evapo heavy	rator and condenser coils shall be copper tubing mechani duty aluminum fins. Aluminum tubes shall not be accept	cally bonded to able.		
ons to the Contract.	2.07 CONTROL A. All op	S AND ACCESSORIES erating and safety controls which are internal to each un	it shall be		
s, Metal Aire, Krueger, Nailor, and rmance, appearance and physical r this specific project.	overlo refrige and lo	y-Installed and shall include, as a minimum, solid state ad protection, magnetic contactors, thermostatic expansion erant line drier(s), outdoor fan and compressor cycling th ow limit protection against excessive temperatures or pres	compressor on valve(s), ermostats, high ssures.		
are, plaque face diffusers capable of	B. A 24 volt ir setbar seaso to mo	volt transformer shall be provided to accommodate an a adoor thermostat complete with an electronic programmat ck, separate automatic heat/cool settings, auto/manual f nal selector. Thermostat shall provide staging of the cool atch the stages of each component.	ccessory 24 ble night fan control and ing and heating		
corner, three-way, and four-way I blow clips. The diffuser shall have tures a secondary 22-gauge panel. means of four hanger brackets. The III be smooth, flat, and free of	C. Auton local duct- on th	natic shutdown controls shall be provided on units ≤2,000 Codes (or NFPA 90A as a minimum) and shall consist of mounted smoke detectors interlocked to the fan coil unit e detection of fire or smoke.) CFM to meet firestats and for shutdown		
RAE Standard 70-1991. The nall not exceed 35 when measured	3.01 INSTALLAT	<u>I</u> ION			
of the device. Diffusers to be e finish shall be baked enamel e Architect. Provide plaster frames n face of diffuser) for diffusers	A. The s accord B. The c	plit systems and associated controls shall be installed in dance with the manufacturer's recommendations. ontrol system shall be completely wired under this Divisio	strict n 23. Wirina		В
,	shall install	pe in accordance with the NEC and shall meet all require ation.	ments for this		
24"x24" plaque face, lay—in type, I. Provide with 15" neck open to cteristics shall be equal to the	A. Provic emplo exterr opera testin phase	e the services of a factory—trained and qualified Service yed by the Unit Manufacturer who shall inspect the instal al interlock and power connections; supervise leak testing tion, calibration of operating and safety controls and sup g including insulation resistance of motors and voltage bo s during starting and running.	Technician Ilation including g, initial ervise electrical alance between		
d, aluminum, radius end cap, radius , adjustable double-deflection type balancing purposes. The outermost	B. This S when	Service Technician shall forward a report in four (4) copie the unit is in safe and proper operating condition. This r	s to the Owner eport shall e readings per		
ei to the long dimension of the el to the short dimension of the keting. The register shall be tested I shall be selected to provide design s shall be Nailor 51DHC and be ot externally insulated, or flush with	includ phase that be lef maint full ur contro	during start and run, and shall list minor discrepancies affect safe and reliable operation. One additional copy of t in the unit control panel. One copy of bound installatio enance service and parts brochures, including applicable s nit description and parts ordering sources, shall be placed of panel at the time of startup; four (4) additional copies	to be corrected the report shall n, operation, serial numbers, i in the unit s shall be		A
	torwar END OF SECTIO	DN			



FAN	SCHED

						FAN	SCHE	IDULE		
I.D. TAG	CAPACITY (CFM)	S.P. (IN. WG)	MOTOR H.P.	DRIVE	VOLTS/ PHASE	MAXIMUM FAN RPM	MAXIMUM NOISE	TYPE OF FAN	BASIS OF DESIGN	REMARKS
TEF-1	70	0.4	F	DIRECT	115/1	736	1.7 SONES	CEILING EXHAUST	GREENHECK SP-B110	12
BAF-A	-	-	1.0	DIRECT	460/3	110	< 55 dBA	BIG CEILING FAN	BIG ASS FAN BASIC 6 (10 FOOT)	5
EF-A	8,004	0.3	1.5	DIRECT	460/3	1750	31 SONES	AXIAL WALL MOUNTED EXHUAST	GREENHECK AER-E24C-323-A15	234

(1) INTERLOCK FAN WITH RESTROOM LIGHTS.

