SECTION 23 31 13 - DUCTWORK

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Construct rectangular ductwork to meet all functional criteria defined in Section VII, of the SMACNA "HVAC Duct Construction Standards Metal and Flexible" latest edition. This shall be subsequently referred to as the SMACNA Manual. All ductwork must comply with all local, state and federal code requirements.
B. Refer to Section 23 05 00 for requirements which are applicable to this section.
C. The SMACNA Manual, ASHRAE Handbooks, International Mechanical Code, and NFPA Pamphlet 90A shall apply to this work.
D. Provide labor, material, equipment, and supervision necessary to install a complete air handling system as indicated on the drawings and specified herein.
E. Contractor is to furnish and install volume dampers in all supply, return, exhaust, and outside air branch ductwork. If these are omitted from the drawings, the contractor is to make an allowance to install them.

1.02 SUBMITTALS

A. Ductwork shop drawings must be properly submitted. Any ductwork installed without prior approval by the engineer and found to be incorrect, shall be replaced at the expense of the contractor.
B. Submit shop drawings of all sheet metal for review. Drawings shall be not less than 1/4" scale and show all light fixtures, steel, piping, conduit, equipment and architectural features. It is unacceptable to resubmit and modify McHugh design documents for sheet metal drawing purposes.
    1. Indicate structural steel and elevation of bottom of beams and joists or floor to bottom dimension.
    2. Indicate ductwork elevation and/or floor to bottom of duct. Verify ductwork fits in available space.
    3. Indicate waste and storm piping where it occurs in the area of ductwork.
    4. Locate electrical gear on plan. Ductwork is not to run above panels.
    5. Ductwork is to be shown double line with indicated width and height.
    6. Allowance to be made for lining and/or insulation.
    7. Duct sizes shown on contract drawings may be flattened to a 4 to 1 ratio when necessary to establish clearance. Such transitions are to be included in the contract price.
    8. Ductwork fabrication shall not proceed until shop drawings are submitted for review.
    9. All dampers, grilles, registers, diffusers, access panels, louvers, coils, filters, and other components of the system are to be indicated.
    10. Provide detail of fire damper assembly.
    11. Provide drawing sections when requested by the engineer. Coordinate sheet metal drawings with light fixture layout and sprinkler system piping and heads and shown on the drawing.
C. Submit manufacturer’s literature and performance data of equipment and devices for review.
D. Samples: Furnish at request of A/E.
E. Contractor to coordinate work with sprinkler piping and head locations.

1.03 QUALITY ASSURANCE

A. The contractor must comply with the enclosed specification in its entirety. If on inspections, the

specifier finds changes have been made without prior approval, the contractor will make the applicable changes to comply with this specification, at the contractor's expense.

B. At the discretion of the specifier, sheet metal gauges, and reinforcing may be checked at various times to verify all duct construction is in compliance.

PART 2 - PRODUCTS

2.01 FABRICATED DUCT REQUIREMENTS - DUCTMATE

A. All interior rectangular ducts shall be constructed with G-60 or better galvanized steel (ASTM A-653-94) LFQ, chem treat. Exterior ductwork shall be G-90 or better galvanized steel LFQ, chem treat. Kitchen, shower, or dishwasher exhaust shall be aluminum with aluminum joints.

B. Materials: Support, access doors not part of ducts, bar or angle reinforcing damper rods and items made of uncoated mild steel shall be painted with two coats of primer or provide galvanized equivalent.

C. Longitudinal Seams. Pittsburgh lock shall be used on all longitudinal seams. All longitudinal seams will be sealed with mastic sealant. Snaplock is not acceptable.

D. Flanged interior Gasket. Ductmate 440 or a Butyl Rubber Gasket which meets Mil-C 18969B, Type II Class B, TT-C-1796 A, Type II Class B, and TTS-S-001657 must also pass UL-723. This material, in addition to the above, shall not contain vegetable oils, fish oils, or any other type vehicle that will support fungal and/or bacterial growth associated with dark, damp areas of ductwork. The recommended test procedure for bacterial and fungal growth is found in 21CFR 177, 1210 closures with sealing gaskets for food containers.

E. Ductmate or W.D.C.I. proprietary duct connection systems will be accepted. Duct constructed using these systems will refer to the manufacturers guidelines for sheet gauge, intermediate reinforcement size and spacing, and joint reinforcements.

