

PROJECT MANUAL

PROJECT: Eddy Street Commons Phase II Parking Garage
1200 Edison Road
South Bend, Indiana

General Construction

City Project No. 108-004

OWNER: City of South Bend
Board of Public Works
1316 County-City Building
South Bend, IN 46601

**CONSTRUCTION
MANAGER:** Kite Realty Group
30 South Meridian Street, Suite 1100
Indianapolis, IN 46204

**ARCHITECT/
ENGINEERS:** Fink Roberts & Petrie, Inc.
4040 Vincennes Circle, Suite 300
Indianapolis, IN 46268

Looney Ricks Kiss
175 Toyota Plaza
Memphis, TN 38103

Circle Design Group
5510 South East Street, Suite F
Indianapolis, IN 46227

PRE-BID MEETING: February 4, 2008
1:30 p.m., EST
1118 North Eddy Street
South Bend, IN

BID DATE: February 21, 2008
9:30 a.m., EST
Board of Public Works
County-City Building – Room 1316
227 West Jefferson Street
South Bend, IN

Fink Roberts & Petrie, Inc. Project No. 07097
January 23, 2008

CONSTRUCTION DOCUMENTS

VOLUME II (Sections 21-28)

Fink Roberts & Petrie, Inc.
January 23, 2008

City of South Bend, Indiana
Eddy Street Commons, Phase II
Parking Garage
South Bend, Indiana
Project No. 108-004

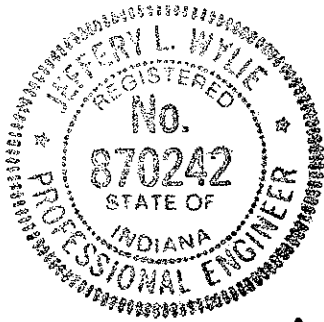
CERTIFICATIONS

PROJECT MANUAL FOR:

Eddy Street Commons
Phase II Parking Garage
South Bend, Indiana

CIRCLE DESIGN GROUP, INC.

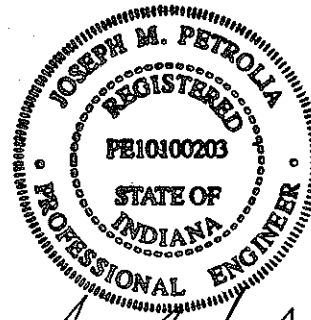
FINK ROBERTS & PETRIE, INC.



Jeffery L. Wylie

Divisions include:

21
22
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26
27
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Joseph M. Petrolia

Divisions include:

0
1
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4 (Section 04810)
5 (Sections 05100, 05310 and 05315)
7 (Section 07100)

Fink Roberts & Petrie, Inc.
January 23, 2008

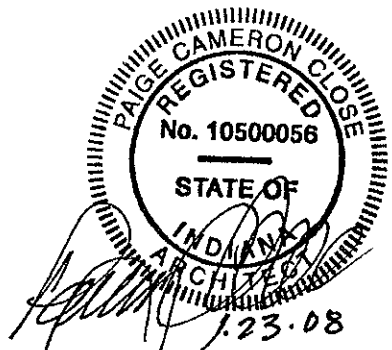
City of South Bend, Indiana
Eddy Street Commons, Phase II
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South Bend, Indiana
Project No. 108-004

CERTIFICATIONS

PROJECT MANUAL FOR:

Eddy Street Commons
Phase II Parking Garage
South Bend, Indiana

LOONEY RICKS KISS ARCHITECTS, INC.



Paige C. Close

Sections Include:

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04811	08911
05500	09220
05511	09260
07115	09900
07131	09963
07425	10200
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CERTIFICATIONS

PROJECT MANUAL FOR:

Eddy Street Commons
Phase II Parking Garage
South Bend, Indiana

WALKER PARKING CONSULTANTS



A handwritten signature in cursive script that reads "Steven F. Totten".

Steve F. Totten

Section 11152

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SECTION 21 01 70
COMPLETION AND STARTUP

PART 1: GENERAL

1.01 **WORK INCLUDED**

- A. Furnish material and labor required to perform startup of the fire suppression system and equipment installed in this project.
- B. Furnish labor and material required to inspect the installed piping systems and correct deficiencies as specified herein.
- C. Furnish labor and equipment required to maintain clean work areas throughout the project and to perform final cleanup.
- D. Provide operating and maintenance instructions to the Owner.

1.02 **RELATED WORK**

- A. General Provisions: Section 21 05 01
- B. Assignment of Miscellaneous Work: Section 21 05 02

PART 2: PRODUCTS

NOT USED

PART 3: EXECUTION

3.01 **GENERAL COMPLETION REQUIREMENTS**

- A. Complete all applicable startup procedures described in preceding paragraphs and in the associated articles for particular systems prior to occupancy of spaces served.
- B. Provide such continuing adjustment services as necessary to insure proper functioning of all fire suppression systems after building occupancy and during warranty period.

3.02 **CLEANING**

- A. Maintain a clean project site throughout the construction period. Provide personnel to regularly remove debris and unused materials. Coordinate this cleaning effort with other contractors.
- B. Remove all debris and unused materials from job site created by fire suppression work.
- C. Clean all equipment to a "like new" condition prior to the system startup and in preparation of final inspection. Vacuum clean all internal components.

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- D. Clean all mechanical rooms housing fire suppression equipment of debris and unused material. Vacuum clean mechanical room floors.
- E. Clean the exterior surfaces of all exposed piping systems. Vacuum clean if appropriate. Damp/wet clean with soap (chemical if necessary) and water where required or directed by Owner/Engineer.

END OF SECTION

SECTION 21 05 01 - PAGE 1

GENERAL PROVISIONS

PART 1: GENERAL

1.01 SUMMARY OF WORK

- A. The requirements of the General Conditions, General Requirements, Special Conditions, Instructions to Bidders, Contract Documents and other information bound herewith form a part of and shall govern all work performed under these specifications.
- B. The accompanying fire suppression drawings are issued as part of this specification. Any requirements shown thereon are equally affective as if included in this specification. Any omissions in the specification or on the drawings are not to be a basis for failure on the part of the Contractor, from installing fire suppression components required by the systems to operate in the intended manner. Should any work be called for on the drawings, specifications or in the codes, in such a manner that the Contractor cannot, in his judgement, comply with the requirements, then the Contractor shall bring the matter to the attention of the Engineer before proceeding with the work.
- C. Work includes the installation of equipment, piping, and components necessary for complete and operable systems.
- D. This project includes the following systems:
 - 1. Automatic dry sprinkler system
 - 2. Dry Standpipe system

1.02 DEFINITIONS AND TERMS USED IN THE DIVISION 21 SPECIFICATIONS AND FIRE SUPPRESSION DRAWINGS

- A. The word "owner" shall mean the party mentioned in the prime contract agreement, or any representative of his party duly authorized to act in his behalf in the execution of the work.
- B. The word "Contractor" shall mean the person, firm or corporation entering into a contract to construct and complete the work as described herein.
- C. The word "Engineer" shall mean Circle Design Group, Inc. and their representatives assigned to this project.

- D. The word "Architect" shall mean Looney Ricks Kiss and their representative acting as the Owner's appointed agent.
- E. The words "furnish" or "supply" shall mean to purchase and deliver to project site, ready for unloading, unpacking, assembly, installation and similar subsequent requirements.
- F. The word "install" shall mean operations at the project site, including unloading, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar requirements.
- G. The word "provide" shall mean to furnish and install complete and ready for intended use.

1.03

CODES, FEES AND MISCELLANEOUS COSTS

- A. All materials and workmanship shall comply with all applicable codes, specifications, local ordinances, industry standards and utility company regulations.
- B. In cases of difference between building codes, specifications, state laws, local ordinances, industry standards and utility company regulations and the Contract documents, the most stringent shall govern. The Contractor shall promptly notify the Engineer in writing of any such differences.
- C. Non-Compliance: Should the Contractor perform any work that does not comply with requirements of applicable building codes, states laws, local ordinances, industry standards and utility company regulations, he shall bear all costs arising for correction of non-complying items.
- D. Applicable Codes and Standards shall include all state laws, local ordinances, utility company regulations and applicable requirements of the following nationally accepted laws, codes and standards. These requirements are to be considered minimum and are to be exceeded when so indicated on the drawings or herein specified.
 - 1. Governing Agencies
 - a. Fire Prevention and Building Safety Commission
 - b. Indiana Department of Health
 - 2. Applicable Codes
 - a. Indiana Building Code (IBC), 2003, consisting of:
 - (1) International Building Code, 2000
 - (2) Indiana Amendments

- b. Indiana Electrical Code (IEC), 2005, consisting of:
 - (1) NFPA 70, National Electrical Code, 2005
 - (2) Indiana Amendments
 - c. Indiana Safety Code for Health Care Facilities, 1991, consisting of:
 - (1) NFPA 99 Standard for Health Care Facilities 1992
 - (2) Indiana Amendments
 - d. Indiana Elevator Safety Code 2002 Edition 675 IAC21 (SCEEMH21)
 - e. Indiana Fire Code (IFC), 2003, consisting of:
 - (1) International Fire Code, 2000
 - (2) Indiana Amendments
3. Standards
- a. ASTM: American Society of Testing Materials
 - b. ANSI: American National Standards Institute
 - c. ASME: American Society of Mechanical Engineers
 - d. NEC: National Electric Code
 - e. NECA: National Electrical Contractors Association
 - f. NEIS: National Electrical Installation Standards
 - g. NEMA: National Electrical Manufacturers Association
 - h. NFPA: National Fire Protection Association
 - i. OSHA: Occupational Safety and Health Act
 - j. UL: Underwriters Laboratories
 - k. ADAAG: Americans with Disabilities Act Accessibility Guidelines

- E. The Contractor shall be responsible for obtaining all permits, payment of all fees, necessary drawings and arranging and paying for all inspections, tests, etc. which may be required by any governing authority or utility company in connection with the furnishing or installation of any of his work.

1.04

WORK AND WORKMANSHIP

- A. All materials and equipment shall be of the highest quality in every respect. All materials and equipment shall be new and of the latest design and free of defects.
- B. Workmanship shall be by skilled workmen of highest standard in strict accordance with all applicable manufacturers' printed specifications (which, by reference, are made completely a part of these specifications as though herein repeated), performed under supervision of competent foremen at all times.
- C. The Owner has full power to condemn or reject any work, materials or equipment not in accordance with these specifications and construction drawings or not in conformance with the manufacturers' specifications or drawings which were approved by the Owner or Engineer.

- D. Work or equipment that is rejected shall be removed and replaced to the satisfaction of the Owner, at the Contractor's expense. Work or equipment that is rejected shall be so stated in writing by the Owner or Engineer.
- E. Such decisions that the Owner or Engineer may make with respect to questions concerning the quality, fitness of materials, equipment and workmanship shall be binding upon the parties thereto.
- F. Special attention shall be given to accessibility of working parts and controlling parts. Adjustable parts shall be within easy reach. Removable parts shall have space for removal.

1.05 DEVIATIONS FROM DRAWINGS

- A. Fire suppression drawings show the intended arrangement and routing of all piping, equipment and appurtenances. They shall be followed as closely as actual building construction and work of other trades will permit.
- B. The Contractor shall investigate structural and finish conditions affecting his work and shall provide any fittings, offsets and accessories required to accommodate said conditions.
- C. Adjustments as a result of coordination with other trades or for reasons to improve performance, etc. may be made upon receiving the approval of the Engineer. The Contractor shall document that the adjustment has been coordinated with all parties concerned.

1.06 OCCUPATIONAL SAFETY AND HEALTH ACT

All work shall comply with the current requirements of the U.S. Department of Labor Occupational Safety and Health Administration, entitled Occupational Safety and Health Standards; National Consensus Standards and Established Federal Standards.

1.07 COORDINATION BETWEEN CONTRACTORS

- A. The Contractor shall study all drawings and specifications for this project so that complete coordination between trades will be obtained. Special attention shall be given to points where piping crosses ductwork, cable tray, other piping, where lights fit into ceilings and where pipe passes through walls and structural elements.
- B. It is the responsibility of the Contractor to leave necessary room for other trades. No extra compensation will be allowed to cover the cost of relocating piping, conduit, ducts or equipment found encroaching on space required by others.
- C. The Contractor shall review the electrical requirements of the final equipment selections to ensure such items receive proper electrical services or connections.

- D. The Contractor shall provide complete information and cooperation to the other Contractors and trades pertaining to his work to accomplish coordination for the complete project.
- E. The Contractor shall coordinate necessary sleeved openings, excavations, etc. Cutting and patching shall be held to a minimum.
- F. The Contractor is required to attend the periodic progress meetings to accomplish coordination with the Owner, Architect and Engineer.

PART 2: PRODUCTS

2.01 PRODUCT AND MATERIAL APPROVAL

- A. A specification followed by one or more manufacturers is limited to those manufacturers. Names of other proposed manufacturers may be submitted for approval to the Engineer a minimum of ten (10) days prior to receiving bids. Approval will be granted only if issued by Addendum (no exceptions).
- B. A specification followed by one or more manufacturers and "or approved equal" is open to equal products or materials. However, the Contractor shall supply one of the listed manufacturers at no additional cost if Engineer determines substituted product unsatisfactory.
- C. Any substituted equipment offered for consideration shall be stated as a separate item with the bid. State any additive or deductive cost.
- D. If changes in piping, equipment, layout or electrical service are brought about by the use of equipment which is not compatible with the layout shown on the drawings, the Contractor shall include the cost of the necessary changes in his bid.

2.02 SUBCONTRACTORS AND MATERIAL LIST

- A. The Contractor shall submit, with his bid, a completed list of manufacturers and suppliers of each item listed. No substitutions will be allowed, by the Contractor, after award of contract.
- B. Failure to submit a fully completed list within the stated time will be cause to reject the bid.
- C. Remove or copy the following list and attach it to the bid form.

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2.03 List for Fire Suppression Contractor: _____
(The Contractor)

Material and Suppliers List

<u>SECTION</u>	<u>MATERIAL</u>	<u>MANUFACTURER</u>	<u>SUPPLIER</u>
21 12 00	Dry Standpipe System	_____	_____
21 13 16	Double Detector Check Valve	_____	_____
	Sprinkler heads	_____	_____
	Pumper connection	_____	_____
	Valves	_____	_____
	Pressure gauges	_____	_____

2.04 EQUIPMENT DELIVERY SCHEDULE

- A. Submit a schedule listing equipment and materials required for complete installation, quantity ordered, date of placing order and the promised delivery dates.
- B. Any and all probable delivery delays shall be identified at the pre-construction meeting.

2.05 EQUIPMENT SHOP DRAWINGS

- A. The Contractor shall submit shop drawings of each piece of equipment and fire suppression system components as stated in the General Conditions and as specified herein.
- B. Approval of shop drawings does not relieve the Contractor of the responsibility for ordering proper quantities and miscellaneous appurtenances required for operation and/or installation of the respective material or equipment.
- C. The following general information is required with each submittal as applicable:
 - 1. The full manufacturer's model number of each item
 - 2. Identification of each item's performance, physical size and construction data.
 - 3. Identification of finishes.
 - 4. Indicate any modifications made to manufacturers' standard design which are required by these specifications.
 - 5. Location of connection points for external piping or electrical connections.
 - 6. Rough-in, foundation and support point dimensions.
 - 7. Complete wiring diagrams and connection identifications.
 - 8. Contractor's stamp, signature and date shall be affixed to shop drawings with indication of his review and approval.
- D. Provide specific information with each submittal as stated in the respective specifications sections.

2.06 RECORD DRAWINGS

- A. The Contractor shall submit record drawings as stated in the General Conditions, and as specified herein.
- B. During construction, maintain a complete and legible set of drawings, at the job site showing changes and deviations between actual construction and Engineer's drawings.

- C. Submit to Engineer for review at the 25%, 50%, 75% and 100% completion of the work a complete, accurate and neat set of marked-up blue-line drawings showing the complete "as built" construction.
- D. This marked-up set shall be returned to the Contractor as many times as necessary in order to obtain desired results.

2.07

MAINTENANCE MANUALS

- A. Contractor shall submit at the job completion, three (3) maintenance manuals to the Engineer for approval. One (1) will be retained by the Engineer and two (2) will be forwarded to the Owner.
- B. Maintenance manuals are to include all information relative to maintenance and operating instructions for all new fire suppression equipment.
- C. Maintenance manuals shall be assembled in the following sections:
 - 1. Section 1
 - a. Title of project
 - b. Name and addresses of:
 - (1) Owner
 - (2) Engineer
 - (3) Contractor
 - 2. Section 2: Index of complete contents
 - 3. Section 3:
 - a. List of all equipment with model number and serial number
 - b. Warranty of each piece of equipment with start and completion dates.
 - 4. Section 4: valve tag chart
 - 5. Section 6: Products
 - a. Incorporate data sheets, operating instructions, maintenance instructions, parts list, installation instruction and performance characteristics on each piece of equipment or system in individually tabbed subsections.
 - b. Label and assemble tabbed sections in numerical order by corresponding specification section number.
- D. Each section shall be separated by a pasteboard tabbed divider. Each section tab shall identify equipment by same name as listed in the index. Tabs shall extend outside of sheet size.
- E. All information shall be arranged in as many three-ring (3" D configuration) vinyl coated notebooks as necessary. Do not overload capacity of binder.

2.08 INSPECTION

At the completion of the fire suppression installation, the Contractor shall inform the local and state authorities to arrange the final inspections of his work. Provide in triplicate a Certificate of Inspection when completed.

PART 3: EXECUTION

3.01 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Handle equipment and components carefully to prevent damaging, breaking, denting and scoring. Do not install damaged equipment or components; replace with new.
- B. Store equipment and components in clean dry place. Protect from weather, theft, dirt, fumes, water, construction debris and physical damage at all times.

END OF SECTION

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SECTION 21 05 02

ASSIGNMENT OF MISCELLANEOUS WORK

PART 1: GENERAL

1.01 WALL OPENINGS

- A. Wall openings for fire suppression work not noted on the Structural drawings shall be arranged for and provided by the Fire Suppression Contractor.
- B. Final sizes and locations of fire suppression penetrations in walls are the responsibility of the Fire Suppression Contractor.
- C. Provide approved fire stops for fire rated wall and floor openings.

1.02 FLOOR OPENINGS

- A. Floor openings for fire suppression work not noted on the architectural or structural drawings shall be arranged for and provided by Fire Suppression Contractor. Miscellaneous framing required and cutting of openings, shall be furnished and installed by the contractors constructing the roof or floor structure. Fire Suppression Contractor is responsible for notifying those Contractors of exact locations and sizes prior to construction of the framing. Openings not coordinated and provided shall be arranged and paid for by the Fire Suppression Contractor.
- B. Final sizes and locations of fire suppression penetrations through the roof and floor structures are the responsibility of the Fire Suppression Contractor requiring the opening.

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PART 2: PRODUCTS
NOT USED

PART 3: EXECUTION

3.01 **PLATFORMS AND SUPPORT STANDS**

- A. Platforms and supporting stands for fire suppression equipment shall be provided by Fire Suppression Contractor.
- B. Each piece of equipment or apparatus suspended from ceiling or mounted above floor level shall be provided with suitable structural support, platform or carrier constructed in accordance with best recognized practice in a neat and workmanlike manner.
- C. Contractors shall exercise extreme care that structural members of building are not overloaded by such equipment. In all cases, details of such hangers, platforms and supports together with total weights of mounted equipment shall be approved by Structural Engineer.

3.02 **ATTACHING TO BUILDING CONSTRUCTION**

- A. Equipment and piping supports shall be attached to structural members (beams, joists, etc) rather than to floor or roof slabs.
- B. Where equipment is suspended from concrete or masonry construction, use expansion shields to attach supports to construction. Expansion shield bolt diameter shall be the same size as support rod diameter, hereinafter specified.
- C. Where existing masonry is not suitable to receive and hold expansion shields or where other means of attachment is advantageous, Contractor shall submit alternate method for approval of Architect and/or Engineer.
- D. Where supports are attached to structural members coated with fireproofing, the contractor shall clean the fireproofing, attach the support and patch the fireproofing with like material.

3.03 ELECTRICAL CONNECTIONS TO EQUIPMENT

- A. In the event that equipment furnished requires a larger starter or disconnect than that which is indicated on the documents, the Contractor supplying the larger equipment shall reimburse the Electrical Contractor supplying the larger starter or disconnect for the difference in labor and material cost.
- B. Detailed diagrams and instructions shall be provided by the Contractor supplying equipment. If connections are different from those shown on the drawings, the contractor shall notify the electrical contractor prior to start of his related work.
- C. Review the electrical drawings and specifications. Relays, switches, contactors, etc. which may be required in addition to those specified or indicated on the electrical drawings shall be furnished by the Contractor for installation by the Electrical Contractor. These devices shall be mounted by the Electrical Contractor at the apparatus to be installed. The Contractor supplying these additional devices shall reimburse the Electrical Contractor for his labor and material costs.
- D. In the event that several pieces of fire suppression equipment from different suppliers are combined into one system, Contractor shall furnish complete interface wiring and control diagram to enable the Electrical Contractor to make proper connections. Diagrams shall be submitted to the Engineer for approval prior to actual wiring.
- E. Contractor shall furnish to Electrical Contractor written notice of approval and acceptance of all control wiring which was installed by the Electrical Contractor for his system(s). Such approval shall be given within thirty (30) days of completion of all such control wiring. The letter shall be copied to the Engineer.

END OF SECTION

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SECTION 21 05 19
METERS AND GAUGES

PART 1: GENERAL

1.01 **WORK INCLUDED**

Provide pressure gauges in the piping systems where shown on the drawings and as specified herein.

1.02 **RELATED WORK SPECIFIED ELSEWHERE**

- A. General Provisions: Section 21 05 01
- B. Fire Suppression Dry Standpipes: Section 21 12 00
- C. Dry Pipe Sprinkler System: Section 21 13 16

1.03 **SUBMITTALS**

Submit shop drawings on each gauge type to be used on this project in accordance with Specifications Section 21 05 01, General Provisions.

PART 2: PRODUCTS

2.01 **PRESSURE GAUGES - STANDARD**

- A. Dial size: 4"
- B. Case: open front style, phenol or stainless steel
- C. Bourdon tube: bronze
- D. Connection: lower or back as required
- E. Accuracy: within 1% of scale range
- F. Range: refer to Application - Part 3: Execution
- G. Manufacturers: Weksler, Ashcroft, Weiss Instruments, Inc.

PART 3: EXECUTION

3.01 **PRESSURE GAUGES - INSTALLATION/APPLICATION**

Connection in piping: provide a 1/4" ball valve ahead of each gauge. Mount gauges for maximum visibility.

3.03 **LOCATION REQUIREMENTS**

- A. Provide standard pressure gauges at all locations shown on drawings.
- B. Provide pressure gauge on service entrance.

END OF SECTION

SECTION 21 05 29

BASIC PIPING REQUIREMENTS

PART 1: GENERAL

1.01 WORK INCLUDED

- A. Pipe Hangers and Supports
- B. Sleeves and Plates
- C. Installation of Piping Systems
- D. Fire Stop Sealants

1.02 GENERAL PIPE SYSTEM INSTALLATION REQUIREMENTS

- A. Fabricate and install all pressure piping systems in accordance with the procedures established in the ANSI B31 Code. Materials and fittings shall be as defined by the applicable standards of NFPA.
- B. Provide fittings in accordance with the ANSI B16 Code for all changes in direction, elevation or size. No mitered joints or pipe bends will be permitted. Reduction of pipe size shall be by reducing fittings or couplings. Bushings will not be permitted.
- C. Each length of pipe, fitting and item shall be marked with the manufacturer's name and material identification.
- D. Install all piping to present a neat and orderly appearance. Run all lines parallel with building walls and construction. Offset piping, in approved manner, where required to avoid interference with other work, to increase headroom under piping or to improve appearance of the work.
- E. Anchor piping to comply with requirements for seismic design Category 'C'.
- F. Provide protection for piping against freezing.
- G. Pipes passing through exposed construction shall be provided with escutcheons or other seals as described herein. Exposed escutcheons in finished areas shall have a chrome finish.

- H. Penetrations of smoke rated walls, floors, roofs and ceilings are to be made with smoke stops equal/exceeding the fire rating of the building separation being penetrated. See Division 07.

1.03 PIPING SYSTEMS WARRANTY

- A. Maintain integrity of all piping systems through warranty period, repairing all leaks.
- B. Warranty work shall include repair/replacement of building materials and finishes damaged by leak(s).
- C. All damage resulting from leaking pipes shall be paid for by the installing contractor.

PART 2: PRODUCTS

2.01 PIPING SYSTEM MATERIALS

All pipe hangers and supports shall conform to the latest requirements of NFPA.

2.02 PIPE HANGERS

- A. Hangers: Steel pipe
 - 1. 2" and smaller: adjustable clevis, light weight
 - a. Grinnell Fig. 65
 - b. Elcen Fig. 12B
 - c. PHD Fig. 440
 - 2. Larger than 2": adjustable clevis
 - a. Grinnell Fig. 260
 - b. Elcen Fig. 12
 - c. PHD Fig. 450
- B. Riser clamps: steel pipe
 - 1. Grinnell Fig. 261
 - 2. Elcen Fig. 39
 - 3. PHD Fig. 550

- C. Floor supports: steel pipe
1. 2" and smaller: U-bolt on structural steel channel secured to floor with angle clips
 - a. Grinnell Fig. 137
 - b. Elcen Fig. 68A
 - c. PHD Fig. 90
 2. larger than 2": adjustable pipe saddle
 - a. Grinnell Fig. 264
 - b. Elcen Fig. 50
- D. Supports at walls or columns: steel brackets properly selected to support weight suspended.
1. Grinnell Fig. 194, 195, 199, 202
 2. Elcen Fig. 56, 57 or 58
- E. Rods: galvanized steel, all threaded hanger rods; threaded both ends
- | <u>Pipe Size</u> | <u>Rod Diameter</u> |
|------------------|---------------------|
| 2" and smaller | 3/8" |
| 2.5" to 3.5" | 1/2" |
| 4", 5" | 5/8" |
| 6" | 3/4" |
| 8" to 12" | 7/8" |
| 16" and larger | 1" |
- F. Turnbuckles: where required to adjust pipe elevation.
- G. Beam Clamps
1. To 400 pounds loading, hardened steel point set screw; 6" pipe malleable iron clamp
 - a. Grinnell Fig. 86
 - b. PHD Fig. 270

2.03 SLEEVES AND PLATES (ESCUTCHEONS)

- A. Schedule of Sleeve Usage:
1. All sleeves through concrete walls shall be Schedule 40 galvanized steel pipe.
 2. All sleeves through wall board, drywall, plasterboard or wall panels shall be 20 gauge galvanized steel.

3. All sleeves through masonry walls, metal roof deck, concrete floors on grade and metal deck shall be Schedule 40 galvanized steel pipe.
- B. Special sleeves and sealing as shown on drawings.
- C. Plates shall be chromium plated for finished areas and may be cast iron elsewhere.

PART 3: **EXECUTION**

3.01 **SEISMIC DESIGN**

- A. General: Design, furnish and install the entire fire protection system in compliance with seismic design category 'C'.
- B. Sprinkler fabrication drawings shall clearly call out where flexible connections are required and intended for use.
- C. Couplings
 1. Provide couplings throughout the system except at locations where the piping is installed vertically, or where flexible connection in a horizontal run is required.
 2. 2 ½" and larger connections: Install lateral sway brace within 24 inches of coupling, where flexible couplings are required in horizontal runs.
 3. Coupling Requirements
 - a. Within 24 inches of the top and bottom of all risers, unless the following provisions are met:
 - 1) In risers less than 3 feet in length, flexible couplings are permitted to be omitted.
 - 2) In risers 3-7 feet in length, one flexible coupling is adequate.
 - b. Within 12 inches above and within 24 inches below the floor in multistory buildings. When the flexible coupling below the floor is above the tie- in main to the main supply that floor, a flexible coupling shall be provided on the vertical portion of the tie- in piping.
 - c. On both sides of concrete or masonry walls within 1 foot of the wall surface, unless clearance is provided in accordance with Section 9.3.4 of NFPA 13.
 - d. Within 24 inches of building expansion joints.
 - e. Within 24 inches of the top and bottom of drops to hose lines, rack sprinklers, and mezzanines, regardless of pipe size.

- f. Within 24 inches of the top and bottom of drops exceeding 15 feet in length to portions of systems supplying more than one sprinkler, regardless of pipe size.
- g. Above and below any intermediate points of support for a riser or other vertical pipe.

D. Sway Brace

- 1. Lateral, longitudinal and 4-way bracing shall be provided as follows:
 - a. Lateral bracing shall be spaced at 40 foot maximum.
 - b. Lateral bracing shall occur within 20 feet of each end of main run.
 - c. Provide bracing on the first piece of pipe on each end of the main.
 - d. Longitudinal bracing shall be spaced at 80 foot maximum.
 - e. Longitudinal bracing shall occur within 40 feet of each end of main run.
 - f. 4-way bracing shall be provided within 24 inches of the top of risers. 4-way brace should be installed in a horizontal position.
 - g. Both lateral and longitudinal bracing may serve as each other's purpose if located within 24 inches of the end of the main run.
 - h. Spacing of braces on the sprinkler drawings shall permit field adjustments. Maximum spacing on plans shall not be permitted.
 - i. Layout of bracing on shop drawings must consider total weight, as well as close coordination with other trades and ceiling space.

E. Seismic Separation

- 1. All piping, regardless of size, shall have a seismic separation assembly while crossing a building separation, or expansion joint.
- 2. Seismic separations shall be comprised of: a six 90-degree elbow step down assembly, or a Metraloop® fitting assembly.
- 3. Metraloop® fitting assemblies must be connected to the piping system with flexible couplings.

F. Clearance: The following clearances are required on pipe penetrations through concrete and masonry floors, ceilings or walls:

- 1. A 1-inch annular space shall be provided around 1 inch thru 3" pipe sizes.
- 2. A 2-inch annular space shall be provided around 4 inch and larger pipe sizes.
- 3. Flexible connections may be used on risers with standard size hole penetrations, provided flexible connectors are placed within 12 inches above and within 24 inches below the penetration.

G. Hangers and Supports

1. C-type clamps (including beam and large flange clamps), used to attach hangers to building structure, shall be equipped with a restraining strap.
2. Restraining straps shall be listed for use with C-type clamps.
3. C-type clamps, with or without a restraining strap, shall not be used to attach braces to the building structure.
4. Where purlins or beams do not provide an adequate lip to be secured by a restraining strap, as defined by NFPA 13, the strap shall be through-bolted or secured by a self-tapping screw.
5. Powder-driven fasteners shall not be used to attach braces to the building structure unless they are specifically listed for service in resisting lateral loads.
6. Powder-driven fasteners shall not be used to attach hangers to the building structure unless they are specifically listed for horizontal force factors in excess of 0.50Wp.

3.02

HANGERS AND SUPPORTS

A. General

1. Furnish and install supports, guides, anchors and swaybraces required for proper installation and support of pipe lines except supports noted to be furnished by others.
2. Pipe suspensions shall prevent excessive stress and excessive variation in supporting force. Fabrication and installation of supports for pipe lines shall not constrain piping to cause excessive transfer of load from supports to piping or from support to support when expansion or contraction occurs. Supports shall be capable of taking entire piping load imposed by expansion or contraction.
3. Piping system where flexibility is not desired shall be supported by rigid hangers.

B. Vibration and Noise Transfer Control: Where pipe vibration can transmit objectionable vibration to building structure or attached equipment, hangers shall be supplemented by spring cushions or an energy absorbing means in supports themselves or through addition of flexible piping connectors or auxiliary equipment.

C. Securing Hangers and Supports at Building Construction

1. Provide, as required, steel or malleable iron inserts in poured concrete construction. Maximum load which may be applied to any one foot length of continuous insert shall not exceed 1000 pounds.

2. Where piping is suspended from masonry construction, use expansion shields to attach pipe supports to construction. Expansion shield bolt diameter the same size as the support rod diameter specified.
3. Where piping is suspended from structural steel building framing or supporting members, furnish and install beam clamps for attaching piping support device to building member beam clamps made of heavy steel forged to fit structural member (I-beam, angle, channel) and securely fastened in place. No building member to be drilled, welded, cut or otherwise deformed in attaching pipe supports unless approved by the Engineer.
4. Where existing masonry is not suitable to receive and hold expansion shields or where other means of attachment is advantageous, the Contractor shall submit alternate method for approval to Engineer.
5. Do not suspend hangers from deck. Suspend from structural framing members in an approved and workmanlike manner.
6. Provide additional bracing and supports wherever needed, in opinion of the Engineer. Install structural steel members, attached to building framing, where required, to provide additional points of support. Drill building structural and miscellaneous steel only as directed by the Engineer
7. Maximum distance between hangers for horizontal piping.

<u>Material</u>	<u>Pipe Size</u>	<u>Spacing</u>
Steel Pipe	1" - 1-1/4"	12'-0"
Schedule 10 and 40	1-1/2" - 8"	15'-0"

8. Pipe hanger rods shall be sized per NFPA 13.

D. Vertical Pipe Hangers

1. Support vertical runs under 15 feet long with hanger adjacent to elbows.
2. Support vertical runs over 15 feet long with riser clamps. Weld clamps to pipe and support on pipe sleeve or building structure. Space clamps at every floor with maximum spacing of 28 feet.
3. Malleable iron risers shall be supported at every floor.
4. All other risers shall be supported at lowest floor through which they pass. Pipe 2" and smaller in size shall be guided at every floor through which it passes. Larger pipe shall be guided at every other floor.
5. Provide floor supports at the bottom of risers with structural steel supports of a Structural Engineer approved design. Secure to floor with angle clips.

3.03 PIPE SLEEVES

- A. Furnish, locate and set pipe sleeves where piping passes through floors, walls and other concrete or masonry structural materials except where tunnels, chases or shafts are provided in the construction.
- B. Wall Sleeves (Above Grade): Sleeves set in walls above grade shall be sized to finish flush with face of walls and shall be constructed of material which is equal to or greater than the fire rating of the wall.
- C. Floor Sleeves: Floor sleeves shall extend 1-1/2" above finished floor. Sleeve shall extend to 3" above finished floors in areas such as kitchens, food preparation, dishwashing and laboratory areas.
- D. Sleeves shall be in accordance with the following schedule unless otherwise specified.

<u>Sleeve Schedule</u>	
<u>Pipe Size</u>	<u>Sleeve Size</u>
1"	2"
1-1/2"	3"
2"	3"
4"	6"
6"	8"

- E. The void between the sleeve and wall, and the pipe shall be neatly filled with an approved fire stop material.

3.04 UNION AND FLANGES

Provide at intervals and locations where they will facilitate disconnection and removal of piping at all valves, at connections to equipment and elsewhere as shown.

END OF SECTION

SECTION 21 05 53

IDENTIFICATION OF PIPING AND EQUIPMENT

PART 1: GENERAL

1.01 **WORK INCLUDED**

- A. Label all fire suppression equipment furnished and/or installed in this project.
- B. Label all electrical equipment furnished under this project.
- C. Label all piping systems installed in this project.
- D. Provide valve tags and chart.

1.02 **RELATED WORK**

- A. General Provisions : Section 21 05 01
- B. Basic Piping Requirements: Section 21 05 29

1.03 **SUBMITTALS**

- A. In accordance with Specifications Section 21 05 01, General Provisions, submit manufacturer's data on labels. Include a listing of labels ordered with name of equipment or control device.
- B. Submit manufacturer's data on valve tags including a list of all valves to be tagged on the project.

PART 2: PRODUCTS

2.01 **EQUIPMENT LABELS**

- A. Labels shall be engraved, laminated plastic plates. Height of letters shall be as scheduled herein.
- B. Letters shall be black; plates shall be white.
- C. Manufacturers: Seton Nameplate Corporation, Brady or approved equal

2.02 CONTROL EQUIPMENT LABELS

- A. Labels shall be engraved, laminated plastic plates. Height of letters shall be as scheduled herein.
- B. Letters shall be black; plates shall be white
- C. Manufacturer: Seton Nameplate Corporation, Brady, or approved equal.

2.03 PIPE LABELS

- A. Furnish snap-around type markers through 5" pipe sizes. Furnish strap-around type markers with nylon ties for 6" pipe sizes and larger.
- B. Letter height shall vary with pipe size as follows:
Thru 1-1/4" insulated pipe: 1/2"
Thru 2" insulated pipe: 3/4"
Thru 6" insulated pipe: 1-1/4"
8" and above: 2-1/2"
- C. Use ANSI/OSHA designated colors.
- D. Manufacturer: "Setmark" system of pipe markers as manufactured by Seton Identification Products, Brady or equal. Equal brands must meet ANSI specifications.

PART 3: EXECUTION

3.01 FIRE SUPPRESSION EQUIPMENT LABEL INSTALLATION

- A. Schedule of Fire suppression Equipment Labels (List is not necessarily inclusive of all equipment on this project to be labeled).

<u>Equipment</u>	<u>Example Wording</u>	<u>Letter Height</u>
Dry Pipe Valve	DRY PIPE VALVE	1"

- B. Labels shall be secured to the equipment in a readily apparent location with a minimum of four (4) screws for 1" size labels and two (2) screws for 1/2" and smaller. (Glue shall not be used.) Drill holes for screw openings. Cracked labels shall be replaced.

- C. Equipment which is not suitable to receive the above fastening method shall be labeled on an adjacent wall, chain hung from the ceiling, or on a readily sighted disconnect switch, at the direction of the Designer.

3.02 ELECTRICAL AND CONTROL EQUIPMENT LABEL INSTALLATION

- A. 1" and ½" letter size labels shall be secured to the devices with appropriately sized screws or rivets. (Glue shall not be used.) Screw holes shall be drilled. Cracked labels shall be replaced.
- B. 1/4" and 1/8" letter size labels shall be glued to the device.

3.03 VALVE TAG INSTALLATION

- A. Install tags on each operating valve installed in this project.
- B. Use scheduled abbreviations for service indication.
- C. Attach tags with nickel plated brass bead chain.

3.04 PIPE LABEL INSTALLATION

- A. Install pipe identification labels where required to provide easy identification of the system and flow.
- B. Minimum requirements include the following:
 - 1. At both sides of all wall penetrations, concealed and exposed, throughout the building.
 - 2. At an accessible location for every exposed 50 lineal feet of piping.
 - 3. At each piece of equipment.
- C. Do not install labels until pipe has been painted.

END OF SECTION

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SECTION 21 11 19

PIPING SPECIALTIES

PART 1: GENERAL

1.01 **WORK INCLUDED**

Backflow preventor shall be designed and manufactured for the purpose of prevention of backflow from non-potable fire suppression system to the potable/municipal water system.

1.02 **RELATED WORK**

- A. General Provisions: Section 21 05 01
- B. Meters and Gauges: Section 21 05 19
- C. Basic Piping Requirements: Section 21 05 29

1.03 **SUBMITTALS**

- A. Submit shop drawings for each type of backflow preventor specified in accordance with Specification Section 21 05 01, General Provisions.
- B. Submit final backflow preventor test report on each unit into the Operator's Maintenance Manuals.

1.04 **AGENCY APPROVAL**

- A. Installation of backflow preventor(s) shall comply with state and local codes and the local water utility requirements.
- B. Compliance shall be in accordance with the following standards:
 - 1. ASSE Standard 1013
 - 2. AWWA Standard C-511-92
 - 3. CSA B64.4
 - 4. USC Manual Section 10
 - 5. IAPMO and UPC approved

PART 2: PRODUCTS

2.01 **DOUBLE CHECK DETECTOR BACKFLOW Preventor**

A Valve Assembly (1/2" - 2-1/2")

1. Cast bronze body, modular construction
2. Replaceable seats and seat discs
3. Maximum design: 175 psi working pressure; 180°F temperature
4. Shut-off valves; quarter-turn ball valves
5. Check valves: captured spring assisted disc with rubber seat discs
6. Test cocks: ball valves
7. Exact size and flow rate as noted on the drawings
8. Manufacturers
 - a. Febco # 850
 - b. Wilkins # 950XLT

B. Valve Assembly (3" and 4")

1. 3" bronze body or epoxy coated cast iron body; 4" stainless steel and bronze internal parts; flanged connections; inlet strainer.
2. Maximum design: 175 PSI working pressure, temperature 110°F.
3. Shutoff valve: OS&Y gate valves (Matco-Watts)
4. Check valves: tight seating rubber face discs with removable seats.
5. Test Cocks: bronze ball valves
6. Bypass assembly: approved double check valve assembly and water meter.
7. UL & FM approved; ASSE 1015
8. Exact size and flow rate as required by hydraulic calculation of the Automatic Sprinkler System.
9. Manufacturers
 - a. Watts Model 709 DCDA
 - b. Febco Model 806
 - c. Hersey Model DDC-II
 - d. Wilkins Model DCDA.

- C. Valve Assembly (6" and larger)
 - 1. Stainless steel construction; epoxy coated gate valves; flanged connection; inlet strainer.
 - 2. Maximum design: 175 psi working temperature; temperature 110°F
 - 3. Shutoff valve: OS&Y gate valves
 - 4. Check valves: spring loaded cam-checks; rubber faced discs with replaceable seats
 - 5. Test cocks, ball valves
 - 6. Bypass assembly; approved double check valve assembly and water meter.
 - 7. UL and FM approved; ASSE 1015
 - 8. Exact size and flow rate as required by hydraulic calculations of the automatic sprinkler system.
 - 9. Manufacturer:
 - a. Ames

- C. Standards
 - 1. ASSE Standard 1015
 - 2. AWWA Std Class D
 - 3. USC Manual as approved by IDEM (Indiana Dept. of Environmental Management)
 - 4. IAPMO and UPC approved
 - 5. UL Listed
 - 6. Factory Mutual

2.02 FIRE DEPARTMENT CONNECTION (WALL MOUNT)

- A. Cast brass flush type hydrant with male outlets, caps and chains. Chrome plated, threads to local fire department specifications, labeled "AUTOSPKR".
- B. Manufacturers
 - 1. Potter-Roemer
 - 2. Allenco #276

Circle Design Group, Inc.
Comm. No. 07098

City of South Bend, Indiana
Eddy Street Commons, Phase II
Parking Garage
South Bend, Indiana
Project No. 108-004

PART 3: EXECUTION

3.01 GENERAL

- A. Pipe relief line where required to nearest drain.
- B. Prior to substantial completion and occupation by the Owner, all strainer assemblies shall be removed and cleaned.
- C. Backflow preventor shall be tested and all defective devices repaired or replaced prior to acceptance at no additional cost to Owner.
- D. Equipment shall be installed in accordance with the drawings and all applicable state and local codes.

END OF SECTION

SECTION 21 12 00

FIRE SUPPRESSION DRY STANDPIPES

PART 1: GENERAL

1.01 WORK INCLUDED

- A. Provide a dry standpipe system for the building as shown on the drawings and described herein.
- B. Secure all approvals and necessary permits to install a completely approved, functional wet pipe automatic sprinkler system.
- C. Contractor is responsible for compliance with all codes and regulations of governing standards and agencies. Compliance includes existing service(s) or system(s) when being extended or modified.
- D. System shall include all required valves, drains, as required for a complete operational system.

1.02 RELATED WORK

- A. Completion and Startup: Section 21 01 70
- B. General Provisions: Section 21 05 01
- C. Assignment of Miscellaneous Work: Section 21 05 02
- D. Meters and Gauges: Section 21 05 19
- E. Basic Piping Requirements: Section 21 05 29
- F. Identification of Piping and Equipment: Section 21 05 53

1.03

QUALITY ASSURANCE

- A. All materials and devices used are to be listed for use by the "Underwriters' Laboratories, Inc." and shall bear their label wherever "Label Service" is a requirement or is available.
- B. Work shall be accomplished by an approved fire protection equipment contractor, regularly employed in the installation of automatic sprinkler systems and approved by the Owner's representative. All equipment supplied for this system shall be the products of a single manufacturer (except as specified otherwise) and shall be readily obtainable products from the manufacturer's stock where possible.
- C. Systems shall comply with the following regulating agencies, organizations and publications, which include but may not be limited to:
 - 1. Indiana Building Code (IBC), 2003, consisting of:
 - a. International Building Code, 2000
 - b. Indiana Amendments
 - 2. Indiana Mechanical Code (IMC) 2003 consisting of:
 - a. International Mechanical Code 2000
 - b. Indiana Amendments
 - 3. Indiana Plumbing Code (IPC), 1999, consisting of:
 - a. Uniform Plumbing Code, 1997
 - b. Indiana Amendments
 - 4. Indiana Fire Code (IFC), 2003, consisting of:
 - a. International Fire Code, 2000
 - b. Indiana Amendments"
 - 5. Underwriters' Laboratories, Inc. (UL)
 - 6. Factory Mutual Laboratories (FM)
 - 7. National Fire Protection Association Standards (NFPA) #13, #14, #20, #24, #26, #231 and #231C.
 - 8. Local jurisdictional agencies, organizations and ordinances.
 - 9. Insurance Service Office of Indiana (I.S.O.)
 - 10. Local water company
 - 11. State Fire Marshal
 - 12. Indianapolis Fire Department
- D. Hazard classifications included in this project are:
 - 1. Light hazard
 - 2. Ordinary hazard, Group 1
 - 3. Ordinary hazard, Group 2
- E. Finishes: component finishes shall be as specified herein.

1.04 CONTRACT DOCUMENTS

- A. It is not the intent of the Contract Documents to neglect or violate any codes or governing agencies by indicating or specifying certain methods, equipment or material. The Contractor is responsible for full building coverage per code. Review all Architectural Documents to ascertain construction and details and be familiar with the entire project.
- B. Purpose for the "Products" and "Execution" portions of this section, as well as related information on the drawings, is to assure quality of system, components, workmanship and aesthetics. These items are above minimum standards required by codes and regulations.

1.05 COORDINATION DRAWINGS

Coordination drawings are required on this project. Fire protection fabrication drawings as defined below may be used.

- A. Submit full set of drawings for each system for Engineer's approval prior to installation. Refer to Specifications Section 21 05 01, General Provisions and Division 1 for submission requirements.
 - 1. Drawings shall be prepared utilizing "Autocad". Contact the Architect to obtain generic floor plans on diskette. Engineers' drawings are not intended for use as coordination drawings.
 - 2. Drawings shall be minimum scale of 1/4" = 1'-0" for floor plans. Include sections and elevations of all pipe offsets or risers.
 - 3. Coordinate the routing with all other trades and the structural/architectural drawings during drawing development period. Detail all areas requiring close or critical coordination points on the drawings.
- B. Thoroughly review all construction documents to verify all routings, heights, and locations of all piping. Visit the job site and field verify all routings, heights, and locations. Notify the Engineer of any conflicts and proposed coordinated solutions.
- C. Completed drawings shall be submitted to General Contractor, Mechanical Contractor, Plumbing Contractor, Sprinkler Contractor, Sheet metal Contractor, Temperature Control Contractor, and Electrical Contractor for their coordination and impact to the final layouts. Prepare any drawing corrections required to obtain a coordinated layout. Provide sufficient sets of drawings for distribution.
- D. No pay requests for installed work will be honored until fully coordinated drawings are accepted by the Owner.

1.06 FABRICATION DRAWINGS

- A. Submit system fabrication drawings to and obtain approvals from the State Fire Marshal and the appropriate inspection and rating organization prior to submitting to the Architect/Engineer. Drawings shall be prepared utilizing "AutoCad". Contact Architect to obtain generic floor plans on diskette.
 - 1. System Fabrication Drawings submitted to code authorities should reflect same general system design and layout as shown on the drawings and as described in these specifications.
 - 2. System Fabrication Drawings submitted to the Architect/Engineer shall bear the "Approval" or "Release" stamp of the State Fire Marshal. Letters of approval or comments from the State Fire Marshal shall also be submitted at this time.
- B. Approval from the governing agencies and the Architect and/or Engineer shall be obtained prior to fabrication or installation of any material or equipment.
- C. Contractor shall assume full responsibility for all work performed prior to receiving said approvals.
- D. Record diskette(s) of final "as built" drawings shall be submitted to Engineer for acceptance at project completion.

1.07 SUBMITTALS

Submit shop drawings on all system components such as valves, flow and tamper switches, etc. Shop drawings shall be in accordance with Specifications Section 21 05 01, General Provisions.

PART 2: PRODUCTS

2.01 INTERIOR PIPE AND FITTINGS

- A. Dry Standpipe System - Pipe Material
 - 1. 1" thru 6" Pipe: Pipe shall be Schedule 40 galvanized steel with screwed fittings.
 - 2. Fittings shall be joined by a UL and FM approved combination of couplings, gaskets and grooves. Grooves may be rolled or cut and they shall be dimensionally compatible with the fitting. All dry sprinkler systems and components must be galvanized.
 - 3. Acceptable pipe manufacturers
 - a. Allied Tube and Conduit Corp.
 - b. American Tube Co. Inc.
 - c. Bull Moose Co.
 - d. U.S. Steel

B. Material - Fittings

1. Screwed fittings shall be cast iron, 125 pound class, (175 pound working pressure) black and in accordance with ANSI B-16.4 or malleable iron, 150 pound class, black and in accordance with ANSI B-16.3.
2. Flanged fittings shall be cast iron, short body, class 125, black and in accordance with ANSI B-16.1. Gaskets shall be full face of 1/8" minimum thickness red sheet rubber. Flange bolts shall be hexagon head machine bolts with heavy semi-flushed hexagon head nuts, cadmium plated, having dimensions in accordance with ANSI B-18.2.
3. Grooved couplings shall be ductile iron conforming to ASTM A-395 Grade 65-45-15 and ASTM A-536 Grade 65-45-12. 350 PSI working pressure for pipe sizes 1-1/4" - 4" and 300 PSI for pipe sizes 5" - 8". Bolts shall be heat treated carbon steel, zinc electroplated to meet ASTM B-633.
 - a. Coupling shall be tested and listed by UL and or FM. Coupling shall be a Style 005 Fire Lock or approved equal.
 - b. Gaskets for Wet Pipe Systems shall be Grade "E" Type A Vic-Plus Gasket System, requiring no field lubrication. Gaskets for Dry Pipe Systems shall be Grade "E" Type A Flushseal Vic-Plus Gasket System.
 - c. Acceptable coupled fitting manufacturers
 - (1) Victaulic
 - (2) Gustin-Bacon
 - (3) ITT Grinnell-Gruvlok
 - (4) Stockham

- C. Automatic ball drips shall be provided where shown on the drawings and where required.

2.02

VALVES

- A. Valves shall be of same size as the pipe shown on the drawings and shall be listed and approved by Underwriters' Laboratories and Factory Mutual.
- B. Gate valve (located on the riser; accessible only from inside a room) shall have a minimum working pressure of 175 psi. Valve shall have a cast iron body with flanged ends, bronze seating ring, bronze stem, cast iron disc with bronze disc ring and Buna-N "O" rings. Valve shall have an outside screw and yoke like Kennedy Valve #68. Valve shall be provided with a UL listed, FM approved electrically supervised tamper switch, such as Notifier "NGV" series as required. Switch shall be mounted so as not to interfere with normal operation of the valve.

- C. Ball valve (2" - 3"): Victaulic "Fire Ball" 727 Series; body and end cap shall be ductile iron conforming to ASTM A-536, painted; Type 316 stainless steel ball; stainless steel stem; virgin tetrafluoroethylene (TFE) seals; actuator arm shall be ductile iron conforming to ASTM A-536, black chromate; steel actuator lead screw; cold rolled steel, painted actuator housing; bronze actuator nut; carbon steel, painted brackets; switches shall be DPDT (rated 10A, 125/150 VAC, 0.25A, 240VDC, 0.5A 125VDC).
- D. Angle drain valve shall have a minimum working pressure of 175 psi and shall have a bronze body, stem and disc holder. Valve shall have Buna-N seat disc such as Kennedy Valve #98-SD with renewable composition discs.
- E. Dry Pipe Valve
 - 1. Differential type with intermediate chamber, cast iron body with brass water seat ring and air seat ring, bronze clapper, rubber clapper facing, velocity check valve assembly, air compressor, UL listed and FM approved.
 - 2. Manufacturers: Automatic Sprinkler Corporation # 39 or approved equal

2.03 SUPERVISORY LIMIT SWITCH

Supervisory limit switches shall be mechanical type unit with an operating mechanism that will signal when the valve is moved from or returned to its normal (open) position.

2.04 MISCELLANEOUS PIPING COMPONENTS

- A. Provide inspectors test connection with proper restriction orifice coinciding with heads used. Sight glass provided shall be similar to Grunau UL/FM type.
- B. Provide automatic ball drips to allow for proper drainage where shown or required. Ball drip shall be 3/4" such as manufactured by Grunau. Pipe to nearest floor drain.

PART 3: EXECUTION

3.01 INSTALLATION

A. Interior pipe and fittings

1. Piping which passes through an electrical switchgear room or transformer room shall be double piped unless the pipe is a branch line serving heads in said rooms. Sleeve shall be set in such a manner as to avoid joints in the room. If a joint is required in the room, it shall be a welded joint. Pipe shall be of Schedule 40, black steel.
2. Drains shall terminate at an open site drain, roof conductor or outside of the building. Location of drains to building exterior shall be approved by the Architect/Engineer.
3. Route piping in order that a minimum number of offsets shall be installed in pipe lines or to avoid shifting equipment. Avoid all lighting fixtures, structural members, ductwork, piping, etc.
4. **Do not route any pipe over an electrical panel(s) or transformer(s).**

B. Heads

1. Heads shall be installed per manufacturer's recommendations.
2. Cover plates shall be protected against scratches, dents and discoloration. Defective items will not be acceptable.

3.02 TESTING OF SYSTEMS

- A. All piping in this system shall be flushed and tested hydraulically to 150 psig or per NFPA Standards if stricter. Test pressure and results shall comply with NFPA #13.
- B. All tests shall be made in the presence of the Owner's representative and representative of the insurance interest. A complete written report of the tests shall be sent to the Engineer within ten days of the completion of the tests stating the results of the test and the names of the representatives present during the test.
- C. Any alterations and repairs shall be made immediately and the tests run to prove final security.

END OF SECTION

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SECTION 21 13 16

DRY PIPE SPRINKLER SYSTEM

PART 1: GENERAL

1.01 WORK INCLUDED

- A. Provide an automatic dry sprinkler system for the building as shown on the drawings and described herein.
- B. The sprinkler system will be hydraulically calculated, fully supervised and installed according to NFPA 13-1999 Edition, "Standard for the Installation of Sprinkler Systems" and as provided herein.
- C. Secure all approvals and necessary permits to install a completely approved, functional wet pipe automatic sprinkler system.
- D. Contractor is responsible for compliance with all codes and regulations of governing standards and agencies. Compliance includes existing service(s) or system(s) when extended or modified.
- E. System shall include all required valves, drains, flow switches tamper switches, etc. and related electrical connections thereto.
- F. Fire protection system backflow preventor shall be open on the double check principle with bypass detector meter and check. It shall be a complete assembly consisting of tight closing OS&Y shutoff valves before and after the backflow devices and protected with an inlet strainer; ASSE 1015. The bypass meter shall be followed by a double check assembly. The device design shall include two (2) rubber coated, positive seating check valves, test cocks, approved meter and bypass double check valve.

1.02 RELATED WORK

- A. Completion and Startup: 21 01 70
- B. General Provisions: Section 21 05 01
- C. Meters and Gauges: Section 21 05 19
- D. Basic Piping Requirements: Section 21 05 29

- E. Identification of Piping and Equipment: Section 21 05 53
- F. Piping Specialities: Section 21 11 19
- G. Electrical: Division 26

1.03

QUALITY ASSURANCE

- A. All materials and devices used are to be listed for use by the "Underwriters' Laboratories, Inc." and shall bear their label wherever "Label Service" is a requirement or is available.
- B. Work shall be accomplished by an approved fire protection equipment contractor, regularly employed in the installation of automatic sprinkler systems and approved by the Owner's representative. All equipment supplied for this system shall be the products of a single manufacturer (except as specified otherwise) and shall be readily obtainable products from the manufacturer's stock where possible.
- C. Systems shall comply with the following regulating agencies, organizations and publications, which include but may not be limited to:
 - 1. Indiana Building Code (IBC), 2003, consisting of:
 - a. International Building Code, 2000
 - b. Indiana Amendments
 - 2. Indiana Mechanical Code (IMC) 2003 consisting of:
 - a. International Mechanical Code 2000
 - b. Indiana Amendments
 - 3. Indiana Plumbing Code (IPC), 1999, consisting of:
 - a. Uniform Plumbing Code, 1997
 - b. Indiana Amendments
 - 4. Indiana Fire Code (IFC), 2003, consisting of:
 - a. International Fire Code, 2000
 - b. Indiana Amendments"
 - 5. Underwriters' Laboratories, Inc. (UL)
 - 6. Industrial Risk Insurance (IRI)
 - 7. Factory Mutual Laboratories (FM)
 - 8. National Fire Protection Association Standards (NFPA) #13, #14, #20, #24, #26, #231 and #231C.
 - 9. Local jurisdictional agencies, organizations and ordinances.
 - 10. Insurance Service Office of Indiana (I.S.O.)
 - 11. Local water company
 - 12. State Fire Marshal
 - 13. Indianapolis Fire Department

- D. Hazard classifications included in this project are:
 - 1. Light hazard
 - 2. Ordinary hazard, Group 1
 - 3. Ordinary hazard, Group 2
- E. Finishes: component finishes shall be as specified herein.

1.05 CONTRACT DOCUMENTS

- A. It is not the intent of the Contract Documents to neglect or violate any codes or governing agencies by indicating or specifying certain methods, equipment or material. The Contractor is responsible for full building coverage per code. Review all Architectural Documents to ascertain construction and details and be familiar with the entire project.
- B. Documents indicate coverage, piping and in some instances head locations in areas where special consideration must be given due to aesthetics, structural or coordination purposes.
- C. Purpose for the "Products" and "Execution" portions of this section, as well as related information on the drawings, is to assure quality of system, components, workmanship and aesthetics. These items are above minimum standards required by codes and regulations.
- D. Contractor shall perform a flow test of which the design is to be based. Flow test data should consist of gpm flow with static and residual pressures. Flow test data will be submitted to Engineer with sprinkler shop drawing for review.
- E. The connection to or extension of the water supply or source shall be considered a suggested method and shall be finalized during the layout and design by this Contractor.

1.06 COORDINATION DRAWINGS

Coordination drawings are required on this project. Fire protection fabrication drawings as defined below may be used.

