- 1.1 WORK INCLUDES ALL LABOR, MATERIAL, AND EQUIPMENT NECESSARY FOR THE INSTALLATION OF OPERATING HVAC SYSTEMS, INCLUDING ALL EQUIPMENT DUCTWORK, CONTROLS, AND RELATED ITEMS AS REQUIRED OR
- SPECIFIED. 1.2 ALL WORK SHALL CONFORM TO THE CURRENT STATE AND LOCAL CODES AND BE APPROVED BY THE AUTHORITY HAVING JURISDICTION, CONTRACTOR SHALL

OBTAIN ALL PERMITS AND PAY ALL FEES FOR THE

WORK INCLUDED. 1.3 PROJECT SUBMITTALS, IF REQUESTED CONTRACTOR SHALL SUBMIT FOR APPROVAL ON ALL MATERIALS AND

METHODS SHOWN IN THESE PLANS.

WHO REQUESTED THE SUBSTITUTION.

- 1.4 ALL SUBSTITUTIONS SHALL BE SUBMITTED IN WRITING AND APPROVED BY THE OWNER OR THE OWNERS REPRESENTATIVE. A CONTRACTOR OFFERING A SUBSTITUTION SHALL ACCEPTS RESPONSIBILITY FOR COORDINATING WITH ALL OTHER TRADES AND ANY ADDITIONAL ENGINEERING REQUIRED, ALL COSTS AND CHANGES RESULTING FROM THE INCLUSION OF SUBSTITUTIONS SHALL BE PAID BY THE CONTRACTOR
- 1.5 IF THE CONTRACTOR FINDS DISCREPANCIES, OR DMISSIONS, OR IS IN DOUBT AS TO THE EXACT MEANING OF THE PLANS OR SPECIFICATIONS, THEY SHALL, BEFORE STARTING WORK, CONTACT THE OWNER OR ENGINEER FOR CLARIFICATION.

DUCT INSULATION

2.1 INSULATE ALL DUCTWORK IN COMPLIANCE WITH ALL

APPLICABLE CODES AND ASHRAE STANDARD 90.1.

HVAC TESTING AND BALANCE 3.1 HVAC SYSTEM SHALL BE BALANCED AND TESTED IN ACCURDANCE WITH SECTION 230593 TO ACHIEVE DESIGN AIRFLOW SPECIFIED ON DRAWINGS.

CLOSEOUT

4.1.1 THE HVAC CONTRACTOR SHALL INSTRUCT THE OWNER IN PROPER OPERATION AND MAINTENANCE OF ALL EQUIPMENT. THE CONTRACTOR SHALL PROVIDE TWO BOUND COPIES OF AN OPERATIONS MANUAL UPON COMPLETION, SAID MANUAL SHALL INCLUDE ALL EQUIPMENT OPERATIONS MANUAL, "CUT" SHEETS OF ALL CONTRACTOR SUPPLIED ITEMS USED ON THE PROJECT AND WARRANTY CERTIFICATES.

GUARANTEE: 5.1.1 HVAC CONTRACTOR SHALL GUARANTEE IN WRITING, ALL LABOR AND MATERIALS FURNISHED AND INSTALLED UNDER THIS SECTION FOR A PERIOD OF ONE YEAR. COVERING MATERIALS AND WORKMANSHIP IN FULL

EQUIPMENT.

END OF SECTION 230500

EXCLUDED FROM THIS GUARANTEE IS OWNER SUPPLIED

- <u>SECTION 230593 TESTING, ADJUSTING, AND BALANCING FOR</u>
- 1 GENERAL
- SUMMARY
- A. SECTION INCLUDES: 1. BALANCING AIR SYSTEMS:
- a. CONSTANT-VOLUME AIR SYSTEMS. DEFINITIONS
- A. AABC: ASSOCIATED AIR BALANCE COUNCIL B. NEBB: NATIONAL ENVIRONMENTAL BALANCING
- C. TAB: TESTING, ADJUSTING, AND BALANCING. D. TABB: TESTING, ADJUSTING, AND BALANCING
- E. TAB SPECIALIST: AN ENTITY ENGAGED TO PERFORM TAB WORK. 1.3 SUBMITTALS
- A. CERTIFIED TAB REPORTS 1.4 QUALITY ASSURANCE
- A. TAB CONTRACTOR QUALIFICATIONS: ENGAGE A TAB ENTITY CERTIFIED BY NEBB OR TABB. 1. TAB FIELD SUPERVISOR: EMPLOYEE OF THE
 - TAB CONTRACTOR AND CERTIFIED BY NEBB OR 2. TAB TECHNICIAN: EMPLOYEE OF THE TAB
- CONTRACTOR AND WHO IS CERTIFIED NEBB OR TABB AS A TAB TECHNICIAN. B. CERTIFY TAB FIELD DATA REPORTS AND
- PERFORM THE FOLLOWING 1. REVIEW FIELD DATA REPORTS TO VALIDATE ACCURACY OF DATA AND TO PREPARE CERTIFIED TAB REPORTS
- 2. CERTIFY THAT THE TAB TEAM COMPLIED WITH THE APPROVED TAB PLAN AND THE PROCEDURES SPECIFIED AND REFERENCED IN THIS SPECIFICATION.
- C. TAB REPORT FORMS: USE STANDARD TAB CONTRACTOR'S FORMS APPROVED BY ARCHITECT D. INSTRUMENTATION TYPE, QUANTITY, ACCURACY, AND CALIBRATION: AS DESCRIBED IN ASHRAE 111, SECTION 5, "INSTRUMENTATION." PART 2 - PRODUCTS (NOT APPLICABLE)

