SECTION 23 05 00 - GENERAL HVAC PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. DRAWINGS AND GENERAL PROVISIONS OF THE CONTRACT, INCLUDING GENERAL AND SUPPLEMENTARY CONDITIONS AND DIVISION 01 SPECIFICATION SECTIONS, APPLY TO THIS SECTION.

1.2 SUMMARY

A. THIS SECTION INCLUDES SPECIFYING THE GENERAL REQUIREMENTS FOR EXECUTION OF THAT PORTION OF THE WORK DEFINED IN DIVISION 23 OF THESE SPECIFICATIONS AND AS INDICATED ON THE DRAWINGS.

B. DIVISION OF WORK: IN ACCORDANCE WITH THE GENERAL CONDITIONS, CONTRACTOR IS RESPONSIBLE FOR DIVIDING THE WORK AMONG THE SUBCONTRACTORS AND SUPPLIERS AND FOR DELINEATING THE WORK TO BE PERFORMED BY SPECIFIC TRADES. THE FOLLOWING ARE SUGGESTIONS AS TO HOW THE WORK MAY BE DIVIDED. THIS IS NOT A COMPLETE LIST OF ALL THE WORK:
1. GENERAL CONTRACTOR:
a. INSTALL ACCESS DOORS.
b. PROVIDE CONCRETE ISOLATION AND HOUSEKEEPING PADS FOR MECHANICAL EQUIPMENT.
c. CUTTING AND PATCHING OF WALLS, CEILINGS, AND FLOORS.
d. PROVIDE ACCESS DOORS IN WALLS AND CEILINGS FOR ACCESS TO MECHANICAL EQUIPMENT.
2. MECHANICAL SUBCONTRACTOR:
a. BEAR FINANCIAL RESPONSIBILITY FOR CUTTING AND PATCHING OF WALLS, CEILINGS, AND FLOORS FOR DIVISION 23 WORK.
b. FURNISH LOCATION, SIZE AND QUANTITY OF OPENINGS TO CONTRACTOR BEFORE CONSTRUCTION OF NEW WALLS, CEILINGS, AND FLOORS.
c. PROVIDE MISCELLANEOUS STRUCTURAL STEEL REQUIRED IN CONNECTION WITH SUPPORT OF THE WORK OF DIVISION 23.
d. PERFORM FINAL CLEANING OF MECHANICAL SYSTEMS AND EQUIPMENT.

1.3 REFERENCES

A. EXCEPT AS HEREIN SPECIFIED OR AS INDICATED ON THE DRAWINGS, THE WORK OF DIVISION 23 SHALL COMPLY WITH THE FOLLOWING:
1. ASME - AMERICAN SOCIETY OF MECHANICAL ENGINEERS:
a. B31.1 - POWER PIPING.
b. B31.9 - BUILDING SERVICES PIPING.
2. ASTM: A325 - STRUCTURAL BOLTS, STEEL, HEAT TREATED, 120/105 KSI MINIMUM TENSILE STRENGTH.

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

A. CONSTRUCTION DETAILS, COMPONENTS, ACCESSORIES, SIZES AND MODEL NUMBERS INDICATED ON THE DRAWINGS OR IN THESE SPECIFICATIONS ARE USED TO INDICATE MINIMUM LEVELS OF QUALITY AND COORDINATION REQUIREMENTS.

B. EQUIPMENT SUPPLIED, WHETHER AS SCHEDULED OR SELECTED FROM LIST OF ACCEPTABLE MANUFACTURERS, MUST MEET MINIMUM REQUIREMENTS LISTED IN SPECIFICATIONS OR ON DRAWINGS, BE COMPATIBLE WITH FACILITY AND INTENDED USE, AND MEET REQUIREMENTS FOR A FUNCTIONAL SYSTEM.

C. DRAWINGS:
1. ARE DIAGRAMMATIC AND INDICATE GENERAL ARRANGEMENT OF SYSTEMS AND WORK INCLUDED.
2. DO NOT NECESSARILY INDICATE EVERY REQUIRED VALVE, FITTING, TRAP, THERMOMETER, GAGE, DUCT, ELBOW, TRANSITION, TURNING VANE, MOUNTING SUPPORT AND ACCESS PANEL.
3. SHALL NOT BE SCALED FOR MEASUREMENT OR INSTALLATION LOCATION.
4. SHALL NOT SERVE AS SHOP DRAWINGS.

D. SCHEDULES SHALL NOT BE USED TO:
1. SERVE AS FINAL, DEFINITIVE QUANTITY REQUIREMENTS. CONTRACTOR SHALL MAKE OWN COUNT AS INDICATED ON DRAWINGS.
2. DETERMINE PROPER TYPE OR MODEL WITH ARRANGEMENT, MOUNTING AND ACCESSORIES APPLICABLE.

E. COORDINATE INSTALLATION WORK OF DIVISION 23 WITH WORK OF OTHER TRADES TO PROVIDE A COMPLETE AND FUNCTIONAL SYSTEM. GENERALLY, THE LOCATION OF DUCTWORK, SANITARY, STORM AND VENT PIPING TAKE PRECEDENCE OVER FIRE PROTECTION AND HVAC PIPING, ELECTRICAL CONDUIT AND CABLE TRAYS.

1.5 SUBMITTALS

A. COORDINATION DRAWINGS:
1. SUBMIT DRAWINGS DEVELOPED FOR COORDINATION OF TRADES CONSISTING OF SCALED LAYOUT OF PIPING, DUCTWORK AND EQUIPMENT INCLUDING, BUT NOT LIMITED TO, SIZES, DIMENSIONS, LOCATIONS AND SLOPES OF HORIZONTAL RUNS AND FLOOR AND WALL PENETRATIONS.
2. SUBMIT DRAWINGS DEVELOPED FOR COORDINATION OF TRADES CONSISTING OF SCALED LAYOUTS OF DIFFUSERS, GRILLES, LIGHT FIXTURES, SPRINKLER HEADS, AND ARCHITECTURAL CEILING GRIDS.