- A. Submit full set of drawings for each system for Engineer's approval prior to installation. Refer to Specifications Section 21 05 01, General Provisions and Division 1 for submission requirements.
 - 1. Drawings shall be prepared utilizing "Autocad". Contact the Architect to obtain generic floor plans on diskette. Engineers' drawings are not intended for use as coordination drawings.
 - 2. Drawings shall be minimum scale of 1/4" = 1'-0" for floor plans. Include sections and elevations of all pipe offsets or risers.
 - 3. Coordinate the routing with all other trades and the structural/architectural drawings during drawing development period. Detail all areas requiring close or critical coordination points on the drawings.
- B. Thoroughly review all construction documents to verify all routings, heights, and locations of all piping. Visit the job site and field verify all routings, heights, and locations. Notify the Engineer of any conflicts and proposed coordinated solutions.
- C. For remodeled areas the Contractor shall visit the job site and field verify all routings, heights, and locations of all piping. Notify the Engineer of any conflicts.
- D. Completed drawings shall be submitted to General Contractor, Mechanical Contractor, Plumbing Contractor, Sprinkler Contractor, Sheet metal Contractor, Temperature Control Contractor, and Electrical Contractor for their coordination and impact to the final layouts. Prepare any drawing corrections required to obtain a coordinated layout. Provide sufficient sets of drawings for distribution.
- E. No pay requests for installed work will be honored until fully coordinated drawings are accepted by the Owner.

1.07 FABRICATION DRAWINGS

- A. Submit system fabrication drawings to and obtain approvals from the State Fire Marshal and the appropriate inspection and rating organization prior to submitting to the Architect/Engineer. Drawings shall be prepared utilizing "AutoCad. Contact Architect to obtain generic floor plans on diskette.
 - 1. System Fabrication Drawings submitted to code authorities shall reflect same general system design and head layout as shown on the drawings and as described in these specifications.
 - 2. System Fabrication Drawings submitted to the Architect/Engineer shall bear the "Approval" or "Release" stamp of the State Fire Marshal. Letters of approval or comments from the State Fire Marshal shall also be submitted at this time.

- B. Approval from the governing agencies and the Architect and/or Engineer shall be obtained prior to fabrication or installation of any material or equipment.
- C. Contractor shall assume full responsibility for all work performed prior to receiving said approvals.
- D. Record diskette(s) of final "as built" drawings shall be submitted to Engineer for acceptance at project completion.

1.08 SUBMITTALS

Submit shop drawings on all system components such as valves, flow and tamper switches, head and escutcheons, alarms, post indicator valves, siamese connections, fire pump, etc.

PART 2: PRODUCTS

2.01 INTERIOR PIPE AND FITTINGS

- A. Dry Sprinkler System - Pipe Material
 - 1. Pipe shall be new, designed for 175 psi working pressure, and conform to the latest approved ASTM standards recognized for the piping specified herein. The piping shall be manufactured in the United States and have the manufacturer's name and brand along with the applicable ASTM standard marked on each length of pipe.
 - 2. 1" thru 6" Pipe: Pipe shall be Schedule 40 galvanized steel with screwed fittings.
 - 3. Fittings shall be joined by a UL and FM approved combination of couplings, gaskets and grooves. Grooves may be rolled or cut and they shall be dimensionally compatible with the fitting. All dry sprinkler systems and components must be galvanized.
 - 4. Acceptable pipe manufacturers
 - a. Allied Tube and Conduit Corp.
 - b. American Tube Co. Inc.
 - c. Bull Moose Co.
 - d. U.S. Steel
- B. Automatic ball drips shall be provided where shown on the drawings and where required.

2.02 VALVES

- A. Valves shall be of same size as the pipe shown on the drawings and shall be listed and approved by Underwriters' Laboratories and Factory Mutual.
- B. Gate valve (located on the riser; accessible only from inside a room) shall have a minimum working pressure of 175 psi. Valve shall have a cast iron body with flanged ends, bronze seating ring, bronze stem, cast iron disc with bronze disc ring and Buna-N "O" rings. Valve shall have an outside screw and yoke like Kennedy Valve #68. Valve shall be provided with a UL listed, FM approved electrically supervised tamper switch, such as Notifier "NGV" series as required. Switch shall be mounted so as not to interfere with normal operation of the valve.
- C. Ball valve (2" - 3"): Victaulic "Fire Ball" 727 Series; body and end cap shall be ductile iron conforming to ASTM A-536, painted; Type 316 stainless steel ball; stainless steel stem; virgin tetrafluoroethylene (TFE) seals; actuator arm shall be ductile iron conforming to ASTM A-536, black chromate; steel actuator lead screw; cold rolled steel, painted actuator housing; bronze actuator nut; carbon steel, painted brackets; switches shall be DPDT (rated 10A, 125/150 VAC, 0.25A, 240VDC, 0.5A 125VDC).
- D. Butterfly valve (4" - 8"): Victaulic "Butterfly Valve" 708 Series; body shall be ductile iron conforming to ASTM A-536, polyphenylene sulfide blend, heat fused; disc shall be ductile iron conforming to ASTM A-536, EPDM coating; bronze stem bearing nuts; steel actuator lead screw; CRS, painted actuator housing; actuator arm shall be ductile iron conforming to ASTM A-536, black chromate; switches shall be DPDT (rated 10A, 125/150 VAC; 0.25A, 250VDC; 0.50A 125VDC); carbon steel, painted switch housing; brackets shall be carbon steel, zinc plated to ASTM B-633, UL/FM rated for 175 psi.
- E. Angle drain valve shall have a minimum working pressure of 175 psi and shall have a bronze body, stem and disc holder. Valve shall have Buna-N seat disc such as Kennedy Valve #98-SD with renewable composition discs.
- F. Post Indicator Valve
 - 1. Seat grate valve with non-rising stem and indicator post flange; cast iron body, 2" square wrench nut, cast iron disc with bronze bushing, flange connection, indicator post to be cast iron with flange connection. Valve with indicator shall be U.L. listed and FM approved.
 - 2. Manufacturer: Mueller Company #A-2075-6 with #A-20804 or approved equal.

G. Dry Pipe Valve

1. Differential type with intermediate chamber, cast iron body with brass water seat ring and air seat ring, bronze clapper, rubber clapper facing, velocity check valve assembly, air compressor, U.L. listed and FM approved.
2. Manufacturer: Automatic Sprinkler Corporation #39 or approved equal.

2.03

SPRINKLER HEADS

- A. Heads shall be of the fusible link or glass bulb design with temperature ratings as required as NFPA.
- B. Provide standard wire guards on heads below 7'-6" above the floor or walkway. Wire guards shall also be provided on heads located in areas subject to physical damage.
- C. Heads shall have a minimum orifice size of ½" or 17/32" and shall be UL listed.
- D. Sprinkler Types and Locations
 1. Sprinklers located in a finished ceiling shall be pendant mounted on concealed piping.
 2. Sprinklers located in blind or furred spaces shall be standard uprights mounted on riser nipples.
 3. Extended coverage sidewall heads shall be used where needed.
 4. Provide standard upright heads on remainder of the system.
- E. Heads, escutcheons and cover plates shall be of the following make, model and finish:
 1. Description
 - a. Recessed heads shall be equal to Viking Corporation's 'Decor' glass bulb, recessed head. Sprinkler head finish shall be satin finished chrome with factory painted escutcheon (white in color).
 - b. Standard upright heads shall be equal to Central Sprinkler Corporation's Model #A fusible-link type head. Sprinkler head finish shall be satin finished chrome.
 2. Acceptable manufacturers
 - a. ASCOA
 - b. Central Sprinkler Corporation
 - c. GEM
 - d. Star Sprinkler Corp.
 - e. Reliable Automatic Sprinkler Co., Inc.
 - f. Viking Corporation

- F. Provide two wrenches which fit each type of sprinkler head to be used on the project.
- G. Provide spare sprinkler heads and cabinets for each type of head to be used on the project as required by NFPA.

2.04 MISCELLANEOUS PIPING COMPONENTS

- A. Provide inspectors test connection with proper restriction orifice coinciding with heads used. Sight glass provided shall be similar to Grunau UL/FM type.
- B. Provide automatic ball drips to allow for proper drainage where shown or required. Ball drip shall be 3/4" such as manufactured by Grunau. Pipe to nearest floor drain.

PART 3: EXECUTION

3.01 INSTALLATION

- A. Interior Pipe and Fittings
 - 1. Piping which passes through a non sprinklered area shall be adequately protected by a required insulating enclosure or automatic sprinklers below the pipe (as required).
 - 2. Drains shall terminate at an open site drain, roof conductor or outside of the building. Location of drains to building exterior shall be approved by the Architect/Engineer.
 - 3. Route piping in order that a minimum number of offsets shall be installed in pipe lines or to avoid shifting equipment. Avoid all lighting fixtures, structural members, ductwork, piping, etc.
 - 4. **Do not route any pipe over an electrical panel(s) or transformer(s).**
- B. Heads
 - 1. Heads shall be installed per manufacturer's recommendations.
 - 2. Piping run above ceilings shall expose only the sprinkler head cover plate below the ceiling surface. Where sprinkler heads are required in a grid or lay-in ceiling, the heads shall be centered both ways in the 2'-0" x 2'-0" tile or grid and in the 2'-0" direction in 2'-0" x 4'-0" tile or grid. Provide arm-overs or swing joints as required to accomplish this centering. The final positioning of the heads shall be done after the ceiling grid is in place but prior to the installation of the tile.
 - 3. Cover plates shall be protected against scratches, dents and discoloration. Defective items will not be acceptable.

C. Hangers and Supports

1. Spacing shall be per NFPA #13.
2. When mechanical grooves or push on fittings are used, hangers and supports shall not exceed maximum spacing recommended by manufacturer.

3.02

TESTING OF SYSTEMS

- A. All piping in this system shall be flushed and tested hydraulically to 150 psig or per NFPA Standards, if stricter. Test pressure and results shall comply with NFPA #13.
- B. All tests shall be made in the presence of the Owner's representative and representative of the insurance interest. A complete written report of the tests shall be sent to the Engineer within ten days of the completion of the tests stating the results of the test and the names of the representatives present during the test.
- C. Any alterations and repairs shall be made immediately and the tests run to prove final security.

END OF SECTION

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SECTION 22 01 70

COMPLETION AND STARTUP

PART 1: GENERAL

1.01 WORK INCLUDED

- A. Furnish material and labor required to perform startup of equipment and systems installed and modified in this project and provide operating and maintenance instructions to the Owner.
- B. Furnish labor and material required to inspect the installed piping systems and correct deficiencies as specified herein.
- C. Furnish labor and equipment required to maintain clean work areas throughout the project and to perform final cleanup.

1.02 RELATED WORK

- A. General Provisions: Section 22 05 01
- B. Assignment of Miscellaneous Work: Section 22 05 02

PART 2: PRODUCTS
NOT USED

PART 3: EXECUTION

3.01 GENERAL COMPLETION REQUIREMENTS

- A. Adhere strictly to the following procedures in completing plumbing systems.
 - 1. Piping
 - a. Inspect screwed joints for leakage and remake each joint that appears to be faulty. Do not wait for rust to form. Clean threads on both parts, apply compound and remake joint.
 - b. Clean dirt pockets, orifices, valve seats and headers in all fluid systems after system has been placed in operation to assure they are free from foreign material.
 - c. Adjust pipe hangers and supports for correct pitch and alignment.

- d. Inspect valves, clean bonnets and stems, tighten packing glands to assure no leakage but permit valve stems to operate without galling. Replace packing in valves that require same to retain maximum adjustment after system is judged complete. Replace entire packing in any valve that continues to leak after adjustment, remove and repair bonnets that leak, coat packing gland threads and valve stems with surface preparation similar to MolyCote or FelPro after cleaning.
 - e. Inspect each pressure gauge and thermometer for calibration and replace those that are defaced, broken or read incorrectly.
2. General
- a. Remove rust, scale and foreign materials from equipment and renew any defaced surfaces. If equipment is badly marred, Engineer shall have authority to request that new materials be provided.
 - b. Repair pipe insulation that may have been damaged during construction period.
- B. Complete all applicable startup procedures described in preceding paragraphs and in the associated articles for particular systems prior to occupancy of spaces served.
- C. Provide such continuing adjustment services as necessary to insure proper functioning of all plumbing systems after building occupancy and during warranty period.

3.02 STARTUP

- A. The Contractor shall bear prime responsibility for startup of all plumbing systems.
- B. Perform a startup of each system installed in this project in strict accordance with manufacturer's printed procedure.
- C. Check for proper rotation of all pumps.
- D. All involved contractors shall submit to the decision of the Owner/Engineer of any conflict of responsibility.

3.03 TOUCH-UP

- A. All plumbing equipment, cabinets, control panels and other enclosures shall be cleaned and paint touched up as necessary to duplicate factory finished appearance. Touch-up paint shall exactly match color, composition and quality of factory applied finish.

- B. Equipment furnished with factory applied finish shall be protected from injury by the installing contractor. Any damaged surface shall be repaired by the installing contractor to match original finish or shall be replaced before final acceptance.

3.04

CLEANING

- A. Maintain a clean project site throughout the construction period. Provide personnel to regularly remove debris and unused materials. Coordinate this cleaning effort with your subcontractors.
- B. Remove all debris and unused materials from job site created by plumbing work.
- C. Clean all plumbing equipment to a "like new" condition prior to systems startup, prior to balancing and in preparation of final inspection. Vacuum clean all internal components.
- D. Clean all mechanical rooms and/or areas of debris and unused material. Vacuum clean mechanical room floors.
- E. Clean the exterior surfaces of all piping systems. Vacuum clean if appropriate. Damp/wet clean with soap (chemical if necessary) and water where required or directed by Owner/Engineer.

END OF SECTION

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SECTION 22 05 01

GENERAL PROVISIONS

PART 1: GENERAL

1.01 **SUMMARY OF WORK**

- A. The requirements of the General Conditions, General Requirements, Special Conditions, Instructions to Bidders, Contract Documents and other information bound herewith form a part of and shall govern all work performed under these specifications.
- B. The accompanying plumbing drawings are issued as part of this specification. Any requirements shown thereon are equally affective as if included in this specification. Any omissions in the specification or on the drawings are not to be a basis for failure on the part of the Contractor, from installing components required by the systems to operate in the intended manner. Should any work be called for on the drawings, specifications or in the codes, in such a manner that the Contractor cannot, in his judgement, comply with the requirements, then the Contractor shall bring the matter to the attention of the Engineer before proceeding with the work.
- C. Work includes the installation of equipment, piping, and components necessary for complete and operable systems.
- D. This project includes the following systems:
 - 1. Sanitary waste and vent system
 - 2. Storm water system
 - 3. Storm sewers

1.02 **DEFINITIONS AND TERMS USED IN THE DIVISION 22 SPECIFICATIONS AND PLUMBING DRAWINGS**

- A. The word "owner" shall mean the party mentioned in the prime contract agreement, or any representative of his party duly authorized to act in his behalf in the execution of the work.
- B. The word "Contractor" shall mean the person, firm or corporation entering into a contract to construct and complete the work as described herein.
- C. The word "Engineer" shall mean Circle Design Group, Inc. and their representatives assigned to this project.

- D. The word "Architect" shall mean Looney Ricks Kiss and their representative acting as the Owner's appointed agent.
- E. The words "furnish" or "supply" shall mean to purchase and deliver to project site, ready for unloading, unpacking, assembly, installation and similar subsequent requirements.
- F. The word "install" shall mean operations at the project site, including unloading, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar requirements.
- G. The word "provide" shall mean to furnish and install complete and ready for intended use.

1.03

CODES, FEES AND MISCELLANEOUS COSTS

- A. All materials and workmanship shall comply with all applicable codes, specifications, local ordinances, industry standards and utility company regulations.
- B. In cases of difference between building codes, specifications, state laws, local ordinances, industry standards and utility company regulations and the Contract documents, the most stringent shall govern. The Contractor shall promptly notify the Engineer in writing of any such differences.
- C. Non-Compliance: Should the Contractor perform any work that does not comply with requirements of applicable building codes, states laws, local ordinances, industry standards and utility company regulations, he shall bear all costs arising for correction of non-complying items.
- D. Applicable Codes and Standards shall include all state laws, local ordinances, utility company regulations and applicable requirements of the following nationally accepted laws, codes and standards. These requirements are to be considered minimum and are to be exceeded when so indicated on the drawings or herein specified.
 - 1. Governing Agencies
 - a. Fire Prevention and Building Safety Commission
 - b. Indiana Department of Health
 - 2. Applicable Codes
 - a. Indiana Building Code (IBC), 2003, consisting of:
 - (1) International Building Code, 2000
 - (2) Indiana Amendments

- b. Indiana Electrical Code (IEC), 2005, consisting of:
 - (1) NFPA 70, National Electrical Code, 2005
 - (2) Indiana Amendments
- c. Indiana Safety Code for Health Care Facilities, 1991, consisting of:
 - (1) NFPA 99 Standard for Health Care Facilities 1992
 - (2) Indiana Amendments
- d. Indiana Mechanical Code (IMC) 2003 consisting of:
 - (1) International Mechanical Code 2000
 - (2) Indiana Amendments
- e. Indiana Plumbing Code (IPC), 1999, consisting of:
 - (1) Uniform Plumbing Code, 1997
 - (2) Indiana Amendments
- f. Indiana Swimming Pool Code (ISPC 20) 1991
- g. Indiana Energy Conservation Code (IECC), consisting of:
 - (1) CABO Model Energy Code, 1992
 - (2) Indiana Amendments
- h. Indiana Elevator Safety Code 2002 Edition 675 IAC21 (SCEEMH21)
- i. Indiana Fire Code (IFC), 2003, consisting of:
 - (1) International Fire Code, 2000
 - (2) Indiana Amendments
- j. Indiana Rules for Boilers and Pressure Vessels and excerpts from Indiana Statue (IC22-12) governing licensing and regulation
- k. Indiana Fuel Gas Code 2003 Edition Consisting of:
 - (1) International Fuel Gas Code 2000
 - (2) Indiana Amendments

3. Standards

- a. ASTM: American Society of Testing Materials
- b. ANSI: American National Standards Institute
- c. AMCA: Air Moving and Conditioning Association
- d. ASME: American Society of Mechanical Engineers
- e. NEC: National Electric Code
- f. NECA: National Electrical Contractors Association
- g. NEIS: National Electrical Installation Standards
- h. NEMA: National Electrical Manufacturers Association
- i. NFPA: National Fire Protection Association
- j. OSHA: Occupational Safety and Health Act
- k. SMACNA: Sheet Metal & Air Conditioning Contractors Assn.
- l. UL: Underwriters Laboratories
- m. ADAAG: Americans with Disabilities Act Accessibility Guidelines
- n. Ten State Standards

- E. The Contractor shall be responsible for obtaining all permits, payment of all fees, necessary drawings and arranging and paying for all inspections, tests, etc. which may be required by any governing authority or utility company in connection with the furnishing or installation of any of his work.

1.04

WORK AND WORKMANSHIP

- A. All materials and equipment shall be of the highest quality in every respect. All materials and equipment shall be new and of the latest design and free of defects.
- B. Workmanship shall be by skilled workmen of highest standard in strict accordance with all applicable manufacturers' printed specifications (which, by reference, are made completely a part of these specifications as though herein repeated), performed under supervision of competent foremen at all times.
- C. The Owner has full power to condemn or reject any work, materials or equipment not in accordance with these specifications and construction drawings or not in conformance with the manufacturers' specifications or drawings which were approved by the Owner or Engineer.
- D. Work or equipment that is rejected shall be removed and replaced to the satisfaction of the owner, at the Contractor's expense. Work or equipment that is rejected shall be so stated in writing by the Owner or Engineer.
- E. Such decisions that the Owner or Engineer may make with respect to questions concerning the quality, fitness of materials, equipment and workmanship shall be binding upon the parties thereto.
- F. Special attention shall be given to accessibility of working parts and controlling parts. Adjustable parts shall be within easy reach. Removable parts shall have space for removal.

1.05

DEVIATIONS FROM DRAWINGS

- A. Plumbing drawings show the intended arrangement and routing of all piping, equipment and appurtenances. They shall be followed as closely as actual building construction and work of other trades will permit.
- B. The Contractor shall investigate structural and finish conditions affecting his work and shall provide any fittings, offsets and accessories required to accommodate said conditions.

- C. Adjustments as a result of coordination with other trades or for reasons to improve performance, etc. may be made upon receiving the approval of the Engineer. The Contractor shall document that the adjustment has been coordinated with all parties concerned.

1.06 OCCUPATIONAL SAFETY AND HEALTH ACT

All work shall comply with the current requirements of the U.S. Department of Labor Occupational Safety and Health Administration, entitled Occupational Safety and Health Standards; National Consensus Standards and Established Federal Standards.

1.07 COORDINATION BETWEEN CONTRACTORS

- A. The Contractor and his subcontractors shall study all drawings and specifications for this project so that complete coordination between trades will be obtained. Special attention shall be given to points where piping crosses ducts, other piping or conduit, where lights fit into ceilings and where pipes, pass through walls and structural elements.
- B. It is the responsibility of the contractor and his Subcontractors to leave necessary room for other trades. No extra compensation will be allowed to cover the cost of relocating piping or equipment found encroaching on space required by others.
- C. The Contractor shall review the electrical requirements of the final equipment selections with the Electrical Contractor to ensure such items receive proper electrical services or connections.
- D. The Contractor shall provide complete information and cooperation to the other Contractors and trades pertaining to his work to accomplish coordination for the complete project.
- E. The Contractor shall coordinate with the Sub Contractor in providing the necessary sleeved openings, excavations, etc. Cutting and patching shall be held to a minimum.
- F. The Contractor and his Subcontractors shall be required to attend the periodic progress meetings to accomplish coordination with the Owner, Architect and Engineer.

PART 2: **PRODUCTS**

2.01 **PRODUCT AND MATERIAL APPROVAL**

- A. A specification followed by one or more manufacturers is limited to those manufacturers. Names of other proposed manufacturers may be submitted for approval to the Engineer a minimum of ten (10) days prior to receiving bids. Approval will be granted only if issued by Addendum (no exceptions).
- B. A specification followed by one or more manufacturers and "or approved equal" is open to equal products or materials. However, the Contractor shall supply one of the listed manufacturers at no additional cost if Engineer determines substituted product unsatisfactory.
- C. Any substituted equipment offered for consideration shall be stated as a separate item with the bid. State any additive or deductive cost.
- D. If changes in piping, equipment, layout or electrical service are brought about by the use of equipment which is not compatible with the layout shown on the drawings, the Contractor shall include the cost of the necessary changes in his bid.

2.02 **SUBCONTRACTORS AND MATERIAL LIST**

- A. The Contractor shall submit, with his bid, a completed list of subcontractors, manufacturers and suppliers of each item listed. No substitutions will be allowed, by the Contractor, after award of contract.
- B. Failure to submit a fully completed list within the stated time will be cause to reject the bid.
- C. Remove or copy the following list and attach it to the bid form.

2.03

LIST FOR PLUMBING CONTRACTOR:

_____ (The Contractor)

A. Sub-Contractors

SUBCONTRACTORS AND MATERIALS

Insulation Subcontractor

B. Material and Suppliers List

<u>SECTION</u>	<u>MATERIAL</u>	<u>MANUFACTURER</u>	<u>SUPPLIER</u>
22 05 53	Equipment and pipe labels	_____	_____
22 05 76	Cleanouts	_____	_____
22 07 19	Pipe insulation	_____	_____
22 13 19	Sanitary drainage fittings	_____	_____
22 14 26	Storm drainage fittings	_____	_____
22 14 29	Sump pump basin	_____	_____

2.04 EQUIPMENT DELIVERY SCHEDULE

- A. Submit a schedule listing equipment and materials required for complete installation, quantity ordered, date of placing order and the promised delivery dates.
- B. Any and all probable delivery delays shall be identified at the pre-construction meeting.

2.05 SHOP DRAWINGS

- A. The Contractor shall submit shop drawings as stated in the General Conditions and as specified herein.
- B. Approval of shop drawings does not relieve the Contractor of the responsibility for ordering proper quantities and miscellaneous appurtenances required for operation and/or installation of the respective material or equipment.
- C. The following general information is required with each submittal as applicable:
 - 1. The full manufacturer's model number of each item
 - 2. Identification of each item's performance, physical size and construction data.
 - 3. Identification of finishes. Furnish two (2) chips for each color for items requiring color/finish selections.
 - 4. Indicate any modifications made to manufacturers' standard design which are required by these specifications.
 - 5. Location of connection points for external piping or electrical connections.
 - 6. Rough-in, foundation and support point dimensions.
 - 7. Complete wiring diagrams and connection identifications.
 - 8. Contractor's stamp, signature and date shall be affixed to shop drawings with indication of his review and approval.
- D. Provide specific information with each submittal as stated in the respective specifications sections.

2.06 RECORD DRAWINGS

- A. The Contractor shall submit record drawings as stated in the General Conditions, and as specified herein.
- B. During construction, maintain a complete and legible set of drawings, at the job site showing changes and deviations between actual construction and Engineer's drawings.

- C. Submit to Engineer for review at the 100% completion of the work a complete, accurate and neat set of marked-up blue-line drawings showing the complete "as built" construction.
- D. This marked-up set shall be returned to the Contractor as many times as necessary in order to obtain desired results.

2.07

MAINTENANCE MANUALS

- A. Contractor shall submit at the job completion, three (3) maintenance manuals to the Engineer for approval. One (1) will be retained by the Engineer and two (2) will be forwarded to the Owner.
- B. Maintenance manuals are to include all information relative to maintenance and operating instructions for all new plumbing products.
- C. Maintenance manuals shall be assembled in the following sections:
 - 1. Section 1
 - a. Title of project
 - b. Name and addresses of:
 - (1) Owner
 - (2) Engineer
 - (3) Contractor
 - 2. Section 2: Index of complete contents
 - 3. Section 3:
 - a. List of all equipment with model number and serial number
 - b. Warranty of each piece of equipment with start and completion dates.
 - 4. Section 4: valve tag chart
 - 5. Section 6: Products
 - a. Incorporate data sheets, operating instructions, maintenance instructions, parts list, installation instruction and performance characteristics on each piece of equipment or system in individually tabbed subsections.
 - b. Label and assemble tabbed sections in numerical order by corresponding specification section number.
- D. Each section shall be separated by a pasteboard tabbed divider. Each section tab shall identify equipment by same name as listed in the index. Tabs shall extend outside of sheet size.
- E. All information shall be arranged in as many three-ring (3" D configuration) vinyl coated notebooks as necessary. Do not overload capacity of binder.

2.08 INSPECTION

At the completion of the mechanical installation, the Contractor shall inform the local and state authorities to arrange the final inspections of his work. Provide in triplicate a Certificate of Inspection when completed.

2.09 REPORTS AND FINAL SUBMISSIONS

- A. The Contractor shall submit, for attachment to the Substantial Completion Certificate, a letter certifying that the plumbing systems are in accordance with the Indiana Mechanical Code, Indiana Plumbing Code and Indiana Fire Code as amended by the State of Indiana.
- B. Submit all other test reports, as hereinafter specified.

PART 3: EXECUTION

3.01 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Handle equipment and components carefully to prevent damaging, breaking, denting and scoring. Do not install damaged equipment or components; replace with new.
- B. Store equipment and components in clean dry place. Protect from weather, theft, dirt, fumes, water, construction debris and physical damage at all times.

3.02 UTILITY START-UPS

Contractor shall facilitate the startup of new utility services for this project and ensure the proper operation of utility metering for billing and energy management.

END OF SECTION

SECTION 22 05 02

ASSIGNMENT OF MISCELLANEOUS WORK

PART 1: GENERAL

1.01 WALL OPENINGS

- A. Wall openings for plumbing work not noted on the Architectural or Structural drawings shall be arranged for and provided by the Plumbing Contractor.
- B. Lintels for wall openings required by plumbing work will be furnished and installed by the Contractor constructing the wall. Plumbing Contractor is responsible for notifying that Contractor of locations and sizes of openings requiring lintels prior to wall construction. Openings not coordinated and provided shall be arranged for and provided by the Plumbing Contractor.
- C. Final sizes and locations of mechanical penetrations in walls are the responsibility of the Plumbing Contractor.
- D. Provide approved fire stops for fire rated wall and floor openings.

1.02 FLOOR OPENINGS

- A. Floor openings for plumbing work not noted on the architectural or structural drawings shall be arranged for and provided by Plumbing Contractor. Miscellaneous framing required and cutting of openings, shall be furnished and installed by the contractors constructing the roof or floor structure. Plumbing Contractor is responsible for notifying those Contractors of exact locations and sizes prior to construction of the framing. Openings not coordinated and provided shall be arranged and paid for by the Plumbing Contractor.
- B. Final sizes and locations of plumbing penetrations through the roof and floor structures are the responsibility of the Plumbing Contractor requiring the opening.
- C. Supports for plumbing work shall be provided by the Plumbing Contractor requiring same.

PART 2: PRODUCTS
NOT USED

PART 3: EXECUTION

3.01 **ATTACHING TO BUILDING CONSTRUCTION**

- A. Equipment and piping supports shall be attached to structural members (beams, joists, etc) rather than to floor or roof slabs.
- B. Where equipment is suspended from concrete or masonry construction, use expansion shields to attach supports to construction. Expansion shield bolt diameter shall be the same size as support rod diameter, hereinafter specified.
- C. Where existing masonry is not suitable to receive and hold expansion shields or where other means of attachment is advantageous, Contractor shall submit alternate method for approval of Architect and/or Engineer.
- D. Where supports are attached to structural members coated with fireproofing, the contractor shall clean the fireproofing, attach the support and patch the fireproofing with like material.

END OF SECTION

SECTION 22 05 29

BASIC PIPING REQUIREMENTS

PART 1: GENERAL

1.01 **WORK INCLUDED**

- A. Pipe Hangers and Supports
- B. Sleeves and Plates
- C. Installation of Piping Systems
- D. Fire Stop Sealants

1.02 **RELATED WORK SPECIFIED ELSEWHERE**

- A. Completion and Startup: Section 22 01 70
- B. General Provisions - Plumbing : Section 22 05 01
- C. Plumbing Pipe and Equipment Insulation: Section 22 07 19
- D. Storm Drainage Piping: Section 22 14 13

1.03 **GENERAL PIPE SYSTEM INSTALLATION REQUIREMENTS**

- A. Fabricate and install all pressure piping systems in accordance with the procedures established in the ANSI B31 Code. Materials and fittings shall be as defined by the applicable standards of ANSI, ASHRAE, ASME, AWWA, API, NPC, Plumbing Code, etc.
- B. Provide fittings in accordance with the ANSI B16 Code for all changes in direction, elevation or size. No mitered joints or pipe bends will be permitted. Reduction of pipe size shall be by reducing fittings or couplings. Bushings will not be permitted.
- C. Each length of pipe, fitting and item shall be marked with the manufacturer's name and material identification.

- D. Install all piping to present a neat and orderly appearance. Run all lines parallel with building walls and construction. Keep piping free from contact with structure or equipment to prevent noise transmission, allowing clearance for expansion and contraction. Offset piping, in approved manner, where required to avoid interference with other work, to increase headroom under piping or to improve appearance of the work.
- E. Anchor piping as required to prevent undesirable movements.
- F. Provide ample space between piping and construction for proper insulation covering thickness.
- G. Provide adequate protection for piping and equipment against freezing.
- H. Penetrations of fire rated walls, floors, roofs and ceilings are to be made with rated fire stops equal/exceeding the fire rating of the building separation being penetrated.

1.04 PIPING SYSTEMS WARRANTY

- A. Maintain integrity of all piping systems through warranty period, repairing all leaks.
- B. Warranty work shall include repair/replacement of building materials and finishes damaged by leak(s).
- C. All damage resulting from leaking pipes shall be paid for by the installing contractor.

PART 2: PRODUCTS

2.01 PIPING SYSTEM MATERIALS

- A. All pipe hangers and supports shall conform to the latest requirements of ANSI Code For Pressure Piping B 31.1

2.02 PIPE HANGERS (UNINSULATED PIPE)

- A. Hangers: Steel and cast iron pipe
 - 1. 2" and smaller: adjustable clevis, light weight
 - a. Grinnell Fig. 65
 - b. Elcen Fig. 12B
 - c. PHD Fig. 440

2. Larger than 2": adjustable clevis
 - a. Grinnell Fig. 260
 - b. Elcen Fig. 12
 - c. PHD Fig. 450

- B. Riser clamps: steel and cast iron pipe
 1. Grinnell Fig. 261
 2. Elcen Fig. 39
 3. PHD Fig. 550

- C. Floor supports: steel and cast iron pipe
 1. 2" and smaller: U-bolt on structural steel channel secured to floor with angle clips
 - a. Grinnell Fig. 137
 - b. Elcen Fig. 68A
 - c. PHD Fig. 90
 2. larger than 2": adjustable pipe saddle
 - a. Grinnell Fig. 264
 - b. Elcen Fig. 50

- D. Supports at walls or columns: cast iron or steel brackets properly selected to support weight suspended.
 1. Grinnell Fig. 194, 195, 199, 202
 2. Elcen Fig. 56, 57 or 58

- E. Trapeze hangers: where parallel pipes may be grouped at approximately the same elevation, supports of unistrut, structural steel angles or channels with rods of sufficient strength to support weight can be used. Provide double nuts on support rods and angles and channels. Review weights with the Structural Engineer on this project.
 1. Secure individual pipes on trapeze with U-bolts specified above.
 2. Uninsulated pipes shall be isolated from the trapeze support with cradles.

- F. Turnbuckles: where required to adjust pipe elevation.

- G. Beam Clamps
 1. To 400 pounds loading, hardened steel point set screw; 6" pipe malleable iron clamp
 - a. Grinnell Fig. 86
 - b. PHD Fig. 270

2.03 PIPE HANGERS (INSULATED PIPE)

- A. Provide hanger and support materials as specified for uninsulated pipe but with the following exceptions:
 - 1. Size hanger ring to fit outside insulation
 - 2. Copper plated rings are not required
- B. Insulation cradles: provide welded saddles on all insulated pipe services to suit insulation thickness

2.04 SLEEVES AND PLATES (ESCUTCHEONS)

- A. Schedule of Sleeve Usage
 - 1. All sleeves through concrete walls shall be Schedule 40 PVC pipe.
 - 2. All sleeves through wall board, drywall, plasterboard or wall panels shall be 20 gauge galvanized steel.
 - 3. All sleeves through masonry walls, metal roof deck, concrete floors on grade and metal deck shall be Schedule 40 galvanized steel pipe.
- B. Special sleeves and sealing as shown on drawings.
- C. Plates shall be chromium plated for finished areas and plain cast iron elsewhere.

2.05 FIRE STOP SEALANTS

- A. Penetration Sealants
 - 1. Dow Corning "Firestop Foam" and "Firestop Sealant"
 - 2. Insta-Foam Products, Inc. "Insta-Foam Seal Silicone RTV Foam"
 - 3. 3M Brand "Fire Barrier" Caulk
 - 4. 3M Brand Moldable Putty "Pads" and Moldable Putty "Stix"
- B. Intumescent sealants for use in openings and sleeves involving plastic pipe, insulated pipe or flexible cable:
 - 1. Dow Corning "Firestop Intumescent Wrap Strip"
 - 2. Fox Coupling, Inc. "Cast-In-Place Firestop Coupling"
 - 3. 3M Brand "Fire Barrier" Caulk with FS-195 wrap strip and CS-195 composite sheet

PART 3: EXECUTION

3.01 HANGERS AND SUPPORTS

A. General

1. Furnish and install supports, guides, anchors and sway braces required for proper installation and support of pipe lines except supports noted to be furnished by others.
2. Pipe suspensions shall prevent excessive stress and excessive variation in supporting force. Fabrication and installation of supports for pipe lines shall not constrain piping to cause excessive transfer of load from supports to piping or from support to support when expansion or contraction occurs. Supports shall be capable of taking entire piping load imposed by expansion or contraction.
3. Piping system where flexibility is not desired shall be supported by rigid hangers.

B. Pipe Hanger and Supports

1. The following piping must be suspended by individual pipe hangers, rather than being suspended with other piping on trapeze type supports.
 - a. All storm water piping
2. Piping, other than as specified above, may be suspended by individual pipe hangers or where two or more pipes are paralleling each other at same elevation, Contractor may at his option support them on common trapeze bars. Construct of structural steel angles or channels with rods of sufficient strength to support weight and of design satisfactory to the Owner. Use U-bolts for securing individual pipes in trapeze. Under no circumstances shall piping be supported from other piping.
3. Where smaller piping must be suspended closer to overhead construction than is possible with single rod hangers, use double rod supports.
4. Spacing
 - a. All pipe hanger spacing specified below are also applicable to trapeze hangers. Spacing shall be determined by smallest pipe among pipes carried on trapeze.
 - b. Spacing of hangers or supports for steel pipe as scheduled below.

	PIPE SIZE	MAXIMUM SPACING
(1)	thru 1"	6'-0"
(2)	1-1/4" thru 2"	10'-0"
(3)	2-1/2" thru 5"	12'-0"
(4)	6" and above	15'-0"

- c. Provide hanger or support at all valves, tees and elbows.
- d. Spacing of hangers or supports for cast iron pipe shall be 5'-0" maximum. Place hanger close to joint.
- e. Other risers shall be supported at lowest floor through which they pass. Pipe 2" and smaller in size shall be guided at every floor.

C. Securing Hangers and Supports at Building Construction

1. Provide as required steel or malleable iron inserts in poured concrete construction. Maximum load which may be applied to any one foot length of continuous insert shall not exceed 1000 pounds.
2. Where piping is suspended from masonry construction, use expansion shields to attach pipe supports to construction. Expansion shield bolt diameter the same size as the support rod diameter specified.
3. Where piping is suspended from structural steel building framing or supporting members, furnish and install beam clamps for attaching piping support device to building member beam clamps made of heavy steel forged to fit structural member (I-beam, angle, channel) and securely fastened in place. No building member to be drilled, welded, cut or otherwise deformed in attaching pipe supports unless approved by the Engineer.
4. Where existing masonry is not suitable to receive and hold expansion shields or where other means of attachment is advantageous, the Contractor shall submit alternate method for approval to Engineer.
5. Do not suspend hangers from deck. Suspend from structural framing members in an approved and workmanlike manner.
6. Provide additional bracing and supports wherever needed, in opinion of the Engineer. Install structural steel members, attached to building framing, where required, to provide additional points of support. Drill building structural and miscellaneous steel only as directed by the Engineer.

D. Vertical Pipe Hangers

1. Support vertical runs under 15 feet long with hanger adjacent to elbows.
2. Support vertical runs over 15 feet long with riser clamps. Weld clamps to pipe and support on pipe sleeve or building structure. Space clamps at every floor with maximum spacing of 28 feet.
3. Malleable iron risers shall be supported at every floor.
4. All risers shall be supported at lowest floor through which they pass. Pipe 2" and smaller in size shall be guided at every floor through which it passes. Larger pipe may be guided at every other floor.
5. Provide supports at the bottom of risers with structural steel supports of a Structural Engineer approved design. Secure to floor with angle clips.

3.02 PIPE SLEEVES

- A. Furnish, locate and set pipe sleeves where piping passes through floors, walls and other concrete or masonry structural materials except where tunnels, chases or shafts are provided in the construction.
- B. Wall Sleeves
 - 1. Below Grade
 - a. Sleeves set in walls below finished grade, in which one side is open to a space within the building, shall be provided with a water stop/collar which will seal against the passage of water between the sleeve and concrete. Sleeve shall be sized to finish flush with face of wall. Manufacturer" 'Century Line Sleeves' or approved equal.
 - b. Sleeves shall be installed where pipes pass under or through footings, grade beams or other structural bearing walls existing or new.
 - 2. Above Grade: Sleeves set in walls above grade shall be sized to finish flush with face of walls and shall be constructed of material which is equal to or greater than the fire rating of the wall.
- C. Floor Sleeves: Floor sleeves shall extend 1-1/2" above finished floor in chases and mechanical spaces. Sleeve shall extend to 3" above finished floors in areas such as kitchens, food preparation, dishwashing and laboratory areas. Sleeves shall be flush with finish floor in occupied spaces.
- D. Sleeves shall be in accordance with the following schedule unless otherwise specified.

SLEEVE SCHEDULE

PIPE SIZE	UNINSUL.	1" INSUL.	1-1/2" INSUL.	2" INSUL.
1"	2"	4"	6"	6"
1-1/2"	3"	4"	6"	8"
2"	3"	6"	8"	8"
3"	4"	6"	8"	10"
4"	6"	8"	10"	10"
6"	8"	10"	12"	12"

- E. The void between the sleeve and wall, and the pipe or insulation jacket shall be neatly filled with an approved fire stop material.

3.03 UNION AND FLANGES

Provide at intervals and locations where they will facilitate disconnection and removal of piping at all valves, at connections to equipment and elsewhere as shown.

3.04 APPLICATION OF FIRE STOP SEALANTS

- A. Prepare and apply preparation sealing system in accordance with manufacturer's printed instructions.
- B. Employ installation techniques which will ensure that fire-stopping is deposited to fill and seal holes and openings.
 - 1. Provide flame (F) rating minimum one-hour, but not less than fire resistance rating of the assembly in which it is installed, per ASTM E-814.
 - 2. Ensure effective smoke seal.
- C. Tool exposed surfaces of applied sealant smooth.

END OF SECTION

SECTION 22 05 41

TRENCHING, BACKFILLING AND COMPACTING (INTERIOR)

PART 1: GENERAL

1.01 **RELATED WORK**

- A. General Provisions - Plumbing: Section 22 05 01
- B. Storm Water Sump Pumps/Basin: Section 22 14 29

1.02 **SCOPE**

Work in this section pertains to that located within the building and to a coordinated point beyond the exterior wall.

1.03 **REFERENCES**

The latest issues of the following American Society of Testing Materials' documents form a part of this specification to the extent hereinafter.

- A. D698 Standard Proctor Maximum Dry Density
- B. D1556-64 Density of Soil in Place by the Sand Cone Method
- C. D2167-66 Density of Soil in Place by the Rubber Balloon Method

1.04 **DELIVERY, STORAGE AND HANDLING**

- A. Imported materials shall be stockpiled on site where directed if not ready for installation. Maintain segregation of differing materials.
- B. Do not deliver materials until ready for incorporation into the permanent work. Storage space is not available.

1.05 **TRENCH CONDITIONS**

Protection of trench surrounding structures, surfaces and equipment:

- A. Embankments and excavations shall be kept shaped and drained.

- B. Operate pumping equipment as required to keep the excavation free of water, firm and undisturbed until approval of the permanent work has been received from the Engineer.
- C. Provide adequate shoring and brace excavations as necessary to prevent cave-ins and excessive settlement
- D. Do not use mechanical excavation equipment within two feet of existing piping, appurtenances, structural columns, footings and grade beams.
- E. Damage of piping, structures or surfaces as mentioned above shall be repaired or replaced by the appropriate trades at the expense of this contractor.

PART 2: PRODUCTS

2.01 **MATERIALS**

- A. Select Aggregate: No. 14-2 sand.
- B. #12 crushed stone with fines

PART 3: EXECUTION

3.01 **TRENCHING**

- A. General: All excavation of every description and of whatever substances encountered shall be performed to the depths indicated or as otherwise specified. During excavation, material suitable for backfilling shall be piled in an orderly manner a sufficient distance from the edge of the floor cut. All slab and excavated materials not required or suitable for backfill shall be removed. Sheeting and shoring shall be placed as may be necessary for the protection of the work and for the safety of personnel. Unless otherwise indicated, excavation shall be by open cut except that short sections of a trench may be tunneled if the pipe can be safely and properly installed and backfill can be properly compacted in such tunnel sections. Where specifically allowed, tunneled pipe shall be in accordance with the Uniform Plumbing Code.

- B. Trench Excavation: Trenches shall be of the necessary width for proper laying of pipe. The banks of pipe trenches shall be as nearly vertical as practical. Care shall be taken not to overexcavate unless the trench bottom is of a non-compressible material (i.e. rock, etc.), refer to overexcavation described below when required. The bottom of the trenches shall be accurately graded to provide a uniform surface for the type of bedding specified. Stones shall be removed as necessary to avoid point bearing. Except as hereinafter specified for wet or otherwise unstable material, overdepths shall be backfilled with materials specified for backfilling the lower portion of trenches. Whenever wet or otherwise unstable material that is incapable of properly supporting the pipe is encountered in the bottom of the trench, such material shall be overexcavated to a depth to allow for construction of a stable pipe bedding. Bedding shall be a minimum of 6" deep.
- C. Special requirements for specific systems.
 - i. Storm, waste and vent piping: The width of the trench at and below the top of the pipe shall be such that the clear space between the barrel of the pipe and the trench wall shall not exceed eight inches on either side of the pipe. The width of the trench above that level shall be as wide as necessary for the proper performance of the work. The bottom of the trench shall be rounded so that at least the bottom quadrant of the pipe shall rest firmly on undisturbed soil for as near the full length of the barrel as proper jointing operations will permit. This part of the excavation shall be done manually, only a few feet in advance of the pipe laying.

3.02

BACKFILLING

- A. General: After bedding, the trenches shall not be backfilled until all required pressure tests are performed. Where damage is likely to result from withdrawing sheeting, the sheeting will be approved to be left in place and the contract price will be adjusted accordingly. Except as otherwise specified for special conditions of overdepths, trenches shall be backfilled to the ground surface with selected material as hereinafter specified. Trenches improperly backfilled shall be reopened to the depth required for proper compaction, then refilled and compacted as specified or the condition shall be restored to its original condition as near as practical and as hereinafter specified.
- B. Backfilling of trench: Backfill material shall be deposited in 6" maximum thickness layers and compacted with suitable tampers to the specified density as described in Specifications, Division I. If any portion of the cover in the lower portion of the trench is in the depth of special compaction and materials requirements under pavement, the special requirements shall control. Special care shall be taken not to damage the coating or wrapping of pipes.

END OF SECTION

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SECTION 22 05 53

IDENTIFICATION OF PIPING AND EQUIPMENT

PART 1: GENERAL

1.01 **WORK INCLUDED**

- A. Label all mechanical equipment furnished and/or installed in this project.
- B. Label all electrical equipment furnished under this project.
- C. Label all piping systems installed in this project.
- D. Provide valve tags and chart.

1.02 **RELATED WORK**

- A. General Provisions: Section 22 05 01
- B. Basic Piping Requirements: Section 22 05 29
- C. Plumbing Pipe and Equipment Insulation: Section 22 07 19

1.03 **SUBMITTALS**

- A. In accordance with Specifications Section 22 05 01, General Provisions, submit manufacturer's data on labels. Include a listing of labels ordered with name of equipment or control device.
- B. Submit manufacturer's data on valve tags including a list of all valves to be tagged on the project.

PART 2: PRODUCTS

2.01 **PLUMBING EQUIPMENT LABELS**

- A. Labels shall be engraved, laminated plastic plates. Height of letters shall be as scheduled herein.
- B. Letters shall be black; plates shall be white.

- C. Manufacturers
 - 1. Seton Nameplate Corporation
 - 2. Brady
 - 3. Or approved equal

2.02 PLUMBING EQUIPMENT CONTROL LABELS

- A. Labels shall be engraved, laminated plastic plates. Height of letters shall be as scheduled herein.
- B. Letters shall be black; plates shall be white
- C. Manufacturers
 - 1. Seton Nameplate Corporation
 - 2. Brady
 - 3. Or approved equal.

2.03 VALVE TAGS

- A. Valve tags shall be consecutively numbered, brass tags (1-1/2" round).
- B. Where valves are located above ceilings, provide a location marker on the ceiling grid, as specified under 2.05, of same general description as brass tags.
- C. All main valves shall include text on the tag to read "Main Shutoff Valve". Tag size shall be increased to include text and valve number.
- D. System shall meet ANSI A13.1-1975 specification.
- E. Manufacturers
 - 1. Seton Nameplate Corporation
 - 2. Brady
 - 3. Or approved equal

2.04 VALVE TAG CHART

- A. Prepare a computer generated chart listing all valves tagged on this project. List the valve number, service and normal position (closed or open). Submit file disk of chart to Owner at project completion.
- B. Chart shall be mounted in a suitably sized frame with shatterproof glass front and installed on the wall of the main mechanical room.

2.05 CONCEALED EQUIPMENT AND VALVE LOCATION MARKERS

- A. Furnish 7/8" wide white plastic marker with engraved black numbers and letters, 1/4" high. Numbers and letters shall match the equipment label wording as scheduled.
- B. Manufacturers
 - 1. Seton Nameplate Corporation, Style No. M5300
 - 2. Brady
 - 3. Or approved equal.

2.06 PIPE LABELS

- A. Furnish snap-around type markers through 5" pipe sizes. Furnish strap-around type markers with nylon ties for 6" pipe sizes and larger.
- B. Letter height shall vary with pipe size as follows:

Thru 1-1/4" insulated pipe:	1/2"
Thru 2" insulated pipe:	3/4"
Thru 6" insulated pipe:	1-1/4"
8" and above:	2-1/2"
- C. Use ANSI/OSHA designated colors.
- D. Manufacturers
 - 1. Seton Identification Products, "Setmark" system
 - 2. Brady
 - 3. Or approved equal meeting ANSI specifications

PART 3: EXECUTION

3.01 **MECHANICAL EQUIPMENT LABEL INSTALLATION**

- A. Schedule of Mechanical Equipment Labels (List is not necessarily inclusive of all equipment on this project to be labeled).

<u>Equipment</u>	<u>Example Wording</u>	<u>Letter Height</u>
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- B. Labels shall be secured to the equipment in a readily apparent location with a minimum of four (4) screws for 1" size labels and two (2) screws for ½" and smaller. (Glue shall not be used.) Drill holes for screw openings. Cracked labels shall be replaced.
- C. Equipment which is not suitable to receive the above fastening method shall be labeled on an adjacent wall, chain hung from the ceiling, or on a readily sighted disconnect switch, at the direction of the Designer.

3.02 **ELECTRICAL AND CONTROL EQUIPMENT LABEL INSTALLATION**

- A. Items to be labeled include:
1. Motor starters: ½" high
 2. Motors which cannot be readily identified by their starter label when observer is standing by the motor: ½" high
- B. 1" and ½" letter size labels shall be secured to the devices with appropriately sized screws or rivets. (Glue shall not be used.) Screw holes shall be drilled. Cracked labels shall be replaced.
- C. 1/4" and 1/8" letter size labels shall be glued to the device.

3.03 VALVE TAG INSTALLATION

- A. Install tags on each operating valve installed in this contract, i.e. main or branch line shutoff valves.
- B. Use scheduled abbreviations for service indication.
- C. Attach tags with nickel plated brass bead chain.

3.04 PIPE LABEL INSTALLATION

- A. Install pipe identification labels on each piping system where required to provide easy identification of the system and flow.
- B. Minimum requirements include the following:
 - 1. At both sides of all wall penetrations, concealed and exposed, throughout the building.
 - 2. At an accessible location for every exposed 50 lineal feet of piping.
 - 3. At each piece of equipment.
- C. Do not install labels until pipe has been insulated and painted.

3.05 CONCEALED EQUIPMENT AND VALVE LOCATION MARKER INSTALLATION

- A. Install plates directly on to exposed bottom of ceiling T-bar, with glue.
- B. Locate plate adjacent to ceiling tile which accesses the equipment or valve above.
- C. Install plates directly on to access panels in drywall ceilings.

END OF SECTION

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SECTION 22 05 76

DRAINAGE PIPING CLEANOUTS

PART 1: GENERAL

1.01 WORK INCLUDED

- A. Furnish and install all piping specialty items as described herein or as shown on the drawings.
- B. Cleanouts shall be required on all soil, waste, and storm water piping as described in the latest Indiana approved edition of the Plumbing Code and as described herein.
- C. Cleanouts are to be installed at intervals not to exceed 50 feet on straight runs of pipe 4" and smaller.
- D. Cleanouts are to be installed at intervals not to exceed 100 feet on straight runs of pipe 5" and larger.
- E. Cleanouts are to be installed inside the building near connection between the building drain and building sewer or installed outside the building and extended to grade where shown on the drawings.

1.02 RELATED WORK

- A. Completion and Startup: Section 22 01 70
- B. General Provisions: Section 22 05 01
- C. Basic Piping Requirements: Section 22 05 29
- D. Storm Water System: Section 22 14 13

PART 2: PRODUCTS

2.01 FLOOR CLEANOUT (FINISHED AREAS)

- A. For concrete floor finished and unfinished surfaces; heavy duty use
 - 1. Cast iron cleanout body with round adjustable scoriated secured nickel bronze top. Bronze inner plug, flange and gasket seal.
 - 2. Manufacturers: J.R. Smith Fig. 4101S-F or equivalent Josam, Wade or Zurn.

2.02 FLOOR CLEANOUTS (UNFINISHED AREAS)

For use in unfinished areas such as equipment rooms, storage rooms, closets, etc.

- A. Heavy duty cast iron cleanout with round adjustable scoriated secured cast iron top. Bronze inner plug with gasket seal.
- B. Manufacturers: J.R. Smith Fig. 4221S or equivalent Josam, Wade or Zurn.

2.03 OUTSIDE OR YARD CLEANOUT

Cleanout housing shall be completely independent of pipe, eliminating undesired load transmission to cleanout branch pipe.

- A. Cast iron cleanout and double flanged housing with heavy duty secured scoriated cast iron cover and lifting device. Bronze inner plug.
- B. Provide a square, concrete pad around cleanout body.
- C. Manufacturers: J.R. Smith Fig. 4251S or equivalent Josam, Wade or Zurn.

2.04 CLEANOUT (PAVED AREAS)

Cleanout housing shall be completely independent of pipe, eliminating undesired load transmission to cleanout branch pipe.

- A. Cast iron cleanout and double flanged housing with heavy duty secured scoriated cast iron cover and lifting device. Bronze inner plug with gasket seal.
- B. Provide a square, concrete pad around cleanout body.
- C. Manufacturers: J.R. Smith Fig. 4251S or equivalent Josam, Wade or Zurn.

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PART 3: EXECUTION

3.01 **GENERAL**

- A. Provide cleanout branches throughout the entire building soil, waste, storm water and condensate drain piping systems. Install at every turn or angle of the piping systems.
- B. All cleanouts above ceilings are to be coordinated with other trades for accessibility.
- C. All floor and wall cleanouts are to be installed flush and true to finished surfaces.

END OF SECTION

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SECTION 22 07 19

PIPE AND EQUIPMENT INSULATION

PART 1: GENERAL

1.01 WORK INCLUDED

Work shall include all labor, equipment, accessories, materials and services required to furnish and install all insulation, fittings and finishes for the following piping systems:

1. Storm water piping

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Completion and Startup: Section 22 01 70
- B. General Provisions - Plumbing: Section 22 05 01
- C. Assignment of Miscellaneous Work: Section 22 05 02
- D. Basic Piping Requirements: Section 22 05 29
- E. Storm Drainage System: Section 22 14 13

1.03 QUALITY ASSURANCE

Insulation shall be installed by skilled workmen regularly engaged in this type of work.

1.04 SUBMITTALS

- A. Submit shop drawings in accordance with Specification Sections 22 05 01, General Provisions.
- B. Submit shop drawings which indicate complete material data, a list of materials proposed for this project and thickness of material for individual services.

1.05 JOB CONDITIONS

- A. Deliver material to job site in original non-broken factory packaging, labeled with manufacturer's density and thickness.
- B. Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Repair separation of joints or cracking of insulation due to thermal movement or poor workmanship.

1.06 SCHEDULING

- A. Work shall be scheduled by the Contractor.
- B. Maintain communication with the Contractor throughout construction period to assure coordination of the insulation installation with the progress of the piping systems.

1.07 DEFINITION OF TERMS

- A. Concealed: shall mean hidden from sight and/or access such as in trenches, chases, furred spaces, pipe shafts, or above suspended ceilings.
- B. Exposed: shall mean that piping or equipment is not "concealed" as defined above. Piping and equipment in service tunnels, mechanical equipment rooms, storage areas or unfinished rooms are to be considered as "exposed".
- C. Accessible: shall mean above suspended lay-in type ceilings.
- D. Inaccessible: shall mean above suspended ceilings not readily accessed from most areas.

PART 2: PRODUCTS

2.01 GENERAL

Pipe insulation and coverings on pipe used in plenums and shafts serving as supply or return air ducts or exposed in finished areas shall have a flame spread rating not exceeding twenty five (25) and a smoke developed rating not exceeding fifty (50).

2.02 INSULATING MATERIALS: PIPING AND EQUIPMENT

Fiberglass - Cold piping: a fine inorganic fibrous glass insulation with factory applied vapor barrier jacket, molded to conform to piping, "K" value at 75°F, maximum 0.24 btu inch/sq.ft./°F/hour.

2.03 MISCELLANEOUS JACKET MATERIALS

- A. Aluminum jacket: embossed aluminum with factory attached 30-9-30 duplex waterproof asphalt laminated paper as manufactured by Childers (0.010" thickness); Childers Eil-Jacs for fittings.
- B. Reinforced foil and paper: FSK (foil-skrim-kraft) aluminum foil reinforced with fiberglass yard mesh and laminated to 40# chemically treated, fire resistant kraft; UL listed.

2.04 ACCEPTABLE INSULATION MANUFACTURERS

- A. Owens-Corning
- B. Johns-Manville
- C. Armstrong
- D. Knauf

2.05 ACCEPTABLE INSULATION SUNDRIES/ADHESIVES MANUFACTURERS

- A. Benjamin Foster
- B. Childers
- C. Vimasco

PART 3: EXECUTION

3.01 GENERAL

Application of insulation materials to piping shall be done in accordance with manufacturers' written recommendations. Where thickness of insulation is not specified, use applicable thickness recommended by manufacturer for specific use.

3.02 PREPARATION

- A. Apply insulation only after piping and equipment have been tested and cleaned.
- B. Protect furniture, equipment, ducts, pipes, etc. with tarpaulins. Keep premises clean.
- C. Insure surface is clean and dry prior to installation. Insure insulation is dry before and during application. Finish with systems at operating condition.

3.03 GENERAL INSTALLATION

- A. All insulation shall be continuous through wall and ceiling openings and sleeves. All covered pipe is to be located a sufficient distance from walls, other pipe, ductwork and other obstacles to permit the application of the full thickness of insulation specified. (If necessary, extra fittings and pipe are to be used.)
- B. Vapor barrier jackets shall be applied with a continuous, unbroken vapor seal.

- C. Pipe hangers shall be sized large enough to be installed over the outer surface of the insulation. Load distributing corrosion resistant #14 USG metal shields shall be installed around the lower one-third circumference of the insulation. Shields shall be 12 gauge for smaller sizes. Length of the shield shall be 12" and up through 6"; 16" for 6" through 12"; and 20" over 12" IPS.