EXAMINATION A EXAMINE THE CONTRACT DOCUMENTS TO BECOME

PART 3 - EXECUTION

- FAMILIAR WITH PROJECT REQUIREMENTS AND TO DISCOVER CONDITIONS IN SYSTEMS' DESIGNS THAT MAY PRECLUDE PROPER TAB OF SYSTEMS AND EQUIPMENT.
- B, EXAMINE SYSTEMS FOR INSTALLED BALANCING DEVICES, SUCH AS TEST PORTS, BALANCING VALVES AND FITTINGS, AND MANUAL VOLUME DAMPERS. VERIFY THAT LOCATIONS OF THESE BALANCING DEVICES ARE ACCESSIBLE
- C. EXAMINE THE APPROVED SUBMITTALS FOR HVAC SYSTEMS AND EQUIPMENT D. EXAMINE DESIGN DATA INCLUDING HVAC SYSTEM DESCRIPTIONS, STATEMENTS OF DESIGN ASSUMPTIONS FOR ENVIRONMENTAL CONDITIONS
- AND SYSTEMS' DUTPUT, AND STATEMENTS OF PHILOSOPHIES AND ASSUMPTIONS ABOUT HVAC SYSTEM AND EQUIPMENT CONTROLS. E. EXAMINE CEILING PLENUMS AND UNDERFLOOR AIR PLENUMS USED FOR SUPPLY, RETURN, OR RELIEF AIR TO VERIFY THAT THEY MEET THE LEAKAGE CLASS OF CONNECTED DUCTS AS
- SPECIFIED IN DIVISION 23 SECTION "METAL DUCTS" AND ARE PROPERLY SEPARATED FROM ADJACENT AREAS. VERIFY THAT PENETRATIONS IN PLENUM WALLS ARE SEALED AND FIRE-STOPPED IF REQUIRED. F. EXAMINE EQUIPMENT PERFORMANCE DATA
- INCLUDING FAN AND PUMP CURVES. 1. RELATE PERFORMANCE DATA TO PROJECT CONDITIONS AND REQUIREMENTS, INCLUDING SYSTEM EFFECTS THAT CAN CREATE UNDESIRED OR UNPREDICTED CONDITIONS THAT CAUSE REDUCED CAPACITIES IN ALL OR PART OF A
- 2. CALCULATE SYSTEM-EFFECT FACTORS TO REDUCE PERFORMANCE RATINGS OF HVAC EQUIPMENT WHEN INSTALLED UNDER CONDITIONS DIFFERENT FROM THE CONDITIONS USED TO RATE EQUIPMENT PERFORMANCE. TO CALCULATE SYSTEM EFFECTS FOR AIR SYSTEMS, USE TABLES AND CHARTS FOUND IN AMCA 201, "FANS AND SYSTEMS," OR IN SMACNA'S "HVAC SYSTEMS - DUCT DESIGN." COMPARE RESULTS WITH THE
- DESIGN DATA AND INSTALLED CONDITIONS. G. EXAMINE SYSTEM AND EQUIPMENT INSTALLATIONS AND VERIFY THAT FIELD QUALITY-CONTROL TESTING, CLEANING, AND ADJUSTING SPECIFIED IN INDIVIDUAL SECTIONS
- HAVE BEEN PERFORMED. H. EXAMINE TEST REPORTS SPECIFIED IN INDIVIDUAL SYSTEM AND EQUIPMENT SECTIONS I. EXAMINE HVAC EQUIPMENT AND FILTERS AND VERIFY THAT BEARINGS ARE GREASED, BELTS
- ARE ALIGNED AND TIGHT, AND EQUIPMENT WITH FUNCTIONING CONTROLS IS READY FOR OPERATION. J. EXAMINE TERMINAL UNITS, SUCH AS VARIABLE-AIR-VOLUME BOXES, AND VERIFY

THAT THEY ARE ACCESSIBLE AND THEIR

- CONTROLS ARE CONNECTED AND FUNCTIONING K. EXAMINE OPERATING SAFETY INTERLOCKS AND CONTROLS ON HVAC EQUIPMENT. L. REPORT DEFICIENCIES DISCOVERED BEFORE AND DURING PERFORMANCE OF TAB PROCEDURES. DBSERVE AND RECORD SYSTEM REACTIONS TO CHANGES IN CONDITIONS. RECORD DEFAULT SET POINTS IF DIFFERENT FROM INDICATED VALUES.
- 3.2 PREPARATION A. PREPARE A TAB PLAN THAT INCLUDES STRATEGIES AND STEP-BY-STEP PROCEDURES. B. COMPLETE SYSTEM-READINESS CHECKS AND PREPARE REPORTS. VERIFY THE FOLLOWING:
- 1. PERMANENT ELECTRICAL-POWER WIRING IS COMPLETE. 2. AUTOMATIC TEMPERATURE-CONTROL SYSTEMS
- ARE OPERATIONAL 3. EQUIPMENT AND DUCT ACCESS DOORS ARE SECURELY CLOSED. 4. BALANCE, SMOKE, AND FIRE DAMPERS ARE OPEN 5. CEILINGS ARE INSTALLED IN CRITICAL AREAS WHERE AIR-PATTERN ADJUSTMENTS ARE REQUIRED AND ACCESS TO BALANCING DEVICES
- 6. WINDOWS AND DOORS CAN BE CLOSED SO INDICATED CONDITIONS FOR SYSTEM OPERATIONS CAN BE MET 3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING A. PERFORM TESTING AND BALANCING PROCEDURES ON EACH SYSTEM ACCORDING TO THE PROCEDURES CONTAINED IN NEBB'S 'PROCEDURAL STANDARDS FOR TESTING, ADJUSTING, AND

IS PROVIDED.