F. Formed - on flanges (T.D.C./T.D.F./T-25A/T-25B) be accepted. Formed on flanges will be constructed as SMACNA T-25 flanges, whose limits are defined on page 1.36 1995 SMACNA Manual, Second Edition. No other construction pertaining to formed - on flanges will be accepted. Formed on flanges shall be accepted for use on ductwork 42" wide or less and must include the use of corners, bolts, and cleat. (Over 42", the reinforcement/joint deflection criteria no longer conform with the UMC).

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G. Rectangular ductwork in the pool and pool equipment room shall be aluminum construction with stainless steel (317L or 904L) hangers, supports, and fasteners.

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H. Rectangular ductwork above the roof or outside shall be 4" water gauge construction.

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I. Pool return or exhaust ductwork above the roof shall be 4" water gauge aluminum.

J. All ductwork in moist areas (Toilet Rooms, locker rooms, kitchens, etc) shall be aluminum construction with aluminum hangers, supports, and fasteners.

2.02 DUCTWORK - SMACNA STANDARDS

A. All sheet metal supply, exhaust, relief, outside and return ductwork shall be formed from galvanized steel sheet unless otherwise specified.

B. Galvanizing shall conform to SMACNA Standards.

C. Exposed rectangular ductwork in finished areas shall have drive slip joints on transverse seams and Pittsburgh lock joints on longitudinal seams.

D. Commercial round ductwork shall be spiral wound with snap lock seams in accordance with SMACNA standards, double wall, 1" insulation, perforated liner. (Does not apply to concealed residential ductwork systems)
E. Rectangular/round spiral ductwork in the pool and shall be aluminum construction. All supports, fasteners, and hangers shall be stainless steel (317L or 904L).
F. Rectangular ductwork in the pool and pool equipment room shall be coated with 4 mils PVC both inside and outside.
G. Rectangular ductwork above the roof or outside shall be medium pressure construction (4" wg)
H. Pool return or exhaust ductwork above the roof shall be coated inside and outside with 4 mils PVC.
I. Round spiral air conditioning ductwork supply shall be double wall lined. This applies to round ductwork in the Gymnasium and the Game Room.
J. Exterior ductwork shall be 4" w. g. pressure construction per SMACNA. Watertight seams.
K. All ductwork in moist areas (Toilet Rooms, locker rooms, kitchens, etc.) shall be aluminum construction with aluminum hangers, supports, and fasteners.

2.03 ROUND AND FLAT OVAL DUCTS

A. Construction: In accordance with HVAC Duct Construction Standards, Section III.
B. Round ductwork shall be spiral seam construction only. Gauges shall be in accordance with SMACNA Duct Construction Standard and fittings in accordance with SMACNA Duct Construction Standard, except as noted:
   1. Joints 0"-20" diameter, interior slip coupling beaded at center, fastened to duct, with sealing compound applied continuously around joint before assembling and after fastening. Wrap joints with 3 inch wide duct tape.
   2. Joints 21" - 72" diameter, use 3 piece, gasketed, flanged joints consisting of 2 internal flanges (with integral mastic sealant) split to accommodate minor differences in duct diameter, and one external closure band designed to compress gasketing between internal flanges. Example: Ductmate Spiralmate or equal.
   3. Joints 73" diameter and up, use companion angle flanged joints only as defined on page 3-6 of the SMACNA Manual. Refer to manual for proper sizing and construction details. Ductwall to be welded longitudinal seams.
   4. Flat Oval Ducts shall be joined with the Ovalmate Connection System manufactured by Ductmate Industries. Consult the manufacturer for installation and construction guidelines. As an option, beaded sleeve joints may be used.
   5. Provide double wall with 1" insulation and perforated liner for all air conditioning supply ducts.

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   6. Round ductwork in the pool shall be aluminum with stainless steel (317L or 904L) hangers, supports, and fasteners.
C. All ductwork in moist areas (Toilet Rooms, locker rooms, kitchens, etc.) shall be aluminum construction with aluminum hangers, supports, and fasteners.