1.6 PRODUCT UNLOADING AND HANDLING

A. UNLOAD EQUIPMENT AND MATERIALS REQUIRED FOR COMPLETION OF THE WORK.

B. HANDLE AND STORE EQUIPMENT AND MATERIALS CAREFULLY TO PREVENT DAMAGE. METHOD OF RIGGING AND HANDLING SHALL BE SUBJECT TO THE APPROVAL OF AN AUTHORIZED REPRESENTATIVE OF THE EQUIPMENT MANUFACTURER WHOSE EQUIPMENT IS BEING HANDLED.

1.7 TROUBLESHOOTING

A. BY CONTRACTOR: IF, DURING THE START-UP OR WARRANTY PERIOD, MECHANICAL SYSTEMS OPERATIONAL PROBLEMS OCCUR FOR WHICH THE ROOT CAUSE IS NOT READILY APPARENT, CONTRACTOR SHALL PROMPTLY, THROUGH A SUBCONTRACTOR OR OTHER RESOURCE DESIGNATED BY SUBCONTRACTOR, PROVIDE DIAGNOSTIC AND INVESTIGATIVE SERVICES TO DETERMINE THE CAUSE OR CAUSES.

B. BY ENGINEER:
1. AT CONTRACTOR'S REQUEST, ENGINEER WILL PROVIDE THE SERVICES NECESSARY TO DETERMINE THE CAUSE OR CAUSES OF THE OPERATIONAL PROBLEMS.
2. UNDER THE PROVISIONS OF THE GENERAL CONDITIONS, ENGINEER WILL ALSO PROVIDE THESE SERVICES IF CONTRACTOR FAILS TO RESPOND SATISFACTORILY TO OPERATIONAL PROBLEMS WITHIN A REASONABLE TIME AFTER WRITTEN NOTICE FROM ENGINEER.
3. IF WHILE WORKING AT CONTRACTOR'S REQUEST OR UNDER THE PROVISIONS OF THE GENERAL CONDITIONS, ENGINEER DETERMINES THAT THE PROBLEMS ARE DUE TO FAILURE OF THE WORK TO COMPLY WITH THE REQUIREMENTS OF THE CONTRACT DOCUMENTS, OWNER WILL COMPENSATE ENGINEER FOR ADDITIONAL SERVICES AND DEDUCT THE AMOUNT PAID FROM PAYMENT OR PAYMENTS TO CONTRACTOR.

1.8 MAINTENANCE

A. SPECIAL TOOLS: WHERE SPECIAL TOOLS ARE REQUIRED FOR OPERATION, FURNISH THESE TO OWNER.

B. LOOSE AND DETACHABLE PARTS:
1. RETAIN LOOSE AND SMALL DETACHABLE PARTS OF THE APPARATUS AND EQUIPMENT FURNISHED UNTIL THE COMPLETION OF THE WORK.
2. TURN OVER THESE PARTS TO OWNER.

C. START-UP FILTERS:
1. DO NOT RUN AIR HANDLING EQUIPMENT WITHOUT FILTERS.
2. USE OF INSTALLED PERMANENT HEATING AND COOLING EQUIPMENT DUCTWORK SYSTEMS SHALL BE IN ACCORDANCE WITH DIVISION 01 SECTION TEMPORARY FACILITIES AND CONTROLS. " "
3. PROVIDE FILTERS AS REQUIRED TO PROTECT THE AIR HANDLING SYSTEMS DURING CONSTRUCTION PHASE WORK.
4. JUST PRIOR TO SUBSTANTIAL COMPLETION, REPLACE FILTER ELEMENTS.

D. PERMANENT HEATING EQUIPMENT:
1. NOTIFY ENGINEER WHEN INSTALLED AND PROPOSED TO BE USED TO HEAT BUILDING INTERIOR.
2. PRIOR TO USING, PROVIDE ADEQUATE MEANS TO KEEP INTERNAL DUCT AND ACOUSTIC LINER SURFACE CLEAN AND IN A LIKE-NEW CONDITION.
3. FILTERS:
a. SECURELY SUPPORTED AT EACH RETURN AND EXHAUST AIR OPEN DUCT END AND GRILLE.
b. SUPPORT FILTER LENGTH AT REQUIRED INTERVALS TO PREVENT FILTER DEFORMATION.
c. REPLACED AT INTERVALS REQUIRED TO KEEP INTERNAL DUCT AND ACOUSTIC [illegible]ING FREE OF CONSTRUCTION DEBRIS AND DUST.
4. DUCTWORK USED BY CONTRACTOR WITHOUT ADEQUATE PROTECTION SHALL BE CLEANED TO ARCHITECT'S SATISFACTION.

E. CONSTRUCTION STRAINERS:
1. REMOVE AFTER FLUSHING AND CLEANING AND PRIOR TO COMMENCEMENT OF TAB.
2. ATTACH REMOVED CONSTRUCTION STRAINER TO PIPING WHERE REMOVED AS PROOF OF REMOVAL.

PART 2 - PRODUCTS

2.1 FABRICATIONS

A. MISCELLANEOUS STRUCTURAL STEEL:
1. STRUCTURAL STEEL WORK SHALL BE DONE IN ACCORDANCE WITH THE AISC SPECIFICATION FOR DESIGN, FABRICATION AND ERECTION OF STRUCTURAL STEEL FOR BUILDINGS, EXCEPT THAT ALLOWABLE STRESSES SHALL BE REDUCED 25%%%.
2. WHERE REQUIRED, HIGH STRENGTH STRUCTURAL STEEL BOLTING CONFORMING TO ASTM SPECIFICATION A325 AND ASSEMBLED TO AISC SPECIFICATIONS FOR ASSEMBLY OF STRUCTURAL JOINTS, USING HIGH STRENGTH STEEL BOLTS" OR WELDING SHALL BE USED IN PLACE OF RIVETS.
3. CONNECTIONS SHALL BE PROPERLY DESIGNED FOR THE TYPE OF CONNECTION AND THE LOADS TO BE CARRIED, AND SHALL BE SUBJECT TO ENGINEER'S OR OWNER'S APPROVAL.
4. WELDING SHALL BE DONE BY OPERATORS WHO HAVE BEEN PREVIOUSLY QUALIFIED BY TESTS AS PRESCRIBED IN THE AMERICAN WELDING SOCIETY "STANDARD QUALIFICATION PROCEDURE" TO PERFORM THE TYPE OF WORK REQUIRED.
5. WELDING TECHNIQUES SHALL CONFORM TO THE AMERICAN WELDING SOCIETY CODE FOR ARC AND GAS WELDING IN BUILDING CONSTRUCTION, SECTION 4, WORKMANSHIP.
6. FINISHED MEMBERS SHALL BE TRUE TO LINE AND FREE FROM TWIST, BENDS AND OPEN JOINTS. B. MATERIAL INSTALLED IN A CEILING PLENUM SHALL BE EITHER NON COMBUSTIBLE OR HAVE A MAXIMUM FLAME SPREAD OF 25 AND A MAXIMUM SMOKE DEVELOPED RATING OF 50.