- BALANCING OF ENVIRONMENTAL SYSTEMS AND IN THIS SECTION. 1. COMPLY WITH REQUIREMENTS IN
- ASHRAE 62.1-2004, SECTION 7.2.2, 'AIR BALANCING." B. CUT INSULATION, DUCTS, AND EQUIPMENT CABINETS FOR INSTALLATION OF TEST PROBES TO THE MINIMUM EXTENT NECESSARY FOR TAB
- PROCEDURES. 1. AFTER TESTING AND BALANCING, PATCH PROBE HOLES IN DUCTS WITH SAME MATERIAL AND THICKNESS AS USED TO CONSTRUCT DUCTS MARK EQUIPMENT AND BALANCING DEVICES, INCLUDING DAMPER-CONTROL POSITIONS, VALVE POSITION INDICATORS, FAN-SPEED-CONTROL LEVERS, AND SIMILAR CONTROLS AND DEVICES,
- WITH PAINT OR OTHER SUITABLE, PERMANENT IDENTIFICATION MATERIAL TO SHOW FINAL

D. TAKE AND REPORT TESTING AND BALANCING MEASUREMENTS IN INCH-POUND (IP) UNITS.

END OF SECTION 230593

- SECTION 230600 HVAC DUCTWORK
 - A. SECTION INCLUDES: 1. RECTANGULAR DUCTS AND FITTINGS.
- 3. SHEET METAL MATERIALS. 4. DUCT LINER.
- 2. ROUND DUCTS AND FITTINGS. 5. HANGERS AND SUPPORTS B. RELATED SECTIONS: 1. 230593 'TESTING, ADJUSTING, AND BALANCING
- FOR HVAC' FOR TESTING, ADJUSTING, AND BALANCING REQUIREMENTS FOR METAL DUCTS. 2. 230700 'HVAC DUCT ACCESSORIES' FOR DAMPERS, SOUND-CONTROL DEVICES, DUCT-MOUNTING ACCESS DOORS AND PANELS TURNING VANES, AND FLEXIBLE DUCTS. PERFORMANCE REQUIREMENTS
- A. DELEGATED DUCT DESIGN: DUCT CONSTRUCTION INCLUDING SHEET METAL THICKNESS, SEAM AND JOINT CONSTRUCTION, REINFORCEMENTS, AND HANGERS AND SUPPORTS, SHALL COMPLY WITH SMACNA'S 'HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE' AND PERFORMANCE REQUIREMENTS AND DESIGN CRITERIA INDICATED IN 'DUCT SCHEDULE
 - ARTICLE. B. STRUCTURAL PERFORMANCE: DUCT HANGERS AND SUPPORTS AND SEISMIC RESTRAINTS SHALL WITHSTAND THE EFFECTS OF GRAVITY AND SEISMIC LOADS AND STRESSES WITHIN LIMITS AND UNDER CONDITIONS DESCRIBED IN SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS -METAL AND FLEXIBLE' AND SMACNA'S 'SEISMIC RESTRAINT MANUAL: GUIDELINES FOR MECHANICAL SYSTEMS. WHEN REQUIRED BY
- C. AIRSTREAM SURFACES: SURFACES IN CONTACT WITH THE AIRSTREAM SHALL COMPLY WITH REQUIREMENTS IN ASHRAE 62.1-2004. SUBMITTALS
- A. PRODUCT DATA: FOR EACH TYPE OF PRODUCT INDICATED. B. SHOP DRAWINGS: 1. FABRICATION, ASSEMBLY, AND INSTALLATION,
- COMPONENTS, AND ATTACHMENTS TO OTHER 2. FACTORY- AND SHOP-FABRICATED DUCTS AND FITTINGS.

INCLUDING PLANS, ELEVATIONS, SECTIONS

- 3. DUCT LAYOUT INDICATING SIZES, CONFIGURATION, LINER MATERIAL, AND STATIC-PRESSURE CLASSES. 4. ELEVATION OF TOP OF DUCTS
- 5. DIMENSIONS OF MAIN DUCT RUNS FROM BUILDING GRID LINES. 6. FITTINGS. 7. REINFORCEMENT AND SPACING.
- 8. SEAM AND JOINT CONSTRUCTION. 9. PENETRATIONS THROUGH FIRE-RATED AND OTHER 10.EQUIPMENT INSTALLATION BASED ON EQUIPMENT BEING USED ON PROJECT.
- 11. LOCATIONS FOR DUCT ACCESSORIES, INCLUDING DAMPERS, TURNING VANES, AND ACCESS DOORS AND PANELS. 12. HANGERS AND SUPPORTS, INCLUDING METHODS FOR DUCT AND BUILDING ATTACHMENT, SEISMIC
- RESTRAINTS, AND VIBRATION ISOLATION. C. DELEGATED-DESIGN SUBMITTAL . SHEET METAL THICKNESSES 2. JOINT AND SEAM CONSTRUCTION AND SEALING 3. REINFORCEMENT DETAILS AND SPACING. 4. MATERIALS, FABRICATION, ASSEMBLY, AND
- SPACING OF HANGERS AND SUPPORTS PART 2 - PRODUCTS 2.1 RECTANGULAR DUCTS AND FITTINGS A. GENERAL FABRICATION REQUIREMENTS: COMPLY WITH SMACNA'S 'HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE' BASED ON INDICATED STATIC-PRESSURE CLASS UNLESS OTHERWISE INDICATED B. TRANSVERSE JOINTS: SELECT JOINT TYPES
 - AND FABRICATE ACCURDING TO SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE, FIGURE 1-4, TRANSVERSE (GIRTH) JOINTS, FOR STATIC-PRESSURE CLASS, APPLICABLE SEALING REQUIREMENTS, MATERIALS INVOLVED, DUCT-SUPPORT INTERVALS, AND OTHER PROVISIONS IN SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE.*
 - C.LONGITUDINAL SEAMS: SELECT SEAM TYPES AND FABRICATE ACCURDING TO SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE, FIGURE 1-5, "LONGITUDINAL SEAMS - RECTANGULAR DUCTS, FOR STATIC-PRESSURE CLASS, APPLICABLE SEALING REQUIREMENTS, MATERIALS INVOLVED, DUCT-SUPPORT INTERVALS, AND OTHER PROVISIONS IN SMACNA'S 'HVAC DUCT CONSTRUCTION
- STANDARDS METAL AND FLEXIBLE." D. ELBOWS, TRANSITIONS, OFFSETS, BRANCH CONNECTIONS, AND OTHER DUCT CONSTRUCTION: SELECT TYPES AND FABRICATE ACCURDING TO SMACNA'S 'HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE, CHAPTER 2, 'FITTINGS AND OTHER CONSTRUCTION. FOR STATIC-PRESSURE CLASS APPLICABLE SEALING REQUIREMENTS, MATERIALS INVOLVED, DUCT-SUPPORT INTERVALS, AND OTHER PROVISIONS IN SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND

- FLEXIBLE." ROUND DUCTS AND FITTINGS A. GENERAL FABRICATION REQUIREMENTS: COMPLY WITH SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE," CHAPTER 3, "ROUND, OVAL, AND FLEXIBLE DUCT, BASED ON INDICATED STATIC-PRESSURE CLASS UNLESS OTHERWISE INDICATED. 1. MANUFACTURERS: SUBJECT TO COMPLIANCE WITH REQUIREMENTS, AVAILABLE MANUFACTURERS OFFERING PRODUCTS THAT MAY BE INCORPORATED INTO THE WORK INCLUDE, BUT ARE NOT LIMITED TO, THE FOLLOWING: a. LINDAB INC. b. MCGILL AIRFLOW LLC SEMCO INCORPORATED.
- d. SHEET METAL CONNECTORS, INC. e. SPIRAL MANUFACTURING CD., INC. B. TRANSVERSE JOINTS: SELECT JOINT TYPES AND FABRICATE ACCORDING TO SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE, FIGURE 3-2, TRANSVERSE JOINTS - ROUND DUCT, FOR STATIC-PRESSURE CLASS APPLICABLE SEALING REQUIREMENTS, MATERIALS INVOLVED, DUCT-SUPPORT INTERVALS, AND OTHER PROVISIONS IN SMACNA'S 'HVAC DUCT
- CONSTRUCTION STANDARDS METAL AND FLEXIBLE." C. LONGITUDINAL SEAMS: SELECT SEAM TYPES AND FABRICATE ACCORDING TO SMACNA'S 'HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE, FIGURE 3-1, SEAMS - ROUND DUCT AND FITTINGS," FOR STATIC-PRESSURE CLASS, APPLICABLE SEALING REQUIREMENTS, MATERIALS INVOLVED, DUCT-SUPPORT INTERVALS, AND OTHER PROVISIONS IN SMACNA'S "HVAC DUCT
- CONSTRUCTION STANDARDS METAL AND FLEXIBLE." D. TEES AND LATERALS: SELECT TYPES AND FABRICATE ACCORDING TO SMACNA'S 'HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE. FIGURE 3-4, "90 DEGREE TEES AND LATERALS," AND FIGURE 3-5, "CONICAL TEES," FOR STATIC-PRESSURE CLASS, APPLICABLE SEALING REQUIREMENTS, MATERIALS INVOLVED, DUCT-SUPPORT INTERVALS, AND OTHER PROVISIONS IN SMACNA'S 'HVAC DUCT
- CONSTRUCTION STANDARDS METAL AND FLEXIBLE." 2.3 SHEET METAL MATERIALS A. GENERAL MATERIAL REQUIREMENTS: COMPLY WITH SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE" FOR ACCEPTABLE MATERIALS, MATERIAL THICKNESSES, AND DUCT CONSTRUCTION METHODS UNLESS OTHERWISE INDICATED. SHEET METAL MATERIALS SHALL BE FREE OF
 - PITTING, SEAM MARKS, ROLLER MARKS, STAINS DISCOLORATIONS, AND OTHER IMPERFECTIONS. B. GALVANIZED SHEET STEEL: COMPLY WITH ASTM A 653/A 653M. C. CARBON-STEEL SHEETS: COMPLY WITH ASTM A 1008/A 1008M, WITH DILED, MATTE FINISH FOR EXPOSED DUCTS.
 - D. STAINLESS-STEEL SHEETS: COMPLY WITH ASTM A 480/A 480M, TYPE 304 DR 316, AS INDICATED IN THE "DUCT SCHEDULE" ARTICLE COLD ROLLED, ANNEALED, SHEET, EXPOSED SURFACE FINISH SHALL BE NO. 2B, NO. 2D, NO. 3, OR NO. 4 AS INDICATED IN THE "DUCT SCHEDULE" ARTICLE.
 - E. ALUMINUM SHEETS: COMPLY WITH ASTM B 209 ALLDY 3003, H14 TEMPER; WITH MILL FINISH FOR CONCEALED DUCTS, AND STANDARD DNE-SIDE BRIGHT FINISH FOR DUCT SURFACES EXPOSED TO VIEW. F. REINFORCEMENT SHAPES AND PLATES: ASTM A 36/A 36M, STEEL PLATES, SHAPES, AND BARS; BLACK AND GALVANIZED.
 - 1. WHERE BLACK- AND GALVANIZED-STEEL SHAPES AND PLATES ARE USED TO REINFORCE ALUMINUM DUCTS, ISOLATE THE DIFFERENT METALS WITH BUTYL RUBBER, NEOPRENE, OR EPDM GASKET MATERIALS. G. TIE RODS: GALVANIZED STEEL, 1/4-INCH MINIMUM DIAMETER FOR LENGTHS 36 INCHES OR
- LENGTHS LONGER THAN 36 INCHES. 2.4 DUCT LINER A. FIBROUS-GLASS DUCT LINER: COMPLY WITH ASTM C 1071, NFPA 90A, DR NFPA 90B; AND WITH NAIMA AH124, "FIBROUS GLASS DUCT LINER STANDARD. MANUFACTURERS: SUBJECT TO COMPLIANCE WITH REQUIREMENTS, AVAILABLE MANUFACTURERS OFFERING PRODUCTS THAT MAY