3.04

APPLICATION OF PIPE INSULATION

- A. All pipe insulation shall be installed with joints butted firmly together.
- B. Seal all punctures in vapor barrier jacket with vapor barrier adhesive on cold piping.
- C. Apply minimum 0.016 thick aluminum metal jackets on all piping, as follows:
1. In finished areas subject to wear from normal traffic.
 2. All insulated pipe installed outdoors.
 3. All exposed vertical and horizontal piping below 6'-0" AFF in mechanical rooms or occupied non-finished rooms, such as storage, work rooms, etc.
- D. Jackets on pipe insulation shall be vapor sealed using self-sealing lap, lap-seal tape gun or adhesive such as 520.
- E. All fiberglass insulation ends are to be tapered at 45° and sealed.
- F. Insulation of valves and fittings
1. Valves and fittings
 - a. Provide mitered sections of fiberglass insulation of same thickness and density as adjoining pipe insulation or provide insulating type cement equal to adjoining pipe insulation thickness.
 - b. Cover insulation with vapor tight jacket of same jacket as adjoining pipe insulation.
 2. Elbows
 - a. Insulate elbows with fiberglass insulation of same thickness and density as adjoining pipe insulation.
 - b. Insulate elbows with high temperature rated fiberglass insulation for steam and condensate piping.
 - c. Cover insulated elbows with pre-molded PVC elbow covers.
 - (1) PVC covers shall be rated for 25 fire/50 smoke develop maximum.
 - (2) Manufacturer: Zeston; or approved equal
 3. Mechanical couplings (mechanical contractor's option): Insulate all mechanical couplings in systems utilizing same (as determined by mechanical contractor) with manufacturer's molded fiberglass insulation sections. Insulation thickness shall be of same density, jacket and thickness as adjoining pipe insulation.

3.05 APPLICATION OF EQUIPMENT INSULATION

- A. General: Insulate all manholes, removable heads and access doors so they may be removed.
- B. Round equipment: Secure insulation with ½" wide metal bands, 12" on center, or with mechanical pins welded to equipment 12" on center.
- C. Flat or irregular equipment (metal partitions, plenums, etc.): Secure insulation with mechanical pins welded to equipment 12" on center each way.

3.06 DRAINAGE SERVICE - PIPE INSULATION

- A. Service - For all horizontal storm water piping, including sump pan and drain body:

- 1. Exposed: Type 1

B. Materials	<u>Type (1)</u>	<u>Type (2)</u>
1. Insulation	Heavy density fiberglass	Elastomeric foam
2. Jacket	Factory ASJ	(Not required)
3. Insulation thickness for pipe:		
Thru 2-1/2"	1"	3 /4"
3" and above	1"	Use Type 1

END OF SECTION

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SECTION 22 11 16

DOMESTIC WATER PIPING SYSTEM

PART 1: GENERAL

1.01 WORK INCLUDED

- A. Furnish and install domestic hot and cold water pipe and fittings to plumbing fixtures and equipment as shown on the drawings or herein specified.
- B. All piping shall be installed in compliance with the latest Indiana approved Plumbing Code and as recommended by the International Association of Plumbing and Mechanical Officials (IAPMO).
- C. All work specified in this section includes domestic water piping and valves within the building.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Completion and Startup: Section 22 01 70
- B. General Provisions: Section 22 05 01
- C. Basic Piping Requirements: Section 22 05 29
- D. Trenching, Backfilling and Compacting (Interior): Section 22 05 41
- E. Identification for Piping and Equipment: Section 22 05 53
- F. Pipe and Equipment Insulation: Section 22 07 19
- G. Plumbing Fixtures and Trim: 22 42 00

PART 2: PRODUCTS

2.01 **PIPING (ABOVE GROUND)**

- A. Maximum Design: pressure 125 psig, temperature 200°F.
- B. Piping System Notes
 - 1. Domestic cold water, hot water and hot water return piping for above ground and exposed installation
 - 2. Fabricate piping system in strict accordance with the materials specified herein and per the following restrictions.
 - 3. Grooved and coupled piping systems are acceptable only in fully accessible locations, no exceptions.
 - 4. Coupled system products are not acceptable for valves, strainers, etc.
- C. Pipe and Fitting Material
 - 1. 1/2" thru 4": Type L, hard drawn, seamless copper pipe and fittings, ASTM B-88, 95-5 'Silfos' soldered joints
- D. Formed tee fittings may be used as follows:
 - 1. Mechanically extracted collars shall be formed in continuous operation consisting of drilling a pilot hole and drawing out the tube surface to form a collar having a height of not less than three times the thickness of the tube wall. The collaring device shall be fully adjustable as to insure proper tolerance and complete uniformity of the joint.
 - 2. The branch shall be notched to conform with the inner curve of the run tube and dimpled to insure penetration of the branch tube into the collar is of sufficient depth for brazing and that the branch tube does not obstruct the flow in the main line tube.
 - 3. All joints shall be brazed in accordance with the Copper Development Association Copper Tube Handbook using B-cup series filler metal. Note: soft soldered joints will not be permitted.
 - 4. All mechanically formed branch collars shall be listed by the National Standard Plumbing Code, B.O.C.A., I.A.P.M.O., S.B.C.C., HUD, VA, U.S. Army Corps of Engineers and Underwriters Laboratory.

2.02 PIPING (BELOW GROUND)

- A. Maximum Design: pressure 125 psig; temperature 200°F.
- B. Pipe and Fittings Material
 - 1. ¾" thru 4"; Type K, hard drawn, seamless copper pipe and fittings ASTM B-88, 95-5/8" Silfos' soldered joints

2.03 VALVES

- A. Shutoff Valves
 - 1. Ball (1/2" thru 2-1/2"): bronze body with chrome plated full port brass ball, brass extension stem teflon or TFE steel handle with vinyl cover, seats and seals, lever operated, threaded, 600 WOG
 - a. 150# Conbraco (Apollo) 70-100 Series
 - b. 150# Crane 9302
 - c. 150# Walworth 575
 - d. 150# Hammond
 - e. 150# Nibco #T-580-70

PART 3: EXECUTION

3.01 TESTING

Cap all plumbing fixture rough-ins and apply hydrostatic pressure to 1-1/2 times the normal operating pressure of the system but not less than 75 psig. System must be able to hold test pressure for thirty minutes. If system fails test, Contractor will drain system, repair leaks and retest until system hold the rated hydrostatic test pressure.

3.02 DISINFECTING

- A. The domestic hot and cold water systems used for potable water shall be disinfected in accordance with AWWA C601 and Indiana Department of Health requirements.
- B. Provide a "Water Sample Report" supplied from the Indiana Department of Health. The sample is to be taken from faucets selected by the Engineer. The Contractor shall be responsible for any costs incurred for water analysis.

END OF SECTION

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SECTION 22 11 19

DOMESTIC WATER PIPING SPECIALTIES

PART 1: GENERAL

1.01 DESCRIPTION

- A. Backflow preventor shall be designed and manufactured for the purpose of prevention of backflow from non-potable water system to the potable/municipal water system.
- B. Domestic water system backflow preventor(s) shall operate on the reduced pressure principle. It shall be a complete assembly consisting of tight closing shutoff valves before and after the backflow device and protected by a strainer. An additional shut off isolation valve shall be located ahead of the strainer.
 - 1. Reduced pressure principle devices shall be designed to include test cocks, a pressure differential relief valve located between two positive seating check valves and have renewable seats. The relief valve shall discharge to an air gap drain funnel assembly (ASSE 1013).
 - 2. Double check principle devices shall be designed to include test cocks and two positive seating check valves with renewable seats (ASSE 1015).
- C. Water hammer arresters shall be sized in accordance with the Plumbing and Drainage Institute (PDI) recommendations.

1.02 RELATED WORK

- A. Completion and Startup: Section 22 01 70
- B. General Provisions - Plumbing: Section 22 05 01
- C. Basic Piping Requirements: Section 22 05 29
- D. Domestic Water Piping System: Section 22 11 16

1.03 SUBMITTALS

- A. Submit shop drawings for each type of backflow preventor specified in accordance with Specification Section 22 05 01, General Provisions.
- B. Submit final backflow preventor test report on each unit into the Operator's Maintenance Manuals.

1.04 AGENCY APPROVAL

- A. Installation of backflow preventor(s) shall comply with state and local codes and the local water utility requirements.
- B. Compliance shall be in accordance with the following standards:
 - 1. ASSE Standard 1013
 - 2. AWWA Standard C-511-92
 - 3. CSA B64.4
 - 4. USC Manual Section 10
 - 5. IAPMO and UPC approved

PART 2: PRODUCTS

2.01 REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTOR

- A. Valve Assembly (1/4" thru 2" size)
 - 1. Bronze body construction, stainless steel and brass internal parts, screwed connection, inlet strainer (union body connections 3/4" and 1" only).
 - 2. Maximum design: 175 psi; temperature 140°F.
 - 3. Shut-off valves: quarter-turn ball valves
 - 4. Check valves: double seated with removable seats
 - 5. Test Cocks: ball valves
 - 6. Exact size and flow rate as noted on the drawings.
 - 7. Manufacturers
 - a. Wilkins
 - b. Hersey
 - c. Febco

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PART 3: EXECUTION

3.01 GENERAL

- A. Pipe relief line where required to nearest drain.
- B. Prior to substantial completion and occupancy by the Owner, all strainer assemblies shall be removed and cleaned.
- C. Backflow preventor shall be tested and all defective devices repaired or replaced prior to acceptance.
- D. Equipment shall be installed in accordance with the drawings and all applicable state and local codes.

END OF SECTION

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SECTION 22 13 16

SANITARY WASTE & VENT PIPING SYSTEM

PART 1: GENERAL

1.01 **WORK INCLUDED**

- A. Furnish and install all sanitary, waste and vent piping from plumbing fixtures, drainage fittings and specialty items as shown on the plumbing drawings.
- B. All piping shall be installed in compliance with the latest Indiana approved Plumbing Code and as recommended by the International Association of Plumbing and Mechanical Officials (IAPMO).
- C. All work specified under this section includes sanitary waste and vent system piping to a coordinated point outside the building.

1.02 **RELATED WORK**

- A. Completion and Startup: Section 22 01 70
- B. General Provisions: Section 22 05 01
- C. Basic Piping Requirements: Section 22 05 29
- D. Trenching, Backfilling and Compacting (Interior): Section 22 05 41
- E. Drainage Piping Cleanouts: Section 22 05 76
- F. Pipe and Equipment Insulation: Section 22 07 19
- G. Sanitary Drains: Section 22 13 19
- H. Plumbing Fixtures and Trim: Section 22 42 00

PART 2: PRODUCTS

2.01 **PIPING SYSTEM MATERIALS**

- A. Sanitary Waste Pipe and Fittings - Underground
 - 1. 2" thru 10": DWV, service weight cast iron soil pipe; plain cut ends; conforming to CISPI 301 and ASTM A888; no-hub coupling with adjustable, stainless band, as conforming to CISPI 310 and ASTM C1277 with neoprene gasket to meet ASTM C564 Standards
- B. Sanitary Waste Pipe and Fittings - Above Ground
 - 1. 2" thru 10": DWV, service weight cast iron soil pipe; plain cut ends; conforming to CISPI 301 and ASTM A888; no-hub coupling with adjustable, stainless band, as conforming to CISPI 310 and ASTM C1277 with neoprene gasket to meet ASTM C564 Standards
- C. Sanitary Vent Pipe and Fittings
 - 1. 2" thru 10": DWV, service weight cast iron soil pipe; plain cut ends; conforming to CISPI 301 and ASTM A888; no-hub coupling with adjustable, stainless band, as conforming to CISPI 310 and ASTM C1277 with neoprene gasket to meet ASTM C564 Standards
- D. Pumped Waste Discharge Pipe and Fittings - Aboveground: 1-1/4" - 4" DWV galvanized steel pipe, screwed or victaulic fittings. ASTM A53, ASTM A120 teflon tape for screwed joints.

PART 3: EXECUTION

3.01 **INSTALLATION**

- A. All horizontal waste drainage piping shall be installed with the minimum required pitch unless otherwise shown or specified.
- B. All joints for no hub systems shall use gasketed stainless steel banding mechanical fasteners.
- C. All cast iron pipe buried in the ground shall have a firm bearing along the entire length of undisturbed earth or engineered bedding.
- D. Any pipe junction shall be made with a "Y" branch or combination "Y" and 1/8 bend.

- E. Cleanout fitting/adaptors shall be of the same manufacturer as the pipe manufacturer.
- F. Horizontal and vertical pipe cleanouts shall be installed in accessible locations with clearances as required by the Plumbing Code. Countersunk cleanout plugs shall be installed where raised heads may cause a hazard.
- G. Cleanout plugs shall be threaded cast brass type; gas and watertight without the use of gasket or packing material.
- H. All openings for connections must be closed with screw plugs until used and all hand holes must be closed at once and the sewer kept clean (any earth or foreign matter that may get into the sewer must be removed by this trade).
- I. Furnish all required plumbing vents from soil and waste pipes. All vents are to extend 12" above the roof line and be provided with regular roof connections to receive flashing made for this purpose.
- J. Rough in piping shall be stubbed three inches from the finished building surfaces. Temporarily plug and cap piping until equipment is ready for final installation.
- K. Obtain dimensioned rough-in shop drawings from the equipment suppliers.
- L. Any suspended drain line serving fixtures on floors above shall be suspended from the floor as high as possible.
- M. Provide on each vent pipe, a seamless lead or neoprene rubber flashing specifically manufactured for vent size penetrating roof.
- N. The installation of polyvinylchloride pipe (PVC) or similar materials shall not be permitted for use in plenums and shafts serving supply or return air streams of the building's ventilation system, unless insulated to meet flame and smoke rating as described in Section 22 07 19, Pipe and Equipment Insulation.

3.02 TESTING - HYDROSTATIC METHOD

- A. The drainage systems shall be tested by plugging the drainage outlets and filling the systems with water which is then permitted to stand thus for one (1) hour. A hydrostatic head of ten feet of water must be attained for the entire test period.
- B. Tests shall be performed before any covering or backfilling is done and before piping is built in or concealed.
- C. The system shall be considered satisfactory only if there is no loss of water or leakage for the duration of the test period.

END OF SECTION

SECTION 22 13 19
SANITARY DRAINS

PART 1: GENERAL

1.01 **WORK INCLUDED**

- A. Furnish and install drainage fittings as shown on the drawings or herein specified.
- B. Fittings include floor drains, shower drains, open site drains, trench drains and specialty fittings.

1.02 **RELATED WORK**

- A. General Provisions - Plumbing: Section 22 05 01
- B. Basic Piping Requirements: Section 22 05 29
- C. Drainage Piping Cleanouts: 22 05 76
- D. Sanitary Waste & Vent Piping System: Section 22 13 16

1.03 **SUBMITTALS**

Submit shop drawings for sanitary waste drainage fittings in accordance with Specifications Section 22 05 01, General Provisions.

PART 2: PRODUCTS

2.01 **DRAINS**

- A. Refer to Drainage Fitting Schedule on drawings for characteristics of drains.
- B. Manufacturers
 - 1. Jay R. Smith
 - 2. Zurn
 - 3. Josam
 - 4. Wade
 - 5. Or approved equal.

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PART 3: EXECUTION

3.01 INSTALLATION

- A. Install drains plumb to finished floor surface.
- B. Drain outlets to be same size as shown on drawings.
- C. Provide deep seal P-traps on all drains not specified with integral traps.

END OF SECTION

SECTION 22 14 13

STORM DRAINAGE PIPING

PART 1: GENERAL

1.01 **WORK INCLUDED**

- A. Furnish and install all storm water piping from roof drains, areas drains, canopy drains, overflow drains, fittings and specialty items as shown on the plumbing drawings.
- B. All piping shall be installed in compliance with the latest Indiana approved Plumbing Code.
- C. All work specified under this section includes storm water system piping to a coordinated point outside the building.

1.02 **RELATED WORK**

- A. Completion and Startup: Section 22 01 70
- B. General Provisions: Section 22 05 01
- C. Basic Piping Requirements: Section 22 05 29
- D. Plumbing Pipe and Equipment Insulation: Section 22 07 19
- E. Storm Drainage Fittings: Section 22 14 26

PART 2: PRODUCTS

2.01 **PIPING SYSTEM MATERIALS**

- A. Storm Water Pipe and Fittings - Underground
 - 1. 2" thru 12": DWV, service weight cast iron soil pipe; plain cut ends; conforming to CISPI 301 and ASTM A888; no-hub coupling with adjustable, stainless band, as conforming to CISPI 310 and ASTM C1277 with neoprene gasket to meet ASTM C564 Standards
 - 2. 2" thru 10": DWV, Schedule 40 PVC, bell ends/couplings; ASTM A-2665; solvent weld joints; ASTM D-2564; ASTM F656; ASTM D2855.

- B. Storm Water Pipe and Fittings - Above Ground
 - 1. 2" thru 12": DWV, service weight cast iron soil pipe; plain cut ends; conforming to CISPI 301 and ASTM A888; no-hub coupling with adjustable, stainless band, as conforming to CISPI 310 and ASTM C1277 with neoprene gasket to meet ASTM C564 Standards
 - 2. 3" thru 10': DWV, Schedule 40 PVC, bell ends/couplings; ASTM D2665 solvent weld joints; ASTM D2564; ASTM F656; ASTM D2855.
- C. Storm Water Pipe and Fittings Larger than 12"

12" thru 16": DWV, Schedule 40 PVC, bell and pipe; solvent weld joints; ASTM D-2665 and ASTM D-1785. Fittings shall be fusion butt-welded or off-set integral ball manufactured to meet or exceed ANSI/NSF Standard 14 certification.
- D. Pumped discharge pipe and fittings - aboveground 1-1/4" - 4" DWV galvanized steel pipe, screwed or Victaulic fittings ASTM A53, ASTM A120 teflon tape for screwed joints.

PART 3: EXECUTION

3.01 INSTALLATION

- A. All horizontal storm drainage piping shall be installed with the minimum required pitch unless otherwise shown or specified.
- B. All joints for no hub systems shall use gasketed stainless steel banding mechanical fasteners.
- C. All cast iron pipe buried in the ground shall have a firm bearing along the entire length of undisturbed earth.
- D. The bell of all horizontal pipe shall not rest upon the earth but have free area for caulking.
- E. Any pipe junction shall be made with a "Y" branch or combination "Y" and 1/8" bend.
- F. Cleanouts are to be provided where shown or where necessary and at the base of all roof conductors.
- G. All openings for connections must be closed with screw plugs until used and all hand holes must be closed at once and the sewer kept clean (any earth or foreign matter that may get into the sewer must be removed).

3.02 TESTING - HYDROSTATIC METHOD

- A. The drainage systems shall be tested by plugging the drainage outlets and filling the systems with water which is then permitted to stand thus for one (1) hour. A hydrostatic head of ten feet of water must be attained for the entire test period.
- B. Tests shall be performed before any covering or backfilling is done and before piping is built in or concealed.
- C. The system shall be considered satisfactory only if there is no loss of water or leakage for the duration of the test period.

END OF SECTION

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SECTION 22 14 26

FACILITY DRAINAGE FITTINGS

PART 1: GENERAL

1.01 WORK INCLUDED

- A. Furnish and install storm drainage fittings as shown on the drawings or herein specified.
- B. Fittings shall include roof drains, overflow roof drains, canopy drains, area drains and specialty fittings.

1.02 RELATED WORK

- A. General Provisions - Plumbing: Section 22 05 01
- B. Identification for Piping and Equipment: 22 05 53
- C. Basic Piping Requirements: Section 22 05 29
- D. Plumbing Pipe and Equipment Insulation: Section 22 07 19
- E. Storm Drainage Piping: Section 22 14 13

1.03 SUBMITTALS

Submit shop drawings for storm drainage fittings in accordance with Specification Section 22 05 01, General Provisions.

PART 2: PRODUCTS

2.01 DRAINS

- A. Refer to Drainage Fitting Schedule on drawings for characteristics of drains.
- B. Manufacturers: Jay R. Smith; Zurn; Josam; Wade; or approved equal

PART 3: **EXECUTION**

3.01 **INSTALLATION**

- A. All roof drains shall be of the size and type noted in the schedule and/or detailed on the drawings.
- B. All roof drains shall be of cast iron construction and have underdeck clamps and body extension when roof insulation of 1" or thicker is utilized.
- C. Provide cleanouts in the base of each roof conductor. Roof drains shall be designed for the type of roof construction to be used.
- D. Install area drains level and plumb to finished surface. Compress insulation to form positive flow from surface into drain.

END OF SECTION

SECTION 22 14 29

STORM WATER SUMP PUMPS/BASIN

PART 1: GENERAL

1.01 **RELATED WORK**

- A. Completion and Startup: Section 22 01 70
- B. General Provisions - Plumbing: Section 22 05 01
- C. Electrical: Division 26

1.02 **SUBMITTALS**

Submit shop drawings on each piece of equipment specified herein in accordance with Specifications Section 22 05 01, General Provisions.

PART 2: PRODUCTS

2.01 **STORM WATER PUMP ASSEMBLY**

- A. General: Furnish and install a storm water pump system with a packaged quick removal system. This system shall include duplex submersible pump with quick removal fittings, galvanized guide rails, pump mounting plates with discharge elbows and bottom guide rail supports, steel main cover with pump access covers and top guide rail supports, NEMA dead front control panel, cover mounted mercury float switches. All to be assembled in a fiberglass basin with discharge piping, valves and fittings.
- B. Pump Basin and Valve Box
 - 1. The pump basin shall be constructed of fiberglass and integral valve box shall also be constructed of fiberglass to a depth as shown on the drawings.
 - 2. The bottom of the basin shall be anchored to a concrete pad. The steel main cover shall be bolted to the top flange of the valve box pump basin segment of the unit. Pump mounting plate shall be bolted to steel plate fastened to the bottom of the fiberglass basin.

C. Piping

1. The discharge piping from the pumps shall be mounted in the basin and extend through the top of the basin joined by flanged connections to the piping, valves and fittings contained in the basin.
2. Where the piping passes through the top of the basin, a compression seal shall be furnished, to provide a water tight seal.

D. Pumps: Provide duplex submersible screenless storm water pumps. Each pump shall be rated as noted in the "Plumbing Equipment Schedule" on the drawings.

1. Motor(s) shall be AC, air filled, NEMA 6 submersible design. Motor shall be furnished with sufficient length of neoprene jacketed power cable.
2. Motor Construction: the motors shall be housed in an air filled watertight cast iron motor shell with the windings having Class 'F' insulation and pre-lubricated double seal bearings. The motor shaft shall be 300 stainless steel with keyway for positive positioning and securing of the impeller. Motor end bell to be designed as a terminal box.
3. Impeller: shall be semi-open type and shall be made of bronze accurately machined to the proper diameter and to be statically and dynamically balanced.
4. Moisture sensor: shall be installed in the motor shell and furnished in main control panel to signal a seal failure and the entry of moisture in the oil chamber.
5. Heat sensor: shall be located inside the stator windings to trip the motor starter out, stopping the motor when the internal motor temperature exceeds the insulation rating.
6. The pump manufacturer shall warrant the pumps being supplied to the Owner against defects in workmanship and materials for a period of five years.

E. Quick Removal System: A separate cast iron base, incorporating a stationary discharge elbow with flexible connector for pump discharge line and bottom guide rail supports for proper alignment shall be furnished. System shall include galvanized guide rails terminating into guide rail supports at the main cover. A gasket shall be furnished between the mating faces of the pump elbow and the fixed discharge elbow to facilitate removal and prevent corrosive bridging; no portion of the pump shall touch the floor of the basin. Pump access hatch shall be furnished, made of steel and equipped with a locking clasp.

- F. Electrical Control Panel: Panel to be remotely mounted, UL listed, NEMA 3R, dead front with weather door and an internal dead front safety door. Panel shall contain a motor disconnect switch and a magnetic starter with three coil overload protection. Panel to have a "Test-Off-Auto" selector switch and a pilot "Run" light for pump. Transformer for 115 control circuitry shall be provided. A terminal strip shall be included for connection of all necessary wires. Panel shall also include an audible and visual alarm signal with provision for silencing the audible alarm.
- G. Basin Level Controls
1. A float type liquid level control shall be furnished for proper pump and alarm operation. Switches sealed in a corrosion resistant float shall be provided. Each switch to have a PVC coated, UL listed cable and be attached to a corrosion resistant bracket to a galvanized suspension rod. The switch bracket to be provided with a reinforcing sleeve to prevent sharp bending and damage to cable.
 2. Operation of System: lowest level switch will de-energize pump. Intermediate level switch will energize pump, through an alternator, and will run pump until lowest level switch is de-energized. Should liquid level continue to rise after pump is energized, and level reaches highest level switch, both visual and audible alarms will be initiated and both pumps will operate.
- H. Manufacturers
1. Weil Model 3-250114-1
 2. Peerless
 3. Hydromatic
 4. Sterling
 5. Armstrong

2.02

PIPING

1-1/2" thru 3": Schedule 40 galvanized steel pipe; screwed or Victaulic fittings; ASTM A-53 Permatex pipe joint compound; Crane 40 or teflon tape.

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PART 3: EXECUTION

3.01 **FACTORY TESTING**

Before shipping, all component parts shall be tested for compliance with the hydraulic, mechanical and electrical requirements of the specifications.

3.02 **SUPERVISION**

When so specified, supervision of the installation and initial startup and adjustment shall be provided by a field trained representative of the manufacturer.

END OF SECTION

SECTION 22 42 00

PLUMBING FIXTURES AND TRIM

PART 1: **GENERAL**

1.01 **WORK INCLUDED**

- A. Work includes the installation and clean up of all plumbing fixtures as shown on the drawings and herein specified.
- B. All plumbing fixtures manufactured and installed under the provisions of this section shall comply with the latest Indiana approved Plumbing Code.

1.02 **RELATED WORK**

- A. Complete and Startup: Section 22 01 70
- B. General Provisions: Section 22 05 01

1.03 **GENERAL**

- A. All equipment, materials and components shall be new and specifically designed for the intended purpose as shown on the drawings.
- B. Fixtures shall have individually trapped waste outlet and individual hot/cold water supply shutoff or stop.
- C. All exposed metal work and tubing in or around the fixtures shall be best quality brass, chromium plated. Supply pipes shall be seamless and chrome plated. Escutcheons for pipes which pass through walls, floors or ceilings shall be chromium plated brass.
- D. Furnish all plumbing fixtures complete with the necessary accessories for a complete installation, such as supplies, shutoff valves for hot and cold water, risers, couplings, nuts, drain fittings, etc.
- E. Provide carriers suitable for the particular installation conditions encountered for the wall hung fixtures.
- F. Vitreous china fixtures to be Class A and white unless color is specifically noted. All enamelware to be acid resisting.
- G. Fixtures and equipment requiring anti-siphon devices shall be constructed to eliminate possibility of siphoning waste or foreign material into water supply.

- H. All fixtures except those provided with flush valves shall be provided with supply stops.
- I. Chromium plate to be in accordance with the U.S. Government standards under license from Chrome Corp. of America.

1.04 SHOP DRAWINGS

Provide shop drawings for all plumbing fixtures and trim in accordance with Specifications Section 22 05 01, General Provisions. Plumbing fixture shop drawings shall contain a picture of the plumbing fixture as well as specific written information on the fixture and accessories as specified herein.

PART 2: PRODUCTS

2.01 GENERAL

- A. All wall hung fixtures shall be mounted on suitable floor mounted fixture carriers as manufactured by J.R. Smith, Josam, Wade or Zurn unless detailed otherwise.
- B. All water closet seats shall be solid plastic and of the style as recommended by fixture manufacturer or as described herein. Acceptable manufacturers are Beneke, Church, Kohler or Olsonite.
- C. Note that all plumbing fixtures marked (ADAAG) shall mean that the fixture(s) is to be of the style designed for persons with disabilities and should be set and plumbed in accordance with practices as set forth by the American with Disabilities Act Accessibility Guidelines.

2.02 EQUIPMENT

- A. Hose Bibb (P-1)
 - 1. Description: brass body construction; wheel handle; vacuum breaker-backflow preventer to meet ASSE #1011 and IAPMO Standard governing cross contamination; 3/4" FPT inlet; 3/4" HPT outlet; brass finish.
 - 2. Manufacturers: Woodford Model #24P-3/4; Smith; or Zurn

PART 3: EXECUTION

3.01 INSTALLATION OF FIXTURES

- A. Contractor shall protect all fixtures from damage until final acceptance. Keep fixtures completely covered and all exposed pipes, fittings and faucets wrapped to prevent injury or scratching.
- B. All fixtures, trim and supplies shall be set plumb and true to wall lines and securely held in place.
- C. The trade shall install all plumbing fixtures complete with all water, waste and vent connections.
- D. Upon completion of the work and before final acceptance, all plumbing fixtures shall be thoroughly tested, inspected and found to be free from defects.
- E. All wall-hung water closets, lavatories, etc. shall be supported by fixed or adjustable chair carriers as required. All chair carriers shall be provided with block base supports or with feet turned backward and bolted to the floor (using each available hole) in pipe spaces.

3.02 CONNECTIONS TO FIXTURES

- A. Each plumbing fixture or equipment item shown or implied shall be provided with all connections required (including piping, valves, union, stops, traps, etc.)
- B. All pipes shall be connected to fixtures with chrome plated brass couplings or unions of such type that fixtures can be removed and reset without making new joints. Supply connections shall be made with ground joint unions and not with slip joints. 7/16" O.D. flexible risers will be permitted for lavatory and sink supply connections. All supply lines shall be securely held in place.
- C. All escutcheons shall be finished to match the pipe rough-ins and shall be provided around waste and supply piping wherever piping passes through the floors, walls or ceilings, including under countertops and within vanities and casework.
- D. A supply stop, finished to match the fixture trim, shall be provided on each supply connection.

3.03 CLEANING FIXTURES

Upon completion of installation, all trade labels shall be removed and all fixtures shall be thoroughly cleaned. The fixtures shall be cleaned and caulked to wall/floor as required a second time immediately before turning them over to the Owner.

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3.04

CAULKING

Caulk plumbing fixtures to finished building surfaces (i.e.: floors, walls, etc.). Use silicone caulking compound with mildew resistive silicone formula.

END OF SECTION

SECTION 23 01 70

STARTUP AND COMPLETION

PART 1: **GENERAL**

1.01 **WORK INCLUDED**

- A. Furnish material and labor required to perform startup of equipment and systems installed and modified in this project and provide operating and maintenance instructions to the Owner.
- B. Furnish labor and material required to inspect the installed piping and duct systems and correct deficiencies as specified herein.
- C. Furnish labor and equipment required to maintain clean work areas throughout the project and to perform final cleanup.

1.02 **RELATED WORK**

- A. General Provisions: Section 23 05 01
- B. Assignment of Miscellaneous Work: Section 23 05 02
- C. Testing, Adjusting and Balancing: Section 23 05 93

PART 2: **PRODUCTS**
NOT USED

PART 3: **EXECUTION**

3.01 **GENERAL COMPLETION REQUIREMENTS**

- A. Adhere strictly to the following procedures in completing mechanical systems.
 - 1. Adjust tension in V-belt drives, adjust vari-pitch sheaves and drives for proper equipment speed. Remove any foreign materials from sheaves or belts before starting operations, adjust drives for alignment of sheaves and V-belts.
 - 2. Adjust direct drives for proper alignment of flexible couplings, provide lubrication of particular couplings so required, check security of couplings to driver and driven shafts, set drive components to assure free rotation with no undesirable stresses present on coupling or attached equipment.

3. Inspect bearings for cleanliness and alignment and remove any foreign materials found. Grease as necessary and in accordance with manufacturer's recommendations. Replace bearings that run rough or noisy.
 4. Check pump packing glands or mechanical seals for cleanliness and adjustment before running pump. Inspect shaft sleeves for scoring and proper placement of packing, replace if necessary. Inspect mechanical faces, chambers and seal rings and replace if necessary. Make sure piping system is free of dirt and scale before circulating liquid through pumps.
 5. Tighten unions and flanges in piping systems after system has been placed in operation. Replace gaskets in flanges that show any signs of leakage after tightening.
 6. Inspect screwed joints for leakage and remake each joint that appears to be faulty. Do not wait for rust to form. Clean threads on both parts, apply compound and remake joint.
 7. Clean strainers, dirt pockets, orifices, valve seats and headers in all fluid systems after system has been placed in operation to assure they are free from foreign material.
 8. Adjust pipe hangers and supports for correct pitch and alignment.
 9. Inspect both hand and automatic control valves, clean bonnets and stems, tighten packing glands to assure no leakage but permit valve stems to operate without galling. Replace packing in valves that require same to retain maximum adjustment after system is judged complete. Replace entire packing in any valve that continues to leak after adjustment, remove and repair bonnets that leak, coat packing gland threads and valve stems with surface preparation similar to MolyCote or FelPro after cleaning.
 10. Inspect and make certain that all control valve seats are free from foreign material and are properly positioned for intended service.
 11. Inspect each pressure gauge and thermometer for calibration and replace those that are defaced, broken or read incorrectly.
 12. Remove rust, scale and foreign materials from equipment and renew any defaced surfaces. If equipment is badly marred, Engineer shall have authority to request that new materials be provided.
 13. After completion of equipment test and balance, replace or clean air filters to like-new condition.
 14. Repair pipe and duct insulation or duct liner that may have been damaged during construction period.
- B. Complete all applicable startup procedures described in preceding paragraphs and in the associated articles for particular systems prior to occupancy of spaces served.
- C. Provide such continuing adjustment services as necessary to insure proper functioning of all mechanical systems after building occupancy and during warranty period.

3.02

STARTUP

- A. A pre-startup construction meeting shall be scheduled by the Mechanical Contractor for the specific purpose of achieving a coordinated systems startup with the Commissioning Engineer and Owner.
- B. The Commissioning Engineer, Owner, Mechanical Contractor, Sheetmetal Contractor, Temperature Control Contractor, Balancing Contractor and Electrical Contractor shall be present at the pre-startup meeting and at the initial startup of each mechanical system and air handling unit.
- C. The Mechanical Contractor shall bear prime responsibility for startup of all mechanical systems.
- D. Perform a startup of each system installed in this project in strict accordance with manufacturer's printed procedure.
- E. Check for proper rotation of all fans and pumps.
- F. Check for proper electrical services and usage during the startup procedure.
- G. Perform operational tests on all equipment as specified in Specifications Section 23 05 93, Testing, Adjusting and Balancing.
- H. If a piece of equipment is not performing satisfactorily during testing and balancing, the Balancing Contractor shall notify the Installing Contractor for corrective action.
- I. All involved contractors shall submit to the decision of the Owner/Engineer of any conflict of responsibility.

3.03 TEMPORARY USE OF NEW EQUIPMENT

- A. The permanent heating and cooling systems shall not be utilized as the temporary tempering source for constructing the building, prior to full enclosure.
- B. When it becomes necessary to operate any equipment during the construction period for system checkouts, or maintaining reasonable temperatures or humidity levels for finishes, the Contractor will be required to do so, but only after proper adjustments, trial operation and Owner or Engineer's approval in writing.
 - 1. When this occurs, the contractor shall prepare a written procedure for the temporary operation to the Owner/Engineer for acceptance. The procedure shall address the following issues:
 - a. All ductwork openings shall be protected with filter media to prevent dust, dirt, and debris from entering. The media shall be maintained and replaced periodically to obtain protection.
 - b. Fire alarms and smoke detectors shall be protected and isolated during operation of air handling equipment. Temporary detectors shall be installed for fire protection to shut down air handling equipment.
 - c. All equipment intended to run shall be protected for operation with all safeties intact and operational.
- C. The warranty on the equipment will not begin until the date of Owner's final acceptance at the completion of the project.
- D. Should the Owner elect to receive beneficial operation of the equipment prior to project final acceptance, he may do so. The warranty period may begin then upon the Contractor receiving written approval from the Owner accepting the equipment with conditions of any incomplete portions of the work.

3.04 TOUCH-UP

- A. All mechanical equipment, cabinets, control panels and other enclosures shall be cleaned and paint touched up as necessary to duplicate factory finished appearance. Touch-up paint shall exactly match color, composition and quality of factory applied finish.
- B. Equipment furnished with factory applied finish shall be protected from injury by the installing contractor. Any damaged surface shall be repaired by the installing contractor to match original finish or shall be replaced before final acceptance.

3.05 CLEANING

- A. Maintain a clean project site throughout the construction period. Provide personnel to regularly remove debris and unused materials. Coordinate this cleaning effort with your subcontractors.
- B. Remove all debris and unused materials from job site created by mechanical work.
- C. Clean all mechanical equipment to a "like new" condition prior to systems startup, prior to balancing and in preparation of final inspection. Vacuum clean all internal components.
- D. Clean all mechanical rooms and/or areas of debris and unused material. Vacuum clean mechanical room floors.
- E. Clean the exterior surfaces of all ductwork and piping systems. Vacuum clean if appropriate. Damp/wet clean with soap (chemical if necessary) and water where required or directed by Owner/Engineer.

END OF SECTION

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SECTION 23 05 01

GENERAL PROVISIONS

PART 1: GENERAL

1.01 **SUMMARY OF WORK**

- A. The requirements of the General Conditions, General Requirements, Special Conditions, Instructions to Bidders, Contract Documents and other information bound herewith form a part of and shall govern all work performed under these specifications.
- B. The accompanying mechanical drawings are issued as part of this specification. Any requirements shown thereon are equally affective as if included in this specification. Any omissions in the specification or on the drawings are not to be a basis for failure on the part of the Contractor, from installing mechanical components required by the systems to operate in the intended manner. Should any work be called for on the drawings, specifications or in the codes, in such a manner that the Contractor cannot, in his judgement, comply with the requirements, then the Contractor shall bring the matter to the attention of the Engineer before proceeding with the work.
- C. Work includes the installation of equipment, piping, ductwork and components necessary for complete and operable systems.
- D. This project includes the following systems:
 - 1. Air distribution system(s)
 - 2. Exhaust system(s)

1.02 **DEFINITIONS AND TERMS USED IN THE DIVISION 23 SPECIFICATIONS AND MECHANICAL DRAWINGS**

- A. The word "owner" shall mean the party mentioned in the prime contract agreement, or any representative of his party duly authorized to act in his behalf in the execution of the work.
- B. The word "Contractor" shall mean the person, firm or corporation entering into a contract to construct and complete the work as described herein.
- C. The word "Engineer" shall mean Circle Design Group, Inc. and their representatives assigned to this project.

- D. The word "Architect" shall mean Looney Ricks Kiss and their representative acting as the Owner's appointed agent.
- E. The words "furnish" or "supply" shall mean to purchase and deliver to project site, ready for unloading, unpacking, assembly, installation and similar subsequent requirements.
- F. The word "install" shall mean operations at the project site, including unloading, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar requirements.
- G. The word "provide" shall mean to furnish and install complete and ready for intended use.

1.03

CODES, FEES AND MISCELLANEOUS COSTS

- A. All materials and workmanship shall comply with all applicable codes, specifications, local ordinances, industry standards and utility company regulations.
- B. In cases of difference between building codes, specifications, state laws, local ordinances, industry standards and utility company regulations and the Contract documents, the most stringent shall govern. The Contractor shall promptly notify the Engineer in writing of any such differences.
- C. Non-Compliance: Should the Contractor perform any work that does not comply with requirements of applicable building codes, states laws, local ordinances, industry standards and utility company regulations, he shall bear all costs arising for correction of non-complying items.
- D. Applicable Codes and Standards shall include all state laws, local ordinances, utility company regulations and applicable requirements of the following nationally accepted laws, codes and standards. These requirements are to be considered minimum and are to be exceeded when so indicated on the drawings or herein specified.
 - 1. Governing Agencies
 - a. Fire Prevention and Building Safety Commission
 - b. Indiana Department of Health
 - 2. Applicable Codes
 - a. Indiana Building Code (IBC), 2003, consisting of:
 - (1) International Building Code, 2000
 - (2) Indiana Amendments
 - b. Indiana Electrical Code (IEC), 2005, consisting of:
 - (1) NFPA 70, National Electrical Code, 2005
 - (2) Indiana Amendments

- c. Indiana Safety Code for Health Care Facilities, 1991, consisting of:
 - (1) NFPA 99 Standard for Health Care Facilities 1992
 - (2) Indiana Amendments
- d. Indiana Mechanical Code (IMC) 2003 consisting of:
 - (1) International Mechanical Code 2000
 - (2) Indiana Amendments
- e. Indiana Energy Conservation Code (IECC), consisting of:
 - (1) CABO Model Energy Code, 1992
 - (2) Indiana Amendments
- f. Indiana Elevator Safety Code 2002 Edition 675 IAC21 (SCEEMH21)
- g. Indiana Fire Code (IFC), 2003, consisting of:
 - (1) International Fire Code, 2000
 - (2) Indiana Amendments
- h. Indiana Rules for Boilers and Pressure Vessels and excerpts from Indiana Statute (IC22-12) governing licensing and regulation

3. Standards

- a. ASTM: American Society of Testing Materials
- b. ANSI: American National Standards Institute
- c. AMCA: Air Moving and Conditioning Association
- d. ASME: American Society of Mechanical Engineers
- e. ASHRAE: American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
- f. NEC: National Electric Code
- g. NECA: National Electrical Contractors Association
- h. NEIS: National Electrical Installation Standards
- i. NEMA: National Electrical Manufacturers Association
- j. NFPA: National Fire Protection Association
- k. OSHA: Occupational Safety and Health Act
- l. SMACNA: Sheet Metal & Air Conditioning Contractors Assn.
- m. UL: Underwriters Laboratories
- n. ADAAG: Americans with Disabilities Act Accessibility Guidelines

- E. The Contractor shall be responsible for obtaining all permits, payment of all fees, necessary drawings and arranging and paying for all inspections, tests, etc. which may be required by any governing authority or utility company in connection with the furnishing or installation of any of his work.

1.04

WORK AND WORKMANSHIP

- A. All materials and equipment shall be of the highest quality in every respect. All materials and equipment shall be new and of the latest design and free of defects.
- B. Workmanship shall be by skilled workmen of highest standard in strict accordance with all applicable manufacturers' printed specifications (which, by reference, are made completely a part of these specifications as though herein repeated), performed under supervision of competent foremen at all times.
- C. The Owner has full power to condemn or reject any work, materials or equipment not in accordance with these specifications and construction drawings or not in conformance with the manufacturers' specifications or drawings which were approved by the Owner or Engineer.
- D. Work or equipment that is rejected shall be removed and replaced to the satisfaction of the owner, at the Contractor's expense. Work or equipment that is rejected shall be so stated in writing by the Owner or Engineer.
- E. Such decisions that the Owner or Engineer may make with respect to questions concerning the quality, fitness of materials, equipment and workmanship shall be binding upon the parties thereto.
- F. Special attention shall be given to accessibility of working parts and controlling parts. Adjustable parts shall be within easy reach. Removable parts shall have space for removal.

1.05

DEVIATIONS FROM DRAWINGS

- A. Mechanical drawings show the intended arrangement and routing of all piping, ductwork, equipment and appurtenances. They shall be followed as closely as actual building construction and work of other trades will permit.
- B. The Contractor shall investigate structural and finish conditions affecting his work and shall provide any fittings, offsets and accessories required to accommodate said conditions.
- C. Adjustments as a result of coordination with other trades or for reasons to improve performance, etc. may be made upon receiving the approval of the Engineer. The Contractor shall document that the adjustment has been coordinated with all parties concerned.

1.06 OCCUPATIONAL SAFETY AND HEALTH ACT

All work shall comply with the current requirements of the U.S. Department of Labor Occupational Safety and Health Administration, entitled Occupational Safety and Health Standards; National Consensus Standards and Established Federal Standards.

1.07 COORDINATION BETWEEN CONTRACTORS

- A. The Contractor and his subcontractors shall study all drawings and specifications for this project so that complete coordination between trades will be obtained. Special attention shall be given to points where ducts cross other ducts, piping or telephone cables, where lights fit into ceilings and where pipe, ducts and conduit pass through walls and structural elements.
- B. It is the responsibility of the contractor and his Subcontractors to leave necessary room for other trades. No extra compensation will be allowed to cover the cost of relocating piping, conduit, ducts or equipment found encroaching on space required by others.
- C. The Contractor shall review the electrical requirements of the final equipment selections to ensure such items receive proper electrical services or connections.
- D. The Contractor shall provide complete information and cooperation to the other Contractors and trades pertaining to his work to accomplish coordination for the complete project.
- E. The Contractor shall coordinate with the Sub Contractor in providing the necessary sleeved openings, excavations, etc. Cutting and patching shall be held to a minimum.
- F. The Contractor and his Subcontractors shall be required to attend the periodic progress meetings to accomplish coordination with the Owner, Architect and Engineer.

PART 2: PRODUCTS

2.01 PRODUCT AND MATERIAL APPROVAL

- A. A specification followed by one or more manufacturers is limited to those manufacturers. Names of other proposed manufacturers may be submitted for approval to the Engineer a minimum of ten (10) days prior to receiving bids. Approval will be granted only if issued by Addendum (no exceptions).

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- B. A specification followed by one or more manufacturers and "or approved equal" is open to equal products or materials. However, the Contractor shall supply one of the listed manufacturers at no additional cost if Engineer determines substituted product unsatisfactory.
- C. Any substituted equipment offered for consideration shall be stated as a separate item with the bid. State any additive or deductive cost.
- D. If changes in piping, ductwork, equipment, layout or electrical service are brought about by the use of equipment which is not compatible with the layout shown on the drawings, the Contractor shall include the cost of the necessary changes in his bid.

2.02

SUBCONTRACTORS AND MATERIAL LIST

- A. The Contractor shall submit, with his bid, a completed list of subcontractors, manufacturers and suppliers of each item listed. No substitutions will be allowed, by the Contractor, after award of contract.
- B. Failure to submit a fully completed list within the stated time will be cause to reject the bid.
- C. Remove or copy the following list and attach it to the bid form.

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2.03 LIST FOR MECHANICAL CONTRACTOR: _____
(The Contractor)

A. Sub-Contractors SUBCONTRACTORS AND MATERIALS

Sheetmetal Subcontractor _____
Insulation Subcontractor _____
Balancing Subcontractor _____

B. Material and Suppliers List

<u>SECTION</u>	<u>MATERIAL</u>	<u>MANUFACTURER</u>	<u>SUPPLIER</u>
23 31 00	Sheetmetal Fabrica- tion Drawings		_____
23 33 00	Balancing Dampers	_____	_____
23 34 00	Fans	_____	_____
23 81 00	Packaged Terminal Air Conditioners	_____	_____

2.04 EQUIPMENT DELIVERY SCHEDULE

- A. Submit a schedule listing equipment and materials required for complete installation, quantity ordered, date of placing order and the promised delivery dates.
- B. Any and all probable delivery delays shall be identified at the pre-construction meeting.

2.05 SHOP DRAWINGS

- A. The Contractor shall submit shop drawings as stated in the General Conditions and as specified herein.
- B. Approval of shop drawings does not relieve the Contractor of the responsibility for ordering proper quantities and miscellaneous appurtenances required for operation and/or installation of the respective material or equipment.
- C. The following general information is required with each submittal as applicable:
 - 1. The full manufacturer's model number of each item
 - 2. Identification of each item's performance, physical size and construction data.
 - 3. Identification of finishes. Furnish two (2) chips for each color for items requiring color/finish selections.
 - 4. Indicate any modifications made to manufacturers' standard design which are required by these specifications.
 - 5. Location of connection points for external piping, duct or electrical connections.
 - 6. Rough-in, foundation and support point dimensions.
 - 7. Complete wiring diagrams and connection identifications.
 - 8. Contractor's stamp, signature and date shall be affixed to shop drawings with indication of his review and approval.
- D. Provide specific information with each submittal as stated in the respective specifications sections.

2.06 RECORD DRAWINGS

- A. The Contractor shall submit record drawings as stated in the General Conditions, and as specified herein.
- B. During construction, maintain a complete and legible set of drawings, at the job site showing changes and deviations between actual construction and Engineer's drawings.

- C. Submit to Engineer for review at the 100% completion of the work a complete, accurate and neat set of marked-up blue-line drawings showing the complete "as built" construction.
- D. This marked-up set shall be returned to the Contractor as many times as necessary in order to obtain desired results.

2.07

MAINTENANCE MANUALS

- A. The Contractor shall submit maintenance manuals as stated in the General Conditions and as described in further detail herein.
- B. Maintenance manuals are to include all information relative to maintenance and operating instructions for all new mechanical equipment.
- C. Maintenance manuals shall be assembled in the following sections:
 - 1. Section 1
 - a. Title of project
 - b. Name and addresses of:
 - (1) Owner
 - (2) Engineer
 - (3) Contractor
 - 2. Section 2: Index of complete contents
 - 3. Section 3:
 - a. List of all equipment with model number and serial number
 - b. Warranty of each piece of equipment with start and completion dates.
 - 4. Section 4: valve tag chart
 - 5. Section 5:
 - a. Air balance report
 - b. Operating and test reports
 - 6. Section 6: Products
 - a. Include performance characteristics of each piece of equipment.
 - b. Incorporate data sheets, operating instructions, maintenance instructions, parts list, installation instruction and performance characteristics on each piece of equipment or system in individually tabbed subsections.
 - c. Label and assemble tabbed sections in numerical order by corresponding specification section number.
 - d. Include a copy of the final approved shop drawing for each piece of equipment.

- D. Each section shall be separated by a pasteboard tabbed divider. Each section tab shall identify equipment by same name as listed in the index. Tabs shall extend outside of sheet size.
- E. All information shall be arranged in as many three-ring (3" D configuration) vinyl coated notebooks as necessary. Do not overload capacity of binder.

2.09 INSPECTION

At the completion of the mechanical installation, the Contractor shall inform the local and state authorities to arrange the final inspections of his work. Provide in triplicate a Certificate of Inspection when completed.

2.10 REPORTS AND FINAL SUBMISSIONS

- A. The Contractor shall submit, for attachment to the Substantial Completion Certificate, a letter certifying that the mechanical systems are in accordance with the Indiana Mechanical Code, as amended by the State of Indiana.
- B. Submit all other test reports, as hereinafter specified.

PART 3: EXECUTION

3.01 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Handle equipment and components carefully to prevent damaging, breaking, denting and scoring. Do not install damaged equipment or components; replace with new.
- B. Store equipment and components in clean dry place. Protect from weather, theft, dirt, fumes, water, construction debris and physical damage at all times.

END OF SECTION

SECTION 23 05 02

ASSIGNMENTS OF MISC. WORK

PART 1: **GENERAL**

1.01 **PAINTING**

- A. Painting of exposed mechanical system in public areas shall be by General Contractor in accordance with applicable requirements of Specifications Section 099000, Painting.
- B. Painting of piping systems in mechanical rooms and fan rooms (color coded) shall be by Mechanical Contractor in accordance with Specifications Section 23 05 64, Painting.
- C. Painting of all non-galvanized metal supports, stands and miscellaneous metal for mechanical equipment and piping shall be by the Mechanical Contractor in accordance with Specifications Section 23 05 64, Painting.
- D. Painting of patched and new ceiling and wall surfaces shall be by Mechanical Contractor in accordance with application requirements of Specification Section 23 05 64, Painting.
- E. Painting of all exterior piping shall be by Mechanical Contractor in accordance with Specifications Section 23 05 64, Painting.
- F. Prime painting of steel chilled water pipe shall be by the Mechanical Contractor in accordance with Specifications Section 23 05 64, Painting.

1.02 **WALL OPENINGS**

- A. Wall openings for mechanical work not noted on the Architectural or Structural drawings shall be arranged for and provided by the Mechanical Contractor.
- B. Lintels for wall openings required by mechanical work will be furnished and installed by the Contractor constructing the wall. Mechanical Contractor is responsible for notifying that Contractor of locations and sizes of openings requiring lintels prior to wall construction. Openings not coordinated and provided shall be arranged for and provided by the Mechanical Contractor.

- C. Final sizes and locations of mechanical penetrations in walls are the responsibility of the Mechanical Contractor.
- D. Provide approved fire stops for fire rated wall and floor openings.

1.03

ROOF AND FLOOR OPENINGS

- A. Roof and floor openings for mechanical work not noted on the architectural or structural drawings shall be arranged for and provided by Mechanical Contractor. Miscellaneous framing required and cutting of openings, shall be furnished and installed by the contractors constructing the roof or floor structure. Mechanical Contractor is responsible for notifying those Contractors of exact locations and sizes prior to construction of the framing. Openings not coordinated and provided shall be arranged and paid for by the Mechanical Contractor.
- B. Final sizes and locations of mechanical penetrations through the roof and floor structures are the responsibility of the Mechanical Contractor requiring the opening.
- C. Roof curbs and supports for mechanical equipment and penetrations shall be provided by the Mechanical Contractor requiring same.
- D. Counterflashing shall be provided by the Mechanical Contractor. Roof flashing shall be provided by others.
- E. All roofing work required on existing building (openings, flashing, etc.) shall be performed by an authorized roofing contractor designated by the agent representing the warranty.
- F. Provide fire retardant plywood sheets on completed roof areas during all operations for walkways and work areas. The Contractors working on the completed new roof shall be responsible for roof protection and assuring the warranty on the roof system is maintained.

1.04

WALL AND CEILING ACCESS PANELS

- A. Wall and ceiling panels are furnished by Mechanical Contractor.
- B. Mechanical Contractor is responsible for coordinating and assisting in locating all access panels, for installation by the General Contractor, prior to his wall or ceiling construction, to obtain access to equipment, dampers and valves, etc.
- C. Access panels are required in inaccessible (non lay-in) ceilings and walls for all valves, actuators, dampers, controls, filters, or other components requiring periodic maintenance. Panels shall be located to be accessible without causing damage to final finishes. Coordinate items requiring access including with other trades so that the quantity of access panels is kept to a minimum.

- D. The panel locations shall be also coordinated with, and receive the approval of, the Architect and Engineer.
- E. Access Panels shall be as specified in Section 08 31 13.

1.05 CUTTING AND PATCHING

- A. Cutting and patching of finished areas for mechanical work shall be provided by the Mechanical Contractor. Mechanical Subcontractors shall coordinate responsibility for cutting and patching with Mechanical Contractor prior to bidding.
- B. Cutting and patching of finished areas shall be provided by the Contractor requiring same, however, the work shall be performed by the trade responsible for this type of work.
- C. Patched surfaces shall be finished to match existing unless the surface is scheduled to receive new finish.

PART 2: PRODUCTS
NOT USED

PART 3: EXECUTION

3.01 PLATFORMS AND SUPPORT STANDS

- A. Platforms and supporting stands for mechanical equipment shall be provided by Mechanical Contractor.
- B. Each piece of equipment or apparatus suspended from ceiling or mounted above floor level shall be provided with suitable structural support, platform or carrier constructed in accordance with best recognized practice in a neat and workmanlike manner.
- C. Contractor shall exercise extreme care that structural members of building are not overloaded by such equipment. In all cases, details of such hangers, platforms and supports together with total weights of mounted equipment shall be approved by Structural Engineer.
- D. Paint all non-galvanized metal supports, rods, etc. in accordance with Specifications Section 23 05 64, Painting.

3.02 ATTACHING TO BUILDING CONSTRUCTION

- A. Equipment, ductwork and piping supports shall be attached to structural members (beams, joists, etc) rather than to floor or roof slabs.
- B. Where equipment is suspended from concrete or masonry construction, use expansion shields to attach supports to construction. Expansion shield bolt diameter shall be the same size as support rod diameter, hereinafter specified.
- C. Where existing masonry is not suitable to receive and hold expansion shields or where other means of attachment is advantageous, Contractor shall submit alternate method for approval of Architect and/or Engineer.
- D. Where supports are attached to structural members coated with fireproofing, the contractor shall clean the fireproofing, attach the support and patch the fireproofing with like material.

3.03 ELECTRICAL CONNECTIONS TO EQUIPMENT

- A. In the event that equipment furnished requires a larger starter or disconnect than that which is indicated on the documents, the Contractor supplying the larger equipment shall reimburse the Electrical Contractor supplying the larger starter or disconnect for the difference in labor and material cost.
- B. Detailed diagrams and instructions shall be provided by Contractor supplying equipment. If connections are different from those shown on the drawings, the contractor shall notify the electrical contractor prior to start of his related work.
- C. Relays, switches, contactors, etc. which may be required in addition to those specified or indicated on the electrical drawings shall be furnished by the supplying contractor for installation by the Electrical Contractor. These devices shall be mounted by the Electrical Contractor at the apparatus to be installed and the contractor supplying these additional devices shall reimburse the Electrical Contractor for his labor and material costs.
- D. In the event that several pieces of mechanical equipment from different suppliers are combined into one system, Contractor shall furnish complete interface wiring and control diagram to enable the Electrical Contractor to make proper connections. Diagrams shall be submitted to the Engineer for approval prior to actual wiring.

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- E. Contractor shall furnish to Electrical Contractor written notice of approval and acceptance of all control wiring which was installed by the Electrical Contractor for his system(s). Such approval shall be given within thirty (30) days of completion of all such control wiring. The letter shall be copied to the Engineer.

END OF SECTION

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SECTION 23 05 13

COMMON MOTOR REQUIREMENTS

PART 1: GENERAL

1.01 WORK INCLUDED

- A. Provide open drip-proof or totally enclosed fan cooled motors for mechanical equipment of the type and efficiency as specified herein.
- B. This section is applicable to motors on the following equipment:
 - 1. Fans

1.02 QUALITY ASSURANCE

All motors shall be designed, selected and applied in accordance with the latest applicable standards of NEMA, IEEE, ANSI, and the current edition of the National Electric Code.

1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. General Provisions: Section 23 05 01
- B. HVAC Fans: Section 23 34 00

1.04 SUBMITTALS

- A. Submit shop drawings in accordance with Specification Section 23 05 01, General Provisions.
- B. Submit shop drawing of motor with each applicable piece of equipment as stated in Item 1.01B above.
- C. Submittal shall indicate full load efficiencies and minimum power factor.

PART 2: PRODUCTS

2.01 ELECTRIC MOTORS (HIGH EFFICIENCY)

- A. Single Phase Motors: Single phase motors shall be the highest energy efficiency available, permanent split-capacitor where possible or as approved. Provide capacitor start or two-capacitor type motor for high torque applications. Provide automatic resetting in-built thermal protection unless otherwise specified.
- B. Three Phase Motors
1. Motors three quarter horsepower and larger shall be three phase unless specifically noted otherwise on the drawings.
 2. Motors shall be designed for Premium Efficiency and tested in accordance with IEEE 112, Test Method B. The Guaranteed Minimum Efficiency values shall be equal to or greater than the qualifying levels listed in Table M1.
 3. Motors shall have a service factor of not less than 1.15.
 4. Motors shall be T-Frame unless otherwise specified.
 5. Motors shall not exceed 1800 RPM as standard whenever possible unless otherwise specified.
 6. Motors shall be constructed using Class "F" Insulation.
 7. Motors shall be designed with a Class "B" temperature rise over an Ambient temperature of 40°C.
 8. Motors shall utilize greaseable-bearings.
 9. Motors shall utilize NEMA Design B as standard whenever possible. NEMA Designs C and D may be used when appropriate for special applications. Motors shall not utilize NEMA Design A unless specifically approved by the specifying engineer.
 10. Specialty motors shall be the highest efficiency available. The motor construction, i.e. design, type, frame, RPM, etc., shall be as appropriate for the application in question while providing reliability and long life expectancy.
 11. Motor nameplate voltage shall match the Nominal System Voltage as closely as possible.
 12. Motors over 5 horsepower shall have grounded rotors where used with variable frequency drives.