PART 3 - EXECUTION

3.1 INSTALLATION

A. QUALITY OF WORK: INSTALLATION SHALL BE EXECUTED IN A WORKMANLIKE MANNER AND SHALL PRESENT A NEAT MECHANICAL APPEARANCE WHEN COMPLETED.

B. LAYING OUT WORK:
1. LAYOUT PIPING, DUCTWORK, EQUIPMENT AND COMPONENTS IN ACCORDANCE WITH THE CONTRACT DOCUMENTS AND THE MANUFACTURER'S RECOMMENDED PRACTICE, INCLUDING PROVISION OF ADEQUATE SPACE FOR MAINTENANCE. REVIEW LAYOUT WITH ENGINEER PRIOR TO INSTALLATION.
2. CHECK DRAWINGS OF OTHER TRADES TO VERIFY SPACES IN WHICH WORK WILL BE INSTALLED. MAINTAIN MAXIMUM HEAD ROOM AND SPACE CONDITIONS AT ALL POINTS. WHERE HEAD ROOM OR SPACE CONDITIONS APPEAR INADEQUATE, NOTIFY ENGINEER BEFORE PROCEEDING WITH INSTALLATION.
3. IF DIRECTED BY ENGINEER, CONTRACTOR SHALL MAKE REASONABLE MODIFICATIONS IN THE LAYOUT AS REQUIRED TO PERMIT PROPER EXECUTION OF THE WORK AND TO PREVENT CONFLICT WITH WORK OF OTHER TRADES. 4. WORK SHALL BE INSTALLED SO AS TO BE READY FOR OPERATION, MAINTENANCE AND REPAIR. MINOR DEVIATIONS FROM DRAWINGS MAY BE MADE TO ACCOMPLISH THIS. CHANGES SHALL NOT BE MADE WITHOUT APPROVAL OF ENGINEER.

3.2 MODIFICATIONS TO EXISTING FACILITIES SELECTIVE DEMOLITION

A. COMPLY WITH THE REQUIREMENTS OF DIVISION 02 SECTION " FOR REMOVAL OF EXISTING DUCTWORK, EQUIPMENT, AND OTHER " SYSTEMS. SELECTIVE DEMOLITION.

B. COMPLY WITH THE REQUIREMENTS OF DIVISION 02 SECTION " FOR ALL WORK RELATED TO THE MODIFICATION, ALTERATION, " CONVERSION, RENOVATION, AND REUSE OF EXISTING FACILITIES.

3.3 START-UP

A. COMPLY WITH THE REQUIREMENTS OF DIVISION 01 SECTION EXECUTION. " "

B. COORDINATE THE START-UP, TESTING AND SHUTDOWN OF THE NEW EQUIPMENT AND SYSTEMS INVOLVED.

C. OPERATING PERSONNEL, FUEL, WATER, POWER AND OTHER UTILITIES NECESSARY FOR EQUIPMENT START-UP, WILL BE FURNISHED BY OWNER. INSTRUCTIONS SHALL BE PROVIDED TO THE OPERATORS BY THE EQUIPMENT VENDOR'S PERSONNEL.

D. INSPECTION:
1. VERIFY THAT PROJECT CONDITIONS COMPLY WITH REQUIREMENTS.
2. VERIFY THAT STATUS OF WORK MEETS REQUIREMENTS FOR STARTING OF SYSTEMS.

E. PREPARATION:
1. COORDINATE SEQUENCE FOR START-UP OF VARIOUS SYSTEMS.
2. NOTIFY ENGINEER 7 DAYS PRIOR TO START-UP OF EACH SYSTEM.
3. HAVE AT HAND DURING ENTIRE START-UP PROCESS:
a. CONTRACT DOCUMENTS.
b. SHOP DRAWINGS.
c. PRODUCT DATA.
d. OPERATION AND MAINTENANCE DATA.
4. VERIFY THAT EACH PIECE OF EQUIPMENT HAS BEEN CHECKED FOR:
a. CONTROL SEQUENCE.
b. OTHER CONDITIONS WHICH MAY CAUSE DAMAGE.
5. VERIFY CONTROL SYSTEMS ARE FULLY OPERATIONAL IN AUTOMATIC MODE.
6. VERIFY THAT TESTS, METER READINGS AND SPECIFIC ELECTRICAL CHARACTERISTICS AGREE WITH THOSE SPECIFIED BY ELECTRICAL EQUIPMENT MANUFACTURER.
7. CONTROL VALVES:
a. INSPECT BOTH HAND AND AUTOMATIC CONTROL VALVES; CLEAN BONNETS AND STEMS.
b. TIGHTEN PACKING GLANDS TO ENSURE NO LEAKAGE, BUT PERMIT VALVE STEMS TO OPERATE WITHOUT GALLING.
c. REPLACE PACKING IN VALVES TO RETAIN MAXIMUM ADJUSTMENT AFTER SYSTEM IS JUDGED COMPLETE.
d. REPLACE PACKING ON ANY VALVE WHICH CONTINUES TO LEAK.
e. REMOVE AND REPAIR BONNETS WHICH LEAK.
f. COAT PACKING GLAND THREADS AND VALVE STEMS WITH A SURFACE PREPARATION OF "MOLY-COTE" OR "FEL-PRO" AFTER CLEANING.
g. VERIFY THAT CONTROL VALVE SEATS ARE FREE FROM FOREIGN MATERIAL AND ARE PROPERLY POSITIONED FOR INTENDED SERVICE.
8. FLANGES:
a. TIGHTEN FLANGES AFTER SYSTEM HAS BEEN PLACED IN OPERATION.
b. REPLACE FLANGE GASKETS WHICH SHOW ANY SIGN OF LEAKAGE AFTER TIGHTENING.
9. SCREWED JOINTS:
a. INSPECT SCREWED JOINTS FOR LEAKAGE.
b. PROMPTLY REMAKE EACH JOINT WHICH APPEARS TO BE FAULTY; DO NOT WAIT FOR RUST TO FORM.
c. CLEAN THREADS ON BOTH PARTS, APPLY COMPOUND AND REMAKE JOINTS.
10. CLEANING:
a. AFTER SYSTEM HAS BEEN PLACED IN OPERATION, CLEAN STRAINERS, DIRT POCKETS, ORIFICES, VALVE SEATS AND HEADERS IN FLUID SYSTEMS, TO ENSURE BEING FREE OF FOREIGN MATERIALS.
b. OPEN STEAM TRAPS AND AIR VENTS; REMOVE OPERATING ELEMENTS. CLEAN THOROUGHLY, REPLACE INTERNAL PARTS, AND PUT BACK INTO OPERATION.
c. REMOVE RUST, SCALE AND FOREIGN MATERIALS FROM EQUIPMENT AND RENEW DEFACED SURFACES. 11. DRAFT GAGES: SET AND CALIBRATE DRAFT GAGES OF AIR FILTERS AND OTHER EQUIPMENT. 12. CONTROL CIRCUITS: CHECK EACH ELECTRICAL CONTROL CIRCUIT TO ENSURE THAT OPERATION COMPLIES WITH SPECIFICATIONS AND REQUIREMENTS TO PROVIDE DESIRED PERFORMANCE.