LESS; 3/8-INCH MINIMUM DIAMETER FOR

- BE INCORPORATED INTO THE WORK INCLUDE, BUT ARE NOT LIMITED TO, THE FOLLOWING: a. CERTAINTEED CORPORATION; INSULATION GROUP. b. JOHNS MANVILLE. c. KNAUF INSULATION d. DWENS CORNING B. SHOP APPLICATION OF DUCT LINER: COMPLY WITH SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE," FIGURE
- 2-19, *FLEXIBLE DUCT LINER INSTALLATION.* . ADHERE A SINGLE LAYER OF INDICATED THICKNESS OF DUCT LINER WITH AT LEAST 90 PERCENT ADHESIVE COVERAGE AT LINER CONTACT SURFACE AREA. ATTAINING INDICATED THICKNESS WITH MULTIPLE LAYERS OF DUCT
- LINER IS PROHIBITED. 2. APPLY ADHESIVE TO TRANSVERSE EDGES OF LINER FACING UPSTREAM THAT DO NOT RECEIVE METAL NOSING 3. BUTT TRANSVERSE JOINTS WITHOUT GAPS, AND
- COAT JOINT WITH ADHESIVE. 4. FOLD AND COMPRESS LINER IN CORNERS OF RECTANGULAR DUCTS OR CUT AND FIT TO ENSURE BUTTED-EDGE OVERLAPPING. 5. DO NOT APPLY LINER IN RECTANGULAR DUCTS
- WITH LONGITUDINAL JOINTS, EXCEPT AT CORNERS OF DUCTS, UNLESS DUCT SIZE AND DIMENSIONS OF STANDARD LINER MAKE LONGITUDINAL JOINTS NECESSARY. 6. SECURE LINER WITH MECHANICAL FASTENERS 4 INCHES FROM CORNERS AND AT INTERVALS NOT EXCEEDING 12 INCHES TRANSVERSELY, AT 3

INCHES FROM TRANSVERSE JOINTS AND AT

- INTERVALS NOT EXCEEDING 18 INCHES LONGITUDINALLY 7. SECURE TRANSVERSELY DRIENTED LINER EDGES FACING THE AIRSTREAM WITH METAL NOSINGS THAT HAVE EITHER CHANNEL OR "Z" PROFILES OR ARE INTEGRALLY FORMED FROM DUCT WALL FABRICATE EDGE FACINGS AT THE FOLLOWING LOCATIONS:
- a. FAN DISCHARGES. b. INTERVALS OF LINED DUCT PRECEDING UNLINED DUCT c. UPSTREAM EDGES OF TRANSVERSE JOINTS IN DUCTS WHERE AIR VELOCITIES ARE HIGHER
- THAN 2500 FPM OR WHERE INDICATED. 8. TERMINATE INNER DUCTS WITH BUILDOUTS ATTACHED TO FIRE-DAMPER SLEEVES, DAMPERS TURNING VANE ASSEMBLIES, OR OTHER DEVICES. FABRICATED BUILDOUTS (METAL HAT SECTIONS) OR OTHER BUILDOUT MEANS ARE OPTIONAL; WHEN USED, SECURE BUILDOUTS TO DUCT WALLS WITH BOLTS, SCREWS, RIVETS, OR
- 2.5 HANGERS AND SUPPORTS A. HANGER RODS FOR NONCORROSIVE ENVIRONMENTS: CADMIUM-PLATED STEEL RODS AND NUTS. B. STRAP AND ROD SIZES: COMPLY WITH SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS -METAL AND FLEXIBLE," TABLE 4-1, "RECTANGULAR DUCT HANGERS MINIMUM SIZE."
 - AND TABLE 4-2, "MINIMUM HANGER SIZES FOR ROUND DUCT." C. STEEL CABLES FOR GALVANIZED-STEEL DUCTS: GALVANIZED STEEL COMPLYING WITH ASTM A 603.
 - D. STEEL CABLES FOR STAINLESS-STEEL DUCTS: STAINLESS STEEL COMPLYING WITH ASTM A 492. E. STEEL CABLE END CONNECTIONS: CADMIUM-PLATED STEEL ASSEMBLIES WITH BRACKETS, SWIVEL, AND BOLTS DESIGNED FOR

DUCT HANGER SERVICE; WITH AN

- AUTOMATIC-LOCKING AND CLAMPING DEVICE. F. DUCT ATTACHMENTS: SHEET METAL SCREWS, BLIND RIVETS, OR SELF-TAPPING METAL SCREWS; COMPATIBLE WITH DUCT MATERIALS G. TRAPEZE AND RISER SUPPORTS 1. SUPPORTS FOR GALVANIZED-STEEL DUCTS GALVANIZED-STEEL SHAPES AND PLATES. 2. SUPPORTS FOR STAINLESS-STEEL DUCTS STAINLESS-STEEL SHAPES AND PLATES. 3. SUPPORTS FOR ALUMINUM DUCTS: ALUMINUM OR GALVANIZED STEEL COATED WITH ZINC
- PART 3 EXECUTION 3.1 DUCT INSTALLATION A. DRAWING PLANS, SCHEMATICS, AND DIAGRAMS INDICATE GENERAL LOCATION AND ARRANGEMENT OF DUCT SYSTEM, INDICATED DUCT LOCATIONS, CONFIGURATIONS, AND ARRANGEMENTS WERE USED TO SIZE DUCTS AND CALCULATE FRICTION LOSS FOR AIR-HANDLING EQUIPMENT SIZING AND FOR OTHER DESIGN CONSIDERATIONS. INSTALL DUCT SYSTEMS AS INDICATED UNLESS DEVIATIONS TO LAYOUT ARE APPROVED ON

CHROMATE.