C. Efficiencies: Motors shall have efficiencies meeting or exceeding the following:

OPEN DRIP PROOF (ODP)

1800 RPM

MOTOR SIZE	GUAR.	NOMINAL.
3	86.5	88.5
5	87.5	89.5
7.5	88.5	90.2
10	89.5	91.0
15	91.0	92.4
20	91.0	92.4
25	91.7	93.0
30	92.4	93.6
40	93.0	94.1
50	93.0	94.1
60	93.6	94.5
75	94.1	95.0
100	94.1	95.0
125	94.5	95.4
150	94.5	95.4
200	94.5	95.4

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TOTAL ENCLOSED FAN COOLED (TEFC)

1800 RPM

MOTOR SIZE	GUAR.	NOMINAL
3	87.5	89.5
5	87.5	89.5
7.5	89.5	91.0
10	89.5	91.0
15	91.0	92.4
20	91.0	92.4
25	92.4	93.6
30	92.4	93.6
40	93.0	94.1
50	93.0	94.1
60	93.6	94.5
75	94.1	95.0
100	94.5	95.4
125	94.7	95.6
150	95.0	95.8
200	95.0	95.8

NOTE: Efficiency level shall be based on NEMA design equipment tested to IEEE 112-B Standards.

MOTOR VOLTAGES

NOMINAL SYSTEM VOLTAGE	MOTOR NAMEPLATE VOLTAGE
208	200
240	230 OR 230/460
480	460 OR 230/460

C. Manufacturers

1. Baldor Super E
2. General Electric Energy Saving CI
3. Louis-Allis Spartan
4. Reliance Duty Master E-2000 or XE
5. Marathon Blue Chip XRI
6. Siemens PE 21+
7. Toshiba EOP

PART 3: EXECUTION

3.01 **MOTOR SIZING**

Motors shall be rated for 1.15 service factor, but shall be selected for operation within their full load rating without applying the service factor.

END OF SECTION

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SECTION 23 05 30

PRE-FABRICATED ROOF CURBS AND SUPPORTS

PART 1: GENERAL

1.01 WORK INCLUDED

- A. Furnish and install prefabricated roof curbs as specified herein and as detailed on the drawings.
- B. Roof curbs for specific roof type mechanical equipment requiring openings shall be furnished by the manufacturer of that equipment selected to its respective size and requirements.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. General Provisions: Section 23 05 01
- B. Assignment of Misc. Work: Section 23 05 02
- C. Basic Piping Requirements: Section 23 05 29
- D. Packaged Heating and Cooling Equipment: Section 23 81 00
- E. Fans: Section 23 34 00
- F. HVAC Ducts and Casings: Section 23 31 00

1.03 SUBMITTALS

Submit shop drawings for each roof curb to be furnished on this project in accordance with Specification Section 23 05 01, General Provisions.

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PART 2: PRODUCTS

2.01 **ROOF CURBS**

- A. Provide roof curbs for all roof penetrating equipment listed as follows:
 - 1. Exhaust fans
- B. Curbs shall be prefabricated 18 gauge or heavier galvanized steel with factory installed, pressure treated wood nailer.
- C. Curbs shall be a minimum of 12" in height above the finished roof surface. Total curb height shall include depth of roof insulation.
- D. Curbs shall be insulated with 1-1/2" thick, 3 pound density, rigid insulation.
- E. Manufacturer:
 - 1. Wherever possible, curbs shall be furnished by the same manufacturer as the equipment it supports, i.e. exhaust fans, relief units, etc.
 - 2. Equipment manufacturer supplied curbs and any additional curbs shall be Thycurb Model TC-3, Pate, Curb Plus Inc., or equal.

PART 3: EXECUTION

3.01 **ROOF CURBS**

- A. Curbs shall be installed on the structural deck, not on insulation or roofing.
- B. All curbs provided for buildings with any roof pitch must be leveled. Prefabricated pitch built into curbs shall be provided.

END OF SECTION

SECTION 23 05 64

PAINTING

PART 1: GENERAL

1.01 WORK INCLUDED

- A. Provide all labor, materials and equipment necessary for painting of mechanical piping systems, equipment supports and of other surfaces as specified herein. All painting shall be performed by a trade responsible for this type of work.
- B. The following surfaces shall be painted:
 - 1. All interior and exterior exposed, non-galvanized, metal hangers, platforms, supports and miscellaneous steel for piping and equipment

1.02 RELATED WORK

- A. Completion and Startup: Section 23 01 70
- B. General Provisions: Section 23 05 01
- C. Assignments of Miscellaneous Work: Section 23 05 02

1.03 CERTIFICATE

Submit to Engineer, prior to any approvals of start of any work, a schedule of the exact materials proposed for each application on all surfaces.

1.04 GENERAL REQUIREMENTS

- A. All surfaces to be painted shall be clean and dry.
- B. Do not paint valve surfaces which are non-ferrous metals such as brass or bronze and those items which have a factory finish.

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1.05 SUBMITTALS

Furnish three (3) samples of each type finish and color to Engineer for approval.

1.06 DELIVERY

All paint shall be delivered to the site in manufacturer's sealed containers. Each container shall be labeled with the manufacturer's labels and shall give manufacturer's name, type of paint, color of paint and instructions for reducing. Thinning shall be done only in accordance with directions of manufacturer.

PART 2: **PRODUCTS**

2.01 ACCEPTABLE PAINT MANUFACTURERS

- A. Porter Paint Company/Pittsburgh Paint (PPG)
- B. Sherwin Williams
- C. Glidden Coatings and resins, Division of ICI Corporation
- D. Benjamin Moore and Co.
- E. M.A. Bruder Co. (MAB)
- F. Dampney (High Temperature Paint)

2.02 QUALITY ASSURANCE

Materials of all kinds shall be first line products and of the best quality and of brands approved by the Engineer. All paint shall be delivered in original containers with unbroken seals, plainly marked with manufacturer's name and the trade name or brand, to be opened and used only after approval and applied strictly in accordance with the manufacturer's recommendations with no substitutions.

2.03 SCHEDULE OF PAINTING AND FINISHING

- A. Interior and exterior bare ferrous metal
 - 1. First Coat: Porter No. 296 Glyptex rust inhibitive metal primer
 - 2. Second Coat: Porter No. 2909 acrylic gloss enamel
 - 3. Third Coat: Porter No. 2909 acrylic gloss enamel

- B. Interior non-ferrous metal
 - 1. First Coat: Porter No. 296 Glyptex rust inhibitive metal primer, MAB 073-1891 primer
 - 2. Second Coat: Porter No. 439 Glyptex eggshell interior alkyd enamel
 - 3. Third Coat: Porter No. 439 Glyptex eggshell interior alkyd enamel

- C. Exterior non-ferrous metal
 - 1. First Coat: Porter No. 296 Glyptex rust inhibitive metal primer, MAB 073-1891 primer
 - 2. Second Coat: Porter No. 619 exterior acrylic gloss
 - 3. Third Coat: Porter No. 619 exterior acrylic gloss

- D. Interior galvanized metal
 - 1. First Coat: Porter No. 215 acrylic rust inhibitive primer (white)
 - 2. Second Coat: Porter No. 439 Glyptex eggshell interior alkyd enamel
 - 3. Third Coat: Porter No. 439 Glyptex eggshell interior alkyd enamel

- E. Exterior galvanized metal
 - 1. First Coat: Porter No. 290 galvanized metal primer
 - 2. Second Coat: Porter No. 619 exterior acrylic gloss
 - 3. Third Coat: Porter No. 619 exterior acrylic gloss

- F. Pipe and duct insulation
 - 1. First Coat: Porter No. 426 vinyl sealer
 - 2. Second Coat: Porter No. 1119 silken touch velvet
 - 3. Third Coat: Porter No. 1119 silken touch velvet
 - 4. For Armaflex Insulation: MAB 036-1581 primer

PART 3: **EXECUTION**

3.01 **PREPARATION**

- A. Steel and Iron: Remove grease, rust, scale and dust by wire brushing and washing and touch up any chipped or abraded places on items that have been shop coated. Where steel and iron have a heavy coating of scale, it shall be removed by a wire brushing or as necessary to produce a satisfactory surface for painting.
- B. Before painting, remove and protect hardware, accessories, plates, lighting fixtures and similar items and replace same upon completion of area. Protect adjacent surfaces during work. Damage to or spillage upon adjacent work shall be repaired and/or cleaned and returned to a finished area.
- C. Apply paint to clean, dry and smooth surfaces only. Apply paint smoothly, worked out evenly and allow to dry a minimum of 48 hours before subsequent coats are applied. Protect from dampness. Do not apply exterior paint in damp, rainy weather or until surface has dried thoroughly. Do not apply any paint when temperature is below 50°F. Avoid painting surfaces while surfaces are exposed to hot sun.
- D. Finished work shall be completely covered, be uniform, smooth and free of runs, sags, clogging or excessive flooding. Make edges of paint adjoining other materials or colors sharp and clean with no overlaps. Use masking where required.
- E. At completion, touch up and restore finish where damaged and leave in new condition.
- F. Concrete and Masonry
 - 1. Fill cracks and irregularities with portland cement grout to provide uniform surface texture.
 - 2. Etch cement and poured concrete surfaces with 5% solution (by weight) of muriatic acid.
 - 3. Fill concrete masonry unit surfaces with block filler.

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3.02 STORAGE

- A. A lockable area will be assigned for storing and mixing paints. The floor of this place shall be covered with an approved, reinforced, kraft building paper and then with tarpaulins. No mixing shall be done in rooms or spaces other than those assigned for such purpose.
- B. Take all necessary precautions to prevent fire, explosions and other damage. All rags and paint or solvent must be stored in closed metal containers at all times.

3.03 CLEANING AND PROTECTION

- A. Any materials of other trades damaged to such extent that they cannot be restored to their original condition shall be replaced by this Contractor at his own expense.
- B. Protect adjacent work and materials by suitable coverings during progress of work. Remove all splatterings from floors and other surfaces. Leave work in a clean, orderly, acceptable condition.

END OF SECTION

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SECTION 23 05 93

TESTING, ADJUSTING AND BALANCING

PART 1: GENERAL

1.01 **GENERAL REQUIREMENTS**

Balancing Contractor to monitor the job progress to schedule his work in conjunction and cooperation with other trades involved and comply with the project completion date.

1.02 **WORK INCLUDED**

- A. Provide equipment, materials, labor and services necessary for complete balancing of systems as shown on the drawings and as specified herein.
- B. Test, balance and adjust every system and piece of equipment installed on this project. They shall include:
 - 1. Exhaust air systems
- C. The Mechanical and/or Sheet Metal Contractor shall furnish to the Balancing Contractor a fan curve for each fan serving systems of 2000 cfm or greater. Copies of these curves shall be included in the final balance report.
- D. Record all test readings on a standard test outlet form which includes room name or number, terminal device designation, manufacturer, model number, size and Ak factor. Include the design conditions, the initial and each follow-up test readings and the final test results.

1.03 **WORK INCLUDED BUT SPECIFIED ELSEWHERE**

- A. Startup and Completion: Section 23 01 70
- B. General Provisions : Section 23 05 01

1.04 **QUALITY ASSURANCE**

- A. This work shall be performed by a Balancing Contractor who specializes in testing and balancing of mechanical systems. The work shall not be performed by the Mechanical or Sheet Metal Contractor subsidiaries owned by the Contractor who successfully bids on this project. However, Balancing Contractors who are owned by bidding Mechanical /Sheetmetal Contractors are encouraged to bid to the other Contractors.

- B. The contractor shall be fully certified by TABB, NEBB or AABC. The lead person in the field on this project shall be qualified as a certified test and balance Engineer who has been issued certification by the National Examining Board.
- C. Approved Balancing Contractors
 - 1. Fulton Air Balance
 - 2. Johnson Controls, Inc.
 - 3. Fluid Dynamics (Fort Wayne, IN)
 - 4. Thermal Balance Inc. (Lexington, KY)
 - 5. Mechanical Systems Balancing (MSB)
 - 6. Midwest Balance and Service Inc. (a Div. of Poynter Sheetmetal)
- D. Other Balancing Contractors shall obtain approval from Engineer. Approval will only be given through written addendum.

1.05

SUBMITTALS: BALANCING REPORT

- A. Each distribution system shall be schematically drawn (single line diagram) on 8-1/2"x11" sheets of paper. Larger systems may require several sheets. All components and terminal devices shall be shown and labeled. Room names or numbers shall be included.
- B. Record operating data for each piece of equipment on 8-1/2"x11" report form. Data shall include pressures, temperatures, amperages, rpm, etc. as outlined below under Part 2 (2.02) and Part 3.
- C. Submit report to Engineer and Contractor of conditions experienced with any piece of equipment or device which did not perform satisfactorily or which required special settings. Include in report, any proposed corrections.
- D. All final reports shall be signed and sealed by the certified Test and Balance Engineer.
- E. Data Sheets
 - 1. Submit data sheets on each item of testing equipment to be used.
 - 2. Include name of device, manufacturer's name, model number, latest date of calibration, and correction factors.

F. Final Report

1. Upon completion, all information shall be neatly printed and three (3) copies submitted to the Engineer through the Mechanical Contractor with accompanying schematic diagrams of systems tested.
2. All test reports shall be assembled, numbered, indexed, and submitted in vinyl covered loose-leaf, 3-ring notebooks with project name and Balancing Contractor's name permanently printed thereon.

1.06

BALANCING REQUIREMENT: AIR SYSTEMS

- A. The requirement of the air system balance is to direct the specified air quantities as shown on the plans to each of the rooms and zones detailed on the plans. The supply system must be set to provide proper quantities and the return system must be adjusted proportionately for an overall balance of supply air, return air and outside air. A balance of $\pm 5\%$ of total design volume shall be the requirement in overall system balance. But beyond this requirement is providing a comfortable, controlled environment of temperature, humidity, noise, ventilation and air motion.
- B. Should noise problems develop when obtaining design air flow, the Balancing Contractor shall aid the Engineer in determining the cause and assist in determining the solution. If in the opinion of the Balancing Contractor, noise occurs due to poor field duct arrangements, the Balancing Contractor shall also report to the Engineer and Sheet Metal Contractor suggested solutions.

1.07

COORDINATION

- A. The Balancing Contractor shall review the fabrication drawings to verify and coordinate the location of all necessary dampers, access doors and duct arrangements to assure a proper air balance can be obtained.
- B. The Balancing Contractor shall review the sheet metal fabrication shop drawings and affix his review stamp before drawings are submitted for final approval to the Engineer.
- C. System Operation: Heating, ventilating, air conditioning equipment including filters, shall be completely installed, duct systems tested and passed for leakage, ceilings installed and in continuous operation as required to accomplish the adjusting and balance work specified. Balancing Contractor shall submit "Check List" with copy to Engineer, to the Mechanical and/or Sheet Metal Contractors which, when completed, and returned, will assure the systems are ready to be balanced.

- D. The Balancing Contractor shall visit the job site when each sheet metal system installation is near complete, but prior to the installation of ceilings, to familiarize himself with the installation and to determine any potential problems in achieving a balanced system. This visit shall be scheduled by the Balancing Contractor and performed with the Mechanical Contractor. Submit report of each trip to Engineer.
- E. The Balancing Contractor shall review all duct pressure test reports and comment on the results and methods.
- F. The Balancing Contractor shall visit the job site when each hydronic loop is near complete, but prior to the installation of ceilings, to familiarize himself with the installation and to determine any potential problems in achieving a balanced system. This visit shall be scheduled by the Balancing Contractor and performed with the Mechanical Contractor. Submit report of each trip to Engineer.
- G. Readjustments
 - 1. Should corrective measures caused by faulty installation require retesting, adjusting and balancing, such work shall be at no additional expense to the Owner.
 - 2. Corrective measures, other than the above, shall be made only as directed by the Engineer

1.08 SYSTEM STARTUP AND INITIAL DUCT TESTING

- A. The Balancing Contractor shall attend scheduled pre-startup meetings.
- B. The Balancing Contractor shall participate in the startup of each system on the project.
- C. After successful startup of each system, perform an initial total air distribution test to determine the system duct leakage. The project requirement is a maximum allowable leakage of 5% total cfm. Should leakage exceed this amount, stop work on that system and notify the Engineer and the contractor. Reference Section HVAC Ducts and Casings, Section 23 31 00.

1.09 RE-INSPECTIONS

Make four (4) return re-inspections during one (1) year warranty period. Each re-inspection shall include a check test of all critical balance conditions including correction or adjustment as required on each system. Coordinate these re-inspections with Owner. Two (2) of these shall be during weather extremes. Send written reports to the Owner and Engineer.

PART 2: **PRODUCTS**

2.01 **INSTRUMENTS**

A. Quality

1. The minimum instrumentation for testing, adjusting and balancing shall be the "TAAB, AABC and/or NEBB Approved Minimum Field Instrumentation".
2. Instruments used for testing and balancing must have been calibrated within a period of six (6) months and checked for accuracy prior to start of work.
3. Instruments must be maintained and carried in such manner to protect them from excessive vibration and moisture conditions.

- B. Approval: All products and instrumentation used shall be subject to approval of the Engineer.

2.02 **EQUIPMENT DATA CARDS**

- A. Record operating data for each piece of equipment on a card, laminated in plastic and attached to the equipment. Operating data should include all final appropriate data such as pressures, temperatures, amperages, revolutions per minute, which are significant to the normal operating points of the equipment.
- B. Cards shall be 5"x8" and shall include Balancing Contractor's name, address, phone number and date of test.

PART 3: **EXECUTION**

3.01 **GENERAL PROCEDURES**

- A. Balance and adjust the systems to obtain the flow quantities shown on the drawings.
- B. Maintain coordination and communication with the Engineer, Owner, Suppliers and Contractors.
- C. Schedule work so that it may be done while the Contractors are on the job site.
- D. If a piece of equipment is not operating in a satisfactory manner, assist the installing contractor in repairing or adjusting. After corrections have been made, proceed with balancing.
- E. Submit reports to the Engineer if a system or piece of equipment cannot be adjusted to operate satisfactorily.

3.02

BALANCING PROCEDURE: AIR HANDLING UNITS AND AIR DISTRIBUTION

- A. Drill probe holes for static pressure readings, duct velocity readings and temperature readings.
- B. Check air handling unit fan:
 - 1. Check motor electric current and voltage supply and rated running amperage.
 - 2. Check initial fan and motor speed.
 - 3. Determine available adjustment tolerance.
- C. Adjust fan to obtain specified total air flow (allow for maximum 5% total system duct leakage). If adjustment in the fan is not available, size a new drive and coordinate the installation of sheaves and belts with the installing contractor.
- D. Upon obtaining specified air flow, proceed with balancing the air distribution System.
 - 1. Set all terminals at design air flow.
 - 2. Perform as many total system readings until a balance is obtained. Record all readings.
- E. Recheck main system traverse to verify total air flow. If the distribution system balance is inadequate, determine probable cause:
 - 1. Check duct system for connection integrity and leakage. Notify Sheet Metal Contractor of deficiencies for correction.
 - 2. If tolerance in the fan is not available, size a new drive and coordinate the installation of new sheaves and belts with the installing contractor.
- F. Balance the outside air, return air and relief air dampers to the specified minimum outside air quantity. Verify proper indexing and modulation from control signal. Set and record minimum and maximum positions of dampers.
- G. Record the final operating conditions of the air handling unit including:
 - 1. Fan rpm and cfm
 - 2. Motor run amperes and voltage
 - 3. Fan inlet and discharge static pressure
 - 4. Filter pressure drop
 - 5. Cooling coil entering and leaving air temperatures (DB & WB) in full cooling cycle (at minimum outside air).
 - 6. Heating coil entering and leaving air temperatures (DB & WB) in full heating cycle (at minimum outside air)

3.03

BALANCING PROCEDURE: EXHAUST SYSTEMS

- A. Drill probe holes for static pressure duct velocity readings.
- B. Check exhaust fan:
 - 1. Check motor electric current supply and rated running amperage and voltage.
 - 2. Check initial fan and motor speed.
 - 3. Determine available adjustment tolerance.
- C. Proceed through entire duct system, opening all dampers to full open position. If dampers are missing, notify the Sheet Metal Contractor to add the dampers.
- D. Perform main system traverse to determine total air flow. Record initial readings including fan rpm, cfm, total static pressure and motor amperage and voltage.
- E. Adjust belt drive fans to obtain specified total air flow (allow for maximum 5% total system duct leakage). If adjustment in the fan is not available, size a new drive and coordinate the installation of sheaves and belts with the installing contractor.
- F. Upon obtaining specified air flow, proceed with balancing the distribution system.
 - 1. Set all terminal devices at design air flow.
 - 2. Perform as many total system readings until a balance is obtained. Record all readings.
- G. Recheck main system traverse to verify total air flow.
- H. If the distribution system balance is inadequate, determine probable cause. Check duct system for connection integrity and leakage. Notify Sheet Metal Contractor of deficiencies for correction.
- I. Record the final operating conditions of the exhaust fan including:
 - 1. Fan rpm and cfm
 - 2. Motor run amperes
 - 3. Fan inlet and discharge (if applicable) static pressure

3.04

OWNER'S INSTRUCTION

Balancing Contractor shall arrange with the Commissioning Engineer, a time for the instruction as to the unique balanced conditions of the project.

3.05 GENERAL COMPLETION REQUIREMENTS

- A. Reinstall belt guards on fan equipment.
- B. Install plugs in all holes drilled for traverse readings and static pressure readings.
- C. Repair insulation torn or removed as a result of obtaining readings.
- D. Upon completion of all water flow readings and adjustments at coils, tag and mark all settings and record data.

3.06 OPERATING AND PERFORMANCE TESTS

- A. Perform operating and performance tests on all equipment and systems installed in this project at completion of the installation. Upon obtaining proper operation and performance, perform demonstration of system sequences in the presence of the commissioning Engineer and/or Owner's designated maintenance personnel.
- B. Operating tests are required on each system. Following are general tests required of certain systems. Not all equipment is listed which requires testing.
 - 1. Air handling systems
 - a. Test each control sequence and safety device associated with each system.
 - b. Determine total btuh output of each coil (sensible and total capacity).

END OF SECTION

SECTION 23 09 13

INSTRUMENTATION AND CONTROL DEVICES

PART 1: **GENERAL**

1.01 **WORK ASSIGNMENT**

Controls will be bid inclusively through the Mechanical Contractor

Controls will be bid in this separate price package and the work will be assigned to the Mechanical Contractor.

1.02 **QUALIFICATIONS**

- A. Temperature Control Contractor shall submit proof of having company-trained service men available to make service calls within four (4) hours of notification and of having installed five (5) projects of equal or greater size and complexity to this installation. Projects must have been within a radius of 100 miles of this project. Twenty four (24) hour service capability, 365 days per year, is required.
- B. Submit immediately after award of contract a diagram of the proposed system architecture, including correct quantities of equipment controllers, cable types, etc. A typical unitary controller can be identified for each EF, PEF, PTAC and DACU's.
- C. Submit with the bid at least two (2) references of similar installations with the contact name and telephone number of the user.
- D. The Owner intends to select the contractor on the basis of who submits and demonstrates a user friendly, trainable, easy to understand system, as a criteria. Initial cost will also be a primary criterion.

1.03 **QUALIFICATION VERIFICATION**

- A. It is the intent of the Owner to preview the system architecture, components, and use methods of the proposed vendors.
- B. Responsive and competitive bidders will be asked to demonstrate their system at the vendors facilities immediately after receipt of bids. The bidder(s) shall host a hands-on pre-training of the proposed system, allowing the Owner's personnel to gain realization and trust in the usability of the format.

- C. Specific emphasis shall be given to use of the graphics to access system points for monitoring, trending and setpoint adjustment.
- D. Acceptable Automation Systems
 - 1. Invensys / Ultivist
 - 2. Siemens / Insight

Note: Contractor must physically demonstrate the above to the Owner and Owners representatives for prequalification before bidding this project. Pre-qualification must be completed at least 5 days prior to bid for the bid to be accepted.

1.04 NARRATIVE OF CONTROL SYSTEM CONCEPT

The control system shall fulfill the sequence requirements from an electric control system interfaced to electric actuation.

1.05 WORK INCLUDED

- A. Provide testing, calibration, adjustment and performance as intended by the sequences described in these specifications and as interpreted by the Engineer.
- B. Provide coordination, interface and interlock control wiring between control system and equipment that is controlled by this project.
- C. Provide all instrumentation to perform and demonstrate each sequence.
- D. Provide coordination and rough-in of all concealed conduit and tubing within the structure. Provide cutting and patching of completed areas to the satisfaction of the Architect/Engineer.
- E. Upon obtaining successful testing and performance, schedule and conduct demonstration (commissioning) of all controls. Schedule this work with the Engineer.
- F. Upon obtaining successful demonstrations schedule and conduct training session(s) with Owner's maintenance personnel.

1.06 WORK INCLUDED BUT SPECIFIED ELSEWHERE

- A. Completion and Startup: Section 23 01 70
- B. General Provisions: Section 23 05 01
- C. Assignments and Misc. Work: Section 23 05 02

- D. Concrete Pads and Curbs: Section 23 05 05
- E. Common Motor Requirements: Section 23 05 13
- F. Low Voltage Electrical Power Conductors and Cables: Section 26 05 19
- G. Basic Piping Requirements: Section 23 05 29
- H. Raceways and Boxes for Electrical Systems: Section 26 05 33
- I. Identification of Piping and Equipment: Section 23 05 53
- J. Sequence of Operations for Controls: Section 23 09 93

1.07 RELATED WORK SPECIFIED ELSEWHERE

- A. Testing, Adjusting and Balancing: Section 23 05 93
- B. HVAC Fans: Section 23 34 00

1.08 SUBMITTALS

- A. Prepare and submit shop drawings and manufacturer's standard specification data sheets on all hardware and software to be provided. No work may begin on any segment of this project until submittals have been reviewed by the Engineer and Owner for conformity with the plan and specifications.
- B. Quantities of items submitted will be reviewed by the Engineer and Owner. Such review shall not relieve the contractor from furnishing quantities required for completion.
- C. Submit to the Engineer, any additional information or data which is deemed necessary to determine compliance with these specifications or which is deemed valuable in documenting the system to be installed.

- D. Submittals to include the following:
1. A complete bill of materials of equipment to be used indicating quantity, manufacturer and model number.
 2. Manufacturers cut sheets for major system components. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and/or drawing that the submittals is being submitted to cover. Include:
 - a. Building Controllers
 - b. Custom Application Controllers
 - c. Application Specific Controllers
 - d. Operator Interface Computer
 - e. Portable Operator Workstation
 - f. Auxiliary Control Devices
 - g. Proposed control system riser diagram showing system configuration, device locations, addresses, and cabling.
 - h. Detailed termination drawings showing all required field and factory termination's. Terminal numbers shall be clearly labeled.
 - i. Points lists showing all system objects, and the proposed English language object names.
 - j. Sequence of operations for each system under control. This sequence shall be specific for the use of the Control System being provided for this project.
 - k. Color prints of proposed graphics with a list of points for display.
- E. Project Record Documents: Upon completion of installation, submit record documents. The documents shall be submitted for approval prior to final completion and include:
1. Project Record Drawings - these shall be "as built" versions of the submitted shop drawings.
 2. Testing and Commissioning Reports
 3. Operating and Maintenance Manual: These shall be "as built" versions of the submittals product data. In addition to that required for the submittals, the Operating and Maintenance Manual shall include:
 - a. Names, address and 24 hour telephone numbers of Contractors installing equipment, and the control systems and service representative of each.
 - b. Operators Manual with procedures of operating the control systems including logging on/off, alarm handling, producing point reports, trending data, overriding computer control, and changing set points and other variables.

- c. Programming manual with a description of the programming language including syntax, statement descriptions including algorithms and calculations used, point database creation and modification, program creation and modification, and use of the editor.
- d. Engineering, Installation and Maintenance Manual(s) that explains how to design and install new points, panels, and other hardware; preventative maintenance and calibration procedures; how to debug hardware problems; and how to repair or replace hardware.
- e. A listing and documentation of all custom software created using the programming language including the point database. One set of magnetic media containing files of the software and database shall also be provided.
- f. One set of magnetic media containing files of all color-graphic screens created for the project.
- g. A list of recommended spare parts with part numbers and supplier.
- h. Complete documentation, installation and maintenance information for all third party hardware provided including computer equipment and sensors.
- i. Provide complete CD with all software including operating systems, programming language, operator work-station software, and graphics software.
- j. Licenses, Guarantee, and Warranty documents for all equipment and systems.
- k. Recommended preventive maintenance procedures for all system components including a schedule of tasks (inspection, cleaning, calibration, etc.) time between tasks, and task descriptions.

1.09

GUARANTEE

- A. Labor and materials for control system specified shall be free from defects for a period of twelve (12) months after final completion and acceptance by the Owner. Control System failures during the warranty period shall be adjusted, repaired, or replaced at no charge or reduction in service to the Owner. The Contractor shall respond to the Owner's request for warranty service within 2 hours.
- B. At the end of the final start-up/testing, if equipment and systems are operating satisfactorily to the Owner and Engineer, the Owner will sign certificates certifying that the control system's operation has been tested and accepted in accordance with the terms of this specification. The date of Owner's acceptance shall be the start of warranty.
- C. Operator work-station software, project specific graphics, database and firmware updates shall be provided to the Owner at no charge during the warranty period. Written authorization by Owner must, however, be granted prior to the installation of such changes.

1.10 STANDARDS

- A. Temperature control system shall be furnished and installed by a factory authorized representative of the manufacturer.
- B. Materials and equipment shall be the catalogued products of manufacturers regularly engaged in production and installation of automatic direct digital temperature control systems and shall be manufacturer's latest standard design that complies with the specification requirements.
- C. All controls shall be of one manufacturer. No mixing of suppliers will be permitted without prior confirmation of acceptability in writing.
- D. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Section 15, Governing Radio Frequency Electromagnetic Interference and be so labeled.
- E. Acceptable Temperature Control Manufacturers/Contractors
 - 1. Precision Controls (Invensys)
 - 2. Johnson Controls, Inc.
 - 3. Siemens
 - 4. Circon (Perfection Services)
 - 5. KMC
 - 6. Honeywell International

1.11 CODES AND STANDARDS

- A. Meet requirements of all applicable standards and codes, except when more detailed or stringent requirements are indicated by the Control Documents, including requirements of this Section.
 - 1. Underwriters Laboratories: Products shall be UL-916-PAZX listed
 - 2. National Electrical Code - NFPA 70.
 - 3. Federal Communications Commission - Part J.
 - 4. ASHRAE/ANSI 135-1995 (BACnet)
- B. All products used in this installation shall be new, currently under manufacture, and shall be applied in similar installations for a minimum of (2) years. This installation shall not be used as a test site for any new products unless explicitly approved by the Owner's representative in writing prior to bid date. Spare parts shall be available for at least 5 years after completion of this contract.

1.12 SYSTEM PERFORMANCE STANDARDS

The system shall conform to the following:

- A. Graphic Display. The system shall display a graphic with a minimum of (20) dynamic points. All current data shall be displayed within (10) seconds of the request.
- B. Graphic Refresh. The system shall update all dynamic points with current data within (10) seconds.
- C. Object Command. The maximum time between the command of a binary object by the operator and the reaction by the device shall be (10) seconds. Analog objects shall start to adjust within (10) seconds.
- D. Object Scan. All changes of state and change of analog values shall be transmitted over the high-speed network such that any data used or displayed at a controller or work station will be current, within the prior (60) seconds.

PART 2: **PRODUCTS**

2.01 INPUT/OUTPUT INTERFACE

- A. Hard-wired inputs and outputs may tie into the system through Building, Custom, or Application Specific Controllers.
- B. All input points and outputs points shall be protected such that shorting of the point to itself, another point, or ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24V of any duration, such that contact with this voltage will cause no damage to the controller.
- C. Binary inputs shall allow the monitoring of on/off signals from remote devices. The binary inputs shall provide a wetting current of at least 12 ma to be compatible with commonly available control devices.
- D. Pulse accumulation input points. This type of point shall conform to all the requirements of Binary Input points, and also accept up to 2 pulses per second for pulse accumulation, and shall be protected against effects of contact bounce and noise.
- E. Analog inputs shall allow the monitoring of low voltage (0-10 Vdc), current (4-20ma), or resistance signals (themistor, RTD). Analog inputs shall be compatible with, and field configurable to commonly available sensing devices.

- F. Binary outputs shall provide for on/off operation, or a pulsed low voltage signal for pulse width modulation control. Binary outputs on custom and building controllers shall have 3-position (on/off/auto) override switches and status lights. Outputs shall be selectable for either normally open or normally closed operation.
- G. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0-10Vdc or a 4-20 ma signal as required to provide proper control of the output device. Analog outputs shall be able to be manually overridden.

2.02 CARBON DIOXIDE SENSOR

- A. Unit to be self contained wall mounted type, have digital display, detect low level carbon dioxide and activate alarm. Unit to operate on 110 volt power.
- B. Manufacturers
 - 1. Nighthawk Industries Model 5U748
 - 2. Telaire Ventostat Series

2.03 CARBON DIOXIDE SENSORS

- A. Space Sensor
 - 1. Suitable for wall mount in the finished space. Mount at 48" AFF adjacent to the room temperature sensor.
 - 2. Factory setting 0-2000 ppm CO2 with accuracy of ± 40 ppm or $\pm 3\%$ of reading, whichever is higher.
 - 3. Lifetime guarantee of minimum 15 year calibration internal requirement.
 - 4. Certification: FCC Part 15, Class B
 - 5. Tamperproof locking screw on cover.
 - 6. LCD display with see-through cover.
 - 7. Manufacturer:
 - a. Telaire Model 8002-K

2.04 CARBON MONOXIDE GAS MONITOR

- A. Unit to be self contained wall mounted type, have digital display with a readout scale in PPM (parts per million), detect low level carbon monoxide and activate alarm. Unit to operate on 110 volt power.
- B. Signal input may be 4 to 20 milliamps or RS-485.
- C. Alarm horn shall be integral and include an acknowledge button.
- D. Manufacturer: MSA Instrument Division (TGM Series)

2.05 RELAYS (ELECTRIC)

- A. Snap acting, enclosed switching type, with built-in 120V to 24V/60 Hz transformer, 24 volt coil, and line voltage contacts as indicated, each rated minimum 7.4 amp running current at 120 VAC.
- B. Snap acting NEMA 1 enclosed switching type with 120V/60 Hz coil and line voltage contacts, as indicated, each rated minimum 7.2 amp running current at 120 VAC.
- C. Snap acting, rated for application, minimum 2 sets of Form C contacts, enclosed in dust-proof enclosure.
 - 1. Contacts: Silver-cadmium with minimum life span rating of 1,000,000 operations.
 - 2. Operating time: 20 milliseconds or less.
 - 3. Release time: 10 milliseconds or less
 - 4. All relays equipped with coil transient suppression devices to limit transients to non-damaging levels.
- D. Acceptable Manufacturers
 - 1. Functional Devices
 - 2. Idec

2.06 CURRENT SENSING RELAYS

- A. Sensing relay shall be a solid state electronic device with split-core design to eliminate the need to remove power conductor for installation or servicing.
- B. Amperage rating of 0 - 135 Amps.
- C. Trip setpoint shall be adjustable to $\pm 1\%$ of range. Provide a trip LED.
- D. Sensor supply current is induced from monitored conductor. Minimum conductor current required is 2 amps. Provide a power LED to indicate that power is available at the current sensing relay.
- E. Sensor shall have 600 VAC rms isolation.
- F. Switch output contacts shall be rated for 0.5 amps @ 30 VAC/DC.
- G. Acceptable Manufacturers
 - 1. Nellsen - Kuljian,
 - 2. Veris Industries H900 Series

2.07 TRANSFORMERS AND POWER SUPPLIES

- A. Control transformers shall be UL listed, Class 2 current-limiting type, or shall be furnished with overcurrent protection in both primary and secondary circuits for Class 2 service.
- B. Unit output shall match the required output current and voltage requirements. Current output shall allow for a 50% safety factor. Output ripple shall be 3.0 mV maximum Peak-to-Peak. Regulation shall be 0.10% line and load combined, with 50 microsecond response time for 50% load changes. Unit shall have built-in over-voltage protection.
- C. Unit shall operate between 0° C and 40° C ambient.
- D. Acceptable Manufacturers
 - 1. Circon CIA332-691V900
 - 2. Kele RIB TR Series

2.08 CONTROL PANELS

- A. Accommodate all ancillary controls and instruments, of each system; totally enclosed in a UL approved cabinet, factory fabricated of steel, aluminum, or high impact plastic, equipped with piano hinged locking-type front door; single cabinet or group of cabinets at one location for all controls for each system.
- B. All control panels are not necessarily shown on Drawings. Individual panel size will depend upon controls and instruments involved and respective manufacturer's standards. TCC shall verify panel sizes and make necessary arrangements for mounting panel on wall or floor. Panels may be either securely attached to the wall, or on a floor stand, adjacent to respective system equipment. TCC to furnish floor stands where required.
- C. Install all control devices in cabinets, except room type instruments and equipment mounted devices (automatic dampers, valves, etc.).
- D. Provide a convenience 120VAC receptacle in each panel.
- E. Factory wire electrical equipment to numbered terminal strip.
- F. All wiring and tubing within the panel shall be run in wiring tray in accordance with NEMA and UL standards, and shall meet all local codes.
- G. Install pressure electric (PE) switches and electric pneumatic (EP) solenoid air valves, not connected in any way to a device located within a cabinet, adjacent to devices to which they are wired.

- H. Detailed drawings shall be submitted for each panel before beginning construction.
- I. As-built control drawings for system being controlled and scaled panel layout drawings shall be mounted inside the panel door at completion of project.
- J. Acceptable Manufacturers
 - 1. Johnson Controls EN series
 - 2. Hoffman Industrial Control type panels
 - 3. Siemens

2.09 RECEIVER CONTROLLERS

- A. Receiver controllers shall be capable of accepting one, two or three inputs as required to meet the specified sequence of operation. All receiver controllers shall have adjustable setpoints, proportional band and authority. Single input units are to also have adjustable authority to facilitate rapid and easy conversion of single input units into multiple logic receiver controllers for system expansion at a later date without adding a new receiver controller. Control action shall be field changeable on each receiver controller from direct to reverse and/or reverse to direct output. Proportional band shall be adjustable from 2 to 20% based on a 5 psi (34.5 kPa) 200%. Setpoint scale shall match the range of the primary transmitter. Internal restrictors shall be provided to facilitate the application of one pipe transmitter. All restrictors for the remote transmitters, as well as the integral restrictor for the receiver controller, shall be field replaceable. All air connections shall be made to barbed fittings on modular, plug-in connectors.
- B. Acceptable Manufacturers
 - 1. Johnson Controls NT or T-5800 Series.

PART 3: **EXECUTION**

3.01 PROJECT MANAGEMENT

Provide a designated project manager who will be responsible for the following:
Construct and maintain project schedule
On-site coordination with all applicable trades and subcontractors
Authorized to accept and execute orders or instructions from owner/engineer
Attend project meetings as necessary to avoid conflicts and delays
Make necessary field decisions relating to this scope of work
Coordination/Single point of contact

3.02 GENERAL

- A. Make all final adjustments to system as many times as necessary to obtain proper operation before turning over to Owner.
 - 1. Check all instruments for proper location and operation and compliance with submittal diagrams. Check each system for sequence of operation.
 - 2. Final check out shall be by a qualified person other than Installing Personnel.
- B. Furnish installation instructions for equipment to be installed by others.
- C. Provide wiring diagrams, check installation and furnish all controls and relays to accomplish electric control and interlocking of equipment.
- D. Location, size, capacity, mounting arrangement and electrical characteristics of equipment shall be as noted on the drawings.
- E. All wiring and conduit required for controls, interlock of control devices, components, equipment, etc. shall be provided by the Temperature Control Contractor.
- F. Mount instruments where they can be easily read and where readings will be truly representative.

3.03 INSTALLATION OF ROOM INSTRUMENTS

- A. Room instruments shall be installed to align vertically or horizontally with other wall type light switches, fire alarm devices, receptacles, etc. Review the instrument location with the electrical drawings and coordinate installation with Electrical Contractor. If unsure of intended alignment, consult the engineer.
- B. Mount room instruments where their location will not interfere with the proposed furnishings, cabinetry, etc. layout. Review alternative location with Engineer.
- C. Mount instruments at 48" above finished floor to center unless noted otherwise on the drawings.
- D. Mount instruments on an insulating base on exterior walls or common walls to unconditioned spaces.
- E. Install sensors in accordance with the manufacturer's recommendations.
- F. Mount sensors rigidly and adequate for the environment within which the sensor operates.

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- B. Mount room instruments where their location will not interfere with the proposed furnishings, cabinetry, etc. layout. Review alternative location with Engineer.
- C. Mount instruments at 48" above finished floor to center unless noted otherwise on the drawings.
- D. Mount instruments on an insulating base on exterior walls or common walls to unconditioned spaces.
- E. Install sensors in accordance with the manufacturer's recommendations.
- F. Mount sensors rigidly and adequate for the environment within which the sensor operates.

- G. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.
- H. All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor readings.
- I. Wiring for space sensors shall be concealed in building walls. EMT conduit is required within mechanical and service rooms.

3.04 INSTALLATION OF CONTROL WIRING

- A. General
 - 1. All control and interlock wiring shall comply with the national and local electrical codes and Division 26 of these specifications. Where the requirements of this section differ with those in Division 26, the requirements of this section shall take precedence.
 - 2. Conceal wiring, except in machine rooms, service tunnels and similar unfinished areas. Rack together groups of wires so individual wires can be traced. Tag concealed cables at the end for easy identification.
 - 3. Exposed: Contractor shall install all wires within conduit.
 - 4. Concealed (Above Accessible Ceilings)
 - a. Plenum cable, either individual or bundled, shall be installed in workmanlike manner securely fastened to fixed members of building structure at sufficient points to avoid excessive freedom of movement.
 - b. Field fabricated bundles shall be tied together with sufficient number of nylon ties to present neat, uniform appearance.
 - 5. Concealed (In All Inaccessible Areas): All cabling shall be run within enclosed trough or conduit.
- B. Where Class 2 wires are in concealed and accessible locations including ceiling return air plenums, approved cables not in raceway may be used provided that:
 - 1. Circuits meet NEC Class 2 (current-limited) requirements. (Low voltage power circuits shall be sub-fused when required to meet Class 2 current-limit).
 - 2. All cables shall be UL listed for application, i.e. cables used in ceiling plenums shall be UL listed specifically for that purpose.
- C. Do not install Class 2 wiring in conduit containing Class 1 wiring. Boxes and panels containing high voltage may not be used for low voltage wiring except for the purpose of interfacing the two (e.g. relays and transformers).

- D. Where Class 2 wiring is run exposed, wiring shall be run parallel along a surface or perpendicular to it, and bundled, using approved wire ties at no greater than 3m (10ft) intervals. Such bundled cable shall be fastened to the structure, using specified fasteners, at 1.5 m (5 ft) intervals or more often to achieve a neat and workmanlike result.
- E. All wire-to-device connections shall be made at terminal blocks or terminal strip. All wire-to-wire connections shall be at a terminal block, or with a crimped connector. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
- F. Maximum allowable voltage for control wiring shall be 120V. If only higher voltages are available, the Control System Contractor shall provide step down transformers.
- G. All wiring shall be installed as continuous lengths, where possible. Any required splices shall be made only within an approved junction box or other approved protective device.
- H. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations in accordance with other sections of this specification and local codes.
- I. Size of conduit and size and type of wire shall be the design responsibility of the Control System Contractor, in keeping with the manufacturer's recommendation and NEC.
- J. Control and status relays are to be located in designated enclosures only. These relays may also be located within packaged equipment control panel enclosures. These relays shall not be located within Class 1 starter enclosures.
- K. Follow manufacturer's installation recommendations for all communication and network cabling. Network or communication cabling shall be run separately from other wiring.
- L. Adhere to Division 26 requirements for installation of raceway.
- M. This Contractor shall terminate all control and/or interlock wiring and shall maintain updated "as built" wiring diagrams with termination's identified at the job site.
- N. Flexible metal conduits and liquid-tight, flexible metal conduits shall not exceed 3'-0" in length and shall be supported at each end. Flexible metal conduit less than 1/2" electrical trade size shall not be used. In areas exposed to moisture, liquid-tight, flexible metal conduits shall be used.

3.05 IDENTIFICATION OF HARDWARE AND WIRING

- A. All wiring and cabling, including that within factory-fabricated panels, shall be labeled at each end within 2" of termination with a cable identifier and other descriptive information.
- B. Permanently label or code each point of field terminal strips to show the instrument or item served.
- C. Identify control panels with minimum 1 cm letters on laminated plastic nameplates.
- D. Identify all other control components with permanent labels. Identifiers shall match record documents. All plug-in components shall be labeled such that removal of the component does not remove the label.

3.06 INSTALLATION OF TEMPERATURE CONTROL PANELS

- A. Where shown on drawings, mount panels on wall surfaces.
- B. Where not feasible to install panels on walls, provide a painted unistrut floor stand adjacent to the equipment suitable for support and rigidity.

END OF SECTION

SECTION 23 09 93

SEQUENCE OF OPERATION

PART 1: GENERAL

1.01 WORK INCLUDED

- A. Provide the engineering and documentation required to obtain the sequence of operation for each system as described herein.
- B. Systems include:
 - 1. HVAC Fans
 - 2. Ductless split system air conditioner
- C. All instruments, room sensors and thermostats shall be field calibrated.

1.02 WORK INCLUDED BUT SPECIFIED ELSEWHERE

Instrumentation and Control Devices for HVAC: Section 23 09 13

PART 2: PRODUCTS

2.01 FACILITY MANAGEMENT SYSTEM

- A. **Software Installation:** Provide all labor necessary to install, initialize, start-up and debug all system software as described in this section. This includes any operating system software or other third party software necessary for successful operation of the system.
- B. **Database Configuration:** Provide all labor to configure those portions of the database that are required by the points list and sequences of operation.
- C. **Status Reports:** Configure status reports for the owner including those listed below:
 - 1. Air handling units
 - 2. Exhaust fan
 - 3. Miscellaneous equipment and systems

- D. Documentation: As built software documentation shall include the following:
 - 1. Descriptive point lists
 - 2. Application program listing
 - 3. Application programs with comments
 - 4. Printouts of all reports
 - 5. Alarm list
- E. Alarms: All monitors or control functions identified by the Owner as a critical alarm shall be programmed to report to the hard copy printers in the security office and control room, with instructions for appropriate action. Coordinate verbage with Owner.
- F. Graphics: complete color graphics are required. See requirements in sequences following.

2.02

GRAPHICS

- A. Furnish custom color graphic of each system in this project. Graphic shall be unique to each system reflecting actual component makeup.
- B. Graphic representation shall allow a "point and click" format to access each controlled or monitored activity for readout, trending or adjustment.
- C. All point numbering of each system component shall include its location by room number, using the Architect's floor plan number system.

2.03

PORTABLE OPERATOR TERMINALS (POT)

- A. Provide two (2) Portable Operator Terminals to allow access to controller set points and analog values of the Terminal Controllers for the FPVAV/VAV Terminal Units.
- B. One POT shall be given to the owner and one shall be provided to the successful Testing & Balancing Contractor for his use in balancing the terminal units. (Subsequently, the Testing and Balancing Contractor shall turn over the POT to the owner's representative after completion of the balancing work.
- C. The POT may be connected into the Terminal Controller via a zone bus jack located in the space sensor, or at any equipment controller.

PART 3: EXECUTION

3.01 PARKING GARAGE EXHAUST SYSTEM CONTROL

- A. Provide a controller for the Garage exhaust fans to obtain the following sequences:
1. Start primary exhaust fans for each of the three (3) garage ventilation shafts. Each fan listed shall start and run continuously. Fan numbers are: EF-1, PG EF-5, and PG EF-9.
 2. Four zoned carbon monoxide monitors on each parking level shall stage on their respective secondary exhaust fan(s) upon sensing carbon monoxide. Fan numbers are EF-2, EF-3, EF-4, EF-6, EF-7, EF-8, EF-10, EF-11 and EF-12.
 3. FMS operator shall have control of all fans for manual start/stop.
 4. Carbon monoxide sensors shall sequence exhaust fans on/off as required to maintain acceptable carbon monoxide levels in garage (EF-2, 3, 4, 6, 7, 8, 10, 11 and 12).

3.02 PACKAGED TERMINAL AIR CONDITIONER CONTROL

- A. Units are located in the Garage Lobbies and Elevator Equipment Room.
- B. Unit manufacturer provided room sensor shall cycle supply fan and energize refrigeration circuit in sequence to maintain setpoint of 72°F.

3.03 CABINET UNIT HEATER CONTROL

- A. Unitary controller shall operate cabinet unit heaters.
- B. Line voltage thermostat shall cycle fan and energize electric heating coil to maintain at setpoint of 70°F.

3.04 PROPELLER UNIT HEATER CONTROL

Line voltage thermostat shall cycle fan and energize electric heating coil to maintain at setpoint of 70°F.

END OF SECTION

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SECTION 23 31 00

HVAC DUCTS AND CASINGS

PART 1: GENERAL

1.01 **WORK INCLUDED**

- A. Furnish and install equipment, specialties and accessories to provide ducted systems as shown on the drawings and herein specified.
- B. Systems in this section include:
 - 1. Exhaust air
- C. Ductwork shall be constructed to meet the following classification(s).
 - 1. Exhaust air: negative 2"W.G.

1.02 **RELATED WORK SPECIFIED ELSEWHERE**

- A. General Provisions: Section 23 05 01
- B. Assignment of Misc. Work: Section 23 05 02
- C. Testing, Adjusting and Balancing: Section 23 05 93
- D. Air Duct Accessories: Section 23 33 00

1.03 **COORDINATION**

- A. Provide coordination with all other trades in the routing of duct prior to installation. No extra compensation for ductwork offsets or routing changes will be allowed due to lack of coordination.
- B. Provide coordination with the project Air Balance Contractor in furnishing and locating all necessary balancing dampers to obtain a properly balanced system.
- C. Install all control dampers and air flow measuring stations furnished by the Temperature Control Contractor. **NOTE** that not all control dampers specified in the sequence of operations necessarily appear on the drawings.

1.04 REFERENCE MANUALS

- A. SMACNA - HVAC Duct Construction Standards, Metal and Flexible, second edition, 1995.
- B. ASHRAE Guide and Data Book, 2005 Fundamentals edition, Chapter on Air Duct Design.
- C. SMACNA HVAC Air Duct Leakage Test Manual

1.05 GENERAL REQUIREMENTS

- A. Ductwork shall be constructed of galvanized steel or aluminum as noted on the drawings.

1.06 SUBMITTALS

- A. Coordination Drawings are required on this project.
 - 1. Sheet metal fabrication drawings as defined below may be used. However, complete coordination with all other trades is required.
 - 2. No pay requests for installed work will be honored until fully coordinated drawings are accepted by the Owner.
- B. Fabrication Drawings
 - 1. Submit full set of duct fabrication drawings for each system for Engineer's approval prior to fabrication or installation. Refer to Specifications Section 23 05 01, General Provisions and Division 1 for submission requirements.
 - a. Drawings shall be prepared utilizing "Autocad". Contact the Architect to obtain generic floor plans on diskette. Engineers' drawings are not intended for use as sheet metal fabrication drawings.
 - b. Drawings shall be minimum scale of 1/4" = 1'-0" for floor plans. Include sections and elevations of all ductwork.
 - c. Include all joints, duct sizes, dampers, diffusers, air quantities, bottom elevations, etc. to reflect a complete and coordinated system layout.
 - d. Coordinate the routing with all other trades and the structural/architectural drawings during drawing development period. Detail all areas requiring close or critical coordination points on the drawings.
 - 2. Thoroughly review all construction documents to verify all routings, heights, and locations of all ductwork. Visit the jobsite and field verify all routings, heights, and locations. Notify the Engineer of any conflicts and proposed coordinated solutions.

3. For remodeled areas the Sheet metal Contractor shall visit the jobsite and field verify all routings, heights, and locations of all ductwork prior to duct fabrication. Notify the Engineer of any conflicts.
4. Completed drawings shall be submitted to General Contractor, Sprinkler Contractor, Mechanical Contractor, Temperature Control Contractor, and Electrical Contractor for their coordination and impact to the final duct layouts. Prepare any drawing corrections required to obtain a coordinated layout. Provide sufficient sets of drawings for distribution.
5. Submit duct fabrication drawings to the Balancing Contractor for that contractor's review and comments before such drawings are submitted for approval.
6. Review and coordinate locations of all controlled dampers with the Temperature Control Contractor for installation criteria.
7. A record diskette of the final "as built" drawings shall be submitted to the Engineer at project completion.

PART 2: PRODUCTS

2.01 RECTANGULAR AND ROUND DUCT

- A. Construct duct of first quality materials in strict accordance with the SMACNA HVAC Duct Construction Standards Manual, Second Edition - 1995, for pressure classification specified herein, unless a more stringent requirement is specified herein.
- B. Duct sizes 19" wide and larger, which have more than 10 square feet of unbraced panels shall be cross broken, unless ducts are noted to be internally lined. This requirement is applicable to 20 gauge or less thickness and 3" W.G. or less.
- C. Fittings
 1. Elbows (30" wide and less): use standard radius elbow. Inside radius shall be same as width of duct, unless specifically noted otherwise on the drawings.
 2. Elbows greater than (31" wide): use radius elbow where shown on drawings with inside radius the same as the duct width. Otherwise use square elbows with turning vanes. Elbows less than 36" wide shall have single bladed vanes. Elbows 36" and over shall have double blade vanes in airfoil pattern.
 3. Main tee connections
 - a. Rectangular to rectangular: radius or 45° inlet
 - b. Round to rectangular: conical connection
 4. Branch tee connections: 45° tap in. Provide balancing damper in branch duct to diffuser or grille.
 5. Transitions, raises and drops: built so that change in direction does not exceed 20° angle measured at centerline of air flow.

2.02 FLEXIBLE CONNECTIONS

Provide flexible connections at each inlet and outlet duct connection to every piece of fan equipment. Fabric fastened to metal with double lock seam. Fabric for ordinary heating, ventilating and air conditioning uses to be waterproof, fire retardant and suitable for temperature of 200°F.

PART 3: EXECUTION

3.01 GENERAL REQUIREMENTS

- A. All duct dimensions shown on the drawings are inside dimensions, including ducts insulated on inside.
- B. All ductwork shall be installed tight to walls, partitions or underside of the structure except where specific elevations are noted on the plans. Provide offsets to accomplish this and to avoid conflicts with other trades. Provide coordination with electrical, plumbing and sprinkler contractors prior to and during fabrication drawing period. No extra compensation from the Owner or Engineer will be approved for duct sizing and routing revisions required for structural or coordination purposes.
- C. Support ducts suspended from floor and roof structural members with band type hangers if maximum width is 47" or less and with trapeze type hangers if 48" and over. Do not support main ducts from roof decking. Hanger rods shall be minimum of 3/8".
- D. Duct support spacing shall comply with local seismic requirements and in accordance with SMACNA, but in no case greater than 6'-0" O.C.
- E. Furnish, locate and set suitable sleeves and trim flanges where ducts pass through walls.
- F. Install duct heating coils furnished by others. Verify exact coil size with supplier. Provide transition sections, if required.
- G. Install dampers for automatic control furnished by others. Verify the exact damper size with supplier.
- H. Provide for maintenance access to VAV terminal units, fire dampers, coils, control dampers, damper operators, filters, balancing dampers, etc.

- I. All ductwork at 7'-0" or below above floor, plus any ductwork which may come near ladders or walkways shall have flattened seams. In addition, this ductwork shall have no protrusions or sharp edges.
- J. Contractor to include all balancing dampers as shown on drawings and as required by the Balancing Contractor to obtain proper flow and noise requirements. Contractor to insure accessibility to all balancing dampers.

3.02 DUCT SEALING REQUIREMENTS

- A. All primary supply air ductwork from VAV air handling units in pressure classification 3" W.G. shall be sealed to SMACNA Seal Class A: all transverse joints, longitudinal seams, and duct wall penetrations.
- B. All exhaust ducts and branch supply ducts that are exposed within the conditioned space they serve, may be sealed to SMACNA seal Class C: transverse joints only.
- C. Neatly caulk all joints, slips and keys to insure an absolutely tight system, suitable to the pressure classification specified.

3.03 DUCTWORK EXPOSED TO VIEW IN OCCUPIED SPACES

- A. Exposed ductwork shall be installed in a neat workmanlike manner. Refer to the mechanical, architectural and structural plans, elevations and sections for routing and heights. A final coordinated, neat appearance is of utmost importance.
- B. Do not initially place, or remove if placed, duct shop labels. Duct shall be free of adhesive.
- C. Provide support cables and fasteners in a manner which is unobtrusive.
 - 1. Use stainless steel cables to support ductwork with single point connection where approved by SMACNA. Otherwise use dual cables. Cables shall attach to full perimeter sheet metal bands.
 - 2. Review support means and spacing with Architect and Engineer prior to fabrication and installation.
 - 3. Duct support spacing shall be coordinated with structural spacing, and be of a consistent spacing in the room or area.
- D. Repair or replace duct sections containing indentures as required by the Architect or Engineer.
- E. Final duct installation shall be cleaned and free of grime, grease or dust suitable for field painting.

- F. Furnish, locate and set suitable sleeves and framed openings where ducts pass through floors, walls and other concrete or masonry materials. Provide trim rings at wall penetrations.
- G. All branch ducts or collars for termination with grilles or diffusers shall be sized to match the outside dimension of the grille flange. Allow for this duct size when ordering balancing dampers.
- H. On galvanized steel ductwork, where galvanizing has been eradicated, it shall be sanded and painted with a 2 mil base coat of Carboline Co. Rust Bond Primer 36C, a second 2 mil coat of Carboline Polyclad #9.33-1 and a third coat same as second coat.

3.04

PROTECTION DURING CONSTRUCTION

- A. Ductwork delivered to the site and stored/staged prior to installation shall be placed in a dry location, and set on skids, etc. Cover ductwork subject to dirt, mud, dust, weather or building leaks.
- B. Schedule a field inspection with the Engineer, Construction Manager or Superintendent for all ducts delivered to the site having an interior liner for observation of liner attachment and sealants.
- C. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- D. When fans are running, filters must be in place and maintained.
- E. Ductwork which becomes dirty during the construction period shall be externally and internally cleaned prior to system startup and acceptance.

3.05

COMPLETION REQUIREMENTS

Contractor shall neatly caulk all joints to insure an absolutely tight system. Neatly tape off straight edge lines on duct perimeter prior to applying sealant. Remove tape and trim excess caulking. Clean all exterior surfaces.