3.4 ADJUSTING

A. ADJUST AND ALIGN EQUIPMENT FOR SMOOTH OPERATION:
1. PLUMB TRUE AND WITH PARTS IN PROPER POSITION AND ALIGNMENT.
2. ROTATING PARTS SHALL TURN FREELY AND IN THE CORRECT DIRECTION.
3. FLEXIBLE COUPLINGS SHALL BE CHECKED FOR ALIGNMENT SUBJECT TO OWNER'S APPROVAL.
4. FOLLOW MANUFACTURER'S INSTRUCTIONS.

B. THE WORK OF INSTALLATION SHALL BE EXECUTED IN CONFORMITY WITH THE BEST PRACTICE, SO AS TO CONTRIBUTE TO EFFICIENCY OF OPERATION, MINIMUM NOISE OR VIBRATION, MINIMUM MAINTENANCE, ACCESSIBILITY AND SIGHTLINESS.

3.5 FIELD QUALITY CONTROL

A. MANUFACTURER'S FIELD SERVICES:
1. PROVIDE WHEN REQUIRED BY INDIVIDUAL SECTION.
2. PROVIDE THE FOLLOWING SERVICES EXCEPT WHERE INDICATED OTHERWISE IN INDIVIDUAL SECTIONS:
a. INSPECT, CHECK AND APPROVE SYSTEM INSTALLATION.
b. SUPERVISE SYSTEM START-UP.
c. PROVIDE WRITTEN REPORT INDICATING THAT SYSTEM:
- HAS BEEN PROPERLY INSTALLED AND LUBRICATED.
- IS IN ACCURATE ALIGNMENT.
- IS FREE FROM UNDUE STRESS IMPOSED BY CONNECTING LINES OR ANCHOR BOLTS.
- HAS BEEN SATISFACTORILY OPERATED UNDER FULL LOAD CONDITIONS.
d. DEMONSTRATE OPERATION OF SYSTEM TO OWNER'S PERSONNEL.
e. INSTRUCT OWNER'S PERSONNEL ON OPERATION AND MAINTENANCE OF SYSTEM.

B. PERFORMANCE TEST:
1. TEST THE ENTIRE WORK, INCLUDING ALL OF ITS INDIVIDUAL SYSTEMS FOR 2 WEEKS BEFORE FINAL PAYMENT WILL BE MADE.
2. EVERY PHASE OF PLUMBING, AIR CONDITIONING AND HEATING AND VENTILATING PLANT SHALL BE OPERATED SEPARATELY, OR IN CONJUNCTION ONE WITH THE OTHER TO DEMONSTRATE TO ENGINEER THE ABILITY OF THE PLANT TO MEET CAPACITY AND PERFORMANCE REQUIREMENTS WHILE MAINTAINING DESIGN CONDITIONS IN ACCORDANCE WITH THE TRUE INTENT AND PURPOSE OF THESE SPECIFICATIONS.
3. MAKE FINAL TESTS IN THE PRESENCE OF OWNER AND ENGINEER.
4. IF A PART OF THE WORK OR EQUIPMENT DOES NOT MEET SPECIFICATIONS:
a. CORRECT THE SITUATION.
b. OBTAIN APPROVAL OF ENGINEER BEFORE FINAL PAYMENT IS MADE.
5. PROVIDE THE PERSONNEL AND BEAR COSTS FOR CORRECTING MALFUNCTIONS.
6. OWNER WILL PROVIDE OPERATING PERSONNEL AND UTILITIES.
7. AIR SYSTEMS BALANCING SHALL BE COMPLETED PRIOR TO PERFORMANCE TESTING.

C. PREPARATION:
1. [illegible] SYSTEM:
a. [illegible] INSPECTED AND [illegible].
b. IS FULLY OPERATIONAL.
2. OPERATION AND MAINTENANCE MANUALS:
a. COMPLETED.
b. SUFFICIENT COPIES AVAILABLE FOR USE IN DEMONSTRATIONS AND INSTRUCTIONS.
AIR AND HYDRONIC SYSTEMS BALANCING SHALL HAVE BEEN COMPLETED PRIOR TO THESE PERFORMANCE TESTS.