(2) PROVIDE FAN WITH A SPEED CONTROLLER AND BACKDRAFT DAMPER. (3) FAN TO BE TIED INTO CARBON MONOXIDE/NITROGEN DIOXIDE DETECTOR.

(4) PROVIDE FAN WITH A WALL MOUNTED SWITCH.

(5) PROVIDE FAN WITH STANDARD WALL MOUNTED ON/OFF SWITCH/SPEED CONTROLLER.

										SPI	LIT S	SYSTEM S	SCH	EDULE	-					
									FAN CO	IL UNIT	DATA					CONDENSING	UNIT DAT	۱.		
I.D. TAG	MINIMUM TOTAL CAP. (BTUH)	MINIMUM SENSIBLE CAP. (BTUH)	AIRFLOW (CFM)	OUTSIDE AIR (CFM)	EXT. S.P. (IN. W.C.) ①	MAX H.P.	COIL °F db	EAT	Volts/ Phase	DRIVE ②	MAX FAN RPM	TYPE OF UNIT	HEATING TYPE	SECTION	AMBIENT TEMP.(°F)	VOLTS/ PHASE	STAGES	MIN. SEER	BASIS OF DESIGN	REMARKS
HU-1/CU-1	12,000		400		0.8		80	67	208/1	D		HORIZONTAL AHU	HP	14,000	95	208/1	1	21.4	MITSUBISHI PVA-A12AA7/PUZ-A12NKA7	46
AHU-2/CU-2	24,000		775				80	67	208/1	D	1075	WALL MOUNTED			95	208/1	VFD	21.4	MITSUBISHI PKA-A24KA7/PUY-A24NHA7	46

U THIS IS THE SE EXTENSIVE TO THE ENTINE FAIR COLE ONT ASSEMBLE (WET COLL, CASINO, CLEAN FILTERS, AND FORMACE LOSSES ARE NOT INCLUDED IN THIS EXT. SF.) (3) PROVIDE WITH CONDENSATE PUMP, PER MANUFACTURERS RECOMMENDATIONS.

(2) B = BELT DRIVE, D = DIRECT

(3) HP STANDS FOR HEAT PUMP AND CAPACITY IS GIVEN IN MBH, ELEC STANDS FOR ELECTRIC HEAT AND VALUES ARE GIVEN IN KW.

(4) PROVIDE WITH REMOTE WALL MOUNTED FULLY PROGRAMMABLE THERMOSTAT LOCATED AS SHOWN ON PLANS.

A

GENERAL NOTES (APPLY TO ALL SHEETS)