END OF SECTION

SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1: GENERAL

1.01 WORK INCLUDED

- A. Provide duct system accessories as shown on drawings and as specified herein.
- B. Accessories shall be constructed of the same material as the duct system served.
- C. Accessories included:
 - 1. Volume dampers
 - 2. Balancing dampers
 - 3. Access doors
 - 4. Test holes
 - 5. Turning vanes

1.02 ALLOWANCES

Provide ten (10) access doors of various sizes beyond the quantity defined in the documents. Installation shall be where instructed by the Engineer.

1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. General Provisions: Section 23 05 01
- B. Testing, Adjusting and Balancing: Section 23 05 93
- C. HVAC Ducts and Casings: Section 23 31 00

1.04 REFERENCE MANUALS

- A. SMACNA - HVAC Duct Construction Standards, Metal and Flexible, second edition, 1995.
- B. ASHRAE Guide and Data Book, 2005 Fundamentals edition, Chapter on Air Duct Design.
- C. SMACNA HVAC Air Duct Leakage Test Manual

1.05 SUBMITTALS

Submit shop drawings on all accessories per Specifications Section 23 05 01, General Provisions.

PART 2: PRODUCTS

2.01 VOLUME DAMPERS

- A. Furnish and install opposed blade dampers where shown on drawings.
- B. Damper blade construction to be minimum 16-gauge die formed, galvanized steel. Shaft shall be steel with brass or nylon, bronze oilite bearings. Blades shall not exceed 6" wide and 48" long. Frames shall be minimum 16-gauge, die formed, welded channel.
- C. Damper Operators: volume dampers to have external, lock type damper operator and linkage as best suits construction and access conditions. Operators to be provided with locking damper quadrants complete with locking nuts and graduated scale.
- D. Operators to have standoff for thickness of insulation.
- E. Design Base:
 - Low Pressure Rectangular: AWV Model VC-31
 - Low Pressure Round: AWV Model VC-24
 - Medium Pressure Rectangular: AWV Model DAA-P-3274
- F. Manufacturers
 - 1. American Warming and Ventilating, Inc.
 - 2. Ruskin
 - 3. Cesco
 - 4. Arrow
 - 5. Louvers & Dampers, Inc.
 - 6. Nailor Industries
 - 7. Greenheck

2.02 BALANCING DAMPERS (RECTANGULAR)

- A. Furnish and install in each branch takeoff to diffusers or grilles and where shown on drawings.
- B. Dampers to be opposed blade.
- C. Damper blade construction to be minimum 16-gauge die formed, galvanized steel. Shaft shall be steel with brass or nylon, bronze oilite bearings. Blades shall not exceed 6" wide and 48" long. Frames shall be minimum 16-gauge galvanized, die formed, welded channel.
- D. Damper Operators: balancing dampers to have external, lock type damper operator and linkage as best suits construction and access conditions. Operators to be provided with locking damper quadrants complete with locking nuts and graduated scale.
- E. Operators to have standoff for thickness of insulation.
- F. Manufacturers
 - 1. Ruskin Model #MD35
 - 2. Cesco-Advanced Air #CDS-OB
 - 3. Arrow #1772-OB
 - 4. Louvers & Dampers, Inc. #CD-400
 - 5. AWW #VC-21
 - 6. Nailor Industries
 - 7. Greenheck

2.03 COUNTERBALANCED BACKDRAFT DAMPERS

- A. Furnish and install counterbalanced type automatic backdraft dampers where shown on the drawings.
- B. Dampers assembly shall be heavy duty construction
 - 1. Frame shall be extruded aluminum with minimum wall thickness of .125".
 - 2. Blades shall be extruded aluminum with minimum wall thickness of .070". Blades shall be equipped with vinyl edge seals. Blades shall be linked with aluminum tie bars.
- C. Counterbalance shall be provided on each blade and shall be field adjustable. Damper shall be suitable for relieving at .02 inches w.g. and above.

- D. Operators to have standoff for thickness of insulation.
- E. Manufacturers
 - 1. Ruskin Model #CBD6
 - 2. Nailor Industries
 - 3. Greenheck
 - 4. Or approved equal.

2.04 DUCT ACCESS DOORS (A.D.)

- A. Furnish and install access door at each fire damper, temperature control/motorized damper, upstream of duct mounted coils, and at air flow measuring stations. Coordinate with wall access door locations needed for shafts with the General Contractor.
- B. Construction: double wall 24 gauge galvanized steel or aluminum (same construction as duct) with 1" fiberglass insulation, 1-1/2 lb./cu.ft. density between door and door liner.
- C. Polyurethane rubber or neoprene gasketing to be on inside of door frame and between duct and door frame. Door metals to be of sufficient gauge for minimizing leakage at various duct pressures. Provide continuous hinges and minimum of two handle type latches. Unhinged access panels are acceptable only where obstructions inhibit door swing.
- D. Access doors shall be 24" x 24" unless duct size is smaller. Access doors for ducts smaller than 24" shall be 2" less than duct size in length and 24" in width.
- E. Manufacturers
 - 1. Ruskin Type #ADH-2
 - 2. Duro-Dyne Type #1AD
 - 3. Curb

2.05 TEST HOLES

- A. Test holes shall be provided before and after coils, filters, mixing plenums and main duct traverse points.
- B. Manufacturer: Duro-Dyne Model TH-1 #8036

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2.06 TURNING VANES

- A. Turning vanes (single vane) shall be utilized in low pressure duct with velocities less than 1500 FPM, constructed with 1" trailing edge and spaced as called for in Figures 2-3 and 2-4 of SMACNA HVAC Duct Construction Standards - 1st Edition.
- B. Turning vanes (double vane airfoil profile) shall be utilized in ducts with velocities exceeding 1500 FPM, constructed with 1" trailing edge and spaced as called for in Figures 2-3 and 2-4 of SMACNA HVAC Duct Construction Standards - 1st Edition.
- C. Where shown on drawings, install vanes in short radius elbows as detailed in Figures 2-5 and 2-6 of SMACNA HVAC Duct Construction Standards - 1st Edition.

PART 3: EXECUTION
NOT USED

END OF SECTION

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SECTION 23 34 00

HVAC FANS

PART 1: GENERAL

1.01 **WORK INCLUDED**

- A. Furnish and install fans as scheduled on the drawings and specified herein.
- B. The fan types used on this project are:
 - 1. Inline Axial Fan

1.02 **DESIGN BASE**

- A. The construction drawings indicate a system based on the information available to Engineer by a selected manufacturer of equipment. Electrical services, size, configuration and space allocations are consistent with that manufacturer's information.
- B. This manufacturer and other listed or approved manufacturers are encouraged to provide equipment on this project; however, it shall be the Contractor and/or Supplier's responsibility to assure the equipment is consistent with the design base. No extra compensation will be approved for revisions required by the manufacturer for any different services, space, clearances, etc.

1.03 **COORDINATION**

- A. Provide coordination with the project Air Balance Contractor in the final balance of the fans.
- B. Fan Speed Adjustment: external resistance (static pressure loss) for each fan system has been estimated and noted on the drawings. Fan speed and fan to motor drive will be selected based on this estimated static pressure loss. The static pressure loss is an estimate; actual loss of completed system may vary above or below estimate. Mechanical Contractor shall change pulleys or sheaves, as required, to suit actual job conditions at no additional cost to the Owner. Refer to Specifications Section 23 05 93, Testing, Adjusting and Balancing, for other requirements.
- C. Should corrective work be required after the initial balance, the Mechanical Contractor shall reimburse the Balancing Contractor for re-balancing. Refer to Specifications Section 23 05 93, Testing, Adjusting and Balancing.

1.04 QUALITY ASSURANCE

Fans shall bear AMCA Certified Ratings Seal for both air and sound performance.

1.05 RELATED WORK SPECIFIED ELSEWHERE

- A. Completion and Startup: Section 23 01 70
- B. General Provisions: Section 23 05 01
- C. Assignment of Misc. Work: Section 23 05 02
- D. Common Motor Requirements: Section 23 05 13
- E. Electrical: Division 26

1.06 SUBMITTALS

- A. Submit shop drawings for each fan to be furnished on this project in accordance with Specifications Section 23 05 01, General Provisions.
- B. Submittals shall include fan curve (graphic) for each fan with the design conditions plotted. (Tables are not acceptable). Forward a copy of each fan curve to the project Balancing Contractor.
- C. Submit installation instructions, parts lists and operation/maintenance data for each fan size and type.

PART 2: PRODUCTS

2 01 INLINE AXIAL FAN

- A. Housing for fans shall be of 14-gauge steel minimum and shall have:
 - 1. Square mounting frame of heavy steel angle to provide for mounting of fan.
 - 2. All steel parts cleaned, conditioned and coated with two coats of enamel primer finish.
 - 3. Hydraulically expanded or spun housing section at wheel raceway to maintain precise tolerance.
 - 4. Diffuser section for stable, spiral free discharge.
 - 5. Flanged connections at both inlet and outlet.
 - 6. Access door in housing.
 - 7. Inlet vanes

- B. Fan wheels shall be axial flow type with cast aluminum blades or tubular centrifugal type constructed of welded steel and have:
1. Airfoil shaped blades.
 2. Dynamic balance for smooth operation.
 3. AISI-C1040 solid steel shaft keyed to the fan wheel.
 4. Grease lubricated bearings selected for a minimum averaging life in excess of 400,000 hours at maximum catalogued operating conditions. Grease lines shall extend to exterior of housing.
- C. Motors
1. Each fan motor shall be sized to drive the fan taking into account belt losses where applicable. (Use three percent to account for belt losses.) Whenever starting requirements exceed operating requirements, the motor shall be large enough to start the fan without overheating.
 2. No motor shall operate within the service factor range. Where necessary to provide practical drive ratios for low fan rpm, a 1200 rpm motor shall be used.
 3. Motors shall be mounted on an adjustable mount furnished with the fan. Motors shall be high efficiency type as specified in Section 23 05 13, Common Motor Requirements.
 4. Drives
 - a. Fans shall have belt drives selected for 1.5 MHP service factor.
 - b. Centerline distances shall not exceed three times the sum of the sheave diameters nor be less than the diameter of the larger sheave.
 - c. Sheaves shall be as large as the minimum sizes recommended for each belt section as adopted by Mechanical Power Transmission Association and Rubber Manufacturers Association. The motor sheave shall meet the minimum diameter and maximum width in accordance with NEMA Standard MG1-14.41a.
 - d. Belt speeds shall be between 1000 and 6000 feet per minute. Sheaves shall be dynamically balanced when speed exceeds 5000 feet per minute.
 - e. The area of belt contact on the smaller sheave shall not be less than 120 degree angle.
 - f. Adjustable pitch drives with four grooves or more shall have companion sheaves.

- D. Isolation shall be provided as follows:
 - 1. Arrangement 1, Class I and II - integral steel base.
 - 2. Fans shall have thrust restraints where necessary to prevent excessive movement on startup.

- E. Manufacturers
 - 1. Trane
 - 2. Greenheck Type TBI-CA
 - 3. Loren Cook
 - 4. ACME

PART 3: EXECUTION

3.01 **GENERAL INSTALLATION REQUIREMENTS**

- A. Refer to drawings for location, size, capacity, mounting arrangement, and electrical characteristics for fans.

- B. All fans shall be installed, aligned, lubricated, started and balanced all in accordance with the manufacturer's published instructions.

- C. Maintain the cleanliness of the fans throughout the construction period, internally and externally. At completion, clean and restore the fans to new condition.

- D. Single speed motor starters shall be furnished by Electrical Contractor. Coordinate electrical characteristics with Electrical Contractor.

- E. Fans shall be installed with vibration isolators (where suspended from or supported on structure) and leveled.

- F. Provide a roof curb of the same manufacturer as the fan. Refer to Specifications Section 23 05 30, Prefabricated Curbs and Equipment Supports, for requirements.

3.02 **STARTERS**

- A. Provide starters for exhaust fans scheduled.

- B. Starters shall comply with requirements of Division 26 of the Specifications.

END OF SECTION

SECTION 23 81 00

PACKAGED HEATING AND COOLING UNITS

PART 1: **GENERAL**

1.01 **WORK INCLUDED**

- A. Furnish and install equipment and accessories to provide complete packaged heating and cooling units as shown on the drawings and herein specified.
- B. Furnish and install temperature controls as specified herein.
- C. Equipment includes:
 - 1. Packaged Terminal Air Conditioner (through the wall)
 - 2. Split System Ductless Heat Pump Unit

1.02 **DESIGN BASE**

- A. The construction drawings indicate a system based on the information available to engineer by a selected manufacturer of equipment and the design data available to the Engineer during construction document preparation. Electrical services, size, configuration and space allocations shall be confirmed with the manufacturer's information.
- B. This manufacturer and other listed or approved manufacturers are encouraged to provide equipment on this project; however, it shall be the Contractor and Supplier's responsibility to assure the equipment is consistent with the design base. No extra compensation will be approved for revisions required by the design base manufacturer or the manufacturer for any different services, space, clearances, etc.

1.03 **COORDINATION**

- A. Provide coordination with the project Air Balance Contractor in the final balance of the fans.

- B. Fan Speed Adjustment: external resistance (static pressure loss) for each fan system has been estimated and noted on the drawings. Fan speed and fan to motor drive will be selected based on this estimated static pressure loss. The static pressure loss is an estimate; actual loss of completed system may vary above or below estimate. Mechanical Contractor shall change pulleys or sheaves, as required, to suit actual job conditions at no additional cost to the Owner. Refer to Specification Section 23 05 93, Testing, Adjusting and Balancing, for other requirements.
- C. Should corrective work be required after the initial balance, the Mechanical Contractor shall reimburse the Balancing Contractor for rebalancing. Refer to Specification Section 23 05 93, Testing, Adjusting and Balancing, Item 1.08F.

1.04

DEFINITIONS AND MINIMUM PERFORMANCE STANDARDS

- A. SEER (Seasonal Energy Efficiency Ratio): All equipment listed herein is required to have minimum SEER rating as specified and certified to ARI in accordance with ARI Standard 210.81.
- B. HSPF (Heating Seasonal Performance Factor): All equipment listed herein is required to have HSPF ratings as specified and certified to ARI in accordance with ARI Standard 240.81.
- C. COP (Coefficient of Performance) Heating
 - 1. The ratio of the rate of net heat output to the rate of total energy input, expressed in consistent units and under designated rated conditions.
 - a. The rate of net heat output shall be defined as the change in the total heat content of the air entering and leaving the equipment (not including supplementary heater).
 - b. Total energy input shall be determined by combining the energy inputs to all elements (except supplementary heaters) of the heat pump including, but not limited to, compressors, pumps, supply air fans and the HVAC system equipment control circuit.
 - 2. Supplementary Heater: The heat pump shall be installed with a control to prevent supplementary heater operation when the heating load can be met by the heat pump alone.
 - a. Supplementary heater operation is permitted during transient periods such as startups, following room thermostat set point advance and during defrost.

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- b. A two-stage thermostat, which controls the supplementary heat on its second stage, shall be accepted as meeting this requirement. The cut on temperature for the compression heating shall be higher than the cut off temperature for the supplementary heat and the cut off temperature for the compression heating shall be higher than the cut off temperature for the supplementary heat.
- 3. The minimum COP for heat pumps during the heating mode shall be as follows:
 - a. Outdoor temperature 47°F db/ 43°F wb: COP 2.2
 - b. Outdoor temperature 17°F db/ 15°F wb: COP 1.2
(based on air entering evaporator: 70° db)

1.05 RELATED WORK SPECIFIED ELSEWHERE

- A. Completion and Startup: Section 23 01 70
- B. General Provisions: Section 23 05 01
- C. Testing, Adjusting and Balancing: Section 23 05 93
- D. Common Motor Requirements: Section 23 05 13
- E. Prefabricated Curbs and Equipment Supports: Section 23 05 30
- F. Raceways and Boxes for Electrical Systems: Section 26 05 33
- G. Wiring Devices: Section 26 27 26

1.06 SUBMITTALS

- A. Submit shop drawings on each unit specified herein in accordance with Specifications Section 23 05 01, General Provisions.
- B. Submit shop drawings for each thermostat type specified herein in accordance with Specification Section 23 0501, General Provisions.

PART 2: **PRODUCTS**

2.01 **PACKAGE TERMINAL AIR CONDITIONER (THROUGH THE WALL)**

- A. Cabinet and Finish: Sleeve and unit chassis shall be 18 gauge, phosphatized, galvanized steel. Exterior parts shall be hot dipped, zinc coated. Bulkhead shall be insulated to resist thermal heat transfer and transmission of noise and vibration. For complete coverage of concealed surfaces, the entire chassis shall be primed and painted as an assembly. Paint shall be electrically bonded to the metal and baked on.
- B. Discharge: indoor section shall have adjustable front discharge. Condenser section shall have combination inlet and discharge grille.
- C. Sound Power Levels: The sound power levels (10^{12} watts) generated on high heat and high coil shall not exceed NC38. Sound measurements for determination of sound power levels shall be based on ASHRAE reference sound source calibration measured in a sound laboratory reverberant room conforming to ASHRAE Standard 36-B63.
- D. Controls:
 - 1. Pushbutton controls shall provide the following functions:
 - a. Off: turn unit off
 - b. Fan only: Indoor fan operates at medium speed
 - c. Hi Cool: provides cooling with high speed indoor fan
 - d. Lo Cool: provides cooling with medium speed indoor fan
 - 2. Unit mounted thermostat shall sense air dry bulb temperature at the fan inlet with a remote sensing bulb and shall be adjustable.
 - 3. All controls shall be hidden behind a hinged control panel cover.
- E. Refrigeration System: Compressor shall be fully hermetic, type, internally isolated within a steel shell, and externally isolated on combination spring and rubber isolators to ensure elimination of compressor sound and vibration. Tubing connections to compressor shall be looped to further isolate vibration. An expansion valve shall be used to protect against coil freeze up and to maintain operating efficiency at low outdoor temperatures, ensuring uniform refrigerant flow. Coils shall be seamless copper tubing mechanically expanded into configured aluminum plate fins. Coils shall be tested at 600 psi and final tested electrically, on cooling operation, condensate shall be evaporated from outdoor coil.

- F. Motor shall be high efficiency, permanent split capacitor (psc) type.
- G. Exterior Grille: Provide an anodized aluminum horizontal louver-type grille (architectural).
- H. Manufacturers:
 - 1. GE Zoneline
 - 2. Trane

2.02 SPLIT SYSTEM DUCTLESS HEAT PUMP UNIT

- A. Casings: panels shall be constructed of heavy gauge steel, cleaned, phosphatized and coated with epoxy primer (exterior surface) and shall be finished with baked enamel, suitable for floor mounting or horizontal mounting exposed indoors.
- B. Condensing unit with specified evaporator coil shall have minimum SEER of 17 and HSPF of 8.2 at the scheduled operating conditions.
- C. Compressor: hermetically sealed, high efficiency heat pump compressor with special lubrication system, bearing surfaces and motor insulation. Internal over current, over temperature and over pressure protection. Provide crankcase heater.
- D. Refrigerant and Circuit: Complete factory operating charge of R-410A refrigerant in both indoor and outdoor coils. High capacity solenoid activated reversing valve for mode control.
- E. Condenser Coil: Specifically designed aluminum fin surface mechanically bonded to stagger row aluminum or copper tubing to facilitate defrost water runoff. Condenser coil shall be protected by a heavy duty grille.
- F. Evaporator Air Coil: Large die formed aluminum fin surface mechanically bonded to multi row aluminum or copper tubing for high heat transfer efficiency.
- G. Condenser Fan: high capacity direct drive propeller fan configured for draw through outdoor air flow.
- H. Unit circuit breaker: all single phase outdoor units shall contain an internal unit circuit breaker to facilitate field wiring and reduce installation time. Provide complete internal wiring.

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Comm. No. 07098

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- I. Defrost Control: temperature differential demand activated defrost system. To initiate defrost, the system shall compare the temperature difference between the outdoor temperature and outdoor fin surface temperature to assess outdoor coil heat transfer capacity. Solid state comparator and defrost logic circuitry shall activate reverse cycle defrost upon demand to eliminate unnecessary defrost cycling.
- J. Evaporator Fan: Direct drive, three speed full width centrifugal blower.
- K. Controls: self contained micro-computer integral with each indoor evaporator unit. Options from face to include: fan speed, temperature, timer, auto-heat-cool-fan. Each unit shall be capable of automatic changeover from heating to cooling.
- L. Manufacturers: Sanyo or Mitsubishi

PART 3: **EXECUTION**

3.01 **GENERAL REQUIREMENTS**

- A. Location, size, capacity, mounting arrangement and electrical characteristics for equipment shall be as shown and scheduled on the drawings.
- B. Clean and lubricate all equipment.
- C. Motor starter for all motors shall be furnished by unit manufacturer.
- D. Unit shall be mounted level.
- E. Control wiring shall be provided as follows:
 - 1. Conduit between air cooled condensing units and respective air handlers shall be provided by Electrical Contractor.
 - 2. Control wiring between air cooled condensing units and respective air handling units shall be provided by Electrical Contractor. Final connections by Mechanical Contractor.
 - 3. Control wiring and conduit to all remote thermostats and ancillary controls shall be provided by Electrical Contractor. Final connections by Mechanical Contractor.
 - 4. Notify Electrical Contractor of wire sizes and quantities.

END OF SECTION

SECTION 26 05 01

GENERAL PROVISIONS

PART 1: GENERAL

1.01 SUMMARY OF WORK

- A. The requirements of the General Conditions, General Requirements, Special Conditions, Instructions to Bidders, Contract Documents and other information bound herewith form a part of and shall govern all work performed under these specifications.
- B. The accompanying electrical drawings are issued as part of this specification. Any requirements shown thereon are equally affective as if included in this specification. Any omissions in the specification or on the drawings are not to be a basis for failure on the part of the Contractor, from installing electrical components required by the systems to operate in the intended manner. Should any work be called for on the drawings, specifications or in the codes, in such a manner that the Contractor cannot, in his judgment, comply with the requirements, then the Contractor shall bring the matter to the attention of the Engineer before proceeding with the work.
- C. The Contractor shall receive, unload, store, protect and install all electrical equipment whether supplied by the Contractor or by others. Equipment furnished by others and received prior to the start of work by the Contractor will be unloaded and stored by others. During the progress of the work, the Contractor shall load and transport such material and equipment to the job site as required. The Contractor shall keep all stored materials clean and protected from the weather.
- D. The Contractor shall be responsible for complete assembly and wiring of all equipment which is purchased disassembled or disassembled for shipping purposes.
- E. Work includes the installation of equipment, conduit and wire and components for complete and operable systems.
- F. General Narrative Description of the Electrical Systems
 - 1. Provide power distribution system (480/270 volt, 3 phase, 4 wire) from utility owned pad mounted transformer to distribution equipment within the Parking Structure to serve lighting and elevator equipment. Transform voltage down to 208/120 volt, 3 phase, 4 wire for branch wiring devices.
 - 2. Lighting: garage lighting will consist mainly of metal halide type fixtures pendant mounted and pole mounted for the top of deck.
 - 3. Conduit Infrastructure: provide conduit and rough-in for security system and devices.
 - 4. Fire alarm: provide devices for elevator recall and sprinkler system.

1.02 DEFINITIONS AND TERMS USED IN THE DIVISION 26 SPECIFICATIONS AND ELECTRICAL DRAWINGS

- A. The word "Owner" shall mean the party mentioned in the prime contract agreement, or any representative of his party duly authorized to act in his behalf in the execution of the work.
- B. The word "Contractor" shall mean the person, firm or corporation entering into a contract to construct and complete the work as specified herein.
- C. The word "Engineer" shall mean Circle Design Group, Inc. and their representatives assigned to this project.
- D. The word "Architect" shall mean Looney Ricks Kiss and their representative acting as the Owner's appointed agent.
- E. The word "furnish" or "supply" shall mean to purchase and deliver to project site, ready for unloading, unpacking, assembly, installation and similar subsequent requirements.
- F. The word "install" shall mean operations at the project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar requirements.
- G. The word "provide" shall mean to furnish and install complete and ready for intended use.

1.03 CODES, FEES AND MISCELLANEOUS COSTS

- A. All materials and workmanship shall comply with all applicable codes, specifications, local ordinances, industry standards and utility company regulations.
- B. In cases of difference between building codes, specifications, state laws, local ordinances, industry standards and utility company regulations and the Contract Documents, the most stringent shall govern. The Contractor shall promptly notify the Engineer in writing of any such differences.
- C. Non-Compliance: Should the Contractor perform any work that does not comply with requirements of applicable building codes, state laws, local ordinances, industry standards and utility company regulations, he shall bear all costs arising for correction of non-complying items.

D. Applicable Codes and Standards shall include all state laws, local ordinances, utility company regulations and applicable requirements of following nationally accepted codes and standards. These requirements are to be considered minimum and are to be exceeded when so indicated on the drawings or herein specified.

1. Governing Agencies
 - a. Fire Prevention and Building Safety Commission
 - b. Indiana Department of Health
2. Applicable Codes
 - a. Indiana Building Code (IBC), 2003, consisting of:
 - (1) International Building Code, 2000
 - (2) Indiana Amendments
 - b. Indiana Electrical Code (IEC), 2005, consisting of:
 - (1) NFPA 70, National Electrical Code, 2005
 - (2) Indiana Amendments
 - c. Indiana Mechanical Code (IMC) 2003 consisting of:
 - (1) International Mechanical Code 2000
 - (2) Indiana Amendments
 - d. Indiana Plumbing Code (IPC), 1999, consisting of:
 - (1) Uniform Plumbing Code, 1997
 - (2) Indiana Amendments
 - e. Indiana Energy Conservation Code (IECC), consisting of:
 - (1) CABO Model Energy Code, 1992
 - (2) Indiana Amendments
 - f. Indiana Elevator Safety Code 2002 Edition 675 IAC21 (SCEEMH21)
 - g. Indiana Fire Code (IFC), 2003, consisting of:
 - (1) International Fire Code, 2000
 - (2) Indiana Amendments
3. Standards
 - a. ASTM: American Society of Testing Materials
 - b. ANSI: American National Standards Institute
 - c. AMCA: Air Moving and Conditioning Association
 - d. ASME: American Society of Mechanical Engineers
 - e. ASHRAE: American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
 - f. NEC: National Electric Code
 - g. NECA: National Electrical Contractors Association
 - h. NEIS: National Electrical Installation Standards
 - i. NEMA: National Electrical Manufacturers Association
 - j. NFPA: National Fire Protection Association

- k. OSHA: Occupational Safety and Health Act
- l. SMACNA Sheet Metal & Air Conditioning Contractors Assn.
- m. UL: Underwriters Laboratories
- n. ADAAG: Americans with Disabilities Act Accessibility Guidelines

- E. The Contractor shall be responsible for obtaining all permits, payment of all fees, necessary drawings and arranging and paying for all inspections, tests, etc. which may be required by any governing authority or utility company in connection with the furnishing or installation of any of his work.

1.04 WORK AND WORKMANSHIP

- A. All materials and equipment shall be of the highest quality in every respect. All materials and equipment shall be new and of the latest design and free of defects.
- B. Workmanship shall be by skilled workmen of highest standard in strict accordance with all applicable manufacturers' printed specification (which, by reference, are made completely a part of these specifications as though herein repeated), performed under supervision of competent foremen at all times.
- C. The Owner has full power to condemn or reject any work, materials or equipment not in accordance with these specifications and construction drawings or are not in compliance with the manufacturers' specifications or drawings which were approved by the Owner or Engineer.
- D. Work or equipment that is rejected shall be removed and replaced to the satisfaction of the Owner, at the Contractor's expense. Work or equipment that is rejected shall be so stated in writing by the Owner or Engineer.
- E. Such decisions that the Owner or Engineer may make with respect to questions concerning the quality, fitness of materials, equipment and workmanship shall be binding upon the parties thereto.
- F. Special attention shall be given to accessibility of working parts and controlling parts. Adjustable parts shall be within easy reach. Removable parts shall have space for removal.

1.05 DEVIATIONS FROM DRAWINGS

- A. Electrical drawings show the intended arrangement and routing of all piping, equipment and appurtenances. They shall be followed as closely as actual building construction and work of other trades will permit.

- B. The Contractor shall investigate structural and finish conditions affecting his work and shall coordinate his work accordingly. Provide any such fittings, offsets and accessories which may be required by such conditions.
- C. Adjustments as a result of coordination or for reasons to improve performance, etc. may be made upon receiving the approval of the Engineer. The Contractor shall document that the adjustment has been coordinated with all parties concerned.

1.06 OCCUPATIONAL SAFETY AND HEALTH ACT

All work shall comply with the current requirements of the U.S. Department of Labor Occupational Safety and Health Administration, entitled Occupational Safety and Health Standards; National Consensus Standards and Established Federal Standards.

1.07 COORDINATION BETWEEN CONTRACTORS

- A. The Contractor and his Subcontractors shall study all drawings and specifications for this project so that complete coordination between trades will be effected. Special attention shall be given to points where ducts cross other ducts, piping or telephone cables, where lights fit into ceilings and where pipe, ducts and conduit pass through walls and structural elements.
- B. It is the responsibility of the Contractor and his Subcontractors to leave necessary room for other trades. No extra compensation will be allowed to cover the cost of removing piping, conduit, ducts or equipment found encroaching on space required by others.
- C. The Contractor shall review the electrical requirements of the final equipment selections to ensure such items receive proper electrical services or connections.
- D. The Contractor shall provide complete information and cooperation to the other Contractors and trades pertaining to his work to accomplish coordination of the complete project.
- E. The Contractor shall coordinate with the General Contractor in providing the necessary sleeved openings, excavations, etc. Cutting and patching shall be held to a minimum.
- F. The Contractor and his Subcontractor shall be required to attend the periodic progress meetings to accomplish coordination with the Owner, Architect and Engineer.

PART 2: PRODUCTS

2.01 PRODUCT AND MATERIAL APPROVAL

- A. A specification followed by one or more manufacturers is limited to those manufacturers. Names of other proposed manufacturers may be submitted for approval to the Engineer a minimum of ten (10) days prior to receiving bids. Approval will be granted only if issued by Addendum (no exceptions).
- B. A specification followed by one or more manufacturers and "or approved equal" is open to equal products or materials. However, the Contractor shall supply one of the listed manufacturers at no additional cost if Engineer determines substituted product unsatisfactory.
- C. Any substituted equipment offered for consideration shall be stated as a separate item with the bid. State any additive or deductive cost.
- D. If changes in conduit, wiring, equipment layout or electrical service are brought about by the use of equipment which is not compatible with the layout shown on the drawings, the Contractor shall include the cost of the necessary changes in his bid.

2.02 SUBCONTRACTORS AND MATERIAL LIST

- A. The Contractor shall submit, with his bid, a fully completed list of subcontractors, manufacturers and suppliers of each item listed. No substitutions will be allowed, by the Contractor, after award of contract.
- B. Failure to submit a fully completed list within the stated time will be cause to reject the bid.
- C. Remove or copy the following list and attach it to the bid form.

2.03 LIST FOR ELECTRICAL CONTRACTOR: _____
The Contractor

- A. Sub-Contractors SUBCONTRACTORS AND MATERIALS
 Fire Alarm Subcontractors _____
 Tele-Comm _____
 Trench/Backfill/Compact
 Subcontractors _____
 Testing Subcontractors _____

B. Material and Suppliers List

<u>SECTION</u>	<u>MANUFACTURER</u>	<u>SUPPLIER</u>
26 05 26	Ground Rods	_____
26 05 33	Sleeves	_____
26 05 33	Conduit	_____
26 05 33	Outlet and Junction Boxes	_____
26 22 13	Dry Type Transformers	_____
26 24 14	Switchboards (277/480V-3PH-4W)	_____
26 24 16	Panelboards	_____
26 27 26	Wiring Devices	_____
26 28 00	Overcurrent Protection	_____
26 29 00	Motor Starters	_____
26 29 00	Safety Switches	_____
26 43 13	Surge Suppression (TVSS)	_____
26 51 00	Light Fixtures Type 'A'	_____
	Type 'B'	_____
	Type 'B1'	_____
	Type 'B2'	_____
	Type 'C'	_____
	Type 'X'	_____
	Type 'X1'	_____
26 82 39	Electric PUH	_____
26 82 40	Electric Wall Heater	_____
28 31 00	Addressable Fire Detection System	_____

2.04 EQUIPMENT DELIVERY SCHEDULE

- A. Submit at Engineer's request a schedule listing equipment and materials for complete installation, quantity ordered, date of placing order and the promised delivery dates.
- B. Any and all probable delivery delays shall be identified at the pre-construction meeting.

2.05 SHOP DRAWINGS

- A. The Contractor shall submit shop drawings as stated in the General Conditions and as specified herein.
- B. Approval of shop drawings does not relieve the Contractor of the responsibility for ordering proper quantities and miscellaneous appurtenances required for operation and/or installation of the respective material or equipment.
- C. The following general information is required with each submittal as applicable:
 - 1. The full manufacturer's model number of each item
 - 2. Identification of each item's performance, physical size and construction data.
 - 3. Identification of finishes. Furnish two (2) color chips for items requiring color/finish selections.
 - 4. Indicate any modifications made to manufacturer's standard design which were required by these specifications.
 - 5. Rough-in, foundation and support point dimensions.
 - 6. Complete wiring diagrams and connection identifications.
 - 7. Contractor's stamp, signature and data shall be affixed to shop drawings with indication of his review and approval.
- D. Provide specific information with each submittal as stated in the respective specification sections.

2.06 RECORD DRAWINGS

- A. The Contractor shall submit record drawings as stated in the General Conditions, and as specified herein.
- B. During construction, maintain a complete and legible set of drawings, at job site showing changes and deviations between actual construction and Engineer's drawings. Submit marked-up set to Engineer for review at each project meeting.

- C. Submit to Engineer for review at the 100% completion of the work a complete, accurate and neat set of mark-up blue-line drawings showing the complete "record drawings" construction.
- D. This marked-up set shall be returned to the Contractor as many times as necessary in order to obtain desired results.

2.07

MAINTENANCE MANUALS

- A. Contractor shall submit at job completion, three (3) maintenance manuals to the Engineer for approval. One (1) will be retained by the Engineer and two (2) will be forwarded to the Owner.
- B. Maintenance Manuals are to include all information relative to maintenance and operating instructions for all new electrical equipment including equipment furnished by Owner and installed by Electrical Contractor.
- C. Maintenance manuals shall be assembled in the following sections:
 - 1. Section 1
 - a. Title of project
 - b. Name and address of Owner, Contractor and Engineer
 - c. Completion date of project
 - 2. Section 2: Index of complete contents
 - 3. Section 3:
 - a. Listing of all equipment with model number, serial number.
 - b. Warranty of each piece of equipment with start and completion dates.
 - 4. Sections 4 thru ___ (as applicable for each piece of equipment)
 - a. Drawings or data sheets on each piece of equipment which was submitted for approval.
 - b. Installation instructions.
 - c. Operating instructions
 - d. Maintenance manuals and parts list
- D. Each section shall be separated by a pasteboard tabbed divider. Each section tab shall identify equipment by same name as listed in the index. Tabs shall extend outside of sheet size.
- E. All information shall be arranged in as many three-ring (3" D configuration) vinyl coated notebooks as necessary. Do not overload capacity of binder.

2.08 MECHANICAL SYSTEMS STARTUP

The Electrical Contractor shall attend pre-startup meetings and shall be present at each mechanical system startup. Refer to Specification Section 23 01 70, Operation and Maintenance of Central HVAC Equipment, Item 3.02.

2.09 INSPECTION

At the completion of the electrical installation, the Contractor shall inform the local and state authorities to arrange the final inspections of this work. Provide in triplicate a Certificate of Inspection when completed.

2.10 REPORTS AND FINAL SUBMISSIONS

- A. The Contractor shall submit, for attachment to the Substantial Completion Certificate, a letter certifying that the electrical system wiring is in accordance with the latest adopted edition of The National Electrical Code.
- B. Submit all other test reports, as hereinafter specified.

PART 3: EXECUTION

3.01 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Handle equipment and components carefully to prevent damaging, breaking, denting and scoring. Do not install damaged equipment or components; replace with new.
- B. Store equipment and components in clean dry place. Protect from weather, theft, dirt, fumes, water, construction debris and physical damage at all times.

END OF SECTION

SECTION 26 05 02

ASSIGNMENTS OF MISC. WORK

PART 1: GENERAL

1.01 IDENTIFICATION

A. Labeling

1. Label all electrical equipment or controls provided or connected by Electrical Contractor by means of engraved laminated plastic plates screwed or riveted to the devices. Height of letters not to be less than 1/4" unless otherwise specified or directed.
2. Items to be labeled shall include, but not be limited, to the following:
 - a. All motor starters, contactors, safety switches, relays, etc.
 - b. All remote pushbutton stations
 - c. Remote control and specialty switches for lights, etc.
 - d. All motors which cannot be readily identified by their starter label when observer is standing at the motor.
 - e. All main switches or circuit breakers
 - f. All panelboards shall be labeled on outside of door with both source and destination. All final destinations shall be labeled with the source. Example: Panel "A" 120/208V-3PH-4W fed from panel "MDP" via "HC-1".
 - g. Panelboard circuit identification cards shall be typewritten.
 - h. Relay cabinets
 - i. Automatic transfer equipment
 - j. Thermostats, temperature sensors
3. Printed card labels may be used on items of equipment furnished with plastic windows. Labeling of card shall be neatly printed using lettering device such as a Leroy Instrument.
4. Embossed, adhesive tape labels are not permitted.
5. Panelboards:
 - a. New Directories: filled in complete (Typewritten) listing each circuit and respective equipment served and rooms where outlets, lights, etc., are located.
 - b. Existing Panelboard Directories: completely retyped; revised to include circuits and equipment added and revised with this contract. Contractor shall verify each existing branch circuit and properly identify on new panelboard directory.

6. In addition all concealed junction and/or pull boxes shall be painted to match the color code of the conduit system to which they are connected and shall be labeled legibly by hand in permanent ink to indicate the panel and circuit numbers which are contained within the junction and/or pull box.
7. Raceway: all raceways both exposed and concealed above accessible ceilings shall be labeled to identify contents. Weatherproof adhesive type labels shall be applied a minimum of every 10'-0" or as required to provide at least one (1) label within each space or room.
8. Wiring and cabling: Systems wiring and cabling not run in conduit shall be tie wrapped and labeled a minimum of every 10'-0" or as required to provide at least one label within every space. Labels for various cable systems shall be grouped together in each location to provide ease of system identification.
9. Examples of system abbreviations/labels shall be as follows: (Note: this list may not be all inclusive.)

Raceway

Power Circuits

Label

"Danger" (voltage contained; normal power black letters; emergency power red letters)

Fire Alarm System
Telecommunications System
Temperature Control

"FA"
"TELE"
"TEMP CTL."

1.03 **WALL OPENINGS**

- A. Wall openings for electrical work not noted on the Architectural or Structural drawings shall be arranged for and provided by the Electrical Contractor.
- B. Lintels for wall openings required by electrical work will be furnished and installed by the Contractor constructing the wall. Electrical Contractor is responsible for notifying that Contractor of locations and sizes of openings requiring lintels prior to wall construction. Openings not coordinated and provided shall be arranged for and provided by the Electrical Contractor.
- C. Final sizes and locations of electrical penetrations in walls are the responsibility of the Electrical Contractor.
- D. Provide approved fire stops for fire rated wall and floor openings.

1.04 ROOF AND FLOOR OPENINGS

- A. Roof and floor openings for electrical work not noted on the Architectural or Structural drawings shall be arranged for and provided by Electrical Contractor. Miscellaneous framing required and cutting of openings, shall be furnished and installed by the contractors constructing the roof or floor structure. Electrical Contractor is responsible for notifying those Contractors of exact locations and sizes prior to construction of the framing. Openings not coordinated and provided shall be arranged and paid for by the Electrical Contractor.
- B. Final sizes and locations of electrical penetrations through the roof and floor structures are the responsibility of the Electrical Contractor requiring the opening.
- C. Counterflashing shall be provided by the Electrical Contractor. Roof flashing shall be provided by others.

1.05 CUTTING AND PATCHING

- A. Cutting and patching of finished areas for electrical work shall be provided by the General Contractor. Electrical Subcontractors shall coordinate responsibility for cutting and patching with Electrical Contractor prior to bidding.
- B. Cutting and patching of finished areas shall be provided by the Contractor requiring same, however, the work shall be performed by the trade responsible for this type of work.
- C. Patched surfaces shall be finished to match existing unless the surface is scheduled for that type of work.

1.06 CONCRETE PADS

- A. Concrete pads for electrical equipment shall be provided by Electrical Contractor in accordance with Specifications Section 26 05 05, Concrete Pads and Curbs.
- B. Concrete pad removals and floor patching by Electrical Contractor.

PART 2: **PRODUCTS**
NOT USED.

PART 3: **EXECUTION**

3.01 **PLATFORMS AND SUPPORT STANDS**

- A. Platforms and supporting stands shall be provided by the Electrical Contractor for their respective equipment.
- B. Each piece of equipment or apparatus suspended from ceiling or mounted above floor level shall be provided with suitable structural support, platform or carrier constructed in accordance with best recognized practice in a neat and workmanlike manner.
- C. Contractors shall exercise extreme care that structural members of building are not overloaded by such equipment. In all cases, details of such hangers, platforms and supports together with total weights of mounted equipment shall be approved by Structural Engineer.
- D. Support raceways on accepted types of wall brackets, specialty steel clips or hangers, ceiling trapeze hangers or malleable iron straps. Plumber's perforated straps are not permitted. Acceptable manufacturers' bracket or hangers are "Kindorf", "Elcan", "Blinkley", "Multi-Frame", "Power-Strut" or "Unistrut". Do not suspend raceways or equipment from steam, water or other piping or ductwork, except as otherwise permitted. Provide independent and secure support methods.
- E. Provide all structural supports for the proper attachment of electrical equipment supplied and also for equipment such as motor controllers, supplied under other sections or by Owner for mounting connection and installation under this section.

3.02 **ATTACHING TO BUILDING CONSTRUCTION**

- A. Equipment and conduit supports shall be attached to structural members (beams, joists, etc.) rather than to floor or roof slabs.
- B. Support equipment suspended from structure by adjustable threaded steel rods of adequate diameter and strength anchored to the floor arch of the structural steel. Support auxiliary steel, if required, from the building steel. Secure no hangers to furred ceilings or ductwork.
- C. Raceways or light fixtures shall not be suspended from ceiling suspension system. The Electrical Contractor shall be responsible for providing adequate support for raceways or fixtures.
- D. Mount wall-mounted equipment directly to wall by means of steel bolts. Maintain at least 1/4 inch air space between equipment and supporting wall. Mount groups or arrays of equipment on adequately sized steel channels, such as those manufactured by Kindorf and Unistrut.

- E. Secure equipment and steel to solid masonry by means of screw and bolt anchors and expansion bolts. On structural steel use clamps, approved by the Engineer, which do not depend primarily on set-screw pressure for security.
- F. Where supports are attached to structural members coated with fireproofing, the Contractor shall clean the fireproofing, attach the support and patch the fireproofing with like material.

3.03

ELECTRICAL CONNECTIONS TO EQUIPMENT

- A. In the event that equipment furnished by other Contractors or Subcontractors requires a larger starter or disconnect that which is indicated on the documents, the Contractor supplying the larger equipment shall reimburse the Electrical contractor supplying the larger starter, disconnect for the difference in labor and material cost.
- B. Connections and wiring diagrams shown on the drawings or described in the specifications are general and are for bidding purposes only. Detailed diagrams and instructions shall be provided by Contractor supplying equipment. Contractor shall notify the Electrical Contractor prior to start of his related work.
- C. Relays, switches, contactors, etc. which may be required in addition to those specified for and indicated on the electrical drawings shall be provided by Mechanical Contractor for installation by the Electrical Contractor. These devices shall be mounted by the Electrical Contractor at the apparatus to be installed and the Mechanical Contractor supplying these additional devices shall reimburse the Electrical Contractor for his labor and material costs. Electrical Contractor shall provide all additional conduit, wire and electrical connections without additional charge to the Owner.
- D. In event that several pieces of mechanical equipment from different suppliers are combined into one system, Mechanical Contractor shall furnish complete wiring and control diagram to enable Electrical Contractor to make proper connection. Diagrams shall be submitted to Engineer for approval prior to actual wiring.
- E. Mechanical Contractor shall furnish to Electrical Contractor written notice of approval and acceptance of all control wiring installed for mechanical systems by Electrical Contractor. Such approval shall be given within thirty (30) days of completion of all such control wiring. Two (2) copies of letter shall be sent to Engineer.

3.04

TEMPORARY ELECTRICAL SERVICE

- A. Provide and maintain temporary electrical service and provide temporary lighting and power to be used by all trades for all construction. Maintain the temporary system, relocate the system as required for all construction. Maintain the temporary system, relocate the system as required for construction progress and remove the system at completion.
- B. The energy cost of power consumed during construction shall be paid by the Owner.
- C. Provide 480 volt, three phase grounded system and required 120/208 volt transformation for temporary light and power distribution. Comply with the requirements set by IOSHA and OSHA.
 - 1. The service amperage shall be adequate for the construction of the project and the testing of the permanent equipment. The permanent electrical service and distribution equipment may be used with the approval of the Owner/Architect/Engineer.
 - 2. A 120 volt lampholder pigtail socket with a 200-watt A23 lamp shall be installed at a minimum of one per room, or in areas over 1200 square feet, one per 1200 square feet of floor space. Generally, in large areas, light stringers shall be installed in rows 30 feet apart with lights spaced 40 feet apart on the stringers. No more than nine lamps shall be installed on any 20 amp circuit. Replacement lamps shall be provided throughout the construction of the project. Number 12 wire may be used for temporary lighting circuits. Additional lighting required to perform the work and as required by applicable laws is specified in Section 01500.
 - 3. Two gang duplex grounded convenience outlets having three wire grounded type receptacles shall be installed within 75 feet of outside walls and 150 ft spacing in any direction within the building. They shall be installed in such a manner that a 100 ft. extension cord connection can reach any part of the building, including enclosed areas such as offices. These circuits shall be ground fault interrupter type circuits.
 - 4. In addition to the above temporary power and lighting, provide and subsequently remove circuits for:
 - a. Temporary safety lighting and security lighting. Security lights to work at all hours and darkness; safety lighting shall be continuous during working hours.
 - b. Project office; 20 amp circuit plus power for electric heat and electric air conditioning.
 - c. Pumping, welding and other special equipment including sump pumps.
 - d. Testing and checking permanent equipment.

3.05 CLEANING

- A. Maintain a clean project site throughout the construction period. Provide personnel to regularly remove debris and unused materials. Coordinate this cleaning effort with your subcontractors.
- B. Remove all debris and unused materials from job site created by electrical work.
- C. Clean all electrical equipment to a "like new" condition prior to systems startup, prior to balancing and in preparation of final inspection. Vacuum clean all internal components.
- D. Clean all electrical rooms and/or areas of debris and unused material. Vacuum clean mechanical room floors.

END OF SECTION

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SECTION 26 05 05

CONCRETE PADS AND CURBS

PART 1: GENERAL

1.01 WORK INCLUDED

Furnish and install cast-in-place concrete pads and curbs for equipment where shown on the drawings and as specified herein.

1.02 RELATED WORK

- A. General Provisions: Section 26 05 01
- B. Assignment of Misc. Work: Section 26 05 02
- C. Switchboards: Section 26 24 14
- D. Low Voltage Distribution Transformers: Section 26 22 13

1.03 SUBMITTALS

Submit complete shop and setting drawings in accordance with Specifications Section 26 05 01, General Provisions.

PART 2: PRODUCTS

2.01 CONCRETE FORMWORK

- A. Design criteria: conform to tables for form design in APA Form V345, including strength.
- B. Lumber: construction standard grade.
- C. Plywood: exterior type softwood plywood, PS 1.
- D. Ties: carbon steel, snap ties, 1" breakback, 1/4" maximum diameter.
- E. Form coatings: non-staining
- F. Form Joint Tape: closed cell foam.

2.02 CONCRETE REINFORCEMENT

- A. Materials
1. Bars: deformed billet steel: ASTM A615, Grade 40.
 2. Wire:
 - a. Cold drawn steel: ASTM A82
 - b. Deformed steel: ASTM A496
 3. Tie Wire: FS-QQ-W-461, annealed steel, black 16 gauge, min.
 4. Welding Electrodes: AWS A5.1, low hydrogen, E70 Series.
 5. Splice Devices: sized to develop 125% of yield strength of bar.
 6. Bar supports: conform to "Bar Support Specifications", CRSI Manual of Standard Practice, Chapter 3.
 7. Wire Fabric: welded steel, ASTM A195
- B. Placement: Set reinforcing accurately and tie all items securely.
- C. Pin all interior pads and curbs to floor slabs, with dowels or bars (exception: do not pin to post tensioned slabs).

2.03 EXPANSION AND CONTRACTION JOINTS

- A. Joint Filler: Pre-molded, treated, non-bituminous, non-extruding wood fiber in concrete color and compatible with specified sealants. Filler shall conform to the performance requirements of ASTM D1752, Type 1.
- B. Acceptable Manufacturers
1. Everlastic
 2. Rescor
 3. Homex 300
 4. Sponge Rubber
 5. Williams Products
 6. W.R. Meadows
 7. Homasote
 8. Construction Gaskets

2.04 CAST-IN-PLACE CONCRETE

- A. Interior: 4000 PSI, ready mix, to conform to ASTM C94.
- B. Exterior and Below Grades: 4000 PSI with 4% - 6% air entrainment.
- C. Slump: 5 inch maximum, tolerance, zero plus and minus 2 inches.
- D. Concrete shall be thoroughly consolidated without honeycombed finish surface.
- E. Provide 1" chamfered edges on perimeter of all pads.

2.05 CONCRETE FINISHING

- A. Interior Pads
 - 1. Provide smooth (floated) sides and top.
 - 2. Grind smooth all chamfered edges
- B. Exterior Pads
 - 1. Provide smooth (troweled) sides
 - 2. Provide broom finish top
 - 3. Grind smooth all chamfered edges

2.06 CONCRETE CURING

- A. Apply concrete curing compound only at exposed slab.
- B. Acceptable Manufacturers
 - 1. Curetox - Toch Brothers
 - 2. Sealtight AR-30C - W.R. Meadows
 - 3. Promulsion 100 - Protex

PART 3: **EXECUTION**

3.01 INSTALLATION

- A. Provide 3-1/2" (Nominal 4") concrete housekeeping pads under all floor mounted Electrical Equipment.
- B. Coordinate location and size of pads with other concerned contractors.
- C. Expansion joints will not be permitted to cross limits of a piece of equipment.
- D. Concrete pad shall extend 6" past all sides of equipment.

END OF SECTION

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SECTION 26 05 19

LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1: GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. General Provisions: Section 26 05 01
- B. Raceways and Boxes: Section 26 05 33

PART 2: PRODUCTS

2.01 WIRE AND CABLE (UP TO 600 VOLTS)

- A. UL Standards: UL 44 and UL 83.
- B. Insulation: color coded thermoplastic type rated 600 volts, 75 degree C except where otherwise noted.
- C. Conductors: soft drawn copper.
- D. Conductors #10 and Smaller
 - 1. For final connections to motors, light fixtures and all locations where vibration or movement is present use Class B, stranded conductors.
 - 2. For all other locations use solid conductors. Stranded conductors may be used on #12 and #10 wire, provided terminations under screw terminals are made using insulated spade connectors such as "Sta-Con" or other approved equivalent connectors.
- E. Conductors #8 and larger: double braid, Class B concentric stranded per ASTM B8.
- F. Minimum Wire Size: General #12; Over 100' #10; Over 200' #8; Control #14; Signal #18 or as detailed in appropriate section of the specifications and/or as shown on the drawings.

- G. Types and Uses (unless otherwise specified or indicated on the drawings). All conduit sizing is based on Type THWN and THHN. (Conduits may need to be increased in size if other wiring is selected).
1. Feeders and service entrance conductors: THWN or THW
 2. Power circuits above 40 amps: THWN or THW (#8 or larger)
 3. Branch lighting, receptacles and small power circuits: THWN (#10 and #12)
 4. Branch circuits in wiring channels of continuous rows of fluorescent lighting fixtures: THHN or THWN
 5. Direct burial feeders and branch circuits: UF
 6. Control Wiring: MTW (#18 and #16)
- H. Wire Tags: Main and feeder cables shall be tagged in all pull boxes, wireways and wiring gutters of panels. Tags shall identify wire or cable number and/or equipment served as shown on the drawings. Tags shall be of flame resisting adhesive material, T & B Type WSL or approved equal.

2.02

CABLE LUGS AND TAPS

- A. Large Cables (No. 8 and larger)
1. Use compression type connectors, taps and splices specifically designed for the particular connection; insulated splice "Bakelite" covers designed to fit around splice. Mechanical lugs approved for use with copper cables only.
 2. Manufacturers: Burndy Engineering Co., Inc. Thomas & Betts, or approved equal.
- B. Branch Circuit Wires (No. 10 and smaller): Use any of the following type of terminals and connecting devices.
1. Hand applied: coiled tapered, spring wound devices with a conducting corrosion-resistant coating over the spring steel and a plastic covered and skirt providing full insulation for splice and wire ends. Screw connector on by hand. Manufacturers: Ideal Industries "Wing Nut"; Thomas & Betts "Piggy"; 3M Company "Scotchlok"; or approved equal.
 2. Tool applied: steel cap with conducting and corrosion-resistant metallic plating, open at both ends, fitted around the twisted ends of the wire and compressed or crimped by means of a special die designed for the purpose. Specially fitted plastic or rubber insulating cover wrap over each connector. Manufacturer: Thomas & Betts "Staken"; Ideal Industries "No. 410 Crimp Connector" and "Wrap-Cap"; Buchanan; Burndy; or approved equal.

2.03 ELECTRICAL INSULATING TAPE

- A. Tape shall be specially designed for use as an insulating tape.
- B. Manufacturers: Scotch #23 (rubber), Scotch #33 (plastic) or equal by Johns-Manville; Minnesota Mining.

2.04 MANUFACTURERS

Southwire, Rome Carroll, American, Okonite, Encore, or Pirelli.

PART 3: EXECUTION

3.01 INSTALLATION

- A. Run all wire in approved conduit, unless otherwise specified, shown on the drawings or directed.
- B. Run all wires of same circuit in same conduit. Maximum number of current carrying conductors in conduit shall be six.
- C. No wire to be pulled until conduit installation is complete.
- D. Pull no thermoplastic insulated wire if temperature is lower than 33°F.
- E. Use approved pull-in compound (similar to Wire-Lube or Y-Er-Ease) to facilitate pulling of wire. Grease or oil not permitted.
- F. Splice and connect wires only in readily accessible boxes.
- G. Care shall be exercised when installing wire so as not to injure the conductor insulation. Lubricating compounds, recommended by the cable manufacturer, may be used when pulling wire or cable.
- H. Bending radius and maximum pull tension of any insulated wire or cable shall not exceed the limits recommended by the Manufacturer.
- I. Splices shall not be permitted except for lighting and as shown on the drawings. After splicing, insulation tape equal to that on the spliced wire shall be applied to each splice but not less than two (2) layers of rubber tape covered by two (2) layers of plastic tape.

3.02

WIRE AND CABLE IDENTIFICATION

- A. Color code wire #10, #12 and #14 AWG as follows:
- | | <u>208V/120V</u> | <u>480V/277V</u> |
|------------|------------------|------------------------------|
| 1. Phase A | Black | Brown |
| 2. Phase B | Red | Orange |
| 3. Phase C | Blue | Yellow |
| 4. Neutral | White or Gray | Gray |
| 5. Ground | Green | Green with
Yellow stripes |
- B. Identify control wires at terminations with numbers shown on the Control Drawings.
- C. Train and lace wiring inside equipment and panelboards with plastic tie wraps for a neat appearance.
- D. Make all spare wires in cabinets or panelboards of adequate length for connections. Terminate with insulating tape and tag.
- E. Factory color code wire No. 10 and smaller. Wire No. 8 and larger may be coded by field painting or by color taping approximately 6" length of the exposed ends.
- F. Circuit/panel identification
1. Provide identification of all panel and motor feeder cables and control wires in pull boxes and at terminations.
 2. Use flameproof cloth, vinyl plastic or aluminum foil markers for labels wrapped around wire.
 3. Mark tags on power cables with panel and circuit name in black on a yellow background.
 4. Mark tags on control wires with terminal numbers and circuit name in black on a yellow background.
 5. Use pre-printed markers with protective coatings wherever possible. Use only black India ink or permanent write-on markers.
 6. Manufacturer: Brady Slip on Markers
- G. Install thermocouple and DC signal wiring conduits separate from power, lighting control wiring and separate from each other. Install such wiring continuous without splices from sensing element to instrument.

3.03 WIRE CONNECTIONS AND DEVICES

- A. Thoroughly clean wires before installing lugs and connectors, so that joint will carry full capacity of conductors without perceptible temperature rise.
- B. Use lugs or connectors of sufficient size to enclose all strands of conductors.

3.04 PULL CABLES

Insert nylon pulling cable with carbon dioxide, compressed air or vacuum.

3.05 277 VOLT LIGHTING AND 480 VOLT CIRCUITS

- A. Test cables with 1000 volt megger between phases and between each phase and ground, with test maintained until readings are steady for three minutes. Readings to be equivalent to the manufacturer's specifications and similar readings not to deviate more than 5%.
- B. Tests must be conducted in the presence of the Owner's representative.

END OF SECTION

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SECTION 26 05 26

GROUNDING AND BONDING

PART 1: GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. General Provisions: Section 26 05 01
- B. Raceways and Boxes: Section 26 05 33
- C. Low Voltage Electrical Power Conductors and Cables: Section 26 05 19

PART 2: PRODUCTS

2.01 GENERAL

- A. Entire installation to be grounded and bonded in accordance with requirements of Article 250 of the National Electrical Code (NEC).
- B. Equipment grounding shall be provided for, but not limited to, the following items:
 - 1. Panelboard tubs, switchboard frames, transformers and electrical structures.
 - 2. All motor frames that are not otherwise effectively insulated from ground.
 - 3. Enclosure for motor controllers and safety switches.
 - 4. Raised computer floor support pedestals.
 - 5. All metal objects with 10'-0" of a swimming pool.
- C. Provide code size grounding conductor in all conduits and raceways.
- D. An equipment bonding jumper shall be used to connect the grounding terminal of a grounding type receptacle to a grounded box.
- E. All grounding type receptacles are to have grounding slot connected to green ground conductor.

2.02 AC SYSTEM GROUND

- A. Ground system shall consist of 3 ground rods in triangle pattern or in a straight line 12'-0" apart. All ground rods shall be 3/4" diameter, 8'-0" sectional, Copperweld Blackburn, Penn Union or Weaver rods driven to a depth required to obtain ground resistance stated above.

- B. In addition to the triangle pattern ground rod system, ground to the street side of the water meter using OZ-Gedney Type 'BJ' Jumper and to building steel as required by the NEC. After the ground system has been installed, but before it is fully covered, it shall be tested and shall be modified as required to obtain the ground resistance specified.