3.6 CLEANING AND FINISHING

A. COMPLY WITH THE REQUIREMENTS OF DIVISION 01 SECTION EXECUTION. " "

B. ENSURE INSTALLATION SHALL BE FREE FROM SURFACE OIL AND GREASE BEFORE WORK WILL BE CONSIDERED FOR FINAL PAYMENT.

C. AFTER TESTS HAVE BEEN MADE AND THE SYSTEM PRONOUNCED TIGHT:
1. CLEAN PIPING AND EQUIPMENT.
2. LUBRICATE BEARINGS.

D. FINAL CLEANING INCLUDES BUT IS NOT LIMITED TO THE FOLLOWING:
1. EQUIPMENT WITH FACTORY FINISHES:
a. WASH FACTORY-FINISHED EQUIPMENT WITH MILD SOAP AND WATER AND LEAVE IN FIRST-CLASS CONDITION, ENTIRELY FREE OF STAINS OR STREAKS.
b. DO NOT USE ABRASIVE MATERIALS. TOUCH UP SCRATCHES OR OTHER VIOLATIONS OF THE FACTORY FINISH PAINT WITH MATCHING PAINT FROM THE EQUIPMENT MANUFACTURER PRIOR TO CLEANING.

SECTION 23 05 93 - TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. DRAWINGS AND GENERAL PROVISIONS OF THE CONTRACT, INCLUDING GENERAL AND SUPPLEMENTARY CONDITIONS AND DIVISION 01 SPECIFICATION SECTIONS, APPLY TO THIS SECTION.

1.2 SUMMARY

A. THIS SECTION INCLUDES A DESCRIPTION OF THE MECHANICAL SYSTEM TESTING, ADJUSTING AND BALANCING (TAB) SCOPE OF SERVICES. THE FOLLOWING SYSTEMS SHALL BE INCLUDED IN THE TESTING, ADJUSTING, AND BALANCING PROCESS:
1. AIR HANDLING/AIR DISTRIBUTION SYSTEMS.
2. VARIABLE FREQUENCY DRIVES.
3. CONDENSING UNITS.

B. DIVISION OF WORK: IN ACCORDANCE WITH THE GENERAL CONDITIONS, CONTRACTOR SHALL BE RESPONSIBLE FOR DIVIDING THE WORK AMONG THE SUBCONTRACTORS AND SUPPLIERS AND FOR DELINEATING THE WORK TO BE PERFORMED BY SPECIFIC TRADES.

1.3 REFERENCES

A. EXCEPT AS HEREIN SPECIFIED OR AS INDICATED ON THE DRAWINGS, THE WORK OF THIS SECTION SHALL COMPLY WITH THE FOLLOWING:
1. SHEET METAL AND AIR CONDITIONING CONTRACTOR'S ASSOCIATION (SMACNA) PUBLICATIONS:
a. PROCEDURAL STANDARDS FOR TESTING, ADJUSTING, AND BALANCING OF ENVIRONMENTAL SYSTEMS.
b. PROCEDURAL STANDARDS FOR MEASURING SOUND OF VIBRATION.
c. TESTING, ADJUSTING, BALANCING MANUAL FOR TECHNICIANS.
2. ASSOCIATED AIR BALANCE COUNCIL (AABC): NATIONAL STANDARDS FOR TOTAL SYSTEM BALANCE, 2002 EDITION.
3. NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB): PROCEDURAL STANDARDS FOR TESTING, ADJUSTING, AND BALANCING OF ENVIRONMENTAL SYSTEMS.

1.4 DEFINITIONS

A. PROPER PERFORMANCE CHARACTERISTICS:
1. PROVIDING ACCEPTABLE THERMAL AND ACOUSTICAL PERFORMANCE IN ALL SERVICE AREAS.
2. AS DIRECTED BY ENGINEER.

1.5 SUBMITTALS

A. SUBMIT PRE TEST AND BALANCE CHECKLIST AND MECHANICAL SYSTEMS TAB REPORT IN ACCORDANCE WITH DIVISION 01 SECTION "SUBMITTAL PROCEDURES".

B. SUBMIT PRE TEST AND BALANCE CHECKLIST AT LEAST 2 WEEKS PRIOR TO SCHEDULED START OF TAB WORK AS SCHEDULED BY CONTRACTOR AND APPROVED BY OWNER.

C. PRELIMINARY TAB SUBMITTAL:
1. PRIOR TO FINAL INSPECTION.
2. 3 COPIES TO ENGINEER.
3. 2 COPIES TO MECHANICAL COMMISSIONING AUTHORITY: AS SOON AS POSSIBLE AFTER BALANCING WORK TO FACILITATE SPOTCHECKING.

D. FINAL SUBMITTAL: 5 COPIES TO ENGINEER. E. THE TAB REPORT SHALL INCLUDE, BUT NOT NECESSARILY BE LIMITED TO, THE FOLLOWING GENERAL ITEMS.
1. SUMMARY REMARKS REGARDING PROBLEMS.
2. INITIAL, INTERIM AND FINAL PERFORMANCE TEST DATA.
3. DESCRIPTION OF TEST PROCEDURES AND EQUIPMENT USED.
4. SYSTEMS' DRAWINGS AND/OR SCHEMATICS CLEARLY MARKED TO IDENTIFY LOCATION OF EQUIPMENT TESTED, DUCT TRAVERSE LOCATION(S), LOCATION OF SYSTEM STATIC PRESSURE SENSOR, ETC.
5. SYSTEMS PERFORMANCE DATA SHEETS SHALL INCLUDE DESIGN CONDITIONS, INSTALLED EQUIPMENT INFORMATION, AND FIELD TEST DATA FOR:
a. AIR SYSTEMS:
- DESIGN CONDITIONS:
1. AIR CAPACITY.
2. SYSTEM TOTAL STATIC PRESSURE DROPS AND PROFILES OF ALL AIR HANDLING SYSTEMS, INCLUDING FILTERS, COILS, ETC.
3. MOTOR HORSEPOWERS AND DESIGN BRAKE HORSEPOWERS.
4. FAN SPEEDS.
5. FAN CURVES OR FAN RATING TABLES SHOWING DESIGN CONDITIONS.
- INSTALLED EQUIPMENT:
1. EQUIPMENT MANUFACTURER.
2. EQUIPMENT MODEL NUMBERS, SIZES, TYPES, ETC.
3. MOTOR TYPES, SIZES AND CHARACTERISTICS.
4. HEATER AND STARTER TYPES, SIZES AND CHARACTERISTICS.
5. DRIVE TYPES, SIZES AND SPEED RANGE.
6. EQUIPMENT RATINGS IF DIFFERENT FROM DESIGN.
7. IDENTIFICATION OF ALL TERMINAL DEVICES, INCLUDING OUTLETS.
8. LOCATION OF ALL SMOKE CONTROL DEVICES.
- FIELD TEST DATA - INITIAL AND FINAL TEST READINGS FOR:
1. AIR CAPACITIES.
2. STATIC PRESSURES THROUGH UNITS AND UNIT COMPONENTS.
3. EQUIPMENT SPEEDS.
4. MOTOR OPERATING VOLTAGES AND AMPERAGES.
5. BRAKE HORSEPOWER.
6. OPERATING PERFORMANCE PLOTTED ON FAN CURVES OR FAN RATING TABLES.
7. SYSTEM SCHEMATIC AND NOTES INCLUDING STATIC PRESSURE PROFILES, SYSTEM STATIC PRESSURE SENSOR VALVE, ETC.
8. AIRFLOW AND STATIC PRESSURE DATA FOR ALL DUCT MAINS AS MEASURED UNDER TYPICAL SYSTEM OPERATION. REPORT WILL NOT BE ACCEPTED WITHOUT AIRFLOW AND STATIC PRESSURE PROFILE (REFER TO PARAGRAPH 3.3).
9. IDENTIFY EACH OUTLET OR INLET [illegible] AREA, SIZE AND [illegible] SYSTEM.
10. REQUIRED AND FIELD MEASURED CFM FOR EACH OUTLET OR INLET.
11. IDENTIFY EACH SMOKE CONTROL DEVICE AND PRESSURE DIFFERENTIAL AND [illegible] TEST DATA.
12. VERIFICATION OF [illegible] SMOKE CONTROL DEVICE OP[illegible].