- 1. THESE DRAWINGS ARE SCHEMATIC IN NATURE AND ARE NOT INTENDED TO SHOW ALL POSSIBLE CONDITIONS. IT IS INTENDED THAT A COMPLETE TENANT MECHANICAL SYSTEM BE PROVIDED WITH ALL NECESSARY EQUIPMENT, ACCESSORIES, OPTIONS AND CONTROLS, COMPLETELY COORDINATED WITH ALL DISCIPLINES. ALL ITEMS AND LABOR REQUIRED FOR A COMPLETE TENANT MECHANICAL SYSTEM IN ACCORDANCE WITH ALL APPLICABLE CODES, STANDARDS AND THE BASE BUILDING CONTRACT DOCUMENTS SHALL BE FURNISHED WITHOUT INCURRING ADDITIONS TO THE CONTRACT.
- 2. REFER TO THE ARCHITECTURAL DRAWINGS FOR EXACT PARTITION LAYOUTS, REFLECTED CEILING PLANS, DIMENSIONS, ETC.
- 3. COORDINATE THE LOCATION OF ALL TERMINAL UNITS (NEW & EXISTING) CLOSELY WITH ALL WALLS THAT GO TO STRUCTURE, COLUMNS, DUCTWORK, ETC. THE UNIT SHALL EITHER BE RELOCATED OR THE WALL OFFSET TO PROVIDE CLEARANCE THE UNIT SHALL HAVE THE GREATER OF 2'-0" OF SERVICE CLEARANCE ALL AROUND OR AS REQUIRED BY CODE.
- 4. REFER TO THE ARCHITECTURAL REFLECTED CEILING PLANS FOR EXACT LOCATIONS OF ALL CEILING MOUNTED AIR DISTRIBUTION DEVICES. IF ANY ITEMS ARE NOT SHOWN ON THE REFLECTED CEILING PLANS, PREPARE A DRAWING OF THE PROPOSED LOCATION AND PRESENT IT TO THE ARCHITECT FOR APPROVAL PRIOR TO INSTALLATION.
- 5. ALL ROUND AND FLEXIBLE DUCTWORK EXTENDING TO DIFFUSERS SHALL BE SIZED FULL SIZE OF DISTRIBUTION DEVICE INLET, AND TAPS TO THE EXISTING LOW-PRESSURE DUCTWORK SHALL BE MADE WITH SPIN-IN FITTINGS HAVING INTEGRAL SCOOPS AND VOLUME DAMPERS. ALL NEW RECTANGULAR DUCTWORK TAPS SHALL BE MADE WITH SPLITTERS OR EXTRACTORS. ALL DUCTWORK SHALL BE CONSTRUCTED AND INSTALLED IN ACCORDANCE WITH SMACNA DUCT STANDARDS. NEW LOW PRESSURE SPIN-IN FITTINGS AND TAPS SHALL NOT BE MADE WITHIN 5 FT OF OUTLET OF EQUIPMENT. NEW LOW PRESSURE SPIN-IN FITTINGS SHALL BE MADE NO CLOSER THAN 2'-6" ON CENTER.
- 6. FLEXIBLE DUCTS SHALL BE INSTALLED FREE OF SAGS AND KINKS; SUPPORTED AT NOT MORE THAN 48" O.C. 7. TEST AND BALANCE ALL DIFFUSERS, BOXES, FANS, ETC. TO THE AIRFLOWS AND CONDITIONS INDICATED. ALL EXISTING
- DIFFUSERS, BOXES, FANS, ETC. WHICH ARE NOT NOTED OTHERWISE SHALL BE BALANCED TO THEIR PRIOR DESIGN AIRFLOWS; REFERENCE THE EXISTING RECORD DRAWING AVAILABLE FROM THE OWNER. TESTING AND BALANCING OF HVAC SYSTEM SHALL BE PERFORMED IN ACCORDANCE WITH THE STANDARDS OF AABC OR NEBB AND SHALL BE PERFORMED UNDER THE DIRECT SUPERVISION OF AN AABC OR NEBB CERTIFIED TEST AND BALANCE ENGINEER. SUBMIT 4 COPIES OF THE REPORT TO THE OWNER.
- 8. NEW PERIMETER SLOT DIFFUSERS SHALL BE PROVIDED AS REQUIRED, AND SELECTED IN ACCORDANCE WITH BASE BUILDING STANDARD.
- 9. PORTIONS OF DUCTWORK VISIBLE THROUGH GRILLES AND REGISTERS IN FINISHED AREA SHALL BE PAINTED FLAT BLACK. 10. ALL CONTROL WIRING AND TUBING INSTALLED ABOVE THE CEILING SHALL BE LOCATED AS HIGH ABOVE THE CEILING AS
- POSSIBLE AND SHALL FOLLOW THE DESIGNATED GENERAL ROUTING OF THE DUCTWORK. DO NOT HANG WIRING OR TUBING FROM DUCTWORK; RATHER, SUSPEND FROM THE STRUCTURE. ALL NEW TERMINAL UNITS SHALL BE TIED INTO THE BASE BUILDING CONTROL SYSTEM. SEE BASE BUILDING SPECIFICATIONS FOR REQUIREMENTS.
- 11. SPRINKLER HEADS AND ASSOCIATED BRANCH PIPING SHALL BE PROVIDED AND RELOCATED IN ACCORDANCE WITH NFPA 13 AND ALL PREVAILING LOCAL CODES AS REQUIRED TO PROTECT ALL SPACES IN THIS TENANT AREA. SPRINKLER HEADS SHALL BE SEMI-RECESSED SPRINKLER HEADS IN TENANT AREAS AND CONCEALED FULLY RECESSED TYPE IN PUBLIC CORRIDORS.
- 12. COORDINATE ALL WORK IN OCCUPIED AREAS WITH THE TENANT IN THAT AREA. COORDINATE ALL WORK IN UNOCCUPIED AREAS AND COMMON AREAS WITH LANDLORD.