PART 3: **EXECUTION**

3.01 **GENERAL**

- A. All grounding system connections shall be made using a thermoweld process similar to "Cadweld" and Thermoweld or a high pressure (non-reversible) compression type system similar to Burdy "Hyground".
- B. Test resistance to ground of ground system or grounding network at point where equipment, raceways and conductors are to be connected. Value of this resistance to ground shall not exceed 5 ohms and shall be measured from ground being tested to the system ground rod driven into the earth.
- C. Ground system tests shall be performed by qualified testing concern normally employed in this field using nationally acceptable test instruments. All test reports shall be certified and shall be submitted to the Engineer for review.
- D. Bond conduits at panels per NEC.
- E. No equipment rated at more than 150 volts to ground shall be grounded in a manner which will permit the building steel to provide the only return path for ground fault currents.
- F. Grounding wire run below grade shall be buried 18" deep (minimum).
- G. All contact surfaces shall be thoroughly clean and bright, before connection are made, to insure making good electrical contact.
- H. Each feeder conduit shall have all joints made with conductive, waterproof joint compound as Sherwin Williams "Zink Clad", T & B "Kopr/Shield" or approved equal.

3.02 GROUNDING SYSTEMS TESTS

- A. Visual and Mechanical Inspection: Inspect ground system for compliance with plans and specifications.

- B. Electrical Tests
 - 1. Perform 3-point fall-of-potential test per IEEE Standard No. 81, Section 9.04 on the main grounding electrode of system.
 - 2. Perform the 2-point method test per IEEE No. 81, Section 9.03 to determine the ground resistance between the main grounding system and all major electrical equipment frames, system neutral and/or derived neutral points.
 - 3. Alternate Method to 2 above: Perform ground continuity test between main ground system and equipment frame, system neutral and/or derived neutral point. This test shall be made by passing a minimum of ten amperes DC current between ground reference system and the ground point to be tested. Voltage drop shall be measured and resistance calculated by voltage drop method.

- C. Test Values: The main ground electrode system resistance to ground should be no greater than five ohms.

END OF SECTION

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SECTION 26 05 33

RACEWAYS AND BOXES

PART 1: GENERAL

1.01 **RELATED WORK SPECIFIED ELSEWHERE**

- A. General Provisions: Section 26 05 01
- B. Low Voltage Electrical Power Conductors and Cables: Section 26 05 19

1.02 **PENETRATIONS**

Penetrations of fire rated walls, floors, roofs and ceiling will be sealed with rated fire stops by General Contractor.

1.03 **WORK INCLUDED**

- A. Furnished all labor, materials and equipment necessary to provide all sleeves and anchors as shown on the drawings.
- B. Any and all penetrations of below grade walls with conduit shall be protected by a sleeve with water sealing assemblies.

PART 2: PRODUCTS

2.01 **METALLIC TYPE CONDUITS**

- A. Rigid Galvanized Steel (RGS): UL 6 and ASA C80.1 Full weight mild galvanized or sheradized steel pipe of standard pipe dimensions; with screwed fittings. Bushing shall be malleable iron. Bushings 1-1/4" and larger shall be insulated throat and grounding lug.
- B. Rigid-Aluminum-Heavy Wall Type (RA): Heavy Wall aluminum pipe of standard pipe dimension.
- C. Intermediate Metal Conduit (IMC): UL 242, Lighter weight galvanized or sheradized steel pipe of standard pipe dimension with full weight screwed fittings. Bushings shall be malleable iron. Bushings 1-1/4" and larger shall have insulated throat grounding lug.
- D. Electrical Metallic Tubing (EMT): UL 797 and ASA C80.3, Galvanized or sheradized thinwall steel conduit. Fittings 1-1/4" and larger shall have nylon insulated throat. Indentor or drive-on fittings are not acceptable.

- E. Flexible Metal Conduit (FMC): UL 1, Galvanized, single strip type with smooth wiring channel. Use in dry locations and for connections to motors, transformers, lighting fixtures and other equipment that may have movement or vibration. Fittings shall be steel .
- F. Liquid tight flexible metal conduit (LFMC): UL 360 galvanized, single strip with smooth wiring channel and neoprene jacket. Fittings shall be compression type. Use in moist locations for final connections to motors, transformers, lighting fixtures or other items with movement or vibration.

2.02 POLYVINYL CHLORIDE TYPE (PVC)

- A. PVC pipe of standard pipe dimensions suitable for use with socket type solvent weld couplings, boxes and fittings.
- B. Conduit shall be PVC Schedule 40 (90°C) for application in underground, encased and exposed applications in accordance with NEC.
- C. PVC conduit and fittings shall be UL rated for electrical use. Material shall comply to NEMA Specifications TC-2, TC-3, Federal Specifications W-C-1094A, UL-651 and ANSI C33.91.
- D. Conduit shall be made from virgin polyvinyl chloride C300 to reduce smoke and HCL emissions in a fire situation.
- E. Conduit, fittings and solvent weld cement shall be produced by same manufacturer to assure system integrity.
- F. Manufacturers: Carlon PV-Duct Plus Systems or approved equal.

2.03 FIRE STOP SEALANTS

- A. Penetration Sealants
 - 1. Dow Corning "Firestop Foam" and "Firestop Sealant"
 - 2. Insta-Foam Products, Inc. "Insta-Foam Seal Silicone RTV Foam"
 - 3. 3M Brand "Fire Barrier" Caulk
 - 4. 3M Brand Moldable Putty "Pads" and Moldable Putty "Stix"
- B. Intumescent sealants for use in openings and sleeves involving plastic pipe, insulated pipe or flexible cable:
 - 1. Dow Corning "Firestop Intumescent Wrap Strip"
 - 2. Fox Coupling, Inc. "Cast-In-Place Firestop Coupling"
 - 3. 3M Brand "Fire Barrier" Caulk with FS-195 wrap strip and CS-195 composite sheet.

2.04 METALLIC STEEL OUTLET BOXES

- A. General use interior boxes shall be galvanized die cast pressed steel units of proper depth and gauge required by the outlet location. Boxes shall be equipped with plaster ring or cover as necessary. These units shall be manufactured by Raco, Steel City or approved equal.
1. Wall outlets: 4" square x 1-1/2" deep (minimum) with plaster ring as required.
 2. Ceiling outlet: 4" square or octagonal x 1-1/2" or 2-1/8" deep with stud or ears where required.
 3. Outlet boxes in finished ceilings or walls shall be fitted with appropriate covers, set to come flush with the finished surface. Where more than one switch or device is located at one point, use gang boxes and covers unless otherwise indicated. Sectional switch boxes or utility boxes will not be permitted. Provide outlet boxes of the type and size suitable for the specific application.
- B. Exposed outlets: malleable iron or heavy cast aluminum with threaded hubs, Type FS, FD or GS as manufactured by Crouse Hinds, Appleton, Killark or approved equal. Die cast stamped steel boxes are not acceptable.
- C. Special system and equipment outlet boxes shall be as recommended by the manufacturers of this equipment. Construct junction or pull boxes not over 150 cubic inches in size as standard outlet boxes and those over 150 cubic inches the same as "cabinets" with screw covers of the same gauge metal.
- D. Telephone/data rough-ins shall consist of a 4" square x 1-1/4" deep (minimum) with plaster ring as required with 3/4" conduit stubbed up to above ceiling and bushed. (One rough-in = 3/4", two rough-ins = 1", three rough-ins = 1-1/4".)
- E. All junction and outlet boxes shall be of a NEMA Type 3R construction in wet outdoor areas and NEMA Type 12 in moist indoor areas.
- F. Unless otherwise noted, locate outlets as follows. Heights listed are from finished floor to center of device. Mounting heights for other equipment are as shown on the electrical or architectural plans or as herein further indicated.
1. Convenience and signal outlets: 18 inches above finished floor unless otherwise noted.
 2. Lighting switches: 4 feet, 0 inches
 3. Outlets: 18 inches above finished floor
 4. Where counter occur, mount all devices 44" AFF to top

2.05 ANCHORS AND FASTENERS

- A. Anchors and fasteners shall be of a type designed and intended for use in the base material to which the material support is to be attached and shall be capable of supporting the intended load and withstanding any associated stresses and vibrations.
- B. In general, screws shall be used in wood, masonry anchors on concrete or brick, toggle bolts in hollow walls, and machine screws, bolts or welded studs on steel.
- C. Nails shall not be used except for temporary support or for light loads in wood frame construction.
- D. In outdoor locations or other corrosive atmospheres, the anchors and fasteners shall be non-corrosive or have suitable corrosion resisting coatings.

2.06 JUNCTION AND PULL BOXES

- A. Special junction boxes shall be sized as required for the conductors and number of splices they are to house. They shall be made from galvanized sheet metal and sized in accordance with the National Electric Code (NEC).
- B. Type: code gauge sheet steel, galvanized sized in accordance with NEC.
- C. Covers: screw attached except as noted.

2.07 WALL SLEEVES

- A. Each sleeve shall consist of a sleeve body, oversized conduit and a pressure clamp, pressure ring and sealing grommet.
- B. The basic design of the sleeve shall be such that will allow the sleeve body and sleeve conduit to be cast into the concrete walls and the sleeve pressure clamp to be installed at a later date.
- C. The sleeve body and conduit shall be so designed to accept several different size pressure clamp assemblies.
- D. Sleeve Construction shall be as follows:
 - 1. Body: the body shall be malleable with hot dip galvanized finish. Provide ground lug connection for #8 AWG copper conductor. Sleeve body shall have a sealing ring between the body and the conduit sleeve.
 - 2. Conduit Sleeve: the conduit sleeve portion shall be oversize PVC sleeve.

3. Pressure Clamp and Pressure Ring with Sealing Grommet: the body shall be so designed to accept the following:
 - a. Pressure Clamp: shall be constructed of malleable iron with hot-dip galvanized finish with hex headscrews that anchor into the sleeve body.
 - b. The sealing grommet shall consist of an expandable type long lasting elastic material that is sandwiched between two (2) malleable hotdip galvanized pressure plates. All sized for the exact O.D. thickness of conduit that will pass through the sleeve.

- E. Manufacturer: similar to O-Z/Gedney type "FSK" #1020, 2030, 3040 or 4050 as indicated on drawings.

PART 3: EXECUTION

3.01 **CONDUIT USAGE**

(All conduit types noted are acceptable for use listed.)

A. General

		<u>Conduit Types</u>		
		RGS	IMC	PVC
1.	Underground electrical & telephone service entrance			
2.	Electrical & telephone services other than underground	RGS	RA	
3.	Conduits in concrete slab		RGS	IMC
4.	Conduits below lowest floor slab.	RGS	IMC	PVC
5.	Conduits in moist locations or exposed to weather	RGS	IMC	RA
6.	Feeders, power circuits (1-1/4" and larger)	RGS	IMC	RA
7.	Branch lighting and receptacle circuits	IMC		
8.	Underground to remote locations. (Rigid or IMC must be liberally coated with asphaltum)	RGS	IMC	PVC
9.	Final connections to motors, transformers or other equipment requiring vibration isolation. (max length of 72")	FMC	LFMC	
10.	From junction box to recessed lighting fixture	FMC	LFMC	
11.	Short connections where use of rigid is impractical	FMC	LFMC	

3.01

CONDUIT USAGE (continued)

(All conduit types noted are acceptable for use listed.)

A. General

Conduit Types

- | | | | |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----|
| 12. | For mechanical protection | RGS | RA |
| 13. | Final connections to motors, transformers, under computer floors or other equipment in moist locations requiring vibration isolation. Maximum length of 72" unless otherwise noted. | LFMC | |
| 14. | For ground electrode connectors | PVC | |

NOTE: RGS: Rigid galvanized steel
IMC: Intermediate metal
EMT: Electrical metallic tubing
PVC: Polyvinyl chloride
FMC: Flexible metal conduit
LFMC: Liquidtight flexible metal conduit

B. Conduit fill shall be limited to not more than six (6) conductors, not including ground conductor.

3.02

PULL WIRES

- A. RGS, IMC, EMT: Use steel, nylon or polypropylene pull wires.
- B. PVC, RA, FMC; LFMC: Use nylon or polypropylene only.

3.03

CONDUIT INSTALLATION (GENERAL)

- A. Conduit system to be electrically continuous and shall be grounded in accordance with NEC. Separate grounding conductors to be used in all conduits.
- B. All conduit terminations to be equipped with locknuts and bushings. Conduits 1-1/4" and larger shall have insulating bushings, grounding lug and shall have locknuts inside and outside the enclosure.
- C. Conduits to be supported by pipe straps or trapeze hangers shall have their supports spaced not more than 8'-0" on center. Secure supports by means of toggle bolts, inserts or expansion bolts.

- D. Conduits to be supported by wall brackets shall have their supports spaced not more than 4'-6" on center. Secure supports by means of toggle bolts, inserts or expansion bolts.
- E. Conduits shall be supported directly from structural members not from ceiling suspensions system, ductwork, air handling units, pump bases, piping, etc. Additional supports shall be provided at junction and pull boxes.
- F. Conceal raceways in floors, walls, ceilings or furred spaces in finished areas wherever possible.
- G. Support single horizontal conduits 1-1/4" and larger by means of rod and cast ring hangers. Support multiple horizontal runs of conduit in similar manner or use common trapeze hanger similar to Unistrut P2000 or P4000 as required for span and loading. Provide end caps on Unistrut type hangers in mechanical rooms. Conduits on Unistrut may be fastened by means of heavy galvanized steel straps if the Unistrut is above 7'-0" above finished floor.
- H. Surface mounted horizontal and vertical conduit supports on walls up to a height of 7'-0" above the floor shall be one or two hole sheet metal pipe straps. Pinch type hangers similar to Minerallac type may only be used at heights greater than 8'-0". The use of pinch type hangers similar to Minerallac type are expressly prohibited on ductwork, air handling units, and other mechanical equipment below 8'-0".
- I. Protect conduits during construction with temporary plugs or caps. All conduit shall be securely capped until wire or cable is installed therein.
- J. Minimum conduit size is 3/4".
- K. Conduit fittings similar to Condulet type shall be used as required to keep conduits close to building surfaces.
- L. No conduit shall be installed in concrete slab.
- M. Furnish expansion fittings where raceway crosses the building expansion joints. (O.Z. Type AX, EX, EXDS, TX, EXE or approved equal.)
- N. Provide pull wire in all conduits where other contractors or utilities are to install cables (i.e.: telephone, computer and other such conduit systems).

- O. Electrical drawings show the intended arrangement and routing of all conduit and devices they shall be followed as closely as actual building construction will allow. The Contractor shall coordinate his work with the different trades so that interferences between conduit, cable tray, piping, equipment, architectural and structural work shall be avoided. Should an interference arise, the Contractor shall inform the Engineer before proceeding with the work. Should the Contractor fail to contact the Engineer and interferences develop, the Owner's Representative will decide which equipment, piping, etc. must be replaced, regardless of which was installed first. The relocating shall be performed at no expense to the Owner.
- P. Conduit shall be continuous between power source, equipment, junction or pull boxes and fittings, and shall enter and be secured to all boxes in such a manner that each system shall be electrically continuous from point of service to all outlets.
- Q. There shall not be more than the equivalent of three 90° bends in any single run of conduit between outlet boxes or fittings. Bends shall be made so that the conduit will not be flattened or kinked and that the internal diameter of the conduit will not be reduced. The radius of the curve of the inner edge of any bend shall not be less than as indicated by the National Electrical Code.
- R. In no case shall any conduit be bent or any fabricated elbow be applied to less than the allowable bending radius, as specified by the cable manufacturer of the installed conductor.
- S. When it is necessary to make field bends, they shall be made with tools designed for conduit bending. Heating of metallic conduit to facilitate bending is not permitted.
- T. Conduit shall be installed so as to incorporate a minimum of one pull box or conduit fitting per 100 foot run for easy installation of wire.
- U. The Contractor shall not cut, burn or drill any structural member to mount electrical equipment or to facilitate tray or conduit installations without having previously received approval, in writing, from the Owner or Engineer.
- V. Use steel set screw type fittings on all EMT conduit, compression type and/or pot metal or die-cast fittings are not acceptable.
- W. Pulling of wire or cable shall be immediately preceded by a thorough cleaning of the conduit to make it completely free of water or foreign matter.
- X. Mount all conduits a minimum of seven inches above any accessible type ceiling or with spacing as required to permit relocation of recessed fixtures to any location.

- Y. Below or in floor conduit installation is to be anchored to prohibit floating within the concrete floor installation. Obtain approval from a flooring consultant on the proper cutting and patching required for existing floor electrical installations to insure proper floor finish results.
- Z. Exterior site lighting conduit will be Schedule 40 PVC with a minimum size of 1". Burial depth shall be a minimum of 24" below grade or below the frost line, whichever is greater.
- AA. All conduit installed outdoors or in concrete shall be temporarily capped or plugged immediately after installation. Seal all conduit penetrations where conduit passes from wet to dry areas.

3.04

SPECIAL CONDUIT LOCATION REQUIREMENTS

- A. Conduit run shall be kept at least six inches from insulated pipes, steam lines or any other hot pipes which they pass. Where the lines are not insulated, the clearances shall be increased until the temperature of the conduit, with no live conductors enclosed, does not rise above the ambient temperature, of the installation area.
- B. The location and sizing of conduit sleeves passing through floors, walls, etc. that are not shown on the drawings, shall be the responsibility of the Contractor subject to the Owner and Engineer's approval.
- C. Install all raceways concealed except at surface cabinets, for motor and equipment connection and in mechanical rooms.
- D. Provide flashing and counterflashing or pitch pockets for waterproofing of all raceways, outlets, fittings, etc. which penetrate the roof.
- E. Route all raceways parallel or perpendicular to the building lines with right angle turns and symmetrical bends.
- F. Provide sleeves in forms for new concrete walls, floor slabs and partitions for passage of raceways. Seal in an approved manner all raceway openings and sleeves through fire rated walls, floors and ceilings after raceway installation. Waterproof all sleeves raceways where required. Submit shop drawings showing locations of all sleeves through slabs, walls and masonry partitions.

3.05 CONDUIT INSTALLATION (RIGID AND IMC)

- A. Rigid and IMC conduit shall utilize threaded type fittings. Ends of conduit shall be threaded with five full threads and shall be reamed out to remove any rough edges and burrs. All conduit shall be thoroughly cleaned internally prior to installation of the conductors. Long threads known as "running threads" shall not be used. Field cuts on conduit shall be made with a hand or power saw or approved cutting machine and shall be made square.
- B. Conduit threads shall be coated with an approved conductive lubricant before the couplings are applied. Teflon tape shall not be used to lubricate any threaded conduit connections.

3.06 CONDUIT INSTALLATION (ALUMINUM)

- A. Use nylon pull ropes only with aluminum conduit.
- B. Lubricate screw threads with approved aluminum lubricant before assembling conduit fittings to pipe.

3.07 CONDUIT SLEEVES

- A. Furnish, locate and set sleeves where conduit passes through floors, walls and other concrete or masonry structural materials except where tunnels, chases or shafts are provided in the construction. Sleeves through poured-in-place concrete floors shall be set prior to the pour and shall be of a design that will seal against passage of water between sleeves and concrete floor.
- B. Wall sleeves shall finish flush with walls. Floor sleeves shall extend 3" above finished floors unless otherwise specified.
- C. The void between the sleeve wall and conduit shall be neatly filled with an approved fire stop material.

3.08 UNDERGROUND RACEWAYS

A. Low Voltage Feeder/Service Entrance

The system shall consist of Schedule 40 PVC, IMC or RGS conduits. Concrete encased and quantity as indicated on drawings. Minimum conduit size is 4" unless otherwise noted on the drawings. Spacing between conduits shall be a minimum of 2" and the concrete envelope where required shall be 3" thick. Use end bell fittings where conduits terminate in manholes or building walls. Plastic conduit spacers shall be used to support conduits and to maintain proper spacing. Install polyethylene plugs on unused conduits. The top of ductbanks shall be minimum of 2'-6" below grade and shall be sloped to drain away from buildings. Install a magnetic type marking tape 1' above top of ductbank. Bends in ductbank shall be 30" minimum radius. Where concrete encased ductbank connects to a building install #4 re-bars in corner and tie to building wall reinforcing steel. Use similar method at manholes. At completion of construction of ductbank pull a brush or pig through all conduits in presence of Owner's representative to verify accessibility of conduit system.

B. Low Voltage Branch Circuits

Minimum burial depth of 2'-6" for Schedule 40 PVC is required. Junction boxes and covers for branch circuits shall be constructed of cast iron or cast aluminum with neoprene gaskets and stainless steel screws.

C. Telecommunication System

1. The underground raceway system for the telecommunication system shall be constructed with similar methods to those outlined above in paragraph 'A' except use Schedule 40 PVC conduit only for telecommunications ducts.
2. Install "inner-duct" in one of the ducts as follows:
 - a. Manhole-to-building" (1) 3 channel inner-duct, 1-1/2" channel.
 - b. Inner-duct shall be U.L. listed for use with telecommunications/fiberoptic cabling systems.
 - c. Manufacturers: Carlon or approved equal.

3.09 OUTLET BOX INSTALLATION

- A. Set box square and true with finished building surfaces and trim.
- B. Secure boxes firmly to building structure.
- C. Verify location of outlets and switches in finished rooms with Architectural Drawings of interior details and finish. In centering outlets and locating boxes, allow for overhead pipes, ducts and mechanical equipment, variations in fireproofing and plastering, window and like, and correct any inaccuracy from failure to do so without expense to the Owner.
- D. Maintain symmetry of all outlets as closely as possible within Architectural Section contained. For example, the Contractor shall center light fixture over doorway or receptacle in section of masonry wall, if shown in that approximate position. If receptacle is shown in same location as counter or bench, determine countertop height and set receptacle to clear top and trim of counter and render outlet easily accessible.
- E. In the event of conflict between locations of electrical outlets as shown on the Electrical Drawings and on the Architectural Drawings, outlets shall be installed in accordance with the latter.
- F. Locate light switches on latch side of door and verify door hinge location in field prior to switch outlet installation.
- G. Protect devices on outlets in locations where outlets are subject to injury, by means of wire guards or other approved means of protection. (Example: Provide wire guards on all "exit" signs, emergency egress lighting and other surface mounted equipment in gymnasiums).
- H. The Owner reserves the right to relocate any device as much as 10'-0" (measured horizontally) from it's indicated location at no additional cost, provided the contractor is notified prior to roughing that device in.

3.10 JUNCTION AND PULL BOX INSTALLATION

- A. Provide pull boxes wherever necessary to facilitate pulling of wire and as indicated.
- B. Locate junction and pull boxes as approved, generally not exposed in finished space unless otherwise indicated or approved by Engineer. Where necessary, reroute conduit or make other arrangements for concealment as required.
- C. Covers shall be accessible.

- D. Junction boxes for fixtures, recessed in hung ceiling, to be accessible through opening created by removal of the fixtures.

3.11 SLEEVE INSTALLATION

- A. Sleeves shall be mounted in concrete forms prior to concrete pour as recommended by sleeve manufacturer.
- B. Oversized PVC conduit sleeve shall be cut off to proper length prior to pour.
- C. Sleeve shall be capped at both ends as recommended by manufacturer to prevent entry of foreign material during concrete pour.

END OF SECTION

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SECTION 26 05 40

TRENCHING, BACKFILLING AND COMPACTING

PART 1: GENERAL

1.01 **RELATED WORK SPECIFIED ELSEWHERE**

- A. General Provisions: Section 26 05 01
- B. Raceways and Boxes: Section 26 05 33

1.02 **REFERENCES**

The latest issues of the following documents form a part of this specification to the extent hereinafter specified.

- A. American Society of Testing Materials (ASTM)
 - 1. D698 Standard Proctor Maximum Dry Density
 - 2. D1556-64 Density of Soil in Place by the Sand Cone Method
 - 3. D2167-66 Density of Soil in Place by the Rubber Balloon Method
- B. Indiana State Highway Commission Standard Specifications (ISHSS), Section 903, Aggregates

1.03 **DELIVERY, STORAGE AND HANDLING**

- A. Imported materials shall be stockpiled on site where directed if not ready for installation. Maintain segregation of differing materials.
- B. Do not deliver materials until ready for incorporation into the permanent work. Storage space is not available.

1.04 **PROJECT/SITE CONDITIONS**

- A. Subgrade and embankment protection
 - 1. During construction, embankments and excavations shall be kept shaped and drained. Ditches and drains along the subgrade shall be maintained in such manner as to drain effectively at all times.
 - 2. Operate pumping equipment as required to keep the excavation free of water and subgrades dry, firm and undisturbed until approval of the permanent work has been received from the Architect.
 - 3. Where ruts occur in the subgrade, the subgrade shall be brought to grade, reshaped if required and recompacted prior to the placing of surfacing.

4. The storage or stockpiling of materials on a finished subgrade will not be permitted.
 5. Erosion control shall be performed by this Contractor until the installation of permanent vegetation, structures and erosion control devices.
- B. Protection of top soil areas: after placement of top soil, all such areas shall be protected from heavy machinery. All topsoil compacted by heavy machinery shall be removed and replaced at no additional cost to the Owner.
- C. Shore and brace excavations as necessary to prevent cave-ins.

PART 2: **PRODUCTS**

2.01 **MATERIALS**

Select Aggregate: No. 14-2 sand in accordance with ISHSS 903.01(g).

PART 3: **EXECUTION**

3.01 **INSPECTION**

Before commencement of work, verify the following with the documents associated with all site work.

- A. Verify installation of fences.
- B. Protective fencing for trees and plants has been installed as specified.
- C. Demolition of miscellaneous structures.
- D. Clearing and grubbing.
- E. Stripping and disposal of sod and stripping and stockpiling of topsoil.

3.02 **PREPARATION**

- A. Layout the various lines on the ground using stakes, flags or painting.
- B. Do not proceed with excavation until layout is approved.
- C. Set line and grade stakes as required or specified in the various sections covering the installation of conduits.

3.03

TRENCHING

- A. General: All excavation of every description and of whatever substances encountered shall be performed to the depths indicated or as otherwise specified. During excavation, material suitable for backfilling shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins. All excavated materials not required or suitable for backfill shall be removed. Grading shall be done as may be necessary to prevent surface water from flowing into trenches or other excavations and any water accumulating therein shall be removed by pumping or by other approved methods. Sheet piling and shoring shall be placed as may be necessary for the protection of the work and for the safety of personnel. Unless otherwise indicated, excavation shall be by open cut except that short sections of a trench may be tunneled if the conduit can be safely and properly installed and backfill can be compacted in such tunnel sections.

- B. Trench Excavation: Trenches shall be of the necessary width for proper laying of conduit. The banks of trenches shall be as neatly vertical as practicable. Care shall be taken not to over-excavate. The bottom of the trenches shall be accurately graded to provide a uniform surface for the type of bedding specified. Stones shall be removed as necessary to avoid point bearing. Except as hereinafter specified for wet or otherwise unstable material, overdepths shall be backfilled as and with materials specified for backfilling the lower portion of trenches. Whenever wet or otherwise unstable material that is incapable of properly supporting the conduit is encountered in the bottom of the trench, such material shall be overexcavated to a depth to allow for construction of a stable conduit bedding.

- C. Special requirements for specific utilities.
 - 1. Electrical Conduits: unless otherwise indicated, trenches shall be excavated to a depth that will provide not less than 3 feet of cover over the top of the conduit from finished grade.
 - 2. Excavation for Appurtenances: Excavation for manholes, junction boxes and similar structures shall be sufficient to leave at least 12" clear space between the outer surface of structure and the bank or timber that may be used to hold and protect the banks. Any overdepth excavation below such appurtenances that has not been directed will be considered unauthorized and shall be refilled with sand, gravel or concrete as directed at no additional cost to the Owner.

3.04

BACKFILLING

- A. General: After bedding, the trenches shall not be backfilled until all required tests are performed. Except as otherwise specified for special conditions of overdepths, trenches shall be backfilled to the ground surface with selected material as hereinafter specified. Trenches improperly backfilled shall be reopened to the depth required for proper compaction, then refilled and compacted as specified or the condition shall be restored to its original condition as near as practicable and as hereinafter specified.
- B. Backfilling lower portion of trench: No. 14 sand shall be deposited in 6-inch maximum thickness layers and compacted with suitable tampers to the specified density and graded as hereinafter specified until there is a cover of not less than one foot over other utility lines unless detailed otherwise. If any portion of the cover in the lower portion of the trench is in the depth of special compaction and materials requirements under pavement, the special requirements shall control. Special care shall be taken not to damage the coating or wrapping of conduit.
- C. Backfilling remainder of trench: Except for special materials for pavements, the remainder of the trench shall be backfilled with excavated material that is free of stones larger than three inches or one-half the layered thickness, whichever is smaller, in any dimension. Backfill material shall be deposited in layers not exceeding the thickness specified hereinafter and each layer shall be compacted to the minimum specified hereinafter as applicable to the particular area.
- D. Backfilled under Roadways, Parking Areas and Walks: Six inch layers, at least 95% of maximum density at moisture contents ranging from 1% below to 4% above optimum up to the elevations at which the requirements for pavement subgrade materials and compaction control.
- E. Trenches within the building: Entire trench shall be backfilled with No. 14-2 sand in six inch layers to subgrade line for capillary water barrier.
- F. Under sodded or seeded areas: Twelve inch layers, at least 88% of maximum density at moisture contents ranging from 1% below to 4% above optimum up to the elevation at which topsoil requirements control.
- G. Topsoil placement: Placement and depth as indicated on the drawings or described herein. Contractor shall overfill by 20% to allow for settlement.

3.05 TESTS

- A. Tests for and Control of Density: Tests for determination of maximum density and optimum moisture shall be the responsibility of the Electrical Contractor and shall be performed by the Testing Agency in accordance with the requirements of ASTM D698 Standard Proctor maximum dry density. Samples shall be representative of the materials to be placed. An optimum moisture-density curve shall be obtained for each principal type of material or combination of materials encountered or utilized. Results of these tests shall be the basis of control for compaction. The above testing shall include Atterberg limits, grain size determinations and specific gravity.

- B. Test for Density Control: The Testing Agency will control the density of the backfill by test made in accordance with ASTM Standard D1556. A density test shall be made for each foot of fill for each 200 lineal feet or less of trench. The Contractor shall make as many additional tests as he requires to obtain the specified density at all points.

3.06 PAVEMENT REMOVAL AND REPLACEMENT

- A. Where construction requires cutting and replacing of flexible pavement, cutting shall be so accomplished that the remaining exposed edges shall conform vertically and horizontally to a straight line. Width of the section of pavement removed shall be of necessary width for proper laying of pipe or duct. After the pavement is removed to its full depth, the surface course shall be cut back one foot on both sides of the trench with a concrete saw to provide a true joint in the surface courses. Pavement removed shall be replaced to the same section, materials and compaction as the original pavement. Waste materials shall be disposed of by the Contractor offsite at his own expense and responsibility.

- B. Where construction requires removal and replacement of rigid pavement, the cutting shall be accomplished by a concrete saw, minimum depth of vertical cut shall be one inch. The remaining depth of section may be broken out in any approved manner. Width of section removed shall be such that no area of pavement removed or replaced and no adjacent slab or portion of slab which remains in the pavement abutting the replacement slab shall have length or width between joints of less than 10 feet. Pavement removed shall be replaced to the same section using Class E concrete. Concrete rubble resulting from the above operations shall be disposed of offsite at the Contractor's expense and responsibility.

END OF SECTION

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SECTION 26 22 13

LOW VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1: **GENERAL**

1.01 **RELATED WORK SPECIFIED ELSEWHERE**

- A. General Provisions: Section 26 05 01
- B. Raceways and Boxes: Section 26 05 33
- C. Low Voltage Electrical power Conductors and Cables: Section 26 05 19
- D. Grounding and Bonding: Section 26 05 26

1.02 **SUBMITTALS**

Submit shop drawings and data sheets on each size of transformer in accordance with Specification Section 26 05 01, General Provisions.

PART 2: **PRODUCTS**

2.01 **GENERAL PURPOSE THREE PHASE TRANSFORMERS (30 KVA AND ABOVE)**

- A. Dry type, air insulated and air cooled.
- B. Insulation: 40°C ambient plus 115°C rise plus 30°C hot spot = 185°C class.
- C. Cores: high grade, non-aging, sheet silicon steel laminations having core plating insulation on both sides of each laminations.
- D. Impedance: not less than 3.5%
- E. Terminal Boards: to be provided on all units.
- F. Connections: 480V-120/208V (delta/wye).
- G. Taps: two 2-1/2% full capacity above normal; four 2-1/2% full capacity below normal.
- H. Overload Capacity: not less than 10% for intermittent operation.
- I. Size: KVA as indicated on the drawings.

- J. Sound Rating: not greater than 50 db up to and including 150 KVA; not greater than 55 db up to and including 300 kva and not greater than 60 db up to 500 kva.
- K. Cabinets: sheet steel, phosphatized having one prime coat and two finish coats of baked enamel.
- L. Nameplate: all transformers to have metal or plastic nameplate listing manufacturer's name, serial number, type, class, KVA, voltage, frequency and showing an internal wiring diagram.
- M. Manufacturers: General Electric; Hevi-Duty; Jefferson; Precision; Cutler Hammer/Westinghouse; Sorgel; Siemens.

PART 3: **EXECUTION**

3.01 **TRANSFORMER INSTALLATION**

- A. Unless otherwise indicated on the drawings, all dry type transformers up to and including 75 KVA shall be mounted on rigid steel platform suspended from building structure by means of steel rods or brackets. Verify structural requirements with Structural Engineer and provide additional supports framing as required for proper installation.
- B. Transformers above 75 KVA shall be floor mounted, unless otherwise indicated on the drawings.
- C. Mount all transformers on Korfund Electro-Rib 1" thick vibration eliminators loaded to 50# per square inch. Provide this vibration eliminator even if transformer is internally isolated.
- D. Conduit connections to transformers shall be liquid tight flexible. Conduit or flexible metal conduit.

3.02 **TRANSFORMERS - TESTING (DRY TYPE)**

- A. Visual and Manual Inspection
 - 1. Inspect for physical damage, cracked insulators, tightness of connections, defective wiring and general mechanical and electrical conditions.
 - 2. Compare equipment nameplate information with latest single line diagram and report discrepancies.
 - 3. Check tightness of accessible bolted electrical joints in accordance with National Electrical Testing Association Standards.
 - 4. Perform specific inspections and mechanical tests as recommended by manufacturer.

5. Make a close examination for shipping brackets or fixtures that may not have been removed during original installation. Ensure resilient mounts are free.
6. Verify proper core grounding.
7. Verify proper equipment grounding.
8. Verify unit is clean and dry prior to testing.

B. Electrical Tests

1. Perform insulation resistance tests, winding-to-winding and windings-to-ground, utilizing a megohmmeter with test voltage output as recommended by manufacturer and National Electric Testing Association. Test duration shall be for 10 minutes with resistance tabulated at 30 seconds, 1 minute and 10 minutes. Dielectric absorption ratio and polarization index will be calculated.
2. Perform a turns ratio test between windings at all tap settings.
3. Perform winding resistance tests for each winding at nominal tap position.
4. Perform individual excitation current tests on each phase in accordance with established manufacturer's procedures.
5. Verify that the tap-changer is set at specified ratio.
6. Measure secondary voltage phase-to-phase and phase-to-ground after final energization and prior to loading.

END OF SECTION

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SECTION 24 24 14

SWITCHBOARDS (277/480V-3PH-4W)

PART 1: GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. General Provisions: Section 26 05 01
- B. Raceways and Boxes for Electrical Work: Section 26 05 33
- C. Low Voltage Electrical Power Conductors and Cables: Section 26 05 19
- D. Panelboards: Section 26 24 16
- E. Low Voltage Controllers: Section 26 29 00
- F. Low Voltage Circuit Protective Devices: Section 26 28 00
- G. Grounding and Bonding for Electrical Systems: Section 26 05 26

1.02 SUBMITTALS

Submit shop drawings in accordance with Specification Section 26 05 01.

1.03 CHARGES BY LOCAL UTILITY COMPANY

Obtain from local utility company, an estimate of the billable expenses that the utility company expects to incur on this project and include this price in your bid. The successful bidder shall pay these charges.

PART 2: **PRODUCTS**

2.01 **SWITCHBOARD**

- A. Switchboard shall be dead front type, completely metal enclosed, self-supporting structure independent of wall supports. It shall consist of the required number of vertical sections bolted together to form one rigid switchboard 90" high incorporating switching and protective devices of the number, ratings and type noted herein with all necessary interconnections, instrumentation and control wiring. Switchboard construction shall be of the universal frame type using die-formed members bolted and braced in such a manner that the bolts which will not loosen during shipment. The sides, top and rear shall be covered with removable screw-on plates having formed edges all around. Front plates shall be sectionalized and removable. All front plates shall be fabricated from code gauge steel and shall have formed edges all around. Ventilation openings shall be provided where required. All covers shall be secured by self-tapping screws. Switchboard shall be Class I.
- B. The bus shall be silver plated copper of sufficient size to limit the temperature rise to 65°C based on UL tests and adequately braced and supported to withstand mechanical forces exerted during short circuit conditions.
- C. Small wiring, necessary fuse blocks and terminal blocks for instrumentation within the switchboards shall be furnished. All groups of control wires leaving the switchboards shall be provided with terminal blocks with suitable numbering strips. All hardware used on conductors shall have a high tensile strength and an anti-corrosive zinc plating. Provide the following switchboard instrumentation via a digital multi-meter
 - 1. Voltmeter with phase selector switch
 - 2. Ammeter with phase selector switch
 - 3. KWH
 - 4. KW Demand
 - 5. KVAR Demand
 - 6. Power factor
- D. A ground lug shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchboard. A ground lug shall be furnished attached to the ground bus in a convenient location.
- E. Switchboard shall be provided with adequate lifting means and shall be capable of being rolled or moved into installation position.
- F. A-B-C type bus arrangement, left-to-right, top-to-bottom, and front-to-rear, as viewed from the front, shall be used throughout.

- G. Each switching and protective device shall be provided with visible means of ON-OFF identification. All terminals shall be of the anti-turn solderless type suitable for Cu or Al cable of sizes indicated.
- H. All exterior and interior steel surfaces of the switchboard shall be properly cleaned and finished with gray baked enamel over a rust-inhibiting phosphatized coating.
- I. Switchboard shall utilize individual fused switches or circuit breakers as required with sections having whatever depth is necessary to accommodate and connect the equipment. All vertical sections shall align front or rear.
- J. All devices, main and feeders, shall be front accessible.
- K. Main horizontal bus bars shall be mounted on glass polyester insulators with all three phases arranged in the same vertical plane. The main bus shall have a maximum ampacity of 4000 amperes and shall be braced for short circuits up to 75,000 amperes. Main bus splices shall be supplied between adjacent distribution sections.
- L. Switchboard shall bear UL labels. Designs shall meet NEC and NEMA standards as well as OSHA requirements.

2.02

CIRCUIT BREAKERS - MOLDED CASE

- A. These units shall be single or multi-pole as required and shall have a quick-make, quick-break mechanism.
- B. Breakers shall have overload elements of the thermal magnetic type that provides inverse time delay and instantaneous short circuit protection. Each pole of a breaker shall contain an overload element. Multi-pole units shall have a common tripping mechanism. Breakers rated 250 amps and above shall have adjustable trip units. Trip setting shall be as indicated on the drawings.
- C. Breakers shall have a toggle type handle with three positions indicating "on", "off" or tripped". A breaker tripping on overload shall be clearly indicated by the handle assuming a midway position between "on" and "off".
- D. All breakers shall be bolt-in type and shall be full size single units.
- E. Trip rating and other interrupting requirements shall be as shown on the drawings. Minimum interrupting capacity shall be 50,000 amps.
- F. Manufacturers: Siemens; Square D; General Electric; Challenger; Cutler-Hammer/Westinghouse

PART 3: EXECUTION

3.01 **INSTALLATION**

- A. Switchboard shall be installed on 3-1/2" high concrete housekeeping pad where indicated on the drawings.
- B. Installation of switchboard shall meet all NEC and manufacturer's requirements.

3.02 **INSPECTION AND TEST PROCEDURES FOR SWITCHGEAR AND SWITCHBOARD ASSEMBLIES**

These tests to be conducted by a National Electrical Testing Association Certified Testing Company.

A. Visual and Mechanical Inspection

- 1. Inspect for physical, electrical and mechanical condition.
- 2. Compare equipment nameplate information with latest single line diagram and report discrepancies.
- 3. Verify that circuit breaker sizes and types correspond to drawings.
- 4. Verify that current and potential transformer ratios correspond to drawings.
- 5. Inspect all bus connections for high resistance. Use low resistance ohmmeter, or check tightness of bolted bus joints by calibrated torque wrench method. Refer to manufacturer's instructions or National Electrical Testing Association Standards for proper torque levels.
- 6. Test all electrical and mechanical interlock systems for proper operation and sequencing.
- 7. Clean entire switchgear using manufacturer's approved methods and materials.
- 8. Exercise all active components.
- 9. Inspect all indicating devices for proper operation.

B. Electrical Tests

- 1. Perform ratio and polarity tests on all current and voltage transformers.
- 2. Perform ground resistance test in accordance with Specification Section 16450, Grounding.
- 3. Perform control wiring performance test. Use the elementary diagrams of the switchgear to identify each remote control and protective device. Conduct tests to verify satisfactory performance of each control feature.
- 4. Perform secondary voltage excitation test on all control power circuits and potential circuits as detailed in Sections 7.1.2.12 and 7.1.2.13. Voltage levels will be checked at each point on terminal boards and at each terminal on devices.

5. Perform current injection tests on the entire current circuit in each section of switchgear.
 - a. Current tests will be made by primary injection, where possible, with magnitudes such that a minimum of 1.0 amp flows in the secondary circuit.
 - b. Where primary injection is impractical, secondary injection shall be utilized with a minimum current of 1.0 amp.
 - c. Incoming and outgoing current will be tested at each device.
 - d. All current transformers will have the following tests performed in accordance with ANSI/IEEE C57.13.1.
 - (1) Determine the burden of the current transformer secondary circuit and saturation level of the current transformer.
 - (2) Test current transformer circuits supplying overcurrent relays to determine proper operation at the relay tap value. Verify that the maximum current deliverable by the CT is not below the maximum value required by the coordination study.
6. Calibrate all meters at midscale. Calibrate watt-hour meters to one-half percent (.05%). Verify multipliers.
7. Control Power and Potential Transformers
 - a. Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
 - b. Verify proper primary and secondary fuse ratings or circuit breakers as indicated.
 - c. Verify proper interlock function and contact operation.
 - d. Verify taps if applicable and connect transformer to desired tap.
 - e. Verify secondary voltage by energizing primary winding with system voltage. Measure secondary voltage with the secondary wiring disconnected.
 - f. Perform secondary wiring integrity test. Disconnect transformer at secondary terminals and connect secondary wiring to proper secondary voltage. Check potential at all devices.

3.03

THERMOGRAPHIC SURVEY OF SWITCHBOARD

- A. Visual and Mechanical Inspection
 1. Inspect for physical, electrical and mechanical condition.
 2. Visually inspect for bus alignment.
 3. Remove all necessary covers prior to scanning.
- B. Equipment to be Scanned: Switchgear, cables, cable and bus connections and circuit breakers.

- C. Provide Report Indicating the following:
1. Problem area (location of "hot spot").
 2. Indicate temperature rise between "hot spot" and normal or reference area.
 3. Indicate cause of heat rise.
 4. Indicate phase unbalance, if present.
 5. Index of areas scanned.
- D. Test Parameters
1. Scanning distribution systems with ability to detect 1°C rise between subject area and reference at 30°C.
 2. Equipment shall detect emitted radiation and convert detected radiation to visual signal.
 3. Provide photographs (thermograms) of the deficient area as seen on imaging system.
 4. Infrared surveys should be performed during periods of maximum possible loading, but not less than forty percent (40%) of rated load of the electrical equipment being inspected.
- E. Test Results
1. Temperature gradients of 1°C to 3°C indicate possible deficiency and warrant investigation.
 2. Temperature gradients of 4°C to 15°C indicate deficiency; repair as time permits.
 3. Temperature gradients of 16°C and above indicate major deficiency; secure power and repair as soon as possible.

3.04 GROUNDING FAULT SYSTEMS (NEC 230-95)

Visual and Mechanical Inspection

- A. Inspect for physical damage and compliance with plans and specifications.
- B. Inspect neutral main bonding connection to assure:
1. Zero sequence sensing system is grounded
 2. Ground strap sensing systems are grounded through sensing device.
 3. Ground connection is made ahead of neutral disconnect link on zero sequence sensing systems.
 4. Grounded conductor (neutral) is solidly grounded.

- C. Inspect control power transformer to ensure adequate capacity for system.
- D. Monitor panels (if present) shall be manually operated for:
 - 1. Trip test
 - 2. No trip test
 - 3. Non-automatic reset
- E. Proper operation and test sequence shall be recorded.
- F. Inspect zero sequence systems for symmetrical alignment of core balance transformers about all current carrying conductors.
- G. Verify ground fault device circuit nameplate identification and device operation.

END OF SECTION

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SECTION 26 24 16

PANELBOARDS

PART 1: GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. General Provisions: Section 26 05 01
- B. Raceways and Boxes: Section 26 05 33
- C. Low Voltage Electrical Power Conductors and Cables: Section 26 05 19

1.02 WORK INCLUDED

Furnish and install material, labor and accessories required for the following pieces of equipment as shown on the drawings and specified herein.

Panelboards

1.03 SUBMITTALS

Submit shop drawings for distribution equipment in accordance with Specifications Section 26 05 01, General Provisions.

PART 2: PRODUCTS

2.01 PANELBOARDS

- A. Provide panels consisting of an assembly of branch circuit switching and protective devices mounted inside a dead front enclosure. Provide the number, size and arrangement of these branch circuit devices as shown on the drawings.
- B. Panelboard Interior
 - 1. Rigid removable assembly of copper bus bars and interchangeable bolted branch circuit devices.
 - 2. Bus bars drilled to permit branch circuit devices of all sizes and number of poles to be interchangeable and installed in any spare space of sufficient size, without disturbing adjacent units, removing main bus or branch circuit connectors and without machining, drilling and tapping.

3. Arrange bus in sequence or distributed phasing so that multi-pole circuit breakers can replace any group of single pole circuit breakers of the same size.

C. Enclosure

1. Code gauge 20" wide (minimum) steel box galvanized after fabrication with turned up peripheral front edge, bolted joints and multiple knockouts on top and bottom.
2. Provide isolated ground bus on inside of tub.
3. Minimum gutter sizes as follows:

Panel Sides	Top and Bottom	
	No Main Lugs	Main Lugs
20 poles or less	4" or 5"	6"
More than 20 poles	6" or 6"	8"
Feed thru cables	8" (one side only)	

4. Flush mounted in finished areas and where indicated. Surface mount elsewhere.

D. Front

1. Provide door in door construction.
2. Heavy code gauge steel reinforced with welded corners on rear as required to maintain panel face flat.
3. Provide lock in stainless steel or brushed chrome finished in door over branch circuit devices (or approved equal). All panels keyed alike. Supply four (4) keys to Owner.
4. Bold front closed with trim clamps.
5. Same size fronts on panels mounted adjacent to other panels or telephone cabinets. Largest required size governs height of all.
6. Factory finished in medium gray baked enamel or two coats of air drying lacquer over a rust inhibitor.

E. Terminals

1. Bolted type, suitable for copper conductors.
2. Locate main lugs properly at top or bottom depending where main feeder enters.

- F. Electrical Ratings
 - 1. 120/208 volts, three phase, four wire, full neutral, Type NQOD (as manufactured by Square D) or equal unless otherwise noted.
 - 2. 277/480 volts, three phase, four wire, full neutral, Type NEHB (as manufactured by Square D) or equal unless otherwise noted.
- G. Manufacturers: General Electrical, Square D, Siemens, Cutler Hammer

PART 3: **EXECUTION**

3.01 **PANELBOARD INSTALLATION**

- A. Support panel cabinets independently to building structure with no weight bearing on conduits.
- B. Securely anchor surface mounted panelboards to masonry walls with heavy duty machine bolt anchors.
- C. Install recessed panelboards to allow cover to be drawn tight against wall to provide neat appearance.
- D. Install panelboards so top breaker is no higher than 6'-0" above the floor.
- E. Protect panelboards and cabinets during construction to prevent damage and entry of dirt, paint, etc.
- F. Adjacent panel cabinets shall be mounted in horizontal alignment at top.
- G. Wiring inside the equipment, panels and boxes shall be installed in a neat and workmanlike manner.

3.02 **BALANCING ELECTRICAL LOAD**

Care shall be exercised in connecting various electrical loads to panelboards in order to arrive at reasonable balance between loads on each phase at each panelboard. It will be the responsibility of the Electrical Contractor to make tests and adjust loads at each panelboard to result in a reasonably balanced load condition, satisfactory to the Owner.

END OF SECTION

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SECTION 26 27 26

WIRING DEVICES

PART 1: GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. General Provisions: Section 26 05 01
- B. Raceways and Boxes for Systems: Section 26 05 33
- C. Low Voltage Electrical Power Conductors and Cables: Section 26 05 19

1.02 SUBMITTALS

Submit shop drawings or data sheets on all devices and plates used in accordance with Specification Section 26 05 01, General Provisions.

PART 2: PRODUCTS

2.01 SWITCHES

- A. Specification grade switches shall be single pole, two pole, three way, four way, momentary, lighted or pilot lighted as required to control lights or other device and shall be toggle or key operated, heavy duty, specification grade, 20 amp, 120/277 volt, quiet type and shall meet the requirements of Federal Specifications WS-896-d and NEMA-WD-1. Assembly shall be by screw to mounting bridge. Screw into plastic base or riveting is not acceptable.
 - 1. Manufacturers: (with unlighted handle) Hubbell #CS1221; Bryant #4901; Cooper #2221; Pass & Seymour #20AC1; G.E. #5931; Leviton 1221-2
- B. Weatherproof switches shall be Bryant #4981, Hubbell #HBL1281 Series "Presswitch" with a #HBL1750 grey "Hypalon" coverplate; or Cooper #2991 Switch with a 2881G coverplate. Where a toggle switch is required, provide Hubbell Plate #1795.
- C. All switches shall have binding post terminals or pre-wired pigtails.

2.02

RECEPTACLES

- A. All receptacles shall be grounding type and shall be Duplex 120 volt, 120/208 volt, single phase, 208/240 volt, 277 volt, single phase or 120/208 volt and 277/480 volt, three phases as scheduled below or as indicated on the drawings.
- B. Specification grade duplex receptacles shall be 15 or 20 ampere, 125 volts, with impact resistant face, wrap around steel mounted strap, and shall meet the requirements of Federal Specification WC-596-e, NEMA WD-1 and UL-498.
 - 1. 15 ampere may be used on general circuits containing 2 or more receptacles.
 - 2. Use 20 ampere on all dedicated circuits with only 1 receptacle.
- C. Ground Fault (GFCI) Receptacles
 - 1. Receptacles shall be duplex style with impact resistant face with built-in ground interrupter set to trip out at a 5 milliamp maximum ground fault. Receptacles shall be rated 15 or 20 amperes, standard or feed-through as required.
 - 2. Manufacturers: Hubbell #GF-5252I; Hubbell #GF-5352I; General Electric #TGTR115; General Electric #TGTR115F; Bryant #GFR Series; Pass & Seymour #2091, Leviton 8899; Cooper XGF15; Cooper XGF20
- D. Weatherproof Duplex Receptacles (wet or damp label locations)
 - 1. Weatherproof duplex receptacles shall be 20 ampere, GFCI type with an appropriate weatherproof, UV stabilized polycarbonate or stainless steel gasketed coverplate with hinged lid that will allow cords to be installed while cover is completely closed and/or locked.
 - 2. Manufacturers:
 - Taymac #20310 - Vertical Mount GFCI
 - Taymac #60310 - Horizontal Mount GFCI
- E. All receptacles shall have binding post terminals. Provide all wiring devices with pigtail connectors. Connectors consists of a 6" long #12 AWG stranded wire with a #10 fork type brass terminal at one end and a factory attached copper alloy spring type twist-in wire connector at opposite end. Pigtails to be similar to Term-A-Nut by Ideal or equal.

F. Schedule of Receptacles, Plugs and Connectors

1. 125 volt, 20 amp, 2 pole, 3 wire grounding

NEMA CONFIGURATION	5-20R
MANUFACTURER	RECEPT.
a. Cooper Wiring Devices	5362
b. Bryant	5362
c. General Electric	5362
d. Hubbell	HBL5362
e. Pass & Seymour	5362A
f. Leviton	5362a

2. Color of Wiring Devices

- a. All device numbers listed herein are brown.
- b. All wiring devices in finished areas shall be (selected by Architect) that correspond to catalog numbers hereinbefore specified.
- c. All wiring devices in exposed boxes shall be (selected by Architect) that correspond to catalog numbers hereinbefore specified.
- d. All emergency receptacles shall be red in color.

3. Device Plates

- a. Provide proper plates on all switches, receptacles, special devices and outlets.
- b. Plates in finished areas shall be smooth type, impact resistant, flexible material similar to nylon. Phenolic not approved. Color shall be same as the device unless noted otherwise.
- c. Provide #302 or 304 brushed stainless steel plates for all receptacles in exposed boxes. Brushed finish shall extend to edges of plate including beveled surfaces.
- d. All general use plates shall be of same manufacturer as devices.
- e. Provide blank plates on all unused boxes.

2.03 PHOTO CELL

- A. Photocell shall be adjustment type rated 1800 watts at 120 volts.
- B. Housing shall be cast aluminum weatherproof with 1/2" nipple for conduit connection.

- C. Manufacturers: Tork #2101; Paragon #CW201; Intermatic K4121; or approved equal.

2.04

ASTRONOMIC TIME CLOCKS

A. General

1. A 40 ampere (tungsten) synchronous motor driven time switch with Astronomic dial.
2. Turns "ON" only at sunset; can be set 20 or 40 minutes before or after normal sunset to adapt to local area.
3. Turns "OFF" at sunrise or can be set from 8:30 pm to 2:30 am in half hour increments; no setting for seasonal changes as trippers follow the seasons.
4. Day-omitting feature: switch shall operate every day unless set to omit selected days.
5. Separate manual "ON/OFF" levers enable operation without disturbing automatic settings.
6. Different dials provided for every 140 miles or 2 degrees of north latitude; specify city of use; maximum 47° north.
7. Reserve power to keep dial on time for 16 hours in case of power failure (optional).

- B. Time switch contacts shall be capable of switching 40 amperes per pole continuously at 277 volts and shall be DPST, 3PDT or SPDT, as required.

- C. Enclosure shall be NEMA 1 surface type. Enclosure shall be finished in baked epoxy enamel with combination 1/2", 3/4" knockouts on bottom, both sides and top and back. Provision shall be made for positive padlocking and/or sealing.

- D. Terminals shall be of the pressure type capable of receiving #8 AWG wire.

E. Manufacturers

1. Tork #7200ZL; Paragon #4004-71SZ (DPST) Intermatic T174
2. Tork #7120ZL; Paragon #4006-71SZ (SPDT) Intermatic T175
3. Tork #7300ZL; Paragon #47217-27SZ (3PST) Intermatic T1471BCR
4. Or approved equal

2.05 CONTACTORS

- A. Use: in separate NEMA 1 enclosures to operate number of circuits simultaneously.
- B. Type
 - 1. Single coil, magnetically operated, mechanically locked type without hooks on latches.
 - 2. Mounting: on dampening device or in insulated cabinet.
 - 3. Contacts: silver with auxiliary arcing contacts.
 - 4. Lockout relays: to prevent simultaneous operation from two remote locations.
 - 5. Solid state control module for 2-wire control.
 - 6. Manufacturers: ASCO, Bulletin #917
- C. Remote control: three position momentary contact switch similar to Hubbell #1557.

2.06 PILOT LIGHT (OTHER THAN FOR MOTORS CIRCUITS)

- A. Red rectangular jewel with integral 125 volt neon lamp. Suitable for mounting in single gang box.
- B. Manufacturers: General Electric #GE04218-0; or approved equal.

PART 3: EXECUTION

3.01 SWITCHES AND RECEPTACLES

- A. Install switches and receptacles of adequate rating and capacity for loads served.
- B. Install single (multi-gang) wall plates for outlet boxes with more than one device.
- C. Receptacle Orientation: Vertically mounted receptacles shall be installed with ground pin slot up; horizontally with neutral blade slot up.

3.02 120 VOLT RECEPTACLE CIRCUITS

- A. Perform operational testing.
- B. Test receptacles with Woodhead #1750 or Hubbell #5200 Tester for proper connection of ground wire, correct polarity and faults in wire.

3.03 LABELS

- A. Coverplate of each receptacle shall be labeled identifying panelboard and branch circuit device serving the receptacle.

- B. Special purpose receptacles such as x-ray or other such equipment shall be labeled with engraved or embossed label identifying load served as well as the circuit and panelboard identification described above.

END OF SECTION

SECTION 26 28 00

LOW VOLTAGE CIRCUIT PROTECTIVE DEVICES

PART 1: GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. General Provisions: Section 26 05 01
- B. Raceways and Boxes: Section 26 05 33
- C. Low Voltage Electrical Power Conductors and Cables: Section 26 05 19
- D. Panelboards: Section 26 24 16
- E. Low Voltage Controllers: Section 26 29 00

1.02 WORK INCLUDED

Furnish and install material, labor and accessories required for the following pieces of equipment as shown on the drawings and specified herein.

- A. Circuit Breakers
- B. Fuses (Low Voltage)

1.03 SUBMITTALS

Submit shop drawings for distribution equipment in accordance with Specifications Section 26 05 01, General Provisions.

PART 2: PRODUCTS

2.01 CIRCUIT BREAKERS

- A. Contractor shall provide the following unless otherwise specified or shown on the drawings. See "Panel Schedules" for minimum panelboard I.C. ratings. All breakers in these panels shall meet the minimum panelboard ratings. Series integrated equipment rating is not acceptable.

	<u>Type of Service</u>	<u>Frame Size (Amperes)</u>	<u>I.C. Rating (Amperes)</u>
1.	120/208 volt, single phase lighting & power	15-60	10,000
2.	120/208 volt, three phase power	15-60	10,000
3.	120/208 volt, three phase power	70-200	22,000
4.	120/208 volt, three phase power	225-400	42,000
5.	120/208 volt, three phase power	450-1200	50,000
6.	277/480 volt, single phase lighting & power	15-60	14,000
7.	277/480 volt, three phase power	70-200	42,000
8.	277/480 volt, three phase power	225-400	42,000
9.	277/480 volt, three phase power	450-1600	42,000

- B. Provide circuit breakers where indicated of proper sizes for loads served.
- C. Do not install two poles in single module.
- D. Install multiple pole breakers with single operating handle. Do not install external mechanical ties between single pole breakers.
- E. Manufacturers: General Electric; Siemens; Square "D"; Cutler-Hammer

2.02 FUSES

- A. 601 amps and above: UL Class L current limiting type, 200,000 amp interrupting capacity, 4 second time delay at 500% rating. Buss Hi-Cap KRP-C; Ferraz-Shawmut Amptrap A4BY, Reliance LCL or Littelfuse KLP-C.
- B. 600 AMPS and Below
 - 1. Protecting branch circuit panelboards and miscellaneous non-inductive loads: fuses to be current limiting type, single element with no time delay, 200,000 amp interrupting capacity. UL Class RK1. Buss Limitron KTN, KTS; Ferraz-Shawmut Amptrap A2K, A6K, Reliance NCL-R, SCL-R or Littelfuse KLN-R, KLS-R.
 - 2. Motor circuits and transformers: dual element type 200,000 amp interrupting capacity. UL Class RK5. Buss Fusetron FRN-R, FRS-R, Ferraz-Shawmut Tri-Onic TR, TRS; Reliance ECN-R, ECS-R; or Littelfuse FLN-R, FLS-R.