- SHOP DRAWINGS AND COORDINATION DRAWINGS B. INSTALL DUCTS ACCORDING TO SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE" UNLESS OTHERWISE INDICATED. C. INSTALL ROUND DUCTS IN MAXIMUM PRACTICAL LENGTHS. D. INSTALL DUCTS WITH FEWEST POSSIBLE
- JDINTS. E. INSTALL FACTORY OR SHOP-FABRICATED FITTINGS FOR CHANGES IN DIRECTION, SIZE AND SHAPE AND FOR BRANCH CONNECTIONS F. UNLESS OTHERWISE INDICATED, INSTALL DUCTS VERTICALLY AND HORIZONTALLY, AND PARALLEL AND PERPENDICULAR TO BUILDING LINES. G. INSTALL DUCTS CLOSE TO WALLS, OVERHEAD
- CONSTRUCTION, COLUMNS, AND OTHER STRUCTURAL AND PERMANENT ENCLOSURE ELEMENTS OF BUILDING. H. INSTALL DUCTS WITH A CLEARANCE OF 1 INCH, PLUS ALLOWANCE FOR INSULATION THICKNESS. 1. ROUTE DUCTS TO AVOID PASSING THROUGH TRANSFORMER VAULTS AND ELECTRICAL
- EQUIPMENT ROOMS AND ENCLOSURES. J. WHERE DUCTS PASS THROUGH NON-FIRE-RATED INTERIOR PARTITIONS AND EXTERIOR WALLS AND ARE EXPOSED TO VIEW, COVER THE OPENING BETWEEN THE PARTITION AND DUCT OR DUCT INSULATION WITH SHEET METAL FLANGES OF SAME METAL THICKNESS AS THE DUCT. OVERLAP OPENINGS ON FOUR SIDES BY AT
- LEAST 1-1/2 INCHES (38 MM). K. WHERE DUCTS PASS THROUGH FIRE-RATED INTERIOR PARTITIONS AND EXTERIOR WALLS, INSTALL FIRE DAMPERS. COMPLY WITH REQUIREMENTS IN DIVISION 23 SECTION "AIR DUCT ACCESSORIES" FOR FIRE AND SMOKE
- DAMPERS. L.PROTECT DUCT INTERIORS FROM MOISTURE, CONSTRUCTION DEBRIS AND DUST, AND OTHER FOREIGN MATERIALS, COMPLY WITH SMACNA'S "DUCT CLEANLINESS FOR NEW CONSTRUCTION GUIDELINES."
- 3.2 INSTALLATION OF EXPOSED DUCTWORK A. PROTECT DUCTS EXPOSED IN FINISHED SPACES FROM BEING DENTED, SCRATCHED, OR DAMAGED. B. TRIM DUCT SEALANTS FLUSH WITH METAL, CREATE A SMOOTH AND UNIFORM EXPOSED BEAD. NOT USE TWO-PART TAPE SEALING SYSTEM C. GRIND WELDS TO PROVIDE SMOOTH SURFACE FREE OF BURRS, SHARP EDGES, AND WELD SPLATTER. WHEN WELDING STAINLESS STEEL WITH A NO. 3 OR 4 FINISH, GRIND THE WELDS FLUSH, POLISH THE EXPOSED WELDS, AND
- TREAT THE WELDS TO REMOVE DISCOLORATION CAUSED BY WELDING D. MAINTAIN CONSISTENCY, SYMMETRY, AND UNIFORMITY IN THE ARRANGEMENT AND FABRICATION OF FITTINGS, HANGERS AND SUPPORTS, DUCT ACCESSORIES, AND AIR DUTLETS. E. REPAIR OR REPLACE DAMAGED SECTIONS AND
- FINISHED WORK THAT DOES NOT COMPLY WITH THESE REQUIREMENTS. 3.3 DUCT SEALING A. SEAL DUCTS FOR DUCT STATIC-PRESSURE, SEAL CLASSES, AND LEAKAGE CLASSES SPECIFIED IN "DUCT SCHEDULE" ARTICLE ACCORDING TO SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE."
- 3.4 HANGER AND SUPPORT INSTALLATION A. COMPLY WITH SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE, CHAPTER 4, "HANGERS AND SUPPORTS." 3.5 CONNECTIONS
- A. MAKE CONNECTIONS TO EQUIPMENT WITH FLEXIBLE CONNECTORS B, COMPLY WITH SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE" FOR BRANCH, DUTLET AND INLET, AND TERMINAL UNIT CONNECTIONS.
- END OF SECTION 230600
- <u> SECTION 230700 HVAC DUCT ACCESSORIES</u>
- PART 1 GENERAL 1.1 SUMMARY A. SECTION INCLUDES: 1. MANUAL VOLUME DAMPERS. 2. CONTROL DAMPERS. 3. FIRE DAMPERS.
- 4. SMOKE DAMPERS. 5. FLANGE CONNECTORS. 6. TURNING VANES. 7. DUCT-MOUNTED ACCESS DOORS. 8, FLEXIBLE CONNECTORS 9. FLEXIBLE DUCTS. 10. DUCT ACCESSORY HARDWARE, 1,2 SUBMITTALS
- A. SHOP DRAWINGS: FOR DUCT ACCESSORIES. INCLUDE PLANS, ELEVATIONS, SECTIONS, DETAILS AND ATTACHMENTS TO OTHER WORK 1. DETAIL DUCT ACCESSORIES FABRICATION AND INSTALLATION IN DUCTS AND OTHER CONSTRUCTION, INCLUDE DIMENSIONS, WEIGHTS LOADS, AND REQUIRED CLEARANCES; AND METHOD OF FIELD ASSEMBLY INTO DUCT SYSTEMS AND OTHER CONSTRUCTION, INCLUDE
 - THE FOLLOWING: a. SPECIAL FITTINGS b. MANUAL VOLUME DAMPER INSTALLATIONS CONTROL DAMPER INSTALLATIONS. d. FIRE-DAMPER AND SMOKE-DAMPER INSTALLATIONS, INCLUDING SLEEVES; AND DUCT-MOUNTED ACCESS DOORS.

e. WIRING DIAGRAMS: FOR POWER, SIGNAL, AND

- CONTROL WIRING. B. OPERATION AND MAINTENANCE DATA. 1.3 QUALITY ASSURANCE A COMPLY WITH NFPA 90A, "INSTALLATION OF AIR CONDITIONING AND VENTILATING SYSTEMS," AND WITH NFPA 90B, "INSTALLATION OF WARM AIR HEATING AND AIR CONDITIONING SYSTEMS. B COMPLY WITH AMCA 500-D TESTING FOR DAMPER
- RATING. PART 2 - PRODUCTS 2.1 MATERIALS A. COMPLY WITH SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE" FOR ACCEPTABLE MATERIALS, MATERIAL THICKNESSES, AND DUCT CONSTRUCTION METHODS UNLESS OTHERWISE INDICATED. SHEETMETAL MATERIALS SHALL BE

