**CONSTRUCTION STANDARD SPECIFICATION**

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**BASIC MECHANICAL MATERIALS AND METHODS**

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes the following basic mechanical materials and methods to complement other Division 15 Sections:

1. Manufacturer's directions
2. Altitude Ratings
3. Welding Requirements
4. Motor Efficiencies
5. Access Doors
6. Interruption of utilities
7. Cooperation with other trades
8. Cutting and patching
9. Mechanical sleeve seals
10. Escutcheons
11. Protection of materials and equipment
12. Roof curbs and bases
13. Concrete base construction requirements
14. Nonshrink grout for equipment installations

15. Special openings

16. Welding foundations

17. Alteration and removal work

18. Tools

19. Protection from rotating parts

20. Shaft alignment

21. Belts and pulleys

22. Cleaning

23. Identification tags and labels

24. Metal and Wood Equipment Supports

25. Pressure vessels

26. Final adjustments

27. Touchup painting and finishing.

B. Nonexistent Conditions or Requirements:
These specifications are general in scope and may contain provisions or requirements that are not applicable to this construction project. Any provision or requirement of this specification which pertains to a nonexistent condition or requirement shall have no meaning in the contract and shall be disregarded.

1.02 REFERENCES

A. American Standards Institute, ANSI

A13.1, "Scheme for Identification of Piping Systems"
B31.1, "Power Piping"

B. American Society of Mechanical Engineers, ASME

"Boiler and Pressure Vessel Code"

C. American Society of Heating, Refrigeration, and Air-Conditioning, ASHRAE

Std. 90.1 , “Energy Standard for Buildings Except Low Rise Residential Buildings”

D. American Welding Society, AWS

D1.1, "Structural Welding Code -- Steel"

E. American Society of Testing and Materials, ASTM

A515, "Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service"

A53, "Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless"

C1107, "Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)"

D709, "Standard Specification for Laminated Thermosetting Materials"

1.03 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoors' ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.04 SUBMITTALS

A. All material and equipment lists submitted for approval shall conform to the requirements of Section 01330, "Submittal Procedures ".

1.05 QUALITY ASSURANCE

A. Pressure Vessels: Prior to installation and acceptance, any power boiler, low-pressure heating boiler, or unfire pressure vessel operated at pressures of 15 pounds per square inch or greater, furnished under this contract will be stamped with ASME Boiler and Pressure Vessel Code Symbol and a National Board of Boiler and Pressure Vessel Inspector's number. This will certify that the vessel has been fabricated and tested per the provisions of the ASME Boiler and Pressure Vessel Code. Manufacturers' data reports (unless exempted by the ASME Code) will be filed with the National Board in Columbus, Ohio. Two copies of these data reports shall be submitted to Sandia National Laboratories (SNL). Testing, certification, and registration will be at the expense of the Contractor. ASTM A-515 and ASME SA-515 type steels shall not be used in the fabrication of pressure vessels.

B. Any boilers or pressure vessels operated at pressures stated above, utilized by the Contractor in his performance of the work, will be similarly tested and certified before being brought on the project and annually thereafter so long as they are used on the project site.

C. Welding: All welding on pressure piping shall conform with the requirements of the American National Standard Code for Pressure Piping, ANSI B31.1, "Power Piping", except that any reference to table 136.4 shall be deleted. The examination method employed will be as prescribed by the Sandia Delegated Representative (SDR). The SDR shall have the right to inspect all welds by any nondestructive examination method of choice or by removing welds and subjecting them to mechanical tests. The inspection may be made during or after the weld has been completed. The acceptance criteria for NDE will be as specified in B31.1 paragraph 136.4, under the NDE method used. The frequency of inspection shall be as specified by the SDR but at a minimum 5% of welds will be inspected with additional welds inspected at the discretion of the SDR if defects are found. Faulty welds shall be removed at no additional cost to SNL. Nondestructive examination shall be performed by others at no additional cost to the Contractor. Any costs for re-test of failed welds that have been repaired will be borne by the contractor and not be accepted until all welds meet the requirements of ANSI B31.1, "Power Piping". All re-tests shall employ the same NDE method that originally exposed the defect.