PART 3: **EXECUTION**

3.01 FUSES

- A. Provide the Owner with 10% additional spare fuses (or a minimum of three which ever is greater) for each size fuse used in the installation.
- B. Fuses to be stored in special cabinet located adjacent to each substation, MCC or fusible panelboard containing fuses.
- C. Submit shop drawings of cabinet for approval.

END OF SECTION

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SECTION 26 29 00

LOW VOLTAGE CONTROLLERS

PART 1: GENERAL

1.01 **RELATED WORK SPECIFIED ELSEWHERE**

- A. General Provisions: Section 26 05 01
- B. Raceways and Boxes Section 26 05 33
- C. Low Voltage Electrical Power Conductors and Cables: Section 26 05 19
- D. Panelboards: Section 26 24 16

1.02 **WORK INCLUDED**

Furnish and install material, labor and accessories required for the following pieces of equipment as shown on the drawings and specified herein.

- A. Motor Starters
- B. Safety Switches

1.03 **SUBMITTALS**

Submit shop drawings for distribution equipment in accordance with Specifications Section 26 05 01, General Provisions.

PART 2: PRODUCTS

2.01 **MOTOR STARTERS**

- A. Type
 - 1. Full voltage across-the-line starters with motor running protection in accordance with Motorized Equipment Schedule shown on the drawings and as indicated below.
 - 2. Starters to be equipped with auxiliary control devices as indicated on Motorized Equipment Schedule.
 - 3. Starters operated at a phase-to-phase voltage of 200 volts or more shall be equipped with individual transformers to provide 120 volt supply for control devices such as pushbutton, relays, float switches, etc.

- B. Use
1. Manual: single phase up to 1/2 HP; with pilot light similar to Allen Bradley Bulletin 600 series.
 2. Manual: single phase 3/4 HP and greater; similar to Allen Bradley Bulletin 609 series.
 3. Magnetic: single or three phase; similar to Allen Bradley 509 series.
 4. Combination magnetic starter with fused switch (circuit breaker switch). Similar to Allen Bradley Bulletin 512 series (513 series).
 - a. All combination magnetic starters shall have hand off automatic switches with pilot light unless otherwise noted.
 - b. All combination magnetic starters to be equipped with control circuit transformers unless otherwise noted.
- C. Pushbutton Stations: heavy duty type in NEMA 1 enclosure; similar to Allen Bradley Bulletin 800H series.
- D. Control Circuits
1. Control circuit voltage shall be not exceed 120 volts and shall be obtained through the use of control circuit transformers.
 2. Transformers shall be of sufficient size to service control device connected thereto.
 3. Control circuit shall be made in the following manner:
 - a. One side of secondary of transformer shall be grounded.
 - b. One side of all operating coils of control devices shall be connected to grounded side of control circuit.
 - c. All contacts of relays, limit switches, etc., shall be connected in series on line side of the control circuits.
 4. A minimum of two (2) spare interlocks shall be furnished per starter or contactor. These interlocks shall be field reversible from normally open to normally closed.
 5. All terminal points, including interlock contacts, shall be brought out to terminal blocks.
- E. Manufacturers: Allen Bradley; Square D; General Electric; Siemens; Cutler Hammer

2.02

SAFETY SWITCHES

- A. UL approved, heavy duty, 2 and 3 pole, quick-make, quick-break fused or non-fusible type, as indicated on the drawings. Fuse clips shall be suitable for the fuses specified under this section.
- B. Totally enclosed with external operating handle. Enclosure to be NEMA type as indicated on the drawings.

- C. Manufacturers: General Electric; Square D; Siemens; Cutler Hammer

PART 3: **EXECUTION**

3.03 **MOTOR STARTER INSTALLATION**

- A. Motor starters furnished under other sections are to be mounted by the Electrical Contractor.
- B. Mount on walls or on approved type floor stands.
- C. Floor stands to be constructed of mild steel angle iron or channel such as Unistrut or Kindorf. Bolts shall not project more than necessary for structural purposes.
- D. Starter interlocked with other starters or control to be provided with labels on inside of cover stating nature of the interlock system. (Example: interlocked with 120V circuit from exhaust fan.)
- E. Rotation
1. Connect motors for correct rotation before they are connected to driven load.
 2. Repair or replace (at the Owner's option) motors and equipment damaged because of incorrect motor rotation.
- F. Conduit: use flexible liquidtight conduit for all connections.
- G. Install overload relay heater elements and ascertain that size of heater elements corresponds to motor full load current and that motors will start and operate immediately.
- H. Mount pushbutton 4'-0" above finished floor.
- I. Mount individual starters 6'-0" from finished floor to top of starter.
- J. Control Circuits
1. Perform continuity tests.
 2. Check control and interlocking wiring for the proper operation.

3.04 MOTOR TESTS AND DATA

- A. Check all motors for correct rotation. The Electrical Contractor shall be available during operation of the balancing and adjusting mechanical systems and shall make such changes in wiring, heater sizes and other adjustments as are required to permit proper balancing of the systems.
- B. Refer to additional testing requirements in Section 26 08 01 Performance Testing and Electrical Systems.

3.05 SAFETY SWITCH INSTALLATION

- A. Mount safety switch on walls or on approved type floor stands with top +6'-0" A.F.F.
- B. Floor stands to be constructed of mild steel angle iron or channel type such as Unistrut or Kindorf. Bolts shall not project more than necessary for structural purposes.
- C. Install HP rated, non-fused, motor disconnect switch at each motor location.

END OF SECTION

SECTION 26 43 13

TRANSIENT - VOLTAGE SUPPRESSION
FOR LOW VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1: GENERAL

1.01 **RELATED WORK SPECIFIED ELSEWHERE**

- A. General Provisions: Section 26 05 01
- B. Raceways and Boxes: Section 26 05 33
- C. Low Voltage Electrical Power Conductors and Cables: Section 26 05 19
- D. Switchboards: Section 26 24 14
- E. Panelboards: Section 26 24 16
- F. Low Voltage Controllers: Section 26 29 00
- G. Low Voltage Circuit Protective Devices: Section 26 28 00

1.02 **SUBMITTALS**

Submit shop drawings or data sheet on TVSS equipment used in accordance with Specification Section 26 05 01, General Provisions.

1.03 **SUMMARY**

These specifications describe the electrical and mechanical requirements for a high energy transient voltage surge suppression system (abbreviated as TVSS in this specification and on all drawings). The specified system shall provide effective high energy surge current diversion and be suitable for application in ANSI/IEEE C62.41 Category A3, B3 or C3 environments, as indicated on drawings. The system shall meet these requirements as tested by ANSI/IEEE C62.11, C62.45. The system shall be connected in parallel with the protected system; no series connected elements shall be used which limit load current or KVA capability.

1.04 **STANDARDS**

- A. The specified system shall be designed, manufactured, tested and installed in compliance with:
 - 1. American National Standards Institute and Institute of Electrical and Electronic Engineers (ANSI/IEEE C62.11, C62.41, and C62.45)
 - 2. Federal Information Processing Standards Publication 94 (FIP PUB 94)

3. National Electrical Manufacturer Association (NEMA Publication LS-1)
 4. National Fire Protection Association (NFPA 20, 70, 75 and 78)
 5. Underwriters Laboratories (UL 1283 and UL 1449)
 6. National Electrical Code (NEC)
- B. The system shall be UL listed as passing the applicable location category current waveforms specified in UL1449 (Adjust Testing Supplement). The listings shall be displayed on the unit with a permanently attached factory label. The ratings of the system must be supported by 'published' test data from an independent laboratory which verifies the repetitive surge current impulse ratings. Also, to support the UL 1449 testing, a report needs to indicate the SVR rating and actual fault current withstand rating.

1.05

SYSTEM DESCRIPTION

- A. System Operating Voltage and applicable modes: The nominal system operating voltage shall be 277/480V, three (3) phase WYE, 4 wire plus ground, L-N, L-G and N-G.
- B. The TVSS maximum continuous operating voltage shall be greater than 115% of the nominal system operating voltage to ensure the ability of the system to withstand temporary RMS overvoltage (swell) conditions.
- C. The operating frequency range of the system shall be at least 57 to 63 Hertz.
- D. Provide capacitors as required to not provide additional noise to system in accordance with UL 1283.
- E. Overcurrent Protection (Fusing): All protection modes of category B3 and C3 TVSS's shall be internally fused with the fuses I²T capability to allow the suppressor's maximum rated transient current to pass through the suppressor without fuse operation. If the rated I²T characteristics of the fusing is exceeded, the fusing shall be capable of opening and clearing both high and low impedance fault conditions. This overcurrent protection circuit shall be monitored and provide indication of suppression failure/operability.
- F. The TVSS shall provide protection for modes as outlined in "system operating voltage and applicable modes" above. Note: L= Line, N= Neutral, G= Ground.

- G. The TVSS multiple surge current minimum rating for any one individual mode (L-L, L-N, L-G or N-G) based on the standard 8 x 20 microsecond impulse shall be no less than:
- Location Category A3 - 35,000 Amperes
 - Location Category B3 - 55,000 Amperes
 - Location Category C3 - 120,000 Amperes
- H. Above surge current ratings are for each individual mode based on multiple strikes. Per phase and single surge ratings are not acceptable!
- I. The system performance ratings shall be based on the appropriate UL, 1449 second revision listing ratings for the applicable IEEE C62.41 Category impulse waveforms. The maximum UL 1449 listed maximum voltage for each of the specified protection modes shall not exceed:
- 400 volts for 120, 120/208, or 120/240 volt systems. (L-N, L-G, N-G)
 - 800 volts for 120/208 or 120/240 volt systems (L-L)
 - 800 volts for 208, 240, 277, 220/380, 240/415 or 277/480 volt systems
 - 1200 volts for 346, 346/600 volt systems
 - 1500 volts for 480 volt systems
 - 2000 volts for 600 volt systems

1.06

DEFINITION

The category of the transient voltage surge suppressor (TVSS) shall be determined by it's location according to the following descriptions:

- Category A3 - This shall be any small (225 amperes or less) branch circuit panel located more than 60 circuit feet from the next level of distribution up stream. The next level of distribution upstream may be a distribution panel or service entrance switchgear.
- Category B3 - This shall be any branch circuit panel less than 60 circuit feet from the next level of distribution upstream. The next level upstream may be a distribution panel or service entrance equipment rated less than 1600 amperes.
- Category C3 - This shall be any service entrance equipment rated 1600 amperes or more.

1.07 PROJECT SCOPE

This project contains the following equipment categories: Category B3

PART 2: **PRODUCTS**

2.01 SURGE SUPPRESSION COMPONENTS

- A. The system shall be constructed using multiple surge current diversion modules utilizing matched metal oxide varistors (MOV). Each module shall be capable of withstanding over 1,000 pulses of the applicable IEEE62.41 Category surge current without failure or degradation of performance when tested per C62.11, C62.45, suggested wait times. The modules shall be designed and constructed in a manner which ensures MOV surge current sharing. No gas tubes, silicone avalanche diodes or selenium plates/rectifiers shall be used. Units that incorporate all 3 phases of protection into one module are not acceptable for Category C use.
- B. Terminals shall be provided for all of the necessary power and ground connections. The terminals shall accommodate wire sizes of up to #6 AWG for Category A3, #2 AWG for Category B3 and #1/0 AWG for Category C3.
- C. All surge current diversion module intra-unit connections shall be by way of low impedance connections. All module mounting hardware and power wiring shall be captive or remain in place when a module is removed or replaced. The system shall be designed for simple change out of any or all TVSS components modules by a qualified electrician.
- D. The specified system shall be provided in a heavy duty NEMA 1 enclosure. The cover of the enclosure shall be hinged and require a tool for access to internal components. Indication of surge current module status shall be visible without opening the door.

2.02 ACCESSORIES

- A. Unit Status Indicators: Status indicators with printed labels shall be provided on the hinged front cover to continually indicate each modules status. Indicator shall reliably indicate that one or more surge current diversion modules or fuses have failed and that service is needed to restore full operation. All protection modules and modes (including N-G) shall be monitored.

- B. Electrically isolated Form C (one N.O. and one N.C.) summary alarm contact rated for at least 120 VAC and 1 ampere shall be provided for remote annunciation of unit status. The summary alarm contact shall change state if any one or more of the surge current diversion modules has failed.
- C. Audible Alarm: The specified system shall be equipped with an audible alarm which shall be activated when any one or more of the surge current diversion modules has failed. In conjunction with the audible alarm, an alarm on/off switch shall be provided to silence the alarm and an alarm push-to-test switch shall be provided to test the alarm function. Both switches and the audible alarm shall be located on the unit's hinged front cover.
- D. Transient Counter: A transient voltage surge counter to totalize all transient voltage surges which caused operation of the TVSS system. The readout shall be at least a five digit LCD located on the unit's hinged front cover. The counter shall be equipped with a battery back-up to retain memory when power is not present. A pushbutton switch on the display's face-plate shall be provided for manual counter reset.
- E. Service Disconnect Switch: The specified system shall include a disconnect switch located in-line with the TVSS system enclosure with an external manual operator. The switch shall disconnect all ungrounded circuit conductors from the high energy surge current diversion modules and all fuses. The switch shall be rated for 600 VAC and 30 amps (minimum) continuous or as required to meet standards listed in Section 1.04. Wiring termination's shall be provided for at least #8 AWG.

2.03

MANUFACTURERS

- A. Current Technology
- B. L.E.A. International
- C. Liebert
- D. Tycor/Cutler-Hammer
- E. E.F.I.
- F. Powerware
- G. Hubbell

PART 3: **EXECUTION**

3.01 **SURGE SUPPRESSION INSTALLATION**

- A. Mount surge device adjacent to panelboards, switchboard and switchgear as indicated on the drawings.

- B. Mount device to maintain minimum wire length between device and protected source. MAXIMUM LENGTH:
 - 1. Switchboards: 48" with minimal wire bends.
 - 2. Panelboards: 12" with minimal wire bends.

- C. Run wiring in non-metallic conduit as straight as possible. If a conduit bend is required use long radius bends.

- D. Install overcurrent protection and disconnecting means for surge devices in accordance with National, State and Local Codes.

END OF SECTION

SECTION 26 51 00

LIGHTING FIXTURES, LAMPS AND BALLASTS

PART 1: GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. General Provisions: Section 26 05 01
- B. Raceways and Boxes: Section 26 05 33
- C. Low Voltage Electrical Power Conductors and Cables: Section 26 05 19

1.02 WORK INCLUDED

Furnish and install material, labor and accessories required for the following pieces of equipment as shown on the drawings and specified herein.

- A. Fluorescent Lighting Fixtures
- B. High Intensity Discharge Lighting Fixtures
- C. Fluorescent Lamps (T-8)
- D. Compact Fluorescent Lamps
- E. Metal Halide (Mogul Base)
- F. Fluorescent Ballasts
- G. High Intensity Discharge Ballasts

1.03 LISTING AND LABELS

- A. Fixtures shall be listed by Underwriters Laboratories, Inc., exceptions shall be only in the event the unit is assembled as a custom designed unit.
- B. Fixtures shall bear the Underwriter's Laboratories' label of approval. Those of a type covered by RLM Standards shall bear the RLM label.

1.04 SUBMITTALS

Submit shop drawings for each type of light fixture scheduled on the drawings, lamps and ballasts in accordance with Specification Section 26 05 01, General Provisions.

PART 2 PRODUCTS

2.01 FLUORESCENT LIGHTING FIXTURES

- A. Fabricate fixture enclosures with a minimum of #22 gauge thick cold rolled sheet steel. Enclosures may be constructed of other metals provided they are equivalent in strength and acceptable for the purpose.
- B. Remove sharp corners and/or edges of metal which can cause injury to wiring and to personnel during installation or servicing of fixtures.
- C. Face plates or frames of recessed fixtures which serve as ceiling trim and which also swing to allow access to the interior of the fixtures, shall be gasketed and positively held to fixture bodies by screws or other adjustable means that permit the face plates or frames to be drawn up to the ceiling as tight as necessary to insure complete contact without any light or air leaks whatsoever at their perimeters.
- D. Provide lampholders for the proper performance of lamps in lighting fixtures, UL listed, of a type designed and acceptable for the purpose and bearing the manufacturer's name or trademark, type, number and rating on each item.
- E. Shielding: fixture shielding media shall be color stabilized 100% virgin acrylic plastic, glass or vinyl, as indicated on the drawings, and not less than .125" thick.
- F. Lens panel frames: lens panels for surface box type fixtures and for recessed troffers shall be framed, hinged and latched. Frames and louvers shall be equipped with retaining means to support frame during relamping.
- G. Housings shall be so constructed that all electrical components are easily accessible and replaceable without removing them from their mountings.
- H. Fixtures for use outdoors or in areas designated as damp locations shall be suitably gasketed and rated for the purpose of preventing the entrance of moisture and shall be constructed of aluminum, stainless steel or non-ferrous material.
- I. Fixture mounting: recessed fixtures shall be suitable for mounting in type of ceiling to be furnished.

- J. Louver and frame supports: all louvers, baffles, shielding panels, etc. shall be equipped with some retaining means such as hinges, clips, chains or other approved device to support louver or panel during relamping or cleaning.
- K. Wires: heat resisting type in accordance with NEC. Furnish each recessed fluorescent fixture with not less than 6'-0" of wire-whip for connection to outlet box. Suspended fixtures shall have enough wire-whip to neatly reach fixture via tie-wrap to cable, chain or stem supports. Minimum wire size #18 AWG.
- L. Ballast mounting: fixture to be designed in such manner that case temperature of ballast does not exceed 90°C. All ballast mounting studs to be welded or bolted to fixture.
- M. Finishing
 - 1. Except for stainless steel, give ferrous metal surfaces a multi-stage phosphate treatment or other acceptable base bonding treatment before final painting and after fabrication.
 - 2. Final finish on all light reflecting surfaces and exposed trim on fixtures shall be baked white high reflective enamel or porcelain enamel.
 - 3. Unpainted non-reflecting surfaces shall be satin finished and coated with baked on, clear lacquer to preserve the surface. Where aluminum surfaces are treated with an anodic process, the clear lacquer coating may be omitted.

2.02

HIGH INTENSITY DISCHARGE LIGHTING FIXTURES

- A. Mounting: units to be furnished complete with all mounting accessories required, pre-wired unless otherwise noted or indicated.
- B. Wiring: high temperature wiring in accordance with NEC.
- C. Lampholders: mogul base porcelain type.
- D. Shielding media shall be color stabilized plastic, glass, polycarbonate or mylar as indicated on the drawings.
- E. Fixture to carry UL rating of 55°C ambient temperature.
- F. Reflector to be constructed of spun aluminum. Adjustment shall be provided in reflector position or lamp position to allow changes in fixture distribution characteristics. Reflector to have safety latch to prevent reflector from separating from remainder of fixture. Aluminum reflectors shall be finished specular, semi-specular or diffuse as required and shall meet or exceed Alzak specifications.

- G. Ballast to be enclosed within case to allow proper heat dissipation for cool operation.

2.03 FLUORESCENT LAMPS

- A. Type: rapid or trigger start, T-8 265mA with medium Bi-pin base, unless specified or indicated otherwise on the drawings.
- B. Color: 3500° kelvin correlated color temperature unless otherwise indicated on the drawings.
- C. Minimum required initial lumen output of 2800.
- D. Manufacturers: General Electric; Phillips; Sylvania/Osram

2.04 COMPACT FLUORESCENT LAMPS

- A. Type: Standard preheat (5, 7, 9 and 13 watts) PL, TT or quad type lamp unless otherwise specified or indicated on drawings.
- B. Type: rapid start (18, 26, 39 and 40 watt) biaxial type lamp unless otherwise specified or indicated on the drawings.
- C. Color: 3500° K - rated 10,000 hours
- D. Minimum required lumen output

<u>Rated Watts</u>	<u>Rated Lumens</u>	<u>Rated Life in Hours</u>
5	250	10,000
7	400	10,000
9	600	10,000
13	825	10,000
18	1250	20,000
26	1800	12,000
39	2850	12,000
40	3150	20,000

- E. Manufacturers: General Electric; Sylvania/Osram; Phillips

2.05 METAL HALIDE (MOGUL BASE)

A. Type: Phosphor coated with lamp life and lumen output as listed below:

<u>RATED WATTS</u>	<u>MINIMUM RATED LIFE IN HOURS</u>	<u>MINIMUM RATED LUMENS</u>
175	7,500	14,000
250	7,500	20,500
400	15,000	34,000
1000	10,000	105,000
1500 *	1,500	155,000

* Clear Lamp

B. Manufacturers: General Electric; Phillips; Sylvania/Osram

2.06 FLUORESCENT BALLASTS

A. Fluorescent electronic ballasts shall be low-energy, solid state, full-light output, capable of operating one, two, three or four T8 lamps as required. All ballasts shall be high power factor, Class P thermally protected, sound-rated A, long life and low weight. Two lamp ballasts shall be "rapid-start". One, three and four lamp ballasts shall be "rapid-start" or "instant-start". All ballasts shall comply with the following ratings:

1. Minimum Power Factor: 98 percent
2. Minimum Ballast Factor: 84 percent
3. Maximum Crest Factor: 1.7
4. Maximum Total Harmonic Distortion: 20 percent
5. Maximum Third Harmonic Distortion: 15 percent

B. Fluorescent electronic ballasts shall conform to the following requirements.

1. FCC Regulations, Part 15, Subpart J for electromagnetic interference.
2. IEEE C62.41, "Guide for Surge Voltages in Low-Voltage AC Power Circuits", Category A, for resistance to voltage surges for normal and common modes.
3. UL 935, "Fluorescent Lamp Ballasts".
4. The standards of the Certified Ballasts Manufacturers' Association (CBM).

C. Preferred Manufacturers

1. Advance Transformer Co.
2. Universal Lighting Technology
3. Lutron Electronics Co., Inc.

D. Ballasts shall be designed for single frequency operation 60 Hz nominal and shall operate at the nominal voltages indicated on label as required by Light Fixture Schedule.

2.07

HIGH INTENSITY DISCHARGE

A. General

1. Ballasts or transformers for high intensity discharge type lamps shall be suitable for operating the indicated lamps.
2. Submit manufacturer certification that ballasts and transformers for discharge type lamps comply with the latest CBM specifications which have been issued.
3. Ballasts for high intensity lighting fixtures shall be UL listed and high power factor type.
4. Fixtures utilizing ballasts or transformers for discharge type lamps shall each bear identification by means of a label on the reflector or body of the circuit voltage at which they are intended to be used.
5. Capacitors shall be highest quality aluminum can type for the type of service intended. Outdoor ballasts shall use capacitors with 90°C case temperature rating and shall provide reliable starting and proper lamp performance to -20°F (-29°C).
6. Ballast shall be rated for (55°C)(65°C) fixture ambient temperature.
7. Ballasts shall be mounted in or on a lighting fixture to produce maximum sound attenuation.

B. Metallic Halide: ballast shall be auto-stabilized type with lead peaked circuiting and a power factor not less than 90%. Regulation: 10% variation in line voltage shall vary lamp watts not greater than $\pm 3\%$. Ballast shall provide sufficient voltage at lamp with a line voltage drop at much at 40% below nominal to prevent the lamp from being extinguished. Ballasts shall be encapsulated using thermosetting epoxy compound.

PART 3: **EXECUTION**

3.01 **LIGHTING FIXTURES, INSTALLATION**

- A. Fixtures shall be rigidly mounted by approved means. Pendant mounted fixtures shall hang plumb with stem fittings and shall be equipped with approved ball type aligners.
- B. Provide adequate protection for fixtures during construction. At completion of work, they shall be clean and free from foreign material.
- C. Furnish and set all inserts, anchors, studs and hangers for the support of lighting fixtures and respective equipment and make all necessary adjustments required therein.
- D. Lighting fixture components shall be suitable for the voltage of the building circuits to which they are applied.
- E. All rows of light fixtures to be properly aligned, plumbed and square with adjacent walls.
- F. Suspended fixtures where stems or cables are not specifically indicated shall be suspended by galvanized chains.
- G. Do not install fixtures and/or parts such as finishing plates and trims for recessed fixtures until all plastering and painting that may mar fixture finish has been completed.
- H. The Light Fixture Schedule on the drawings contains a written description of fixture and manufacturer's catalog numbers. Numbers provided are intended to indicate design and quality desired. Fixtures must meet requirements of this specification and of the description contained in the Schedule.
- I. If outlet does not have fixture symbol, install fixture of same type in similar locations elsewhere on the drawings.
- J. Provide additional trim as required for neat mounting of recessed fluorescent lights mounted in patterns.

- K. Light fixtures shall have 1/8" galvanized steel safety cable, #12 gauge galvanized carbon steel hanger wire or #12 jack chain attached to a minimum of two (2) opposite corners of the fixture. The safety cable, wire or chain shall attach directly to the building structure and shall be of sufficient strength to support the weight of the fixture in the event the ceiling system would collapse.

It is the responsibility of the Electrical Contractor to insure adequate safety supports are installed. Do not support fixtures from suspended grid type ceiling systems.

- L. Do not support light fixtures directly from light weight roof decks. Provide supplemental angle iron support as required. Do not connect to bottom cord of roof joist without supplemental angle iron ties to the upper cord of joist.
- M. Light fixtures must be suitable for mounting in or on the type of ceiling to be furnished. The contractor must verify the type of ceiling and provide appropriate fixtures and mounting hardware prior to ordering.
- N. Coordinate with other trades so lights are properly aligned with diffusers, grilles, speakers, etc. If necessary, relocate lights as directed so there will be no conflict with the other trades' equipment.
- O. Fixtures suspended from sloping ceiling surfaces shall have ball aligner hangers in ceiling outlet boxes to insure plumb suspension.
- P. Samples: Bidder shall undertake to submit samples of all fixtures required for inspection by the Owner and the Engineer prior to award of contract. Request by the Owner or Engineer for samples of fixtures shall not be construed by the bidder as indication of award of contract.
- Q. Adjust all adjustable fixtures to the satisfaction of the Engineer and the Owner.
- R. Remove all conspicuous trade labels.
- S. All permanent fixtures used for temporary lighting shall be cleaned and relamped in order to insure that at the time of Owner's acceptance all lamps will be new.
- T. Lighting locations in mechanical and electrical equipment rooms are approximate. Coordinate mounting height and location of lighting fixtures to clear mechanical, electrical and plumbing equipment and to illuminate adequately meters, gauges and equipment.
- U. Support all lighting fixtures independently of ductwork, ceiling grid system and piping.

- V. Whenever a fixture or its hanger canopy is applied to a surface mounted outlet box, a finishing ring shall be utilized to conceal the outlet box.
- W. Splices in internal wiring shall be made with approved insulated "wire nut" type mechanical connectors, suitable for the temperature and voltage conditions to which they are subjected.
- X. Fixtures shall be complete with all internal wiring and all flexible conduits, pigtails and the like necessary for external connections. Grounding type flexible conduit shall be used for lighting fixture pigtails and grounding type connectors shall be used for installing same.
- Y. Internal wiring shall contain a minimum number of splices.
- Z. Provide zinc coated or cadmium plated sheet steel outlet boxes not less than four inch octagonal or square unless otherwise noted. Equip fixture outlet boxes with 3/8 inch, no-bolt, fixture studs. Where fixtures are mounted on or in an accessible type ceiling, provide a junction box and extend flexible conduit to each fixture.

3.02 LAMPING AND RELAMPING

- A. Install proper number, type and size lamp in light fixture as indicated on the drawings.
- B. Replace all burned out lamps at the time of acceptance.
- C. Relamp all lighting fixtures in service during construction with new lamps prior to turning the premises over to the Owner or give the equivalent of a new lamping to the Owner.

3.03 BALLAST INSTALLATION

- A. Provide proper size, type and number of ballasts as indicated on the drawings in "Light Fixture Schedule".
- B. When remote mounting is indicated on the drawings or in the schedule, provide installation in accordance with ANSI Standards.

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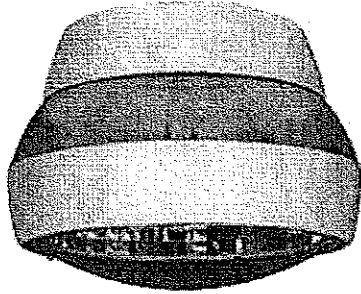
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Parking Garage
South Bend, Indiana
Project No. 108-004

3.04

AIMING DEVICES

Lighting fixture manufacturer shall provide a computer printout showing the maintained horizontal and fifteen-degrees-from-vertical footcandle levels to be attained over the sports field and shall provide an aiming diagram showing the angular positioning for each sports lighting fixture for use by the Contractor in mounting and setting the fixtures.

END OF SECTION



Type: A

Description: Pendant mounted HID cut off parking garage light fixture. HPF -20° ballast, U.L. wet location, swivel ceiling canopy and self-leveling junction box.

Remarks:

Finish: Selected by Architect

Lamp: 175w metal halide

Manufacturer: Lithonia #PGR-175M-277-TP-LP-OJB
Kim #PGL1HP/175MH277/TS
Gardco #GPI-175MH-277-TP-LFI-JB

Fixture Wattage: 216

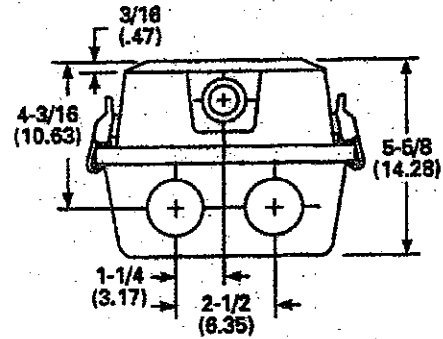
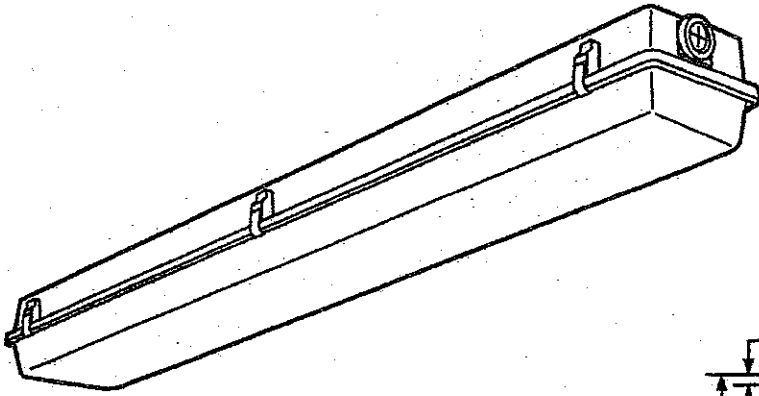
Supply Voltage: 277



Architect: Looney Ricks Kiss
Project: Eddy Street Commons Parking Facility

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Type: B

Description: 1' x 4' surface mounted dust and moisture resistant (DMR) lensed fluorescent fixture with reinforced polyester fiberglass housing, High impact acrylic 50% DR gasketed lens, wet listed and 0° electronic ballast.

Remarks:

Finish: white painted

Fixture Wattage: 63

Lamp: (2) 32w T8

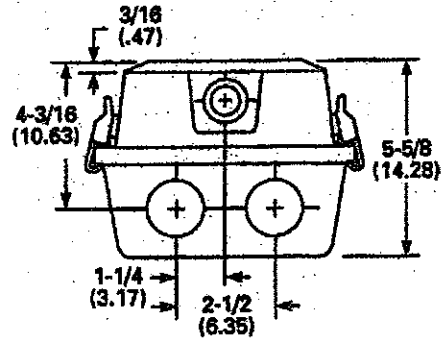
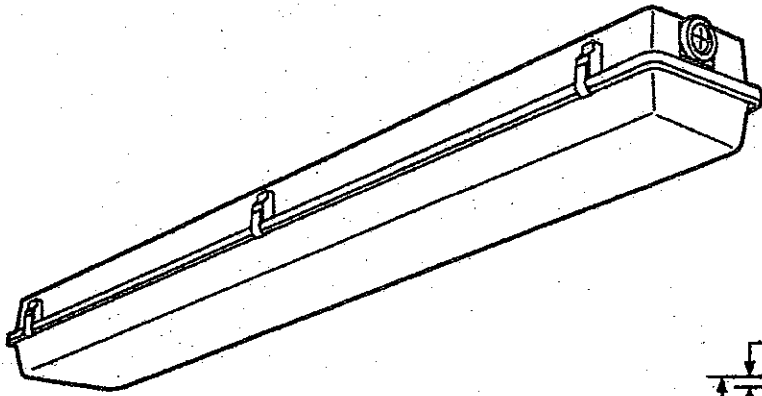
Supply Voltage: 277

Manufacturer: Lithonia #DMW2 32 AR 277 GEB10IS
Columbia #LUN-4-2-32-EB8Z-277-DR
HEWilliams #92-4-232-DR-EB2-277



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Type: B1

Description: 1' x 4' surface mounted dust and moisture resistant (DMR) lensed fluorescent fixture with reinforced polyester fiberglass housing, High impact acrylic 50% DR gasketed lens, wet listed, 0° electronic ballast and emergency inverter unit.

Remarks:

Finish: white painted

Fixture Wattage: 63

Lamp: (2) 32w T8

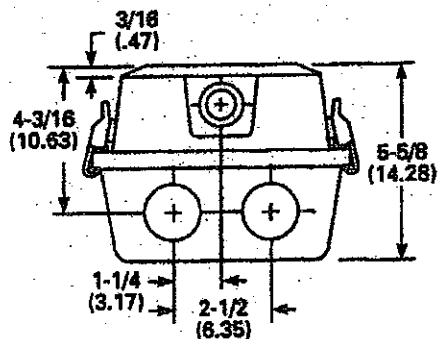
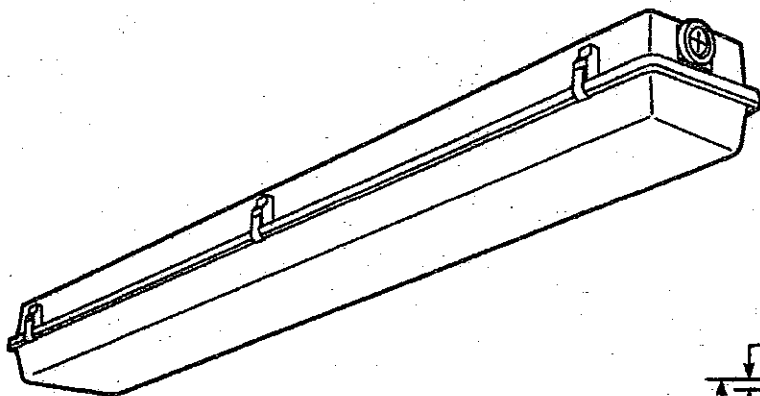
Supply Voltage: 277

Manufacturer: Lithonia #DMW2 32 AR 277 GEB1OIS-EL
Columbia #LUN-4-2-32-EB8Z-277-DR-EL
HEWilliams #92-4-232-DR-EB2-277-EL



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Type: B2

Description: 1' x 4' surface mounted dust and moisture resistant (DMR) lensed fluorescent fixture with reinforced polyester fiberglass housing, High impact acrylic 50% DR gasketed lens, wet listed, 0° ballast and emergency inverter unit.

Remarks: Fixture only operates under power outage in the building.

Finish: white painted

Fixture Wattage: 63

Lamp: (2) 32w T8

Supply Voltage: 277

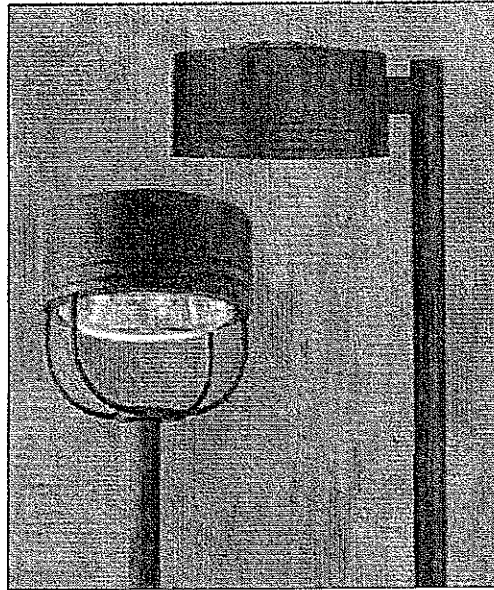
Manufacturer: Lithonia #DMW2 32 AR MVOLT GEB101S B50CW
Columbia #LUN-4-2-32-EB8Z-277-DR-B50CW
HEWilliams #92-4-232-DR-EB2-277-B50CW



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Type: C

Description: Exterior pole mounted Quad (4) 175-watt metal halide round light fixture. Heavy-gauge, spun aluminum housing, aluminum reflector, impact resistant, clear, 3/16" thick, tempered drop lens. Fixture arm mounted atop a 20-foot round non-tapered aluminum pole painted to match fixture. Asymmetric distribution, full-cut off, HPF ballast and single fuse.

Remarks: Pole mounted to top of provided column. Coordinate installation with general contractor. Refer to detail on structural drawings.

Finish: Selected by Architect

Fixture Wattage: 864

Lamp: 175w metal halide

Supply Voltage: 277

Manufacturer: Lithonia #KVR2-175M-ASYDL-277-RPD12-SF-20' NON TAPPERED

ALUMINUM POLE

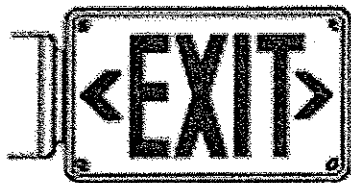
Kim #VL-4C-VLA-25W3-175MH277-XX-X-VSF-4C-20' NON
TAPPERED ALUMINUM POLE

Gardco #CA-17-4-VS-175MH-277-XXX-F20' NON TAPERED
ALUMINUM POLE

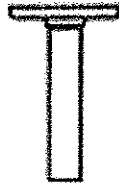


Architect: Looney Ricks Kiss
Project: Eddy Street Commons Parking Facility

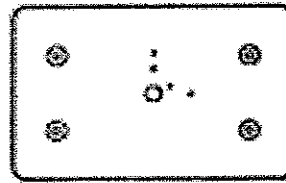
Date: 01-23-08
Project Number: 07098



EndMount



TopMount



BackMount

Type: X

Description: Wet location LED green "EXIT" sign with Nema 4x thermoplastic or die-cast aluminum housing, nickel-cadmium battery, universal mounting bracket and tamper proof cover screws with tool.

Remarks: Refer to drawings for single or double face, directional arrows, ceiling or wall mount and unit shall be rated for extreme temperature operation (-30° to 50°C).

Finish: White

Fixture Wattage: 10

Lamp: L.E.D.

Supply Voltage: 277

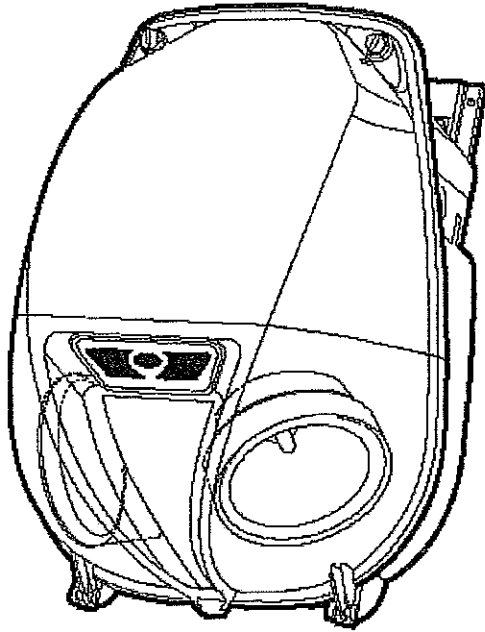
Manufacturer: Lithonia #LVSXG 120/277UM ELNUMCW
Dual-lite #LN4X-G-W-E-XTR-TR
Sure-lites #UX70G WHSDUXKWH0590-12SP



Architect: Looney Risks Kiss
Project: Eddy Street Commons Parking Facility

Date: 01-23-08
Project Number: 07098

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Type: X1

Description: Wet location EMERGENCY EGRESS fixture with Nema 4x thermoplastic or die-cast aluminum housing, heater, thermostat, battery blanket with high temp. lead-calcium battery, self-diagnostics, time delay and audible failure indication. UL listed for -40 degree C to 55 degree C. Tamper proof cover screws with tool.

Remarks:

Finish: Grey

Lamp: 50W/12V

Manufacturer: Lithonia #INDX12100-H5012S-ULT

Or equal by

Dual-lite

Sure-lites

Fixture Wattage: 100

Supply Voltage: 277



Architect: Looney Risks Kiss
Project: Eddy Street Commons Parking Facility

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SECTION 26 82 39

ELECTRIC PROPELLER UNIT HEATERS

PART 1: GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. General Provisions: Section 26 05 01
- B. Raceways and Boxes: 26 05 33
- C. Low Voltage Electrical Power Conductors and Cables: Section 26 05 19
- D. Low Voltage Controllers: Section 26 29 00
- E. Low Voltage Circuit Protective Devices: Section 26 28 00

1.02 SUBMITTALS

Submit shop drawings on each electric propeller unit heater in accordance with Specification Section 26 05 01, General Provisions.

PART 2: PRODUCTS

2.01 ELECTRIC PROPELLER UNIT HEATERS

- A. General: units shall consist of propeller type fan directly connected to totally enclosed rear mounted fan motor, replaceable electric resistance heating elements, adjustable discharge louvers, casing with mounting hardware, brackets and controls. Unit shall be UL labeled. Heater and supply wiring diagram shall be permanently attached to inside of the unit door.
- B. Controls: unit shall be supplied with mounted contactor for heating element and for fan motor, thermostat for remote mounting, control circuit transformer and transformer for fan motor where required. Control wires shall be 120 volt.
- C. Voltage shall be as scheduled on the drawings.
- D. Manufacturers: Q-Mark; Type MUH Series, Trane "UHE-C" Series, Markel

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PART 3: **EXECUTION**

3.01 **GENERAL**

Units shall be installed per manufacturer's instructions and shall be wired in accordance with the National Electric Code (NEC).

END OF SECTION

SECTION 26 82 40

ELECTRIC WALL HEATERS

PART 1: GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. General Provisions: Section 26 05 01
- B. Raceways and Boxes: Section 26 05 33
- C. Low Voltage Electrical Power Conductors and Cables: Section 26 05 19

1.02 SUBMITTALS

Submit shop drawings for each wall heater in accordance with Specification Section 26 05 01, General Provisions.

PART 2: PRODUCTS

2.01 ARCHITECTURAL WALL HEATERS

- A. General: unit to consist of steel cabinet, totally enclosed permanently lubricated motor and electric heating elements.
- B. Cabinet shall be heavy gauge steel housing with aluminum trim and shall have baked enamel finish. Unit to have removable front and heavy duty 16 gauge steel bar grilles. Finish shall be as directed by the Architect.
- C. Coils: steel finned metal sheath electric heating elements. Elements to be enclosed, non-glowing type. Unit to UL labeled. Voltage to be as scheduled on the drawings.
- D. Control: unit to factory wired with built-in power disconnect switch, contactors, automatic reset thermal cut-out and integral thermostat. All control knobs and adjustable devices to be concealed.
- E. Mounting: recessed type cabinet approximately 15" wide x 20" high with overlapping type front cover projecting a maximum of 2" from wall surface.
- F. Manufacturers: Q-Mark; Trane; Markel

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PART 3: **EXECUTION**

3.01 **INSTALLATION**

Electric wall heater shall be installed in accordance with manufacturer's instructions and wired in accordance with the National Electric Code (NEC). Coordinate location with trade constructing wall to insure proper location and mounting.

END OF SECTION

SECTION 27 05 28

PATHWAYS AND COMMUNICATIONS SYSTEMS

PART 1: GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. General Provisions: Section 26 05 01
- B. Raceways and Boxes: Section 26 05 33
- C. Low Voltage Electrical Power Conductors and Cables: Section 26 05 19

PART 2: PRODUCTS

2.01 PLYWOOD MOUNTING BOARDS

Provide 3/4" thick, flame retardant, plywood terminal boards for telephone service entrance and satellite boards sized as indicated on drawings.

2.02 CONDUIT REQUIREMENTS

- A. Provide underground conduit for service and distribution as indicated on the drawings.
- B. Provide 3/4" blank conduit concealed in walls and stubbed up above ceiling. Terminate with insulated bushing.
- C. Provide pull cord in all telephone/data conduits.

PART 3: EXECUTION

3.01 GENERAL

Install all conduit in accordance with Specifications Section 26 05 33, Raceways and Boxes.

END OF SECTION

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SECTION 28 31 00

ADDRESSABLE FIRE DETECTION AND ALARM

PART 1 – GENERAL

1.01 SCOPE OF WORK

- A. Provide a complete fire alarm system of the Class B electrically supervised, addressable, closed circuit, non-coded, low voltage type as herein described and as indicated on the Drawings.
- B. The work covered by this section of the specifications includes the furnishing of labor, equipment, materials, and the performance of operations in connection with the installation and testing of a complete new intelligent reporting, microprocessor controlled, fire detection and alarm system.
- C. Provide necessary cabling and miscellaneous parts as required for a complete and operational system, whether or not such parts are specifically enumerated herein.
- D. All equipment shall be new and shall be the manufacturer's current model.
- E. Provide all software configuration and modifications as necessary for a complete and operational system as described in the Contract Documents and requested by the Owner.
- F. Contractor that is approved by the equipment manufacturer shall perform final connection, system programming, starting and testing. This will ensure that the fire alarm system is installed in accordance with manufacturer's recommendations.
- G. The complete installation is to conform to the most recent edition of NFPA-72 and the Indiana Electrical Code (IEC) with particular attention to Article 760.
- H. The entire installed system and integrated system operations shall conform to the guidelines of Underwriter's Laboratories, Inc. (UL) and Factory Mutual (FM).

1.02 RELATED DOCUMENTS

- A. The requirements of the General Conditions of the Contract, Notice to Bidders and General Requirements apply to the work specified in this section as though bound herein.
- B. The Fire Alarm System shall be properly integrated with related work specified elsewhere.

1.03 APPLICABLE STANDARDS

The following standards shall apply to the work of this section and are adopted by reference as though bound herein.

- A. National Fire Protection Association (NFPA):
 - 1. NFPA No. 70 National Electrical Code (current edition for the State of Indiana Amendments).
 - 2. NFPA No. 72 National Fire Alarm Code (latest Edition).
 - 3. NFPA No. 170 Fire Safety Symbols (latest Edition).
- B. Underwriter's Laboratories (UL):
 - 1. UL No. 50 Enclosures for Electrical Equipment.
 - 2. UL No. 268 Smoke Detectors for Fire Protective Signaling Systems.
 - 3. UL No. 864 Control Units for Fire Protective Signaling Systems.
 - 4. UL No. 268A Smoke Detectors for Duct Application.
 - 5. UL No. 521 Heat Detectors for Fire Protective Signaling Systems.
 - 6. UL No. 228 Door Closers-Holders, with or without Integral Smoke Detectors.
 - 7. UL No. 464 Audible Signal Appliances.
 - 8. UL No. 1971 Signaling Devices for the Hearing Impaired.
 - 9. UL No. 38 Manually Actuated Signaling Boxes.
 - 10. UL No. 346 Waterflow Indicators for Fire Protective Signaling Systems.
 - 11. UL No. 1481 Power Supplies for Fire Protective Signaling Systems.
- C. Americans with Disabilities Act (ADA).
- D. Factory Mutual (FM): Reference Loss Prevention Data Sheets and the Approval Guide.
- E. Current Edition of Indiana State Building Code and Indiana Fire Code.

F. Current Indiana Mechanical Code.

1.04

QUALITY ASSURANCE

A. EQUIPMENT:

1. The equipment shall be furnished by a manufacturer who has been engaged in the continuous production of equipment of the type specified herein for at least five (5) years.
2. Specific manufacturers and model numbers contained herein are not intended to be restrictive; however, equipment may have been selected for certain features, levels of performance or other reasons. Therefore, approval of equals shall be at the sole discretion of the Architect/Engineer and shall comply with the related documents.
3. Approved fire alarm equipment manufacturers:
 - a. Siemens, Pyrotronics Division
 - b. Spectronics
 - c. Notifier
4. Reference Standard:
 - a. CPU and Control Panel:
Pyrotronics MXL addressable series with MMB-2 Main Board or most recent generation of MMB-2
 - b. Remote Indicator:
Pyrotronics RLX series
 - c. Manual Station
Pyrotronics MS series
 - d. Ionization Detectors
Pyrotronics ILI series
 - e. Photoelectric Detectors
Pyrotronics ILP or FP11 series
 - f. Rate of rise/fixed temperature thermal detectors
Pyrotronics ILT series
 - g. Addressable interface devices
Pyrotronics TRI Series
 - h. Horn/Strobe Assembly (Fire Alarm)
Wheelock AS-Series or MT-Series or newer version
 - i. Strobe only assembly
Wheelock RSS-Series or newer version

- j. Remote Control Unit/Annunciator
Pyrotronics RCC-1
- k. Notification Appliance Circuit Power Supply/Extension
Pyrotronics PAD-2
- l. Remote Power Supply and control
Pyrotronics PSR
- m. Repeater
Spectronics 324/MXR-4

B. ACCEPTABLE INSTALLERS:

- 1. Termination and testing of the fire alarm system shall be performed by qualified fire alarm system installers with at least five (5) years experience that can assure the installation and testing parameters are met for the fire alarm systems of the type specified herein. Installers and programmers shall be factory certified to work on the product line being provided.
- 2. The contractor shall maintain a fully equipped service organization within 125 miles of the installation site.
- 3. The contractor shall stock sufficient parts to provide Warranty service on the complete system.
- 4. The contractor shall employ equipment manufacturer trained technicians having a NICET Level II, or higher, Fire Alarm Technology certification. This certification will be verified prior to construction.

1.05

SUBMITTALS

- A. Submit 5 copies to the Architect/Engineer for distribution to the following:
 - 1. Indiana State Fire Marshal.
 - 2. Architect/Engineer
- B. Submit descriptive literature and shop drawings to Architect/Engineer in accordance with Section 01330. Complete descriptive literature on each item of equipment proposed for use on the project with index to all equipment.

- C. Shop Drawings shall include the following data:
1. Working drawings shall be prepared using AutoCad Release 12, 13 or 14. Owner will provide to the contractor floor plans in AutoCAD format for use in preparing working drawings. The drawings shall include:
 - a. Floor plans to scale showing equipment and interconnecting raceway and wiring.
 - b. Schematic connection diagrams.
 - c. Rough in and installation details.
 - d. System riser diagram showing devices, cabinets, junction boxes, cables and conduit sizes. Digital address for each addressable device shall be included. Initiating circuits shall be noted.
 - e. Details of Control Panel components and wiring diagram with terminal block designations.
 - f. Dimensional data of equipment.
 2. Accessories provided.
 3. Current manufacturer's specifications
- D. Battery calculations for battery (secondary) power supplies indicated to be furnished in the Contract Documents. Calculations are to show that batteries intended to be furnished meet back-up power supply requirements given herein for the equipment to be powered.
- E. Contractor shall prepare a schedule to indicate circuit loads and voltage drop calculations.
- F. Upon Completion of Final Testing and Acceptance, submit the required record documents in accordance with section 3.10.

1.06

SYSTEM DESCRIPTION

- A. General
1. Provide a complete Fire Alarm System as described herein and as shown on the plans to be wired, connected, and left in first class operating condition. Include a control panel, remote control annunciator, manual pull stations, automatic fire detectors, audible devices, visual strobe light units, addressable interface modules, wiring, connections to devices, outlet boxes, junction boxes, and other necessary material for a complete operating system.

2. The new system shall be microprocessor based, multiplexed, 24 volt DC system, Code 3 with horn silencing and strobe continuous, electronically supervised, point location annunciated, closed circuit, Class B wired, capable of identifying which individual device initiated alarm or trouble. The system shall provide fire and sprinkler piping alarm and trouble signaling to the central monitoring station that is staffed all the time.
3. The system shall be user programmable to add or delete devices as needed. Provision shall be included to have user-defined points or addresses, schedules, and functions recorded into solid state, non-volatile memory devices, with such recorded data capable of being overridden by user programmed data entries.
4. Panels and peripheral devices shall be the standard product of a single manufacturer and shall display the manufacturer's name on each component. Peripheral devices listed for use with the control panel may be of a different, single, manufacturer.
5. Panel shall be UL/FM listed for both fire alarm and security system use and capable of integrating future security detection, notification, and control devices into system programming for future use as building security system as well as fire alarm system.
6. Alarm signals arriving at the main FACP shall not be lost following a power failure (or outage).

B. Operation

1. On Pyrotronics systems only, under normal condition, the front panel shall display a "SYSTEM NORMAL" message and the current time and date.
2. Operation of any fire alarm initiating device shall automatically and simultaneously cause the following:
 - a. Audible alarm notification appliances shall sound.
 - b. Visible alarm notification appliances and ADA strobes shall display a continuous pattern until system is reset.
 - c. An annunciation to display at annunciator panel.
 - d. A supervised signal to notify the Central Station shall be activated. This shall be done utilizing a Spretronics MXADM type transponder on phone lines. The phone lines to be supplied by Owner.

- e. An alarm shall be displayed on the panel display. The alarm LED shall flash on the control panel (and the remote annunciator) until the alarm has been acknowledged at the control panel (or the remote annunciator). Once acknowledged, this same LED shall latch on. A subsequent alarm received from any other device after acknowledged shall flash the alarm LED on the control panel; the panel display shall show the new alarm information and shall re-initialize alarms. A pulsing alarm tone shall occur within the control panel (and the remote annunciator) until acknowledged. Audible appliances shall have the ability to be silenced while strobes continue to operate.
 - f. Provide appropriate signaling for environmental control and smoke evacuation system.
 - g. Annunciation to display at system video display terminals (VDT's).
 - h. Provide a hard copy printed record on system printer identifying device location, type, and address that initiated the alarm.
 - i. Provide 32 characters alphanumeric LED display on main control panel identifying addressable device location and type-initiated alarm.
 - j. Provide appropriate signaling to elevator controller for elevator recall (coordinate with elevator supplier).
 - k. Alarm initiating devices include:
 - 1) Manual pull stations.
 - 2) Smoke Detectors:
 - a) Photoelectric.
 - b) Ionization.
 - 3) Monitor modules connected to fire protection water flow switches.
 - 4) Fire pump running.
3. Operation of any supervisory initiating device shall automatically and simultaneously cause:
- a. Audio-visual sprinkler supervision annunciation to display at annunciator panel.
 - b. A 32-character alphanumeric LED display on main control panel identifying addressable device location and type that initiated sprinkler supervision alarm.
 - c. Individual annunciation of each supervisory point. There shall be no grouping of supervisory points.

- d. Initiation of a sprinkler system supervisory indication from the following devices:
 - 1) Monitor modules connected to fire protection system valve tamper switches. Valve tamper switches shall activate the monitor module when the OS&Y, butterfly, or post indicator valve is operated from its normal position by no more than 20% of its operating range.
 - 2) Monitor modules connected to low air pressure indicators on dry pipe or pre-action sprinkler system.
 - 3) Monitor modules connected to fire pump supervisory signals such as loss of power, phase reversal or operating on generator power.

- 4. Operation of any trouble signaling device shall automatically and simultaneously cause:
 - a. An audible signal to sound at main control panel, annunciator panel, but shall not put the system in alarm.
 - b. System shall acknowledge trouble conditions, silence trouble signals, and automatically display on system. Annunciation shall remain illuminated until the cause of the trouble condition is remedied, at which time the corrected condition shall display on the display terminals. Subsequent trouble condition shall re-activate sounding of audible signal and annunciation.
 - c. Trouble devices shall include:
 - 1) Loss of power.
 - 2) Battery disconnected.
 - 3) Any modular component of control system becomes unplugged or disconnected.
 - 4) Ground fault detection.
 - 5) System components and cables shall be continually, repetitively supervised; an open, ground, or short circuit condition of any device or cable shall automatically and simultaneously cause annunciation and displays to occur identifying fault nature and location.
 - 6) Removal of any fire alarm device from its respective circuit.
 - 7) Trouble signal from peripheral panels such as notification circuit power supplies, special hazard suppression control panel.
 - 8) Smoke detectors reach pre-determined thresh-hold as being "dirty" or unresponsive.
 - 9) Any other condition required by UL/FM requirements to cause trouble on the fire alarm system.

- d. Should a trouble condition be present within the system and the audible trouble signal silenced, the trouble signal shall resound at preprogrammed time intervals to act as a reminder that the fire alarm system is not 100% operational. Both the time interval and the trouble reminder signal shall be programmable to suit the owner's application. In addition, the trouble reminder feature shall be capable of being deactivated at owner's discretion.
5. Operation of any security alarm initializing device shall automatically and simultaneously cause:
- a. If provided, security alarm notification appliances shall sound and visible security notification appliances shall display a continuous pattern.
 - b. Security alarm signal shall not display at annunciator panel.
 - c. A supervised signal to notify Central Station shall be activated. This shall be done utilizing a Spectronics MXADM type transponder on phone lines. The phone line to be supplied by Owner.
 - d. An alarm is to be displayed on the panel display. The alarm LED shall flash on the control panel (and the security device) until the alarm has been acknowledged at the control panel (or the security device). Once acknowledged, this same LED shall latch on. A subsequent alarm received from any other device after acknowledged shall flash the alarm LED on the control panel; the panel display shall show the new alarm information and shall re-initialize alarms. A pulsing alarm tone shall occur within the control panel (and the security device) until acknowledged.
 - e. Provide 32 characters alphanumeric LED display on main control panel identifying addressable device location and type that initiated the alarm.
 - f. Provide appropriate output signaling to other equipment as required.

1.07

POWER REQUIREMENTS

- A. The control panel shall receive 120 VAC power (as noted on plans) via a dedicated circuit from a branch panelboard (emergency panelboard where available). Branch panelboard schedule shall be labeled indicating dedicated circuit for fire alarm.
- B. The incoming power to the system shall be supervised so that any power failure shall be audibly and visually indicated at the control panel. A green "power on" LED shall be displayed continuously while incoming power is present.