2.04 FIBERGLASS DUCTBOARD

A. Fiberglass ductboard is not acceptable.

2.05 SEALERS

A. Duct sealer shall be flexible, water-based, adhesive sealant designed for use in all pressure duct systems. After curing, it shall be resistant to ultraviolet light and shall seal out water, air and moisture. Sealer shall be UL listed and conform to ASTM E84. Sealer shall be Ductmate PROseal or an approved equal.

B. All joints shall be sealed.

2.06 DUCTWORK HANGER/SUPPORT

A. Hang and support ductwork as defined by SMACNA, Section IV 1995 Manual, Section Edition, or as defined within. Hanger spacing not to exceed 8'.
B. Not Permitted: Sheetmetal screws in a metal deck.

2.07 ACCESS DOORS IN DUCTWORK

A. Access doors shall be hinged or Ductmate Sandwich Type Access Doors manufactured by Ductmate Industries, Inc. Doors shall be of adequate size to allow easy access to hardware which needs to be maintained.

2.08 TURNING VANES

A. Turning vanes shall be Harper single wall turning vanes fabricated from the same material as the duct. Tab spacing shall be SMACNA standard. Rail systems with non-standard tab spacing's shall not be accepted. All tabs shall be used, do not skip tabs. Mounting rails shall have friction insert tabs which align the vanes automatically. Vanes shall be subjected to tensile loading and be capable of supporting 250 lbs. when fastened per the manufacturer's instructions. Approved Systems: Ductmate PRO-Rail.

2.09 SOUND ATTENUATING DUCT LINING

A. Includes:
   1. All interior supply air ductwork.
   2. All exterior supply air ductwork. Refer to exterior ductwork specifications (23 07 00) for additional requirements.
   3. All interior return ductwork.
   4. Return ductwork: Line the first 10'-0" of the main return ductwork extending from the air handling units.
   5. All outside air ductwork.
   6. All transfer air ductwork.
   7. No kitchen supply and return ductwork shall be lined.
B. Duct liner shall have a flame spread of not over 25, a fuel contributed of not over 50 and a smoke developed of not over 50.
C. Liner shall be minimum 1 inch thick, 1.5 Lbs./Cu. Ft. density with a thermal conductance of .24 at 50 deg. F. mean temperature. (Conductance: BTU/Sq. Ft./F/Hr.).
D. Liner shall not spall or deteriorate at air velocities to 4000 FPM when installed in accordance with the manufacturer's recommendations.
E. Liner shall be Johns-Manville Linacoustic or approved substitute by Owens-Corning, CertainTeed, or Knauf. Observe all installation instructions.
F. Any ductwork in unconditioned spaces or outdoors shall have insulation totaling R-8.3.

2.10 FLEXIBLE INSULATED DUCTWORK

A. Contractor may utilize flexible factory insulated ductwork for short connections from trunk ducts to diffusers when concealed. Lengths shall not exceed 10 feet.
B. Pressure rating: Minimum 10" w.g.
C. Outer Jacket: Aluminum equivalent to Flexmaster 5M 4.2 vapor barrier
D. Insulation for ductwork in conditioned spaces: R-4.2.

E. Insulation for ductwork in unconditioned spaces/outdoors - R-8.
F. Liner: Wire with laminated mylar
G. Manufacturer: Atco, Flexmaster. Or prior approved equal.
H. Applies to supply ductwork only. Exhaust and return ductwork to be rigid ductwork.
I. Flexible insulated ductwork to comply with 25/50 flame spread and smoke density ratings.

2.11 FLEXIBLE CONNECTIONS

A. Between all fans, air handlers, A/C units and ductwork.
B. Material: Woven fiberglass with mounting accessories.
C. Minimum 1" and maximum 4" between adjacent sections.

2.12 DAMPERS

A. Location: Where required to control flow of air or to balance air systems. Additionally, includes at each supply/return/outside/exhaust air branch ductwork, each air device, individual duct risers, branch ductwork off duct risers, VAV box inlet.
B. Type: Opposed blade, bearings at each end, adjustment quadrant and locking device for ducts over 1 square foot. Under 1 square foot dampers may be single blade with locking device.
C. Leakage: 8 cfm maximum at 4" S.P. for 4 Sq. Ft. damper. Class 1.
D. Material: galvanized steel in galvanized steel ductwork, extruded aluminum in aluminum ductwork.