D. Equipment Selection: Equipment of different type, electrical characteristics, physical dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. All related modifications necessary to allow for changes shall be at the contractor's expense. If minimum energy ratings or efficiencies of equipment are specified, equipment must meet design and commissioning requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.

B. Protect stored pipes, tubes, and equipment from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.

C. Protect flanges, fittings, and piping specialties from moisture and dirt.

D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

E. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical injury. At completion of all work, the materials and equipment shall be thoroughly cleaned.

F. Cover the ends of ducts stored outdoors with plastic to prevent contamination by dirt, debris, and moisture.

1.07 PROJECT CONDITIONS

A. Altitude Ratings: Unless otherwise noted, all specified equipment capacities, air quantities are for an altitude of 5,500 feet above sea level for Albuquerque and Tonopah area and sea level for Livermore area. Adjustments to manufacturers' ratings must be made accordingly.

1.08 SEQUENCING AND SCHEDULING

A. Coordinate mechanical equipment installation with other building components.

B. The contractor shall refer to other parts of these specifications covering the work of other trades, which must be carried on in conjunction with the mechanical work, so that the construction operations can proceed without interference or delay.

C. Arrange for pipe spaces, duct spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.

D. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.

E. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.

F. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services.

G. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Section 08110 "Steel Doors and Frames."

H. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

I. Interruption Of Mechanical Utilities: The Contractor shall not interrupt any main interior or exterior mechanical utility without written request for an outage and a subsequent approval by SNL, nor shall he interrupt any branch line to an outlet or item of equipment without verbal approval from the Sandia Construction Observer (SCO).

1. Written request for outages shall be submitted using the Outage Request Worksheet, according to the instructions and advance notice requirements on the Worksheet.

2. Unless otherwise noted on the drawings, or directed, any tie-ins or connections to existing utilities or equipment that necessitate interruptions of service shall be performed during non-standard hours.

3. The work to be performed during the interruption will be preceded by all possible preparation, and will be carefully coordinated to minimize the duration of the interruption and work will proceed continuously until the system is restored to normal.

4. Unless otherwise directed, the manipulation of existing main valves to isolate piping, the shutdown of fans, pumps, and other equipment will be done by SNL maintenance personnel.

## PART 2 - PRODUCTS

### 2.01 MECHANICAL SLEEVE SEALS

A. Description: Modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates. Seals shall be insulating type and rated for the temperature service of the pipe system.

## 2.02 PIPING SPECIALTIES

A. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:

1. Steel Sheet Metal: 24 gauge minimum thickness, galvanized, round tube closed with welded longitudinal joint.

2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.

3. Cast Iron: ASTM A74

B. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type if required to conceal protruding fittings and sleeves.

1. ID: Closely fit around pipe, tube, and insulation of insulated piping.

2. OD: Completely cover opening.

3. Cast Brass: One piece, with setscrew.

a. Finish: Polished chrome-plate.

4. Cast Brass: Split casting, with concealed hinge and setscrew.

a. Finish: Polished chrome-plate.

5. Stamped Steel: One piece, with setscrew and chrome-plated finish.

6. Stamped Steel: One piece, with spring clips and chrome-plated finish.

7. Stamped Steel: Split plate, with concealed hinge, setscrew, and chrome-plated finish.

8. Cast-Iron Floor Plate: One-piece casting.

## 2.03 IDENTIFYING DEVICES AND LABELS

A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 15 Sections. If more than one type is specified for application, selection is Installer's option, but provide one selection for each product category.

B. Equipment Nameplates: Metal nameplate with operational data engraved or stamped; permanently fastened to equipment.

1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliance, and similar essential data.