STAINS, DISCOLORATIONS, AND OTHER

IMPERFECTIONS. 2.2 MANUAL VOLUME DAMPERS A. STANDARD, STEEL, MANUAL VOLUME DAMPERS: 1. MANUFACTURERS: SUBJECT TO COMPLIANCE WITH REQUIREMENTS, AVAILABLE MANUFACTURERS OFFERING PRODUCTS THAT MAY BE INCORPORATED INTO THE WORK INCLUDE, BUT ARE NOT LIMITED TO, THE FOLLOWING : a. AIR BALANCE INC.; A DIVISION OF MESTEK,

FREE OF PITTING, SEAM MARKS, ROLLER MARKS,

b. AMERICAN WARMING AND VENTILATING; A

- DIVISION OF MESTEK, INC. c. FLEXMASTER U.S.A., INC d. MCGILL AIRFLOW LLC e. METALAIRE, INC.
- f. NAILOR INDUSTRIES INC. g. POTTORFF; A DIVISION OF PCI INDUSTRIES,
- h. RUSKIN COMPANY. TROX USA INC. VENT PRODUCTS COMPANY, INC. 2.3 FLEXIBLE CONNECTORS A. MANUFACTURERS: SUBJECT TO COMPLIANCE WITH REQUIREMENTS AVAILABLE
- MANUFACTURERS OFFERING PRODUCTS THAT MAY BE INCORPORATED INTO THE WORK INCLUDE, BUT ARE NOT LIMITED TO, THE FOLLOWING: 1. DUCTMATE INDUSTRIES, INC.
- 2. DURO DYNE INC. 3. VENTFABRICS, INC. 4. WARD INDUSTRIES, INC.; A DIVISION OF HART & COOLEY, INC.
- B. MATERIALS: FLAME-RETARDANT OR NONCOMBUSTIBLE FABRICS. C. COATINGS AND ADHESIVES: COMPLY WITH UL 181, CLASS 1.
- 2.4 FLEXIBLE DUCTS A. MANUFACTURERS: SUBJECT TO COMPLIANCE WITH REQUIREMENTS[AVAILABLE MANUFACTURERS OFFERING PRODUCTS THAT MAY BE INCORPORATED INTO THE WORK INCLUDE, BUT
- ARE NOT LIMITED TO, THE FOLLOWING: 1. FLEXMASTER U.S.A., INC. 2. MCGILL AIRFLOW LLC. 3. WARD INDUSTRIES, INC., A DIVISION OF HART &
- COOLEY, INC. 2.5 DUCT ACCESSORY HARDWARE A. INSTRUMENT TEST HOLES: CAST IRON OR CAST ALUMINUM TO SUIT DUCT MATERIAL, INCLUDING SCREW CAP AND GASKET. SIZE TO ALLOW INSERTION OF PITOT TUBE AND OTHER TESTING
 - INSTRUMENTS AND OF LENGTH TO SUIT DUCT-INSULATION THICKNESS B. ADHESIVES: HIGH STRENGTH, QUICK SETTING, NEOPRENE BASED, WATERPROOF, AND RESISTANT
- TO GASOLINE AND GREASE.
- PART 3 EXECUTION 3.1 INSTALLATION A. INSTALL DUCT ACCESSORIES ACCORDING TO APPLICABLE DETAILS IN SMACNA'S 'HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE" FOR METAL DUCTS AND IN NAIMA AH116, "FIBROUS GLASS DUCT CONSTRUCTION STANDARDS, FOR FIBROUS-GLASS DUCTS.
 - B. INSTALL DUCT ACCESSORIES OF MATERIALS SUITED TO DUCT MATERIALS; USE GALVANIZED-STEEL ACCESSORIES IN GALVANIZED-STEEL AND FIBROUS-GLASS DUCTS,
 - STAINLESS-STEEL ACCESSORIES IN STAINLESS-STEEL DUCTS, AND ALUMINUM ACCESSORIES IN ALUMINUM DUCTS. C. INSTALL VOLUME DAMPERS AT POINTS ON SUPPLY, RETURN, AND EXHAUST SYSTEMS WHERE BRANCHES EXTEND FROM LARGER DUCTS WHERE DAMPERS ARE INSTALLED IN DUCTS
 - HAVING DUCT LINER, INSTALL DAMPERS WITH HAT CHANNELS OF SAME DEPTH AS LINER, AND TERMINATE LINER WITH NOSING AT HAT CHANNEL. 1. INSTALL STEEL VOLUME DAMPERS IN STEEL
- 2. INSTALL ALUMINUM VOLUME DAMPERS IN ALUMINUM DUCTS. D. SET DAMPERS TO FULLY OPEN POSITION BEFORE TESTING, ADJUSTING, AND BALANCING. E. INSTALL TEST HOLES AT FAN INLETS AND DUTLETS AND ELSEWHERE AS INDICATED.
- F. INSTALL FIRE DAMPERS ACCORDING TO U G. INSTALL DUCT ACCESS DOORS ON SIDES OF DUCTS TO ALLOW FOR INSPECTING, ADJUSTING AND MAINTAINING ACCESSORIES AND EQUIPMENT
- AT THE FOLLOWING LOCATIONS 1. ON BOTH SIDES OF DUCT COILS. 2. UPSTREAM ROM DUCT FILTERS
- 3. AT OUTDOOR-AIR INTAKES AND MIXED-AIR PLENUMS 4. AT DRAIN PANS AND SEALS. 5. DOWNSTREAM FROM MANUAL VOLUME DAMPERS. CONTROL DAMPERS, BACKDRAFT DAMPERS, AND
- EQUIPMENT. 6. ADJACENT TO AND CLOSE ENOUGH TO FIRE OR SMOKE DAMPERS, TO RESET OR REINSTALL FUSIBLE LINKS, ACCESS DOORS FOR ACCESS TO FIRE OR SMOKE DAMPERS HAVING FUSIBLE LINKS SHALL BE PRESSURE RELIEF ACCESS DOORS; AND SHALL BE OUTWARD OPERATION FOR
- ACCESS DOORS INSTALLED UPSTREAM FROM DAMPERS AND INWARD OPERATION FOR ACCESS DOORS INSTALLED DOWNSTREAM FROM DAMPERS. H. LABEL ACCESS DOORS TO INDICATE THE PURPOSE OF ACCESS DOOR.
- I. INSTALL FLEXIBLE CONNECTORS TO CONNECT DUCTS TO EQUIPMENT. 3.2 FIELD QUALITY CONTROL A. TESTS AND INSPECTIONS:
 - 1. OPERATE DAMPERS TO VERIFY FULL RANGE OF MOVEMENT. 2. INSPECT LOCATIONS OF ACCESS DOORS AND VERIFY THAT PURPOSE OF ACCESS DOOR CAN BE PERFORMED. 3. OPERATE FIRE AND SMOKE DAMPERS TO VERIFY
- FULL RANGE OF MOVEMENT AND VERIFY THAT PROPER HEAT-RESPONSE DEVICE IS INSTALLED. 4. INSPECT TURNING VANES FOR PROPER AND SECURE INSTALLATION.
- END OF SECTION 230700 <u> SECTION 230800 - HVAC DIFFUSERS</u>
- 1.1 SUMMARY A. SECTION INCLUDES: RECTANGULAR AND SQUARE CEILING DIFFUSERS. 1.2 SUBMITTALS A. PRODUCT DATA: FOR EACH TYPE OF PRODUCT INDICATED, INCLUDE THE FOLLOWING:
 - 1. DATA SHEET: INDICATE MATERIALS OF CONSTRUCTION, FINISH, AND MOUNTING DETAILS; AND PERFORMANCE DATA INCLUDING THROW AND DROP, STATIC-PRESSURE DROP, AND NOISE RATINGS 2. DIFFUSER, REGISTER, AND GRILLE SCHEDULE:
- INDICATE DRAWING DESIGNATION, ROOM LOCATION, QUANTITY, MODEL NUMBER, SIZE, AND ACCESSORIES FURNISHED. B. SAMPLES: FOR EACH EXPOSED PRODUCT AND FOR EACH COLOR AND TEXTURE SPECIFIED.
- PART 2 PRODUCTS 2.1 CEILING DIFFUSERS 1. BASIS-OF-DESIGN PRODUCT: SUBJECT TO COMPLIANCE WITH REQUIREMENTS, PROVIDE PRODUCT INDICATED ON DRAWINGS OR