1.6 QUALITY ASSURANCE

A. QUALIFICATIONS:
1. TAB FIELD TECHNICIAN PERSONNEL:
a. TRAINED AND EXPERIENCED IN THE OPERATION OF THE TEST AND BALANCE EQUIPMENT.
b. KNOWLEDGEABLE OF THE DESIGN OF ALL SYSTEMS SCHEDULED FOR TESTING AND BALANCING.
2. TAB ENGINEER:
a. A CERTIFIED MEMBER OF EITHER THE FOLLOWING ORGANIZATIONS:
- AABC.
- NEBB.

B. REPORTS:
1. THE REPORT FORMS INCLUDED IN THE APPENDIX OF THE [illegible] STANDARD ARE INCORPORATED IN THE WORK OF THIS SECTION FOR THE PURPOSE OF IDENTIFYING THE LEVEL OF DETAIL REQUIRED FOR TESTING AND REPORTING.
2. TAB ENGINEER MAY USE THE AABC FORMS OR OTHER SIMILAR FORMS WHICH PRESENT EQUIVALENT INFORMATION IN A LOGICAL FORMAT.

PART 2 - PRODUCTS

2.1 MATERIALS

A. PATCHING MATERIALS:
1. COMPLY WITH REQUIREMENTS AS SPECIFIED IN OTHER SECTIONS WHERE APPLICABLE TO PROVIDE MATERIALS ESSENTIALLY AND FUNCTIONALLY IDENTICAL TO ORIGINAL INSTALLATION BEFORE TESTING AND BALANCING WORK.
2. MAINTAIN THE INTEGRITY OF SYSTEMS FOR AIR TIGHTNESS, WATER TIGHTNESS, AND DURABILITY OF FINISH.

2.2 INSTRUMENTS

A. INSTRUMENTS USED FOR TAB WORK SHALL BE AS INDICATED IN THE REFERENCED STANDARDS.

B. CALIBRATION:
1. INSTRUMENTS TO HAVE BEEN CALIBRATED WITHIN ONE YEAR OF START OF TAB WORK.
2. APPROPRIATE DOCUMENTATION SHALL BE MADE AVAILABLE TO THE ENGINEER ON REQUEST.

PART 3 - EXECUTION

3.1 PROCEDURES

A. GENERAL:
1. DETERMINE WHAT ACTUAL PERFORMANCE CHARACTERISTICS ARE DEEMED PROPER DURING SYSTEM TESTS.
2. IF THE DESIGN SUPPLY, RETURN OR EXHAUST AIR QUANTITIES FOR A SPACE CREATE A SPACE PRESSURE OTHER THAN NEUTRAL, OR IF A SPACE IS INDICATED TO BE A CERTAIN PRESSURE, PROVIDE BALANCING TO THE EXTENT REQUIRED TO ACHIEVE THIS DESIGNED PRESSURE.
3. DURING HEATING (AND COOLING) SEASON OF THE FIRST YEAR OF OPERATION, AT TIMES WHEN DIRECTED, MAKE FINAL ADJUSTMENTS UNTIL ALL OCCUPANTS ARE REASONABLY SATISFIED AND ALL EQUIPMENT IS OPERATING AT PEAK EFFICIENCY.
4. CONFIRMATION OF PROPER EQUIPMENT OPERATION MUST BE THROUGH ACTUAL OBSERVATION. COMPUTER SIMULATION AND SENSOR READOUTS ARE NOT ACCEPTABLE PROOF.