2.13 FIRE DAMPERS

A. Furnish and install pre-manufactured dampers with 1 1/2 hr. UL Label where required by code or indicated on the drawings.
B. Fusible links shall be set at 160 deg. F. Provide 10 % extra links to the owner.
C. SET FIRE DAMPERS IN 20 GAUGE SLEEVES WITH BREAKAWAY CONNECTIONS TO THE DUCTWORK ON EACH SIDE. SEE STANDARD SMACNA DETAILS FOR INSTALLATION. DAMPERS INSTALLED INCORRECTLY WILL BE REQUIRED TO BE REMOVED AND REPLACED CORRECTLY.
D. Damper shall be set in wall or floor construction.
E. Install in accordance with manufacturer’s instructions and the authority having jurisdiction.
F. Damper blades shall be held out of airstream for ducts smaller than 14".
G. Provide 12" x 12" access door in ductwork for access to each damper. Label "FIRE DAMPER ACCESS" with 2" high stenciled letters.
H. Manufacturers; Prefco, American Warming and Ventilating, Air Balance, Phillips, Nailor-Hart, Lloyd.
I. Fire dampers in fiberglass ductboard systems shall be installed in steel sleeves. The fiberglass duct shall be terminated and the steel sleeve installed at the fire wall or floor. Rigid ductboard shall not continue thru the fire wall.

2.14 SMOKE DAMPERS (COMBINATION SMOKE/FIRE DAMPERS)

A. Furnish and install smoke dampers of the size indicated on the drawings or required by the sheet metal shop drawings as a result of field coordination.
B. Dampers shall meet all of the requirements per the latest edition of NFPA 90.
C. Dampers shall be furnished with both the 1 1/2 hour (or 3 hour) UL label for fire dampers - UL 555 and the UL label for leakage resistance (smoke) - UL 555S. The leakage rating of the dampers shall be no more than 11 CFM/2 @ 1" W.G. after exposure to 1,000 deg. F. for one (1) hour. To maintain this leakage rating the amount of torque required to hold the damper closed shall not exceed 0 Lb. In.
D. Dampers shall incorporate an integrated resettable and reusable UL listed electric link / mechanical

lock assembly replacing standard fusible links and separate locking devices. The link shall be activated and the damper shall close and lock by either smoke detector signaled release (120V or 24V A.C. /D.C.) or excessive duct ambient temperature. Upon cessation of the detector signal or normalization of the duct ambient temperature the link assumes it original position enabling the damper to be reopened by the motor actuator automatically.

E. Dampers shall be installed in accordance with the manufacturers UL installation instructions.
F. All combination smoke/fire dampers shall be Prefco Products, Cesco, Inc. model 5010 or equal by Phillips or Nailor-Hart.

2.15 SPIRAL DUCT LINING

A. Supply spiral duct shall be lined with 1" Johns Manville Spiracoustic Plus or Spiracoustic round duct liner or prior approved equal.
B. Material shall meet NFPA 90A and 90B as well as FHC 25/50 flame/smoke ratings.
C. Material shall conform to ASHRAE 62/89.
D. Install per manufacturer's instructions.
E. Spiracoustic Plus is round liner board. Spiracoustic is preformed round liner.

2.16 VOLUME DAMPER CONTROL - REMOTE EXTERNAL CONTROL

A. Applications: Drywall ceilings or where shown on drawings.
B. Location: In ductwork where required to control air flow or balance air systems.
C. Volume damper type: Opposed single blade round butterfly damper for external control, EPDM low leakage seals, scoop and spin-in type shell, Young Regulator Co. 5020 CC Series. Rectangular: #830-CC Series.
D. Leakage: 10 CFM maximum at 4" s.p. for 4 square foot damper.
E. Material: Galvanized steel in galvanized steel ductwork, extruded aluminum in aluminum ductwork.
F. Controls: Bowden Cable Control Kit 270-896C to include hardware, for ceiling mounting in conjunction with external control of round or rectangular dampers, flush 7/8" diameter cold rolled steel cover is zinc plated for painting, 12" wrench (damper adjustments), metal clad control cable.