13. ALL MATERIALS IN PLENUM SHALL BE PLENUM-RATED.

- 14. THERMOSTATS SHALL BE LOCATED IN EACH ZONE AS SHOWN. THE EXACT LOCATION ON THE WALL INDICATED SHALL BE AS DIRECTED BY THE ARCHITECT. NEW THERMOSTATS SHALL BE SELECTED TO MATCH EXISTING BASE BUILDING THERMOSTATS AND SHALL BE COMPATIBLE WITH EQUIPMENT SERVED. THERMOSTATS ON EXTERIOR WALLS SHALL BE PROVIDED WITH INSULATED BACKING.
- 15. MATERIALS EXPOSED WITHIN THE PLENUM SHALL BE NONCOMBUSTIBLE OR HAVE A FLAME SPREAD INDEX OF NOT MORE THAN 25 AND A SMOKE-DEVELOPEMENT INDEX OF NOT MORE THAN 50 AS DETERMINED IN ACCORDANCE WITH ASTM E 84.

MECHANICAL SU MECHANICAL SYSTEMS, SERVICE	IMMARY SYSTEMS AND EQUIPMENT	ABBREVIATIONS					
Method of Compliance:		A/C		ID	INSIDE DIMENSION		
🛛 Prescriptive 🗌 Energy cost Budget		AD	ACCESS DOOR	IN	INCHES		
Thermal Zone 3A		ADJ	ABOVE FINISHED FLOOR	12\\\/			
winter dry bulb: 18 deg F		AUTO AC	AUTOMATIC AIR CONDITIONING	r vv	REOWATTS		
summer dry bulb: 94 deg F		AHU	AIR HANDLING UNIT	LAT	LEAVING AIR TEMPERATURE		
Interior design conditions		DAL		LB LG	POUNDS LINEAR GRILLE		
summer dry bulb: 70 deg F		BDD	BACKDRAFT DAMPER		LINEAR RETURN GRILLE		
relative humidity: 50%		B/G	BELOW FLOOR BELOW GRADE	LWS	LOOP WATER SUPPLY		
		B ³ FLY RHP	BUTTERFLY BRAKE HORSEPOWER				
Total tenant heating load N/A		BCO	BASE CLEANOUT	MIN MAX	MINIMUM MAXIMUM		
Total tenant cooling load				MD	MANUAL DAMPER		
Total tenant cooling load N/A		CFM CBCR	CUBIC FEET PER MINUTE CURVED BLADE CEILING REGISTER	MOD	MANUFACTURER		
Mechanical Spacing Conditioning System		CD	CEILING DIFFUSER CONDENSING UNIT				
Unitary description of unit N/A		CW	COLD WATER (DOMESTIC)	NC NG	NORMALLY CLOSED NATURAL GAS		
heating efficiency N/A		CHWS	CHILLED WATER RETURN	NFWH	NON-FREEZE WALL HYDRANT		
cooling etticiency N/A heat output of unit N/A		CWS CWR	CONDENSER WATER SUPPLY CONDENSER WATER RETURN	NOM	NOMINAL		
cooling output of unit N/A		CON	CONCENTRIC CLEANOUT				
Boiler total boiler output N/A		COND	CONDENSATE	OA OD	OUTSIDE AIR OUTSIDE DIMENSION		