B. AIR SYSTEMS:
1. GENERAL:
a. ADJUST AND SET ALL DAMPERS, DEFLECTING VANES, DISCHARGE VANES AND ACCESSORY ITEMS TO ACHIEVE PROPER AIR DISTRIBUTION AND PATTERNS IN ALL PARTS OF THE AIR SUPPLY, RETURN AND EXHAUST SYSTEMS:
- DETERMINE AIR FLOW AND STATIC PRESSURE IN ALL BRANCH DUCTS BY VELOCITY TRAVERSE AND BALANCE OUT ALL BRANCHES BY MEANS OF BRANCH DUCT MANUAL DAMPERS.
- BALANCE TERMINAL OUTLETS ON EACH BRANCH DUCT USING VOLUME DAMPERS IN RUN-OUT DUCT TO THE OUTLET, NOT THE TERMINAL OUTLET DAMPERS.
b. MARK FINAL BALANCE POSITION FOR ALL DAMPERS WHICH ARE NOT LEFT 100%%% OPEN WITH AN INDELIBLE PEN.
c. ADJUST AND SET ALL BELTED FAN SPEEDS AS REQUIRED TO ATTAIN PROPER TOTAL AIR FLOW.
d. MEASURE SUPPLY FAN TOTAL AIR FLOW AT BOTH THE FULL RETURN AIR AND FULL OUTDOOR AIR DAMPER POSITIONS.
e. MAKE SMOKE GUN TESTS, IF NECESSARY, TO CHECK FOR DRAFTS AND MAKE FINAL ADJUSTMENTS AND SETTINGS FOR OPTIMUM COMFORT CONDITIONS.
2. METHODS: ACCEPTABLE PROCEDURES FOR OBTAINING PERFORMANCE MEASUREMENTS ARE LISTED BELOW:
a. CFM AIRFLOW FOR DUCT SECTIONS:
- DUCT TRAVERSE AS SPECIFIED IN SMACNA MANUAL "HVAC SYSTEMS - TESTING, ADJUSTING AND BALANCING," CHAPTER V, SECTION 4-B, USING A PILOT TUBE AND INCLINED MANOMETER.
- ACCEPTABLE METHODS:
1. PITOT TUBE ARRAY WITH READING BY INCLINED MANOMETER.
2. ELECTRONIC MANOMETER.
3. HOT-WIRE ANEMOMETER.
b. CFM AIRFLOW, FOR ROOM SUPPLY, RETURN AND EXHAUST, AT DIFFUSERS, REGISTERS AND GRILLES: USE AIRFLOW HOOD.
c. FAN TSP: USE INCLINED MANOMETER.
d. EQUIPMENT PRESSURE DROPS: USE INCLINED MANOMETER.
e. AIR TEMPERATURES: USE THERMOMETER.
f. SMOKE TESTING: USE TITANIUM TETRACHLORIDE.
g. CFM DIFFERENTIAL AIRFLOW READING:
- BLOCK DOOR ENTRANCE LEAVING 1 OR 2 SQUARE FOOT MEASURED OPENING.
- READ OPENING WITH THERMAL ANEMOMETER.
h. DIFFERENTIAL PRESSURE: IN CASES WHERE SENSORS FOR DIFFERENTIAL PRESSURE ARE PERMANENTLY INSTALLED, DIFFERENTIAL PRESSURE MAY BE READ DIRECTLY USING AN ELECTRONIC DIGITAL MANOMETER.
3. TAB PROCEDURES FOR AIR SYSTEMS:
a. CHECK ALL MOTORIZED, BALANCING AND GRAVITY RELIEF DAMPERS FOR PROPER POSITION.
b. INSPECT COILS, FILTERS AND FANS FOR CLEANLINESS.
c. "BUMP" MOTOR TO CHECK FOR PROPER FAN ROTATION.
d. CHECK UNIT PERFORMANCE INCLUDING:
- FAN SPEED.
- AMPERAGE AND VOLTAGE.
- SUCTION, DISCHARGE AND TOTAL STATIC PRESSURES AT FAN.
- SUPPLY AIR VOLUME OF FAN BY TAKING DUCT TRAVERSE IN DISCHARGE DUCT OR ZONE DUCTS.
e. NOTE: CHECK UNIT PERFORMANCE IN BOTH 100%%% OUTSIDE AIR AND 100%%% RETURN AIR POSITIONS. INCLUDING STATIC PRESSURES ACROSS INDIVIDUAL EQUIPMENT COMPONENTS.
f. SET OUTSIDE AIR MOTORIZED DAMPER AT PROPER MINIMUM POSITION.
g. SEE THAT NECESSARY ADJUSTMENTS OR CHANGES ARE MADE TO ACHIEVE DESIGN AIRFLOW CAPACITIES OR CONSULT ENGINEER IF CHANGE(S) REQUIRED ARE BEYOND THE SCOPE OF THE TAB CONTRACT.
h. BALANCE LOW VELOCITY DUCTWORK:
- TAKE TRAVERSE AND STATIC PRESSURE READINGS IN MAIN BRANCH DUCTS AND SET BALANCING DAMPERS FOR APPROXIMATE CORRECT DISTRIBUTION OF AIR.
- PROPORTIONATELY BALANCE ALL BRANCH DUCTS.
- PROPORTIONATELY BALANCE ALL OUTLETS AND INLETS.
- MAKE SMOKE GUN TESTS TO CHECK FOR DRAFTS AND MAKE FINAL SETTINGS FOR OPTIMUM COMFORT CONDITIONS IN OCCUPIED SPACE.
- RECHECK SUPPLY AIR UNIT PERFORMANCE AND MAKE ANY NECESSARY FINAL ADJUSTMENTS. INCLUDE ALLOWANCES FOR WET COIL, DIRTY FILTERS, AND OTHER NORMAL OPERATING CONDITIONS WHICH MAY REDUCE AIR FLOW.
- RECORD FINAL MEASUREMENTS AS REQUIRED.

C. SPECIAL INSPECTION FOR SMOKE CONTROL:
1. SMOKE CONTROL SYSTEMS SHALL BE TESTED BY A SPECIAL INSPECTOR.
2. TESTING SCOPE SHALL BE AS FOLLOWS:
a. DURING ERECTION OF DUCTWORK AND PRIOR TO CONCEALMENT FOR PURPOSES OF LEAKAGE TESTING AND RECORDING OF DEVICE LOCATION.
b. PRIOR TO OCCUPANCY AND AFTER SUFFICIENT COMPLETION FOR PURPOSES OF PRESSURE DIFFERENCE TESTING, FLOW MEASUREMENTS AND DETECTION AND CONTROL VERIFICATION.

3.2 FIELD QUALITY CONTROL

A. PRELIMINARY REVIEW AND ANALYSIS:
1. IF AFTER STANDARD BALANCING PROCEDURES HAVE BEEN CARRIED OUT AND READJUSTMENTS ATTEMPTED, THE SYSTEM DOES NOT PERFORM AS SPECIFIED, ENGINEER SHALL BE NOTIFIED AT ONCE.
2. ALL "AS IS" FIELD DATA SHALL BE SUBMITTED IN A PRELIMINARY REPORT FOR REVIEW AND ANALYSIS.
3. MANIPULATION OF SYSTEM TO ACHIEVE AIR FLOW AND BALANCE WITHOUT MEETING INTENDED AND SPECIFIED TOTAL SYSTEM AIR FLOW WILL NOT BE ACCEPTED IN A BALANCE REPORT. SHOULD THIS OCCUR, REBALANCE SHALL BE AT THE CONTRACTOR'S EXPENSE.