2. Location: Accessible and visible location.

C. Stencils: Standard stencils, prepared for required applications with letter sizes complying with recommendations of ASME A13.1 for piping and similar applications, but not less than 1-1/4-inch- high letters for ductwork and not less than 3/4-inch- high letters for access door signs and similar operational instructions.

1. Stencil Paint: Standard exterior-type stenciling enamel; black, unless otherwise indicated; either brushing grade or pressurized spray-can forms and grade.

D. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, permanent adhesive, color-coded, pressure-sensitive vinyl, complying with ASME A13.1.

E. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated.

1. Fabricate in sizes required for message.

2. Engraved with engraver's standard letter style, of sizes and with wording to match equipment identification.

3. Punch for mechanical fastening.

4. Thickness: 1/8 inch, unless otherwise indicated.

5. Fasteners: Self-tapping stainless-steel screws or contact-type permanent adhesive.

F. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in mechanical identification, with corresponding designations indicated on the drawings. Use numbers, lettering, and wording indicated for proper identification and operation/maintenance of mechanical systems and equipment.

2.04 GROUT

A. Epoxy Grout for Equipment Bases: Loctite Fixmaster Deep Pour Grout, Product No. 99545.

2.05 MOTORS

A. Unless stated otherwise on the drawings, the minimum efficiency of motors shall comply with Table 10.2 of ASHRAE 90.1 – 1999.

PART 3 – EXECUTION

3.01 PIPING AND DUCT SYSTEMS - COMMON REQUIREMENTS

A. General: Install piping and duct work as described below, unless piping Sections specifies otherwise. Individual Division 15 piping Sections specifies unique piping installation requirements.

B. General Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping and duct systems. Indicated locations and arrangements were used to size pipe and ducts, and calculate friction loss, expansion, pump/fan sizing, and other design considerations. Install piping and ducts as indicated, unless deviations to layout are approved by the SCO.

C. Install components with pressure rating equal to or greater than system operating pressure.

D. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.

E. Install piping to allow application of insulation plus 1-inch clearance around insulation.

F. Install pipe escutcheons in finished spaces for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:

1. Bare Piping Wall and Ceiling Escutcheons: Cast brass or stamped steel one piece, with setscrew, and polished chrome-plated finish. Use split-casting escutcheons if required, for existing piping.

2. Insulated Piping: Cast brass or stamped steel; with concealed hinge, spring clips, and chrome-plated finish.

3. Uninsulated Piping Floor Plates: Cast-iron floor plates.

G. Install sleeves for pipes passing through interior concrete and masonry walls, fire rated gypsum-board partitions and walls, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

    a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Build sleeves into new walls and slabs as work progresses.

3. Install sleeves large enough to provide a minimum 1/2-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

    a. Steel Pipe Sleeves: For pipes smaller than 6-inch NPS.
    b. Steel, Sheet-Metal Sleeves: For pipes 6-inch NPS and larger, penetrating gypsum-board partitions.
    c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Section 07600, "Flashing and Sheet Metal" for flashing.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants. Refer to Section 07900, "Joint Sealants" for materials.

5. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise indicated.

H. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.

2. Install cast-iron "wall pipes" for sleeves 6 inches in diameter and larger.

3. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.

I. Underground, Exterior-Wall, Pipe Penetrations: Install steel pipe sleeves furnished with continuously welded water stop and anchor plate. Core drilled openings are permitted if approved ahead of time by the SCO. Seal pipe penetrations using mechanical sleeve seals. Size sleeve to meet the requirements of the mechanical seal manufacturer.

1. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.

J. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping materials. Refer to Section 07270, "Firestop and Smoke Stop Systems" for materials.

K. Verify final equipment locations for roughing-in.

3.02 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. The Contractor shall install equipment in strict accordance with the directions and recommendations furnished by the manufacturer. Prior to installation of equipment the contractor shall have on-site the OEM's installation requirements for the particular equipment for reference by the installing trade and the Sandia inspector (SCO). This working copy of the installation instructions is in addition to any installation instructions required in the submittal list. Where such directions are in conflict with the plans and specifications, the Contractor shall inform the SCO of such conflict before proceeding with the work.

B. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

3.03 LABELING AND IDENTIFYING

A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.

1. Self-sticking vinyl pipe markers, with application systems. Install on insulation segment if required for hot, uninsulated piping.

2. Locate pipe markers as follows if piping is exposed in finished spaces, machine rooms, and accessible maintenance spaces, such as shafts, tunnels, plenums, and exterior nonconcealed locations:

a. At each valve and control device.
b. At each branch, excluding short takeoffs for fixtures and terminal units. Mark each pipe at branch, if flow pattern is not obvious.
c. Near locations if pipes pass through walls, floors, ceilings, or enter nonaccessible enclosures.
d. At access doors, manholes, and similar access points that permit view of concealed piping.

e. Near major equipment items and other points of origination and termination.
f. Spaced at maximum of 25-foot intervals along each run. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

B. Equipment: Install engraved plastic-laminate sign or equipment marker on or near each major item of mechanical equipment.

1. Lettering Size: Minimum 1/4-inch- high lettering for name of unit if viewing distance is less than 24 inches, 1/2-inch- high lettering for distances up to 72 inches and proportionately larger lettering for greater distances. Provide secondary lettering two-thirds to three-fourths of size of principal lettering.
2. Text of Signs: Provide name of identified unit. Include text to distinguish between multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

C. Duct Systems: Identify air supply, return, exhaust, intake, and relief ducts with duct markers; or provide stenciled signs and arrows, showing duct system service and direction of flow.

1. Location: In each space, if ducts are exposed or concealed by removable ceiling system, locate signs near points where ducts enter into space and at maximum intervals of 50 feet.

D. Controls: All automatic controls, control panels, zone valves, pressure electric, electric pressure switches, relays and starters shall be clearly tagged and identified. Wording shall be identical to that on the control diagram in the contract drawings.

E. Valves: All main service valves, including fire protection and all fuel valves located inside the building shall be tagged and identified as to the type of service. All gate valves or stop cocks controlling branch mains or risers to various portions of the building shall be tagged and identified as to the areas served.

F. Adjusting: Relocate identifying devices as necessary for unobstructed view in finished construction.

## 3.04 ACCESS DOORS FOR WALLS AND CEILINGS

A. Provide access doors in walls and rigid ceilings to access concealed valves, instruments, controls and equipment. Unless shown otherwise on the drawings, the doors shall be minimum 16 gauge, galvanized steel with a prime coat finish suitable for painting, and compatible for the type of wall/ceiling system to be installed. The hinge shall be concealed, pivoting rod or piano hinge. The latch

shall be screwdriver operated. Doors in fire rated walls and ceiling shall be UL rated and meet ANSI-UL 10B consistent with the rating for the wall/ceiling to be installed. Doors shall be sized to provide access for both operations and maintenance of concealed items.

3.05 PAINTING AND FINISHING

A. Refer to Section 09900, "Painting" for paint materials, surface preparation, color-coding, and application of paint.

B. Do not paint piping specialties, which have factory-applied, finish.

C. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.06 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psig, 28-day compressive-strength concrete and reinforcement as specified in Section 03300, "Cast-in-Place Concrete."

3.07 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Field Welding: Comply with AWS D1.1, "Structural Welding Code--Steel."

3.08 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage to support and anchor mechanical materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.09 DEMOLITION

A. All alteration and removal work, when required or specified, shall be as indicated in the applicable contract drawings or in the "Special Conditions." Work shall conform to the “Environment, Safety and Health for Construction and

Maintenance Service Contracts" in Division 1 and the Section 02222, “Selective Demolition” specification of SNL Specifications.

B. Disconnect and remove equipment and materials as specified in Division 15 Sections. Removal shall be done in a manner to protect the salvage value of the equipment or materials.

C. Construction affecting existing equipment containing CFC refrigerants shall be done in accordance with the requirements in Division 15 Sections.