PART 3 - EXECUTION

3.01 DUCTWORK

A. Dimensions on drawings are inside of lining.
B. Ducts shall be concealed unless otherwise indicated.
C. Changes in direction shall be made with radius bends or turning vanes.
D. Ducts shall be cross-broken or machine grooved over 18 inches in width.
E. Supports: Galvanized steel per SMACNA.
F. Longitudinal joints; Pittsburg Lock or Inside Groove.
G. Connections to wall louvers shall be sloped down to louver connection to prevent water draining into interior.
H. All ducts to have nested takeoffs, 45 degree cants, or adjustable turning vanes at all branch duct takeoffs.

3.02 ACCESS DOORS

A. Furnish and install at all fire dampers, heating coils, humidifiers, filters, smoke dampers, valves,

volume dampers and wherever indicated on the drawings.

B. Minimum 12" x 12" double thick 22 gauge with 1" fiberglass, fully gasketed and with cam lock or latches.

3.03 LOUVERS

A. Ductwork to an intake or exhaust louver shall slope down to the louver as to prevent water entering the ductwork.

3.04 LEAK SEALING

A. All joints shall be sealed to prevent leakage.
B. Systems shall be sealed with high velocity duct sealant.

END OF SECTION

SECTION 23 31 21 - DUCTWORK CLEANING

PART 1 - GENERAL

1.01 REFERENCE

A. Refer to Section 23 05 00 for requirements which are applicable to this section.
B. Refer to NFPA and International Mechanical codes.
C. Refer to ASHRAE, ASTM, OSHA and UL standards.
D. Refer to NADCA (National Air Duct Cleaners Association) standards.
E. Refer to ACR 2006 assessment, cleaning, and restoration of HVAC systems.

1.02 WORK INCLUDED

A. Provide all labor, material, equipment, and supervision necessary to inspect, clean and internally coat the existing supply air and return air duct system.

1.03 SUBMITTALS

A. Submit manufacturers' data sheets of coating.

1.04 QUALITY ASSURANCE

A. Provide adequate supervision of labor force to see that cleaning and coating operations are performed correctly.
B. Work shall be performed by certified National Air Duct Cleaners Assoc. Specialists.
C. Provide NADCA certificate at completion of work.

PART 2 - PRODUCTS

2.01 FUNGICIDAL PROTECTIVE COATING

A. Polyacrylate copolymer emulsion specifically formulated for long term fungicidal activity, with no loss of activity on aging shall contain fungicides that will effectively prevent the growth and spread of molds and bacteria on its surface and provide a tough, elastic protective finish that allows for movement without splitting to create lodging places for bacteria.
B. Properties:
   1. Color: White
   2. Application Consistency: Brush or Airless Spray
   3. Average non-volatile (ASTM C 461) - 58% by volume.
   4. Coverage Range (FSTM 71) - Wet coverages shown are for smooth non-porous surfaces. Porous or rough surfaces may require higher gallonage to obtain required dry thickness. 1.25 gal. /100 square feet 2 (0.51 1/m 2); .020 in. Wet thickness (.51 mm); .011 in. Dry thickness (.27 mm).
   5. Drying Time (ASTM D 1640) - Set to touch: 4 hours; dry through: 16 hours.

6. Water Vapor Permeance (ASTM F 1249) - Tested at 90% R. H. differential and 100 deg. F (38 deg. C) 6.0. Perms at .011 in. (4.0 metric perms at .26 mm).
7. Service Temperature Limits (FSTM 70) (Temperature at coated surface) - Minus 20 deg. F to 200 deg. F (-29 deg. C to 93 deg. C).
8. Safety - Wet flammability (ASTM D 3278). No flash to boiling 210 deg. F (99 deg. C).
9. Surface Burning Characteristics (ASTM E 84) - Flame Spread: 15 - Smoke Developed: 5. Tested at coverage rate of 80 square feet per gallon. Applied to inorganic reinforced cement board. The flame spread may vary at different product thicknesses and/or when applied over other surfaces.