B. FINAL INSPECTION: PRIOR TO FINAL ACCEPTANCE, ALL SYSTEMS SHALL BE OPERATED TO TEST PERFORMANCE AS DIRECTED TO THE SATISFACTION OF THE ENGINEER:
1. STEAM AND WATER SHALL CIRCULATE THROUGHOUT ENTIRE SYSTEM WITHOUT NOISE, EVIDENCE OF LEAKS AND TRAPPING OR AIR-BINDING.
2. AIR IN DUCTS SHALL CIRCULATE WITHOUT EXCESSIVE NOISE.
3. MOTORS, FANS AND OTHER EQUIPMENT SHALL OPERATE WITHOUT EXCESSIVE NOISE OR VIBRATION.
4. SYSTEMS SHALL BE BALANCED TO OPERATE WITHIN STATED TOLERANCES. IF ANY HEATING UNIT, CHILLED WATER COOLING COIL, OR AIR OUTLET DOES NOT OPERATE WITHIN THE STATED TOLERANCES, THEN THE ENTIRE SYSTEM SHALL BE CONSIDERED OUT OF BALANCE AND SHALL BE READJUSTED UNTIL ALL UNITS ARE WITHIN THE STATED TOLERANCES.
5. HEATING, VENTILATING AND AIR-CONDITIONING SYSTEMS SHALL MAINTAIN UNIFORM TEMPERATURES WITHOUT DRAFTS.
6. BURNERS SHALL BE TESTED AND SET FOR HIGH EFFICIENCY AND SMOKELESS COMBUSTION.

C. TESTING:
1. TAB ENGINEER SHALL COORDINATE WITH ENGINEER TO SCHEDULE ACCESS TO SITE TO PERFORM AIR SYSTEM TESTING TO WHATEVER EXTENT ENGINEER DETERMINES IS NECESSARY TO VERIFY ACCURACY OF MECHANICAL SYSTEMS TAB REPORT.
2. TAB ENGINEER WILL REPEAT SYSTEM TESTING, ADJUSTING, AND BALANCING UNTIL ENGINEER VERIFIES ACCURACY OF DATA.

3.3 STATIC PRESSURE AND AIR FLOW PROFILE

A. PROVIDE A STATIC PRESSURE AND AIR FLOW PROFILE DIAGRAM.
1. AIR FLOW READINGS SHALL BE BASED ON A DUCT TRAVERSE.
2. DATA SHALL REFLECT ACTUAL COINCIDENT SYSTEM PERFORMANCE ESTABLISHED AT TOTAL SYSTEM BALANCE:
a. THROTTLING OF ONE BRANCH BELOW DESIGN TO OBTAIN DESIGN PERFORMANCE IN ANOTHER IS NOT ACCEPTABLE. REFER TO PARAGRAPH 3.2.A.
b. DIVERSITY IN VARIABLE AIR VOLUME SYSTEMS SHALL BE REFLECTED ON PROFILE DIAGRAM.
3. PROVIDE DATA FOR EACH DUCT MAIN AND A MINIMUM OF ONE SET OF READINGS FOR EACH FLOOR FOR MULTIPLE FLOOR SYSTEMS.

3.4 PRE TEST AND BALANCE CHECKLIST

A. CONTRACTOR SHALL COPY THE PRE TEST AND BALANCE CHECKLIST (EXHIBIT B, ATTACHED) AND SUBMIT ONE COMPLETED CHECKLIST FOR EACH [illegible] AND FAN.

B. TAB ENGINEER MAY BE [illegible] TO BE COMPENSATED FOR [illegible] REQUIRED DUE TO FAILURE OF OTHER SUBCONTRACTORS TO [illegible] COMPLETE THEIR WORK.

END OF SECTION

SECTION 23 05 01 INSULATION

1.1 INSULATION

A. LINE ALL LOW VELOCITY RECTANGULAR AIR CONDITIONING SUPPLY AIR DUCTS. DUCT DIMENSIONS ON DRAWINGS ARE INSIDE FREE AREA DIMENSIONS. INCREASE SHEET METAL SIZES TO ALLOW FOR DUCT LINER THICKNESS.

B. USE NEOPRENE FACED 1" THICK, 3.7 R-VALUE FIBERGLASS LINER. APPLY WITH MASTIC AND PINS WITH EROSION PROTECTION ON ALL EXPOSED EDGES. RETURN AIR SOUND BOOTS SHALL HAVE 1" LINER.

C. ROUND SUPPLY DUCTS SHALL HAVE 2" THICK, 1 LB. DENSITY FIBERGLASS WRAP WITH VAPOR BARRIER.

D. CONDENSATE DRAIN PIPING: INSULATE CONDENSATE DRAIN LINES WITH 1/2" THICK ARMAFLEX II SLIP ON TYPE INSULATION. DO NOT SPLIT.

E. ALL DUCTS SHALL BE SEALED. JOINTS AND SEAMS SHALL COMPLY WITH SECTION 603.9 OF THE INTERNATIONAL MECHANICAL CODE.

END OF SECITON

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SHEET LEGEND

G000's	GENERAL INFORMATION & SCOPE OF WORK
N100's	EGRESS / ADA PLANS & DETAILS
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A200's	EXTERIOR & INTERIOR ELEVATIONS
A300's	BUILDING SECTIONS
A400's	ENLARGED PLANS
A500's	EXTERIOR & INTERIOR DETAILS
A600's	DOOR SCHEDULE, DOOR DETAILS, FINISH SCHEDULE, FINISH PLANS
Q100's	AUDITORIUM SIGHT LINE SECTIONS
Q120's	AUDITORIUM SEATING PLAN
S's	STRUCTURAL
M's	MECHANICAL
P's	PLUMBING
E's	ELECTRICAL
WF's	WAYFINDING DETAILS
FS's	CASEWORK & EQUIPMENT

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