Chiller				OBD	OPPOSED BLADE DAMPER		
total chiller capacity N/A		db DN	DRY BULB DOWN				
List equipment efficiencies		DR	DRAIN DITTO	PIU PSI	POWERED INDUCTION UNIT POUNDS PER SQUARE INCH		
Equipment schedules with motors (mechanical	systems)	dB	DECIBELS				
motor horsepower		Dwg	DRAWING	RA	RETURN AIR Radius		
number of phases		EA	EACH	RAG	RETURN AIR GRILLE		
motor type		EAT FCC	ENTERING AIR TEMPERATURE	RED RL	REDUCER REFRIGERANT LIQUID		
# of poles		EF	EXHAUST FAN	RS RTU	REFRIGERANT SUCTION ROOFTOP UNIT		
		EOD	EXHAUST REGISTER	RAR	RETURN AIR REGISTER		
		ESP EWT	EXTERNAL STATIC PRESSURE ENTERING WATER TEMPERATURE				
	LEGEIND	EXH EFF	EXHAUST EFFICIENCY	SP SPS	STATIC PRESSURE SENSOR		
	CEILING DIFFUSER			SA	SUPPLY AIR SANITARY		
	CEILING RETURN AIR GRILLE	F	FAHRENHEIT	SD	SMOKE DAMPER SENSIBLE		
	SIDE-WALL OF DUCT MOUNTED	FCU	FLOOR CLEANOUT FAN COIL UNIT	SCIN			
	REGISTER	FSD FD	FIRE/SMOKE DAMPER FIRE DAMPER OR FLOOR DRAIN	SR ST	STORM		
	SLOT DIFFUSER		FLOOR DRAIN (only)	SS	SPLII SYSTEM		
	MANUAL VOLUME DAMPER	FOB	FLAT ON BOTTOM				
	FIRE DAMPER	FOR	FUEL OIL KETUKN	TG	TRANSFER GRILLE		
		FOT FPM	FLAT ON TOP FEET PER MINUTE	TYP	IYPICAL		
	NIGHT SET-BACK	FPS FT	FEET PER SECOND FFFT	UON	UNLESS OTHERWISE NOTED		
	MOTOR OPERATED DAMPER			50,1			
	EXISTING WORK	G	GATE	V	VENT		
	NEW WORK	GA GPM	GAUGE GALLONS PER MINUTE	VA VTR	VALVE VENT THRU ROOF		
	WORK TO BE REMOVED	GL	GLOBE GRADE CLEANOLIT	VAV	VARIABLE AIR VOLUME		
	FLOOR DRAIN	000		L			
	HOSE BIBB	HD	HUB DRAIN	wb WC	WATER COLUMN		
 	WALL CLEAN-OUT	НР нтс	HORSEPOWER HFATING	WHA WT	WATER HAMMER ARRESTOR WEIGHT		
	DUCT ACCESS PANEL	HW	HOT WATER (DOMESTIC)	W	WASTE		
	DOUL NOULDO LANLL	I HWR					

Hz HERTZ

8

ELECTRIC HEATER SCHEDULE								
I.D. TAG	DESCRIPTION	CAPACITY KW	MIN CFM	VOLTS/ PHASE	BASIS OF DESIGN	REMARKS		
UH-A	FAN FORCED HEATER	13.0	800	460/3	REDDI UH	1		
-						-		

(1) PROVIDE HEATER WITH UNIT MOUNTED THERMOSTAT AND INTEGRAL DISCONNECT.

(6) PROVIDE WITH LOW AMBIENT CONTROLS.