COMPARABLE PRODUCT BY ONE OF THE

a. ANEMOSTAT PRODUCTS; A MESTEK COMPANY b. CARNES. HART & COOLEY INC. d. METALAIRE, INC. e. NAILOR INDUSTRIES INC.

f. PRICE INDUSTRIES.

FOLLOWING:

- h. TUTTLE & BAILEY. 2.2 REGISTERS AND GRILLES BASIS-OF-DESIGN PRODUCT: SUBJECT TO COMPLIANCE WITH REQUIREMENTS, PROVIDE
 - PRODUCT INDICATED ON DRAWINGS OR COMPARABLE PRODUCT BY ONE OF THE FOLLOWING: a. A-J MANUFACTURING CO., INC. b. ANEMOSTAT PRODUCTS: A MESTEK COMPANY
 - CARNES. d. DAYUS REGISTER & GRILLE INC. f. HART & COOLEY INC. KRUEGER. METALAIRE, INC. NAILOR INDUSTRIES INC

. PRICE INDUSTRIES.

k. TUTTLE & BAILEY.

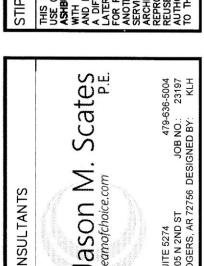
- 2.3 SOURCE QUALITY CONTROL A. VERIFICATION OF PERFORMANCE: RATE DIFFUSERS, REGISTERS, AND GRILLES
- ACCORDING TO ASHRAE 70. "METHOD OF TESTING FOR RATING THE PERFORMANCE OF AIR DUTLETS AND INLETS." PART 3 - EXECUTION
- 3.1 INSTALLATI□N A. INSTALL DIFFUSERS, REGISTERS, AND GRILLES LEVEL AND PLUMB. B. CEILING-MOUNTED OUTLETS AND INLETS:
- DRAWINGS INDICATE GENERAL ARRANGEMENT OF DUCTS, FITTINGS, AND ACCESSORIES. AIR DUTLET AND INLET LOCATIONS HAVE BEEN INDICATED TO ACHIEVE DESIGN REQUIREMENTS FOR AIR VOLUME, NOISE CRITERIA, AIRFLOW PATTERN, THROW, AND PRESSURE DROP. MAKE FINAL LOCATIONS WHERE INDICATED, AS MUCH AS PRACTICAL. FOR UNITS INSTALLED IN LAY-IN CEILING PANELS, LOCATE UNITS IN THE
- CENTER OF PANEL. WHERE ARCHITECTURAL FEATURES OR OTHER ITEMS CONFLICT WITH INSTALLATION, NOTIFY ARCHITECT FOR A DETERMINATION OF FINAL LOCATION. C. INSTALL DIFFUSERS, REGISTERS, AND GRILLES

WITH AIRTIGHT CONNECTIONS TO DUCTS AND TO

- ALLOW SERVICE AND MAINTENANCE OF DAMPERS, AIR EXTRACTORS, AND FIRE DAMPERS. 3.2 ADJUSTING A AFTER INSTALLATION, ADJUST DIFFUSERS, REGISTERS, AND GRILLES TO AIR PATTERNS
- INDICATED, OR AS DIRECTED, BEFORE STARTING AIR BALANCING.

END OF SECTION 230800

PLANS ON JOE INSPECTION



 \Box 0 [+] 437 A

PLANS ON JOB INSPECTION

SSUE BLOCK

CHECKED BY: RAWN BY: OCUMENT DATE: 04/17/19

ASON M. SCATES Lie. No. 402048734

PLANS REVIEWED BY LOUDOUN COUNTY

REJECTED REVIEW & RESUBMIT

DATE 5/20/19 BY CM

APPROVED SUBJECT TO FIELD INSPECTION

____ APPROVED AS NOTED SUBJECT TO FIELD INSPECTION

PLANS ARE:

PLUMBING & PLANS ON JOB **MECHANICAL** FOR SPECIFICATIONS

INSPECTION

PM2