C. Manufacturer: Foster 40-20.

PART 3 - EXECUTION

3.01 DUCT CLEANING

A. Preparing and protecting work areas with 4ml. Poly, as necessary.
B. Performing the work in compliance with the Occupational Safety and Health Administration (OSHA) Standards requiring compliance by all private employers on an ongoing basis under the General Industry (29CFR 1910) and Construction Industry (29CFR 1926). Regulations, which include but is not limited to:
   - Record keeping OSHA 1910.20.
   - Confined Space Entry Requirements OSHA 1910.146
   - Respiratory Protection OSHA 1910.134
   - Hazardous Communications OSHA 1910.1200
   - Lock-Out/Tag-Out Protection OSHA 1910.147
C. Marking the position of all balancing dampers prior to cleaning process.
D. Removing and cleaning supply registers and exhaust air grills and louvers. (If removable)
E. Providing access ports in accordance with SMACNA standards where necessary to thoroughly clean the entire system. Provide pre-manufactured latchable access panels.
F. Removing, inspecting and installing upon completion all filtration devices. Install new filters matching existing filters.
G. Removing of all visible debris and contaminants from the outside air duct system and other associated components. This is to be performed in accordance with NADC Standards 1992-01.
H. Leaving all work areas in a neat and orderly fashion, and removing all accumulated debris from work site.
I. All registers, grilles louvers to be securely reinstalled and mechanical dampers restored to their original positions.
J. Checking total system upon completion to ensure functional operation in similar manner in which system was operating prior to cleaning process.
K. Any deficiencies reported to project engineer.

3.02 INTERNAL DUCT CLEANING AND COATING

A. After cleaning and vacuuming inspect internal duct for damage and/or deterioration. Upon completion of the inspection, repair ductwork is required.
B. After installation of the required access doors in the duct work and the removal of all loosened contaminants is completed, resurfacing, shall be accomplished as follows:

1. Using a spraying system with approved resurfacing agent, Foster 40-20, apply a one (1) mil thickness wet application to the liner surfaces, or as recommended by the manufacturer's specifications. Ensure even coating with broad spray tip.
2. Odors shall be controlled through the filters in the collection devices. Collection devices shall be connected to the targeted duct section so that a minimum negative pressure is maintained. Pressure within the area being resurfaced may be adjusted based on the size of the duct to restrict over spray or removal of the resurfacing. The intent of the negative pressure is to eliminate odors and to assist in the drying process, not to draw resurfacing agent into collection systems. A minimum negative pressure of .125" wg shall be used.
3. Resurfacing agent shall be approved for use inside of air distribution systems. Additives for agents shall be approved by the Owner and shall be accompanies by a current MSDS.

3.03 FUNGICIDAL COATING

A. Material Preparation: Do not thin. Keep container closed when not in use. Do not apply outdoors in damp or rainy weather.
B. HVAC Systems: Galvanized surfaces need to be vacuumed or washed clean of all accumulated mold, dust and loose particles. Following complete cleaning procedures, sanitize the entire air duct surfaces with an approved sanitizer following manufacturer's directions. Insure that all interior surfaces are thoroughly dry before applying 40-20. All rusted metal surfaces must be primed with Foster 40-26 before application of 40-20. Lined air ducts should be lightly vacuum cleaned to remove all mold, dust and loose particles, being careful not to tear or loosen the liner. Following complete cleaning procedures, the entire air duct surfaces are to be sanitized as above.
C. Application: Apply Foster 40-20 to all surfaces by brush, airless spray at a rate of approximately 1.25 gal. Per 100 square foot. Always ensure adequate ventilation. Brushing will require two coats applied at 90 degrees to each other. Under normal circumstances a spray application can be completed in one coat, but for extremely porous or irregular surfaces, a second coat may be required. Insure that the finished surface is smooth and homogeneous. For airless spray application, uses an electric 30:1 unit such as a Graco EH-433 with a .021-.025 fluid tip and 800-900 psi atomizing pressure at the gun.
D. For HVAC systems interior surfaces: Always ensure negative air pressure in the HVAC system during application. After one hour has elapsed from completion of application, circulate fresh air throughout the system to dry the coating. Be sure exhausted air is odorless before ventilating into occupied room areas.
E. Clean-up - Use fresh water to clean brushes and equipment before product dries. Dry product may be removed with chlorinated solvents (non-flammable) or Xylol (flammable).
F. Hazard Statement: Harmful if swallowed or absorbed through skin. Causes moderate eye irritation. Prolonged skin contact may cause irritation. Acute overexposure to vapors may cause dizziness, headache, nausea, and unconsciousness. Since emptied containers may retain product residue, follow label warnings even after container is empty.

3.04 CERTIFICATION

A. At completion of the work submit certification of the National Air Duct Cleaners Association stating that work was performed in accordance with their standards.

END OF SECTION