COMMISSIONING NOTES: 1. THE 2018 NC ENERGY CODE REQUIRES THE MECHANICAL AND SERVICE WATER HEATING SYSTEMS IN BUILDINGS WITH A FLOOR AREA IN EXCESS OR 10,000 SQ. FT TO BE COMMISSIONED BY A REGISTERED DESIGN PROFESSIONAL.

- THE CONTRACTOR SHALL OBTAIN THE SERVICES OF A NC LICENSED ENGINEERING PROFESSIONAL TO PERFORM ALL REQUIRED COMMISSIONING. PRIOR TO ISSUANCE OF CERTIFICATE OF OCCUPANCY A SIGNED <u>STATEMENT OF SYSTEM COMMISSIONING</u> (SEE APPENDIX C1) SHALL BE PROVIDED TO CODE OFFICIAL AND FACILITY OWNER.
- COMMISSIONING HAS BEEN EXCLUDED FROM BARRETT, WOODYARDS DESIGN SCOPE. HOWEVER, WE CAN PERFORM SAID SERVICES UNDER THE CONTRACTORS SCOPE.
- COMMISSIONING SHALL BE DONE IN ACCORDANCE WITH SECTION C408 OF THE 2018 NC ENERGY CODE. COMMISSIONING SHALL INCLUDE: 4.1. A COMMISSIONING PLAN WITH: A) A NARRATIVE OF THE ACTIVITIES TO BE PERFORMED AND BY
 - WHO. B) A LIST OF EQUIPMENT TO BE COMMISSIONED.
 - C) FUNCTIONS TO BE TESTED.
 - D) CONDITIONS UNDER WHICH TESTS SHALL BE PERFORMED. E) MEASURABLE CRITERIA FOR PERFORMANCE.
- 4.2. HVAC SYSTEMS SHALL BE TESTED AND BALANCED. REFER TO SPEC SECTION 23043 FOR TEST AND BALANCE REQUIREMENTS.
- 4.3. HYDRONIC SYSTEMS SHALL BE BALANCED ACCORDING TO THE REQUIREMENTS SET FORTH IN C408.2.2.2.
- 4.4. ALL CONTROLS SHALL BE COMMISSIONED TO ENSURE ALL SYSTEM ARE OPERATING IN ACCORDANCE WITH APPROVED PLANS AND
- SPECIFICATIONS. 4.5. FUNCTIONAL TESTING TO ENSURE SYSTEMS ARE OPERATING IN ACCORDANCE WITH APPROVED PLANS AND SPECIFICATIONS.
- CONTRACTOR SHALL PROVIDE TO THE OWNER AND SYSTEM COMMISSIONING AGENT, ALL INSTRUCTIONS ON MAINTENANCE AND OPERATION OF ALL SYSTEMS AND EQUIPMENT. THE DOCUMENTATION SHALL INCLUDE THE FOLLOWING, AT A MINIMUM:
- A) SUBMITTAL DATA B) OPERATION AND MAINTENANCE MANUALS FROM MANUFACTURER.
- C) NAME AND ADDRESS OF AT LEAST ONE SERVICE AGENCY. D) CONTROL SYSTEM MAINTENANCE AND CALIBRATION INFORMATION.
- E) TEST & BALANCE REPORT
- CONTRACTOR TO PROVIDE AT PROJECT COMPLETION, PRIOR TO OBTAINING CERTIFICATE OF OCCUPANCY, PRESENT AT FINAL INSPECTION TO THE JURISDICTION'S AHJ A SIGNED AND DATED STATEMENT OF SYSTEM COMMISSIONING FOR ALL MECHANICAL & HYDRONIC SYSTEMS. THE FORMAT OF THE STATEMENT OF SYSTEMS COMMISSIONING SHALL BE IN THE FORM REQUIRED BY THE STATES'S ENERGY CONSERVATION CODES AND/OR AHJ REQUIREMENTS, THE DOCUMENT SHALL BE SIGNED BY THE CONTRACTOR'S LICENSED PROFESSIONAL ENGINEER REPRESENTATIVE.

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