D. If pipe, ductwork, insulation, or equipment to remain is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.

E. Accessible Work: Remove indicated exposed pipe and ductwork in its entirety.

F. Work Abandoned in Place: Cut and remove underground pipe a minimum of 2 feet beyond face of adjacent construction unless indicated otherwise on the drawings. Cap and patch surface to match existing finish.

G. Removal: Remove indicated equipment from Project site. Unless indicated otherwise, equipment that is removed shall be delivered to Sandia Reclamation Yard (the Reapplication Yard is located south of Hardin Blvd., east of Wyoming Blvd.)

H. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.

## 3.10 CUTTING AND PATCHING

A. Cutting the work installed by other trades shall not be done without approval. Where cutting becomes necessary, the Contractor shall employ the trade, which originally installed the work to do the cutting and to restore such cutwork.

B. The cutting of structural members for the passage of ductwork, piping or for hangar fastenings will not be permitted, except by prior written approval.

C. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved.

D. Repair cut surfaces to match adjacent surfaces.

## 3.11 GROUTING

A. Install epoxy grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placing of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases to provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout according to manufacturer's written instructions.

## 3.12 ADJUSTMENT AND CLEANING

A. Shaft Alignment: All motors and pumps (or drives) connected by a shaft coupling, whether factory or field assembled, shall be aligned during installation using a dial indicator applied to both ends of both shafts for a full 360 degrees prior to operation. Alignment of the shafts shall be less than the maximum allowable tolerances as recommended by the coupling or equipment manufacturer. Alignment of shafts shall be rechecked after several hours of operation and equipment has reached operating temperature.

B. Belts and Pulleys: All equipment 5 horsepower and over and all equipment with multi-belt drives shall be furnished with fixed sheaves. The Contractor shall make any changes or replacements of pulleys and belts required for correct balance of the system.

C. Protection from Rotating Parts: All belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts shall be fully enclosed or properly guarded.

D. Final Adjustments: The Contractor shall adjust all new heating, cooling and plumbing equipment for proper operation, including calibration of all new control equipment and existing equipment as noted on the contract drawings.

E. Cleaning: At the completion of the work, all parts of the installation shall be thoroughly cleaned. All equipment, pipe, valves, and fittings shall be cleaned of grease, metal cuttings, and sludge, which may have accumulated by operation of the system before and after the testing. Any stoppage or discoloration, or other damage to parts of the building, its finish or furnishings, due to the Contractor's failure to properly clean the system, shall be repaired by the Contractor.

## 3.13 SYSTEMS AND EQUIPMENT START-UP AND CHECKOUT

A. The contractor is responsible for the start-up and checkout of all systems and equipment. Start-up of equipment shall be in accordance with the manufactures requirements and shall be performed by individuals knowledgeable with the equipment and its requirements. Provide start-up and checkout by manufactures certified technicians when required by the manufacture or as noted in the specifications and drawings. Prior to start-up of equipment the contractor shall have on-site the OEM's Operations and Maintenance (O & M) requirements for the particular equipment for reference by start-up personnel and the Sandia inspector (SCO). This working copy of the (O & M) instructions is in addition to any (O & M) manuals required in the submittal list.

B The contractor shall operate systems and equipment at full and part load conditions to prove capability to meet specified requirements.

C. The contractor is responsible for coordinating all start-up activities and making systems and equipment ready for use. The contractor shall provide a start-plan two weeks prior to start-up of a system or equipment. The plan shall include;

1. Cleaning, filling, testing, and venting for piping and ductwork.
2. Adjustment, alignment, and calibration of equipment, instruments, hangers and braces.
3. Scheduling of start-up personnel.
4. Start-up and fuctional performance testing.
5. Support for Test and Balance activities.
6. Training for SNL maintenance and operations personnel.

## 3.14 SPECIAL TOOLS

A. All special tools for the proper operation and maintenance of each system and major items of equipment shall be identified and installed in a location acceptable.

END OF SECTION 15050