- C. The system shall be provided with sufficient battery capacity to operate the entire system under maximum normal load for a period of twenty-four (24) hours upon loss of normal 120 VAC. In addition, at the end of the time period, operate all alarm notification appliances used for evacuation for a period of ten (10) minutes. The system shall automatically transfer to the standby batteries upon power failure without the loss of signals. All battery charging and recharging operations shall be automatic. Batteries, once discharged, shall recharge at a rate to provide a minimum of 70% capacity in twelve (12) hours. Termination to battery shall not be soldered.
- D. All circuits requiring system-operating power shall be 24 VDC (except door holders) and shall be individually fused at the control panel.
- E. Location of the panelboard and circuit number supplying power to the fire alarm control panel shall be indicated on a label installed inside the fire alarm control panel.
- F. Wiring System Materials:
1. Wiring shall be installed in EMT conduit when concealed in walls, above ceilings and in furred spaces. IMC shall be used where conduit is exposed and/or in moist locations and exposed to weather. Threaded fittings shall be used with IMC, and steel compression fittings shall be used with EMT.
 2. Initiating loops and control/monitoring circuits shall be stranded, copper, shielded, twisted pair cable and sized in accordance with manufacturers written specifications, but shall not be smaller than 16 AWG. Notification appliance circuits and 24 VDC power circuits shall be sized in accordance with manufacturers written specifications, but not smaller than 14 AWG solid copper conductor. Where terminals on approved equipment will not accommodate 14 AWG conductors, appropriate terminal lugs shall be used.
 3. Terminations and splices shall be made in junction boxes, appropriately sized per NEC, and the junction box location shall be indicated on record documents. Terminations and splices shall be labeled with circuit and device number.
 4. Power limited circuit conductors and their installation shall meet all applicable requirements of NEC Article 760.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by FM for use as part of a protective signaling system, meeting the NFPA-72.
- B. All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.

2.02 MAIN CONTROL EQUIPMENT

Refer to Section 1.04 A 7. for equipment model numbers.

- A. Fire Alarm Control Panel (FACP)
 - 1. The fire alarm control panel (FACP) shall consist of a main control board, display section, power supply, interface modules and initiating and output modules housed within a NEMA 1 enclosure. The FACP shall meet the requirements of NFPA 72, shall be UL listed in accordance with UL 864 and UL 1076, and shall be FM approved. FACP shall also house power supply and secondary power batteries and charging circuit. Batteries and charging circuit shall be fully supervised. Features of the FACP are broken out below by sub-components.
 - a. Main Control Board: The main control board shall have a microprocessor for control of the system. Nonvolatile memory (such as EPROMs) shall be used for storage of system configuration and custom programming. Programming and configuration shall be protected by multi-level passwords. Programming shall be configurable in the field from either the front panel controls on the display module or an RS-232 communication port. Software shall provide an adjustable alarm signal level for required alarming of individual detectors, action to be taken upon alarm of a detector, summing of multiple detectors required for alarm, assignment of trouble indication to device and control of output modules and drivers based upon system status. Software shall also have macro programmability allowing multiple functions to be combined into one command and assigned to a single control on the front panel. Unit shall have a software controlled on-board clock and shall allow for specific alarm monitoring and reporting functions to be time or date linked. The main control board shall monitor other models

and components in the fire alarm system. A failure or loss of communications with any of the other components shall be logged and reported by the system. Contacts on the main control board shall be utilized for auxiliary alarm, trouble, and sprinkler supervisory points for connection to central monitoring system. The main control board must be capable of driving video terminals, printers and remote control annunciators. Provide one (1) main control board: Cerberus/Pyrotronics Model MMB-2 or Spectronics Model 641/MXADM.

- b. Display Module: The module shall display system status, alarm conditions, trouble conditions, time and date and shall be used for programming and event history review. The module shall have an alphanumeric display panel providing a minimum of 80 characters with navigational buttons. Unit shall also have buttons for entering alphanumeric data, for resetting the system, for silencing the audible notification devices and shall have user assignable macro function keys. The display shall support custom labeling of output messages. Module shall have discrete indicator LED's for: alarm, trouble, AC power, sprinkler supervision and signals silenced. The module shall also have an output port for connection to a printer for history and event printing. User assignable keys shall allow for macro programming of such actions as notification device mute for testing, drill test function, reporting test, etc. The module shall also have an audible device that sounds differently during each key press to provide an audible feedback (chirp) to ensure that the key has been pressed properly. Provide one (1) display module: Cerberus/Pyrotronics Model MKB-2 or Spectronics Model MXLC8.
- c. Loop Interface Module: Input/output communication board designed to communicate with intelligent initiating devices and with main control board. Unit shall support Style 4 (Class B) or Style 6 (Class A) devices. Multiple loop interface boards, each with a unique address, may be installed in the fire alarm system. Provide quantity of Loop Interface Modules necessary to support 100 addressable devices: Cerberus/Pyrotronics Model ALD-2I or Spectronics Model 624/IH. Provide surge and spike protection for loops.

- d. Signal Module: Output board designed to provide fully supervised Style Y (Class B) or Style Z (Class A) notification appliance circuits. Output shall be filtered and regulated, power limited, 24 VDC. Multiple signal modules, each with a unique address, may be installed in the fire alarm system. Provide quantity of Signal Modules necessary to support notification devices shown on the Contract Document Drawings with audible and visual devices connected to separate loops and with 50% spare capacity: Cerberus/Pyrotronics Model CSM-4 or Spectronics Model 624/IH and/MX-ADS.
- e. Power Supply: The Power Supply shall operate on 120 VAC, 60 Hz, and shall provide 24-volt DC power for the FACP. The power supply shall provide line filtering and shall have overload and short-circuit protection. Surge suppression shall be selected for ANSI/IEEE C62.41, Cat. B, medium to low. Provide one (1) power supply: Cerberus/Pyrotronics Model MPS-6 or Spectronics 640/PS3F.
- f. Enclosures: The control panel shall be housed in a UL listed cabinet suitable for surface or semi-flush mounting. Cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. Enclosure shall be as manufactured by the fire alarm system manufacturer specifically for housing the fire alarm control equipment indicated. Panel shall be labeled inside the enclosure to indicate panelboard name, location, and circuit breaker number(s) supplying 120 volts AC.
- g. Component mounting: Provide necessary card cages, mounting hardware and expansion cabinets as required to properly install the fire alarm system as indicated in the Contract Documents.
- h. Panel shall have space for additional future modules to include:
 - 1) Space for one future fire alarm initiation device module. Module shall be capable of serving a minimum of 100 individually addressable points.
 - 2) Space for one future fire alarm notification device module. Module shall be capable of serving a minimum of 2 circuits, each having a capacity of 2 amperes.
 - 3) Space for two future security system initiation device modules.
 - 4) Space for two future security system notification device modules.

B. Remote Control Annunciator

The Remote Control Annunciator unit shall display the same information in parallel with the FACP in real time. Alarm silence, macro keys, trouble indicators, etc. shall be duplicated at the annunciator. Annunciator shall be housed in a locked enclosure (keyed the same as the FACP enclosure):

1. The annunciator shall communicate to the control panel over one twisted shielded pair of wire. Operating power shall be 24 VDC and shall be fused at the control panel.
2. Enclosures: The remote control annunciator shall be housed in a UL listed cabinet suitable for surface or semi-flush mounting. Cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. Enclosure shall be as manufactured by the fire alarm system manufacturer specifically for housing the remote control annunciator.

C. Auxiliary Power Supply Panel

1. Provide and install auxiliary power supply panels as required to power notification appliances. The panel construction shall be modular with solid state, microprocessor based electronics. Power supply shall be UL listed and FM approved.
2. Modular functions may include alarm initiation, supplementary relays, alarm extension, power failure annunciation, and any other function necessary to complete the system as herein specified and shown on Drawings. Provide relays necessary to initiate power supply and to monitor power supply for trouble.
3. Plug-in modules and panel connectors shall be supervised so as to give a trouble signal if removed or disconnected. Trouble signal shall be received and annunciated by the existing fire alarm control panel.
4. Panel shall contain standby battery with capacity to operate system as described in Section 1.07 C on page 11. Battery shall be of the sealed, gelled electrolyte type. Battery module shall contain proper charging circuits to maintain battery in fully charged condition.
5. Panel shall be housed in a surface type cabinet with locking cover. Door lock on the unit shall be keyed to match FACP.
6. Input voltage to panel shall be 120 VAC. System operating voltage shall be 24 VDC.
7. Panel shall include an AC line filter for surge and noise suppression on the 120V primary input circuit or circuits. Surge suppression shall be selected for ANSI/IEEE C62.41, Category B, medium-to-low.
8. Panel shall be labeled to indicate panelboard name, location and circuit breaker number supplying 120 VAC.

2.03 INITIATING DEVICES

Refer to Section 1.04 A.7 for equipment model numbers.

All initiation devices shall be labeled with each device's digital address. Labels shall be made with Brother label maker. Labels shall have ½ inch letters with the following color scheme: red devices shall have red letters on a white background; devices of other colors shall have black letters on a white background.

A. Manual Pull Station

1. Addressable Pull Stations (Manual Fire Alarm Boxes): Addressable pull stations shall contain electronics that communicate the station's status (alarm, normal) to the control panel over two wires which also provide power to the pull station. The address shall be set on each station. The stations shall be manufactured from high impact red Lexan. Lettering shall be raised and painted white. The station shall mechanically latch upon operation and remain so until manually reset. Pull stations shall be single action.
2. All pull stations shall have ½ inch white label with red lettering stating the digital address of the device. Mount label at top of pull station.

B. Ceiling Smoke Detector

1. Smoke Detector: Smoke detector heads shall be photoelectric type utilizing 2-wire loop interface with the fire alarm control panel (FACP). The detector head shall be a separate unit from the base housing. Unit shall have a unique address set on the head or on the base. Reporting of an alarm condition to the FACP shall occur when a preset quantity of smoke enters the unit. Each sensor base shall contain an LED to indicate status. Sensors that do not provide a visible indication of an abnormal condition at the sensor location shall not be acceptable. A mesh insect screen to reduce possibility of false alarms shall protect detector chamber. Detectors shall meet the guidelines of NFPA 72 and shall have a nominal coverage area of 900 square feet. Units shall be designed to operate in ambient temperatures of -10 degrees C to 50 degrees C. The sensors shall be listed to UL Standard 268 and shall be documented as compatible with the control equipment to which they are connected. The sensors shall be listed for ceiling mount applications. Detectors must be removable by twisting and dropping from base with no tools or release mechanics. Provide quantity of smoke detectors as indicated on the Contract Drawings

2. Standard Base: Detector base shall accommodate plug-in smoke or thermal detector head. Base shall be designed for surface mounting and shall have rear mounted wiring terminals. Provide quantity of bases as necessary for smoke detector heads. Detector bases shall be labeled on two sides with ½ inch labels so that persons traversing corridors or spaces searching for the device can see labels. Label shall have digital address on it.
3. Relay Base: Detector base shall accommodate plug-in smoke or thermal detector head. Base shall be designed for surface mounting and shall have rear mounted wiring terminals and relay for interconnection with external equipment. Provide quantity of bases as indicated on the Contract Drawings. Relays must be protected from RFI and EMF.
4. Remote Indicator: Remote station with LED alarm status indicator on a single gang mounting plate. Provide remote indicator for all detectors concealed from plain view.

C. Sprinkler System Initiating Devices

1. Sprinkler system initiating devices are to be furnished and installed by the fire protection system piping trades in accordance with Division 23 of the specifications. Sprinkler system initiating devices include, but are not limited to PIV, OS&Y, and butterfly valve tamper switches, flow switches, air pressure monitoring switches and fire pump supervisory switches.
2. Sprinkler system initiating devices shall be connected to compatible addressable interface devices that are connected to the fire alarm system.

2.04 NOTIFICATION APPLIANCES

Refer to Section 1.04 A.7 for equipment model numbers.

- A. Horn/Strobe Unit: 24 VDC, ADA compliant, strobe and horn unit mounted on common faceplate. Strobe unit shall have an output of 75 candelas in accordance with UL 1971 and ADA. Horn unit to have a minimum output of 90 dBA as measured in an anechoic chamber at 10 feet. Strobe assembly to have clear lens supported by white escutcheon having the word "FIRE" in red lettering. Strobe shall be synchronized type to flash in time with other strobe units. Provide quantity of horn/strobe units as indicated in the Contract Documents.
- B. Strobe Unit: 24 VDC, ADA compliant strobe unit. Strobe unit shall have an output of 75 candelas as in accordance with UL 1971 and ADA. Strobe assembly to have clear lens supported by white escutcheon having the word "FIRE" red lettering. Strobe shall be synchronized type to flash in time with other strobe units. Provide quantity of strobe units as indicated in the Contract Documents.

2.05 ADDRESSABLE INTERFACE DEVICES

Refer to Section 1.04 A.7 for equipment model numbers.

All addressable interface devices shall be labeled with each device's digital address. Labels shall be made with Brother label maker. Labels shall be minimum of ½ inch in width with the following color scheme: red devices shall have red letters on a white background; devices of other colors shall have black letters on a white background.

- A. Addressable interface devices shall be used for monitoring of sprinkler water flow, valve tamper and sprinkler supervisory switches. These shall be monitored individually. No "gang" monitoring shall be acceptable.
- B. Addressable interface devices shall monitor all nonaddressable initiating devices specified in contract document/drawings.
- C. Addressable interface devices shall be used to interface the fire alarm system with elevator controls for fire service recall.
- D. Addressable interface devices shall be provided for all devices where not previously specified so that all nonaddressable equipment required will function as a complete and operational addressable system.

2.06 MISCELLANEOUS DEVICES

All miscellaneous devices shall be labeled with each device's digital address. Labels shall be made with Brother label maker. Labels shall be minimum of ½ inch width with the following color scheme: red devices shall have red letters on a white background; devices of other colors shall have black letters on a white background.

- A. RELAYS: Relays (if required) shall be plug in type and rated for the application. Relays shall be placement supervised, if relay is taken out of service, a trouble signal will be sent to the fire alarm panel. Relay usage shall be coordinated with IUPUI design team and Fire Protection Services.
- B. END OF LINE DEVICES: End of line devices shall be of the type specified by the manufacturer of the fire alarm control panel.

2.07 CABLE, RACEWAY AND ENCLOSURES

- A. Cabling shall have a UL "FPL" listing.
- B. INITIATING DEVICE CABLE: Cable shall have a UL "FPL" listing and be so labeled on cable jacket. Size of conductors, number of conductors and overall cable composition shall be in accordance with fire alarm system manufacturer's recommendations. Cable shall in no case have conductors smaller than 16 AWG. Wire insulation color shall be consistent for all initiating circuits. Cable to be as manufactured by Belden, West Penn, or approved equal.
- C. NOTIFICATION APPLIANCE CABLE: Cable shall have a UL "FPL" listing and be so labeled on cable jacket. Cable shall have #14 AWG solid copper conductors. Conductor insulation shall be color coded to distinguish strobe and horn circuits. Wire insulation color shall be consistent for all notification circuits but different from other alarm circuits.
- D. Conductors shall be permanently identified at all connections and junctions so as to quickly identify actual circuits in the field. Digital address loop numbers shall be used as identifying numbers. Identification shall also be included in long runs. Labels shall be Brady wire wrap or Panduit Pan Mark for windows, PROG-WIN2, heat shrink. Information shall be typed or printed, not hand written.
- E. Cabling
 - 1. Wiring color code shall be consistent throughout.
 - a. Addressable system initiating/control circuits' cable shall be red with red (+) and black (-) conductors.
 - 2. Notification device cabling shall be separated into separate loops for the visual and audible notification devices. Separation is not necessary if separate signal for visual alarms and a separate signal for audible alarms can be accommodated on a single loop.
- F. Raceway:
 - 1. Install fire alarm system cabling and wiring in metal conduit:
 - a. Use EMT conduit when concealed in walls, above ceilings and in furred spaces. Steel compression fittings shall be used.
 - b. Use IMC conduit in mechanical rooms, tunnels and areas subject to high moisture. Threaded fittings shall be used.

- c. Use liquid tight flexible metal conduit where conditions of installation, operation or maintenance require flexibility or protection from liquids, vapors or solids.
2. Cabling run underground shall be installed in PVC conduit 36 inches below grade. Warning tape shall be installed 12 inches below grade. Only clean compacted backfill shall be used around conduit or encased concrete. Cable shall have IMSA direct burial rating.
3. Fire alarm system wiring shall be installed in complete metallic raceway system separate from power, lighting and communication.
4. Connections to valve monitors, flow switches, and equipment sensors shall utilize jacketed flexible metal conduit.
5. Provide separate raceway for initiating device circuit and notification device circuit wiring as required by specific manufacturer.

PART 3 – EXECUTION

3.01 GENERAL

Prior to commencing the work of this section, the Contractor shall convene a meeting with Construction Management, and the Architect/Engineer for the purpose of reviewing all contract documents including plans, specifications, and addenda. Review shall include procedures for change orders and other project documents. System testing procedures and requirements shall be confirmed at this time. Contractor shall provide test report forms and schedule for review. Inspection milestones shall be set and notifications scheduled.

Contractor shall schedule regular job progress meetings with Construction Management, Architect/Engineer, and Installers Representatives.

- A. Installation shall be in accordance with the NEC, NFPA 72, NEMA's "Standard of Installation", local and state codes, as shown on the drawings, and in accordance with the equipment manufacturer's written instructions.
- B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Fire alarm devices shall have a protective covering installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect any fire alarm device from contamination and physical damage.
- C. Wiring of the fire alarm system is work included in this section, but is not specifically detailed on drawings.
 1. Complete wiring in accordance with manufacturer's requirements. Color code wiring and install per manufacturer's point-to-point wiring diagram.

2. Where there are a number of power requiring devices such as smoke detectors and fan relays, installed in a circuit, group in numbers so power required **does not exceed 75% of manufacturer's power supply or circuit ampacity rating**. Provide extra wiring, or extra power supplies required to fulfill this requirement. In addition, provide extra or larger size wiring to alleviate voltage drops that make devices operate beyond voltage limits for which they were designed. Determine above requirement with manufacturer's representative before equipment is installed. Provide voltage drop calculation to Engineer.
- D. Fire alarm system wiring shall be installed in a complete metallic raceway system separate from power, lighting, and communication systems.
- E. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.
- F. Provide the system in accordance with the plans and specifications, applicable codes and the manufacturer's recommendations. Wiring shall be installed in strict compliance with the provisions of IEC – Article 760 A and C, Power-Limited Fire Protective Signaling Circuits, or if required, may be reclassified non-power limited and wired in accordance with IEC – Article 760 A and D. Upon completion, and prior to final testing, the contractor shall certify, that work has been installed in accordance with the code provisions, and that the manufacturer's requirements for warranty support have been met by providing a Record of Completion as outlined in NFPA 72, 1-7.2 to the Owner and general contractor.
 1. Installation of equipment and devices that pertain to other work in the contract shall be closely coordinated with the appropriate subcontractors.
 2. The contractor shall clean dirt and debris from the inside and the outside of the fire alarm equipment after completion of installation.
 3. The manufacturer's authorized representative shall provide on-site supervision of the installation.

3.02

INSTALLATION OF FIRE ALARM CONTROL PANEL, ANNUNCIATORS AND TRANSPONDER:

- A. Install fire alarm control panel where indicated with top of cabinet not more than 6 feet above the finished floor. Annunciator panel shall be mounted at approximately +66 inches to top above finished floor level unless otherwise indicated by Contract Documents.

3.03 INSTALLATION OF INITIATING DEVICES:

- A. Manual pull stations, unless otherwise indicated, shall be mounted semi-flush in recessed back boxes with operating handles 48 inches to center above finished floor.
- B. Smoke Detectors
 - 1. Install detectors indicated to be ceiling mounted not less than 4 inches from a side wall to the near edge. Center ceiling mounted detectors in corridors and spaces as much as possible. Install detectors no closer than 5 feet from air registers.
- C. Sprinkler System Initiating Devices:
 - 1. Provide conduit, wiring, connections, and appropriate initiation and signal circuits as needed to interface properly with sprinkler system initiating devices as listed in section 2.03 C.
 - 2. Sprinkler system initiating devices shall be installed in locations that are environmentally suitable or shall be protected or listed for use in the hostile environment.

3.04 INSTALLATION OF NOTIFICATION DEVICES:

- A. Audible notification appliances shall be installed at 80 inches above the finished floor (to bottom of device) or 6 inches below the ceiling (to top of device); whichever is lower in accordance with ADA. Install operating mechanism concealed behind a grille. Combine audible and visible appliances at the same location into a single unit.
- B. Visual notification appliances shall be installed at 80 inches above the finished floor to bottom of device, or 6 inches below the ceiling to top of device, whichever is lower.
- C. T tapping of notification appliance device conductors to notification appliance circuit conductors shall NOT be accepted. Exception: Simplex addressable notification devices.

3.05 ADDRESSABLE INTERFACE AND MISCELLANEOUS DEVICES:

- A. Provide conduit, wiring, connections, and appropriate initiation and signal circuits as needed to interface properly with addressable interface devices and any other devices required for a complete and operable system as described in the construction documents.
- B. Miscellaneous equipment such as monitor and control modules, end-of-line devices, etc. shall be installed in UL listed enclosures. In finished areas these enclosures shall be flush mounted with room surfaces. In unfinished areas these enclosures may be surface mounted.

3.06 SOFTWARE PROGRAMMING:

Provide the services of a factory trained and authorized technician to perform all system software modifications, upgrades or changes.

3.07 FINAL TESTING AND ACCEPTANCE:

- A. System testing shall not commence until installer provides written certification that system has been installed in compliance with codes, plans, specifications and manufacturer's printed instructions. Refer to section 3.01 F.
- B. Contractor and Owner's designated personnel shall perform final testing. Coordinate final testing with Owner.

3.08 SYSTEM TRAINING:

- A. Engage a factory-authorized service representative to demonstrate system to Owner's personnel as specified below:
 - 1. Train Owner's personnel on procedures and schedules for operating, programming, troubleshooting, adjusting, and maintaining equipment. The Contractor shall provide training on equipment based on existing technology.
 - 2. Use the approved final version of the operation and maintenance manual as a training aid.
 - 3. Schedule training with Owner with at least seven days' advance notice.
- B. System training shall not be scheduled until testing has been completed, discrepancies have been corrected, and system is in full operation.
- C. Factory authorized personnel shall train owner's technical/professional staff on programming the system with software provided in accordance with specification section 3.06.

3.09 WARRANTY:

- A. Contractor shall warrant the completed fire alarm system wiring and equipment to be free from inherent mechanical and electrical defects in materials and installation for a period of two (2) years from the date of Final Acceptance.
- B. In addition to any requirements listed above, the fire alarm equipment manufacturer's distributor who supplied the fire alarm equipment shall provide the following service for a period of two years from the date of substantial completion:
 - 1. Twenty-four hours a day, seven days a week availability by manufacturer certified service personnel to receive service calls and initiate problem resolution either by phone with Owner's representative or by going on-site as deemed necessary by Owner's representative.
 - 2. Restoration of system to proper normal operation within twenty-four hours of notification by Owner's representative

3.10 RECORD DOCUMENTS:

- A. Three (3) copies of each document package submitted.
- B. Provide documents within 14 days of final completion of fire alarm system work.
- C. Submit the following documents bound in a "slant-D" 3-ring binder:
 - 1. Completed and certified copy of the NFPA 72-1996 "Record of Completion" document.
 - 2. Completed and certified copy of the NFPA 72 1996 "Inspection and Testing" document.
 - 3. Operation and maintenance manuals (originals and copies).
 - 4. Equipment installation instructions (original and copies).
 - 5. Sequence of operation in tabular and narrative format.
 - 6. Calculation of the battery amp-hours needed to meet the requirements of Sections 1.05 E and 1.07 C and the actual amp-hours available with the existing or furnished batteries for:
 - a. FACP (Fire alarm control panel).
 - b. FAPS(s) (Fire alarm power supply).

- D. Submit three copies of the following documents in drawing format as full size (24" x 36") printed drawings and two CD's with electronic AutoCAD Release 12, 13 or 14 files.
1. Scale floor plan drawings shall indicate device locations, circuiting, routing of conductors, and location of any splices. Drawings shall also include schematic of panels indicating all panel components, terminals, and identification of circuits corresponding to plans. Devices and equipment to be labeled with tag numbers and other identifiers.
 2. FACP layout and configuration drawing indicating module and card locations and interconnecting wiring.

END OF SECTION

SECTION 11152 – PARCS

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section.
- B. List of Abbreviations:
 - 1. ACS Access Control System
 - 2. APM Automated Payment Machine
 - 3. CCTV Closed Circuit Television
 - 4. ENC Entrance Controller
 - 5. EXC Exit Controller
 - 6. ID Identification
 - 7. NEMA National Electrical Manufacturing Association
 - 8. PARCS Parking Access and Revenue Control System
 - 9. POF Pay on Foot
 - 10. RCS Revenue Control System
 - 11. PROX Proximity Card Read Technology
 - 12. UPS Uninterruptible Power Supply

1.2 SUMMARY

- A. This Section includes provision of all material, labor, equipment, services and training necessary to furnish and install fully integrated on-line, real-time PARKING ACCESS AND REVENUE CONTROL SYSTEM (PARCS) that shall function in manner described herein.
- B. The following sections contain requirements that relate to this section:
 - 1. Concrete work is specified in Division 03.
 - 2. Signs are specified in Division 10.
 - 3. Electrical work is specified in Division 16.
- C. System Design: This system shall be a gated PARCS with the following subsystems:
 - 1. Facility Management System (FMS): FMS shall be a network consisting of server, task or subsystem computers, and workstations that provide on-line monitoring and control of all PARCS devices. Through information generated by system reports, complete FMS shall be capable of:
 - a. Correlating RCS and ACS entries and exits with vehicles present;
 - b. Reconciling time parked with revenue generated; and
 - c. Providing independent and consolidated occupancy and activity counts for both RCS and ACS systems.
 - d. Monitoring all lane equipment.

2. Revenue Control System (RCS): For parkers who pay for parking on each visit, an RCS in a pay-on-foot (POF) configuration shall be provided.
3. Access Control System (ACS): For regular parkers who will either prepay or prearrange for payment of parking, an ACS using Proximity Card Read Technology (PROX) shall be provided. Payment methods include monthly parking and automatic credit card billing. Payment shall be made either through automatic credit card charge or through manual payment. These parkers shall bypass ticket/cash payment system.

D. Primary components of integrated system shall include:

1. FMS, including software, computers with related monitors, data storage devices and printers.
2. RCS consisting of entrance controllers, automated pay machines, and exit controllers.
3. ACS consisting of PROX card readers and access cards.
4. Parking barrier gates for gated control points.

E. Additional components and accessories include:

1. Loops and detectors.
2. Initial supply of operating stock items.
3. Spare components and parts.
4. Intercom stations and master panel.
5. Electronic signs.

F. System Configuration;

Napoleon Street

1. One (1) entry lane (Lane 1) equipped with entrance controller, PROX reader, automatic gate, lane battery backup, intercom, lot full sign and other equipment as shown on the drawings.
2. One (1) exit lane (Lane 2) equipped with exit controller, PROX reader, automatic gate, intercom unit, lane battery backup and other equipment as shown on the drawings.

Hotel Street

1. One (1) entry lane (Lane 3) equipped with entrance controller, PROX reader, automatic gate, lane battery backup, intercom, lot full sign and other equipment as shown on the drawings.
2. One (1) reversible entry/exit lane (Lanes 4 and 5) equipped with entrance controller, exit controller, two PROX readers, two automatic gates, two intercom units, two lanes with battery backup, lot full sign and other equipment as shown on the drawings.

3. One (1) exit lane (Lane 6) equipped with exit controller, PROX reader, automatic gate, intercom unit, lane battery backup and other equipment as shown on the drawings.

Eddy Street

1. One (1) entry lane (Lane 7) equipped with entrance controller, PROX reader, automatic gate, lane battery backup, intercom, lot full sign and other equipment as shown on the drawings.
2. One (1) exit lane (Lane 8) equipped with exit controller, PROX reader, automatic gate, intercom unit, lane battery backup and other equipment as shown on the drawings.

Basement Level Hotel Guest/Condo Resident Parking

1. One (1) entry lane (Lane 9) equipped with entrance controller, PROX reader, automatic gate, lane battery backup, intercom and other equipment as shown on the drawings.
2. One (1) exit lane (Lane 10) equipped with exit controller, PROX reader, automatic gate, intercom unit, lane battery backup and other equipment as shown on the drawings.

Fourth Level Apartment Resident Parking

1. One (1) entry lane (Lane 11) equipped with PROX reader, automatic gate, lane battery backup, intercom and other equipment as shown on the drawings.
2. One (1) exit lane (Lane 12) equipped with PROX reader, automatic gate, intercom unit, lane battery backup and other equipment as shown on the drawings.

Parking Management Office

1. Server/host computer(s), and all task/subsystem controllers, software and associated monitors, printers and other accessories shall be furnished in the parking management office. The server/host computer will be used for system administration, programming and consolidation of data. Provide server/host computer(s) with Facility Management System software and associated workstations, monitors, printers and other accessories.

Count Control Subsystem

1. The main parking areas on the Ground Level through Level 3 of the parking structure will be treated as one parking zone for occupancy and count purposes. The Basement Level as well as Level 4 nested parking levels will be treated as separate parking zones for occupancy and count purposes.

Hotel Subsystem

1. Hotel Guest Overnight Self Parking System - System component shall allow the hotel to convert a ticket, pulled by a guest who has entered the main parking area, to a multi-day pass with in/out privileges for the duration of stay at the hotel, and

require the vehicle to enter and exit the basement level of the garage. The system shall be able to provide an expiration date corresponding to the last day of stay (duration and/or expiration time will be selectable by Hotel). If the hotel guest overstays the expiration period, guest shall be required to pay additional fee at the exit controller or APM. The bidder shall provide a detailed description including all associated equipment required for their proposed system. System shall track duration of stay, date/time of entries and exits during the stay and also maintain anti-passback control.

2. Hotel day-guests shall be able to park in the basement level by inserting their ticket pulled from the main garage entrances into the basement entrance controller. The hotel may validate these tickets which will allow a guest to exit the basement and the main garage exit lanes. Garage shall bill back the hotel for the number/amount of validations issued by hotel for vehicles not parked in the basement.
3. Transient customers who park in the basement level can pay for parking at an APM or by credit card at the basement level exit controller. The system shall track revenue associated with these transactions separately, and generate a report to the hotel workstation documenting the revenue collected by the garage for all parking in the basement.

Pay-on-Foot Machine Locations

Eddy Street

1. Two (2) cash/credit APM machines installed at locations as shown on the drawings.

Hotel Street

1. One (1) cash/credit APM machine installed at location as shown on the drawings.

Napoleon Street

1. One (1) cash/credit APM machine installed at location as shown on the drawings.

G. Work Included:

1. Fabricate, deliver, and install all new PARCS equipment as described in this Section.
2. Intercom substations and master station.
3. Comply with all applicable codes and standards including State and Americans with Disabilities Act.
4. Review plans and specifications to be certain that all functional requirements, as described, can be achieved with equipment to be supplied.
5. Provide Shop Drawings and product literature as specified herein and in Division 01.
6. Coordinate final and precise layout of conduits, stubs, detector loops, bollards, and anchor bolts with those responsible for installation.
7. Electrical sub-contractor shall provide all electrical/communication conduit and power wiring.

8. PARCS sub-contractor shall provide and install all necessary device control wiring and communications wiring to equipment provided in this contract. Furnish and install all modems, electronics and communications equipment for fiber optic communication network. Terminate and connectorize all communications cabling. Test, adjust and interface circuits prior to installation of PARCS equipment. Provide and install detector loops. Make all connections of wiring to components.
9. Attend construction meetings, provide schedules as requested, and schedule fieldwork that shall be coordinated with other trades.
10. Test equipment in accordance with Part 3 of these specifications.
11. Provide record drawings, operating manuals, maintenance manuals, spare parts, and training sessions as specified herein.
12. Provide information to Owner about type, location and phone line needs for credit card processing system within four weeks after notice to proceed.

1.3 SUBMITTALS

- A. General: Submit the following according to Conditions of Contract and Division 01 Specifications Sections.
- B. Schedule: Contractor shall submit schedule of fabrication, delivery, installation, and testing within 30 days after award of contract. Update schedules at 30-day intervals.
- C. Shop Drawings shall include:
 1. Dimensioned drawings showing plans, elevations, sections and large-scale details indicating coordination and relationships with other construction.
 2. Product literature for each component or product.
 3. Wiring diagrams detailing wiring for power, signal and control systems, and differentiating clearly between wiring installed by manufacturer, installer and others, such as electrical sub-contractor.
 4. Detailed information about FMS software and associated hardware including:
 - a. Configuration diagram
 - b. Software platforms and programming language
 - c. Communication protocol, polling procedures and transaction message flow from peripheral devices to and through FMS
 - d. Communication failure/error identification and recovery
 - e. Fault tolerance
 - f. Back-up procedures
 - g. Data storage and retrieval
- D. Samples: Submit samples of paint finishes, tickets, standard reports and other elements to be selected by Owner within 30 days after approval of contract. Approval/selections will be returned to Contractor within 30 days of submittal.
- E. Operating Documentation: Prior to initiation of field test and training, Contractor shall deliver operations manuals, maintenance and administration manuals in number as specified below:

1. Supervisor Manual - Manual is designed for Supervisor or authorized individual for day-to-day operation of specified software package(s). It shall explain all features and functions (e.g., log-on/off, monitors, sort, prepare and print standard and ad hoc reports) required for day-to-day management. Manual shall have a section for problems and/or exception conditions so Supervisor can resolve common operating problems. Manual shall also contain instructions on how to perform normal maintenance (e.g., changing paper for printer). Manual shall not contain any installation or power explanations. One hard copy and one reproducible copy shall be provided.
2. Maintenance Manual - This manual shall contain detailed instructions on how to perform regular and preventive maintenance on all components of PARCS and communications network that can be performed by Owner's staff. One hard copy and one reproducible copy shall be provided. Manual shall include:
 - a. Description of unit and component parts, including complete nomenclature and commercial number of all replaceable parts.
 - b. Operating procedures: Include start-up; break-in; routine and normal operating instruction; regulation, control, stopping, shutdown and emergency instructions; and special operating instructions as applicable.
 - c. Maintenance procedures: Include routine operations; guide to trouble shooting; servicing and lubrication schedule; list of lubricants required; description of sequence of operation; as-installed control diagrams; as-installed color coded piping and wiring diagrams; and a list of spare parts and recommended quantities to be maintained in storage on-site.
 - d. Include trouble-shooting guide for repairs that can be performed by Owner's staff.
 - e. Include manufacturer's product data with each sheet annotated to clearly identify data applicable to installation and delete references to inapplicable information.
 - f. Supplement product data with drawings as necessary to clearly illustrate relations of component parts of equipment and systems.
 - g. Include copy of each manufacturer's warranty and give information sheet for proper procedures in event of failure and instances that may affect validity of warranties.
3. System Administration Manual - This manual shall contain all procedures necessary for proper monitoring and administration of PARCS as might be required by Owner's parking manager. One hard copy and one reproducible copy shall be provided.
 - a. At a minimum, manual shall contain separate sections that cover the following topics: day-to-day operations, modification of field programmable settings, back-up and recovery, audit and control procedures, report production, contingency plans, configuration control, and system diagnostics.
 - b. A separate, removable section of System Administration manual shall contain information on proper administration and control of security features built into system. Some of information to be contained in this section includes maintenance of user identifiers, password control, rule maintenance and security policy review.

- F. Record Drawings: Provide Owner with a reproducible set of drawings and a CAD file in AutoCAD 2004 format showing any modifications or clarifications not present on original Contract Drawings including actual equipment field wiring diagram and electrical circuitry and service schematics.
- G. Contractor shall also deliver to Owner a copy of PCI-CISP Certification of all System parts and equipment, original copies of all licenses, registrations, documentation, disks and other media as may have been included with those commercially available software packages provided with system. In addition, Contractor shall ensure that all licenses, registrations and warranties have been transferred to Owner prior to final software turnover.
- H. At least one month prior to scheduled training sessions, Contractor shall deliver a Training Plan which shall include at a minimum:
 - 1. A description of all training courses including identification of instructional outcome, duration of course, type of presentations (lectures, labs) and identification of facility and training equipment requirements (e.g., lecterns, overhead projectors, TVs, VCR, PARCS hardware elements).
 - 2. A list of instructors who shall conduct training and a description of their skills, experience and qualifications.
 - 3. Course critique and evaluation forms for trainees.
- I. Testing Plan and Documentation: Provide a test plan for review and approval by Owner and Engineer/Architect 30 days prior to start of first test. Plan shall include demonstrations of compliance with specifications, contractual compliance, definitions of all test objectives, participant responsibilities, documentation for tests, and procedures for dealing with failures during test. Provide three copies of checklists which detail tests for every functional requirement of each entry and exit lane, specified supplies/spare parts, training, operating and maintenance manuals and provide space for sign-offs by Contractor and Owner's Representative.

1.4 QUALITY ASSURANCE

- A. Allow Owner and/or its Representative(s) free access to facility(s) at any time to observe installation process.
- B. Provide seven days notice to Owner and Engineer/Architect to review completed installation prior to acceptance testing.
- C. Provide equipment incorporating features which minimize maintenance and meet the following requirements:
 - 1. Provide for ease of performance verification and failure detection while minimizing effort required for adjustment.
 - 2. Provide unobstructed access to equipment components.
 - 3. Minimize requirements for special tools and test equipment.
 - 4. Provide for easy removal and replacement of components.

- D. Provide a system and components that have a service life of ten years and specify periodic maintenance requirements in maintenance manual to meet that life expectancy.
- E. If Contractor elects to integrate components from different manufacturers, Contractor shall be responsible for insuring that all specified features are provided and fully operating when system is turned over to Owner for testing and acceptance.
- F. Contractor shall be responsible for all software and insure that communications are properly received and sent by all computers and peripheral devices.

1.5 QUALIFICATIONS

- A. Contractor/Installer shall:
 - 1. Have continuously worked successfully with equipment manufacturer for minimum of three years.
 - 2. Be approved in writing by PARCS manufacturer(s).
 - 3. Provide in writing proof of installer's manufacturer's training within last two years.
 - 4. Have a manufacturer approved equipment service center in sufficient proximity to respond on-site to service calls within four hours.
 - 5. Use only fiber-certified technicians for fiber installation and connections.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Contractor shall:
 - 1. Assume care, custody and control of all PARCS equipment and components
 - 2. Replace damaged materials at no cost to Owner
 - 3. Deliver equipment to site packaged to prevent damage and marked for easy identification
 - 4. Store equipment in original containers in clean, dry location designated by General Contractor or Owner and agreed to by PARCS Contractor.

1.7 TIME OF COMPLETION

- A. Contractor shall coordinate installation and testing of equipment so that Owner may begin operation of PARCS at time parking facility is opened to public for use. First 30 days of operation after opening of new facility shall constitute test period as described in Part 3 of this Specification.

1.8 WARRANTY

- A. General: Contractor shall warrant equipment and installation (100% parts and labor) in each phase for period of one year from date of final acceptance of that phase by Owner. System shall be maintained and serviced against any and all malfunctions due to manufacturing or installation defects at no cost to Owner during warranty period.

Maintenance shall include preventive maintenance per manufacturer's recommendations, or as necessary to keep equipment in good working order. Contractor shall be responsible for performing all maintenance and repair during warranty period, including all preventive maintenance and minor repair tasks. Software support shall also be provided during warranty period. Contractor shall keep a log of all maintenance, preventive maintenance and repair work performed under warranty to give to Owner at end of warranty period.

- B. **Warranty Period:** Warranty period shall begin after Contractor has demonstrated satisfactory performance of completed PARCS as specified in Part 3, "Operational and Test Cycle".
- C. **Response:** Warranty response period shall be seven days per week, eight hours per day excluding holidays. Response time from initiation of trouble call to on-site response of qualified service technician shall not exceed four hours.
- D. **Repair:** Contractor shall repair or replace all defective or damaged items delivered under contract by end of calendar day the following day on which notice was given by Owner or its agent. Contractor may elect to have any replaced item returned to manufacturer at no additional expense to Owner. If Contractor is not available, Owner/operator personnel may effect repairs. Contractor shall then reimburse Owner for parts and labor necessary to correct deficiencies as defined within warranty clause and time. Contractor shall pre-qualify appropriate Owner/ Operator personnel to effect repairs and identify types of repair each trained individual is qualified to perform after training of owner personnel.
- E. **Limitations:** Warranty shall not cover acts of vandalism, damage caused by third party, or natural phenomena. Warranty shall not cover damage caused during maintenance actions by untrained/unapproved Owner personnel.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS OF PRIMARY COMPONENTS

- A. Acceptable manufacturers for any and all primary components shall meet the following requirements:
 - 1. Manufacturer shall have been continuously in operation for past five years.
 - 2. Manufacturer shall have current version of each primary component currently operating successfully in two or more parking facilities of similar size and activity.
 - 3. If all components of PARCS are not from same manufacturer, Contractor shall be responsible for performance of these components, as they relate to proper functioning of system as required herein.
 - 4. Manufacturer shall be able to demonstrate successful performance of proposed system and equipment. Proof of successful performance shall be submitted as specified herein.

2.2 PROJECT SITE CONDITIONS

- A. PARCS components shall operate dependably within environmental conditions indigenous to South Bend, Indiana in which PARCS is installed. Components located in a 24-hour climate controlled office shall be capable of normal performance in a business environment. Outdoor equipment shall be capable of operating in temperature extremes of geographic area stated.
- B. Special electrical power and grounding.
1. Furnish and install on-line, regulating computer grade uninterruptable power supply (UPS) for:
 - a. Servers and task computers (system controllers) with 30 minutes of back-up battery power.
 - b. Work stations, entrance controllers, exit controllers, automatic gates, APM and local controllers (both revenue and access) with 15 minutes of back-up battery power.
 2. Owner will provide back-up emergency power.
 3. Owner will provide "clean" power that for purposes of this Project shall be defined as 115 VAC +/- 10% and 60 Hz from circuits dedicated to PARCS. Contractor shall provide any additional power conditioning required for operation of system as described herein.
 4. Provide dust and noise protection in strict accordance with equipment manufacturer's recommendations.
 5. Equipment layout shall be in strict accordance with manufacturer's recommendations to allow proper movement of air through and around equipment.
 6. All communication runs longer than 100 feet shall be fiber optic. Provide lightning protection devices at both ends of all communication wiring longer than 25 feet that is not fiber optic.
- C. Fiber optic (F/O) cabling requirements – To be installed by Certified F/O technicians
1. Pull boxes shall be as noted on drawings or per industry standards.
 2. Provide and install multimode 62.5 / 125um plenum rated optic cable or of quality required to provide communication and data transfer in underground conduit.
 3. Provide a detailed part listing, number and manufacturer, for all fiber backbone material. (F/O cable, Terminators, Patch Panels, Fiber Duplex Patch Cords, etc)
 4. Label all F/O components as per TIA/EIA-606. (Cables, Connectors, Hub facilities, Termination facilities, Conduits, and Pathways). All Drops are to be labeled.
 5. Do not exceed minimum bend radius for all F/O cable.
 6. Do not exceed allowable tensile rating for F/O cable during installation. If a winch or pulling machine is used, a dynamometer must be used to monitor tension.
 7. F/O testing and certification of all runs is a requirement, per industry standards. Written test results of each test must be submitted to Engineer for review.
 - a. End-to-End Attenuation testing.
 - b. Optic Time Domain Reflectometer (OTDR) testing.

2.3 EQUIPMENT REQUIREMENTS

- A. Provide complete operational parking system with all necessary components. It is PARCS Contractor's SOLE RESPONSIBILITY to provide every component necessary for a complete functioning system.
- B. See Contract Drawings for lane layout.
- C. Provide Owner with two sets of keys for each piece of equipment with locks and two sets of master keys. Keys shall be unique to this parking equipment: they shall not fit any other equipment in same city or metropolitan area.
- D. Spare Components: Furnish the following spare components, complete and ready to use, prior to commencement of operational testing and maintain inventory of spare components at this level as components are used during warranty period. After expiration of warranty period, Owner will pay for replacement of parts as used from this inventory.
 - 1. Automatic pay machine:
 - a. Four each coin vault
 - b. One coin dispenser
 - c. Four note acceptor lockable vaults
 - d. One note acceptor unit
 - e. Eight note dispenser lockable vaults
 - f. One note dispenser unit
 - 2. ACS
 - a. One ACS reader/controller
 - 3. For gates
 - a. One detector
 - b. One gear reducer
 - 4. For primary component (entry controller, APM, exit controller, ACS reader, gate)
 - a. One ticket mechanisms/printer
 - b. One each controller/board
 - c. One each communication/port controller
 - d. One each local/remote lane controller
 - 5. One intercom remote station
 - 6. Two relays for count and lane monitoring
- E. Stock: Furnish the following operating stock items prior to commencement of operational testing. Contractor shall provide samples for Owner approval prior to final order of any item that is custom printed. Manufacturer shall select actual size of tickets and ACS ID devices. Owner must approve color and artwork of tickets and ACS ID devices. Owner will provide camera-ready artwork for logos.

1. 100,000 tickets printed to Owner's specifications
2. 500 ACS ID devices
3. 50 rolls paper for APM receipt printers
4. 12 reams paper for each laser printer
5. Three spare ribbons for each printer requiring ribbon
6. Gate parts
 - a. Four Vee Belts (if gate is belt driven)
 - b. 24 each drive pins
 - c. Six limit switches
 - d. Two dozen assorted cotter pins
 - e. Two each gate arm
 - f. One pint reducer oil for gates

2.4 SOFTWARE AND COMPUTER PERFORMANCE SPECIFICATIONS

- A. General: Primary components of PARCS shall meet the following specifications:
1. Components shall be microprocessor controlled, in on-line, real-time communication with FMS.
 2. Each component shall communicate complete transaction log to FMS. In event of communication failure with FMS devices shall continue to operate in off-line mode and shall store a minimum of 1,000 transactions, or have sufficient system redundancy, to insure availability of transaction data upon restoration of FMS. In event of failure during communication an error checking and recovery program shall be employed to prevent corruption of data files.
 3. All field programmable functions of each device shall be reprogrammed from FMS (password protected), and any and all reprogramming changes shall be reported to daily log.
- B. Facility Management System:
1. Facility Management System (FMS) shall be a software package operating on a network of computers and/or servers that provide on-line monitoring and control of all PARCS equipment. FMS system shall include individual and multiple software packages capable of running concurrently with other active programs under control of operating system.
 2. Warning alarms are required within FMS to alert parking manager of atypical lane activity, equipment malfunctions, equipment vandalism, vehicle occupancy thresholds, and insertion of stolen, void, or backout ticket at APMs or fee computer. These alarms are to be visual and audible at each computer workstation provided. When an alarm is turned off, visual and audible signal shall stop at all workstations. A daily log report shall be produced which identifies all system alarms as reported to parking manager.
 3. FMS shall be configured with subsystems. Each subsystem shall be password protected to restrict access to individual functions of each subsystem to authorized users. Subsystems are:
 - a. Revenue Reporting
 - b. Access Reporting

- c. Occupancy Monitoring
 - d. Equipment Functions
- C. Revenue Reporting/Control Subsystem shall accomplish the following tasks from any workstation in FMS, with appropriate password:
- 1. Remote programming of payment machines.
 - 2. Test fee structure against existing facility usage statistics.
 - 3. Uploading and consolidating reports from payment machines.
 - 4. Retrieval and review of individual transactions. Retrieval shall be based upon user-defined parameters. Reports shall be displayed on a monitor, printed on a printer, and/or converted to an ASCII file.
 - 5. Consolidating and retaining data that allow for report generation. The following are minimum required reports. Reports shall be either viewed on a workstation monitor or printed.
 - a. **Daily Event Log** - A listing of changes to system and users who made changes. It shall include print communication messages, facility lane equipment alarms, remote gate opening, and system log on/off's.
 - b. **Hotel Overnight Guest Report** - Shall provide a detailed report of all overnight hotel guests not parking in their designated area.
 - c. **Detailed Credit Card Report** - Shall provide a sum total and chronological listing of each credit card transaction by credit card company, by equipment location for a selected time period. Report shall include credit card payments made to all machines within PARCS. This report is used to reconcile credit card transactions with processor payments.
 - d. **Exception Transaction Report** - Shall provide all exception transactions in chronological order or by transaction type. Report shall be available for a selected time period and also by machine. This report is used to audit APM activity and performance.
 - e. **Daily and Monthly Lane Activity Report** - For each exit lane, provide a summary of activity type (normal, exception, credit card). This report provides trend analysis of transactions by type.
 - f. **Daily and Monthly Non-Revenue Transaction Report** - Shall provide all non-revenue transactions in chronological order, by type, for a specified time period up to monthly. This report is used for statistical information.
 - g. **Automatic Pay Machine Report** - A summary report of APM daily activity from all pay stations and for each APM:
 - 1) Revenue total and a summary of revenue by transaction type (credit card, cash) and parking rate.
 - 2) Summary of number of transactions by type including lost ticket.
 - 3) Summary of change dispensed.
 - h. **Monthly Lane Volume Report** - Shall provide entry and exit counts by date. This report is used for management planning and statistical information.
 - i. **Monthly Duration Report** - Shall provide duration of stay (variable by owner) based on patrons' elapsed parking time and patron time of entry. This report is utilized in rate structure and facility usage analysis,

management planning, statistical information, rate analysis, and revenue analysis.

6. Ticket Tracking: FMS shall provide the following reports and information.
 - a. **Ticket Sequence Report** – Provide a complete sequence of transactions related to individual tickets (i.e., information about how and when ticket was issued shall be tied to how and when fee was paid and ticket was processed).
 - b. **Monthly Ticket Value Report** - Provide ticket stratification based upon value of all transactions processed. Breakdowns shall be provided for each rate structure. This report is used for revenue analysis, rate analysis, management planning, and statistical information.
 - c. **Outstanding Ticket Report** – Provide a listing of tickets that have been issued but are not yet processed at an exit. FMS shall receive data on each ACS transaction from ACS controller, adding it to transaction log and consolidating it into daily activity reports. It shall also be capable of retrieving from transaction data base information for ad hoc reports on ACS activity.
 - d. **Stolen Ticket List** – Provide a chronological list of stolen tickets issued by entrance controller for selectable times. Provide a chronological list of stolen tickets processed by exit lane or Cashier for selectable times.

D. ACS Software shall provide the following features:

1. ACS shall be an on-line, computer-based access control system for those authorized by Owner to have access to parking facility or commercial vehicle area without being processed through revenue control system. Distributive, networked or centralized processing may be employed, so long as required multi-lane control features such as anti-passback, occupancy and activity tracking are maintained. System shall employ Proximity Card Read Technology (PROX) as specified herein for access. System shall control access for the following distinct user groups:
 - a. Owner vehicles requiring free and fast ingress and egress to parking facilities.
 - b. Monthly parkers who will prepay for parking on a monthly basis and have unrestricted in and out privileges during certain hours of operation.
 - c. Hotel Overnight Guest Parkers.
 - d. Hotel Day Guest Parkers.
 - e. Condominium Owners.
 - f. Apartment Residents.
2. System shall:
 - a. Individually recognize and process at least 2,500 ACS users at 36 reader locations.
 - b. Have at least 16 preprogrammed access levels. Access level of tags shall be capable of being changed without reprogramming of ACS. User capacity shall not be lost due to changes to ACS programming and access levels.

- c. Provide anti-passback control. With this feature, users shall enter and exit in proper sequence (i.e., entry, exit, entry, exit, etc.). System shall be selectable to allow either "hard" (out of sequence user is rejected and an alarm is generated at ACS controller and FMS) or "soft" mode (out-of-sequence user is allowed access.) Access shall be programmable as soft or hard per user. In both hard and soft modes, each out-of-sequence event is reported as an exception transaction in daily ACS access log. Timed anti-passback (in which tag cannot be used out-of-sequence until programmable time period has elapsed from last ACS use) is not acceptable. A password-protected "resynchronization" of all users to one access before return to anti-passback control shall be provided.
 - d. Link users to each other to allow one entity to be identified with and/or pay for a group of users. Up to 100 such ACS groups shall be provided.
3. Central ACS controller, independently and in concert with FMS, shall:
- a. Issue and reprogram ID devices.
 - b. Allow authorized supervisor to create, store, send and receive user programming from ACS readers. Access to programming shall be password protected, with multiple levels of access. System shall have password-protected access to any and all information regarding specific blocks and/or suites of cards.
 - c. Provide a data base for ACS management including the following:
 - 1) Provide at least 20 programmable record fields on each monthly parker, condominium and apartment resident PROX tag holder.
 - 2) Provide at least 12 programmable record fields on Owner vehicles.
 - 3) Allow specific parker record files to be retrieved, displayed and/or printed based on selectable criteria, such as current ACS status, access group, access level, and/or ID numbers (except data that is password protected.)
 - 4) Allow searching, sorting and printing of database by any field for routine and special forms such as invoices or mass-mailings.
 - 5) Consolidating and retaining data that allow for report generation. The following are minimum required reports. Reports shall be both viewed on a workstation monitor and printed on demand.
 - a) **Activity Usage Reports** – Provide a chronological list of ACS usage and include date, time, card number, and location of entries and exits. Data shall be capable of being sorted by date, time, card number, and entry/exit lane.
 - b) **Count Reports** – Monitor and report counts of ACS holders present on hourly basis by group, lot and total occupancy. Track occupancy and report peak occupancy during each hour to FMS. Provide for reports to show daily and/or weekly peak occupancy by access level, group and lot.
 - c) **Active Card User Report** – a listing of all cards that have access into or out of facility whether they are owner, courtesy maintenance, or revenue generating. Report shall be in numerical order, include sum total of all active cards, and can

- be generated on demand. Report is used to compare revenue generated to card users.
- d) **Violation Report** – a chronological listing of all cards violating the anti-passback or nesting requirements of the facility.
- d. System shall be capable of collection of fees from parkers on monthly prepayment, end of month billing, and/or credit card basis. Fee schedule for ACS parkers shall be same as or discounted from schedule employed for RCS parkers.
- 1) System shall monitor and report revenue associated with ACS system to FMS. **Revenue Report** shall separate revenue by type of payment (prepayment, monthly billing or credit card) and shall indicate the ACS ID device number(s), account number(s), and month(s) for which payment was received.
 - 2) System shall provide for positive posting of payments and automatic lockout of ACS users within programmable grace period after expiration of a prepaid account.
- e. Invoicing Package – System shall issue billing invoices for monthly accounts as well as separate and/or consolidated violation billing invoice. Each invoice shall include the ACS ID device number(s), account number(s) and monthly rate associated for each ACS ID device being invoiced. System shall provide a monthly report listing the total number of ACS ID device numbers invoiced and the total dollar amount invoiced.
- f. System shall provide a credit card billing interface similar to that in automated pay station to allow automated credit card billing for those electing that payment option. Credit card number shall be "on file" rather than swiped for each transaction. Credit card file shall be password protected independently from other ACS data.
- g. An Accounts Receivable package shall handle all normal accounting functions associated with ACS revenue. The package shall include such functions as an invoice report, cash receipts journal, accounts receivable ledger with supporting subsidiary ledgers for each account, accounts receivable aging report for selectable time periods, account history reports, indicating invoices and payments by customer. Efficient monitoring of Accounts Receivables shall be provided through a series of management and audit reports.
- h. System shall provide automatic on-line real-time monitoring of ACS usage with CD-ROM storage of transaction data for audit and analytic purposes.
- i. System shall allow supervisor user with appropriate password to change rate structures.
- j. System shall have capability of monitoring and reporting of alarm conditions to FMS.
- k. All administrative actions shall be password protected and report to FMS in daily log.
- E. Occupancy Monitoring Software: Subsystem shall provide the following counting functions:

1. Every vehicular entry or exit lane from each area or floor designated as a zone shall serve as a counting location. Each counting location shall be equipped with two vehicle detection loops to provide directional logic at each location and shall transmit counting pulses to FMS. Each entering vehicle shall subtract a count of one from number of available spaces. Each exiting vehicle shall add a count of one to number of available spaces. Directional logic shall be installed so that a vehicle entering an area through an entrance lane or through an exit lane shall be counted as an inbound vehicle. Vehicle exiting an area through an exit lane or through an entrance lane shall be counted as an outbound vehicle.
2. Total number of parking spaces within areas shall be field programmable. Number of available parking spaces within each area shall be tracked and displayed, upon demand, on computer monitor(s). Anti-coincidence packages shall be provided which accurately monitors entering and exiting traffic that may occur simultaneously.
3. Each area shall have two programmable thresholds. One threshold shall be used to trigger "full status". When full status is reached count system shall operate in one of two modes, selectable by owner. Mode one signals an alarm and relies on human intervention to activate appropriate dynamic signs and gate status changes. Mode two automatically activates appropriate dynamic signs and gate status changes. Second threshold shall be used to trigger "open status". Two operating modes also apply to open status threshold. Software shall allow for manual overriding of "full status" of each area.
 - a. Count subsystem shall maintain and display separate counts for each parking facility, lot or zones within a facility, each with total occupancy or spaces available, total RCS and ACS occupancy and total RCS and ACS spaces available.
4. Count subsystem shall activate any and all electronic signs. This includes pedestal mounted "FULL" signs, lane control lights, and exterior message lights, etc. provided by PARCS Contractor as well as dynamic signage on roadways and ramps provided by others. Disable entrance controllers at entry lanes when facility is full. Full status shall be capable of being overridden from FMS.
5. Count subsystem shall maintain for each entry and exit lane:
 - a. Non-resettable counters tracking monthly, transient and total parking patron usage.
 - b. Counts of illegal entry/exit for each lane.
 - c. Vends, loops, and gate counts.
6. System shall store lane, facility and zone counts at hourly intervals in daily files. This data shall be available for specialized reports to analyze lot utilization and activity levels.
7. Transaction Counts: count system shall provide, display and compare three separate counts related to each transaction. At entry lanes entrance controller count shall be compared against directional loop counter and gate counter. Gate counter records number of gate operations. Similar counts are also necessary to track activity first at central payment area and then through an exit lane. APM or fee computer vend count records number of transactions processed. At exits, exit controllers, and access readers also vend counts. Loop counter records number

of vehicles passing through lane. Gate counter records number of gate operations.

F. Equipment Monitoring Software: Subsystem shall have the following characteristics:

1. Monitor operational status of all entry and exit lanes with equipment supplied by this contract.
2. For each entrance lane indicate and display:
 - a. Lane status; open or closed.
 - b. Gate failure.
 - c. Gate up.
 - d. Low-ticket supply.
 - e. Ticket in throat.
 - f. Illegal exit - reverse direction through lane.
 - g. Backout.
 - h. Remote gate opening – origin of remote signal.
3. For each exit lane indicate and display:
 - a. Lane status; open or closed.
 - b. Gate failure.
 - c. Gate up.
 - d. Illegal entrance - reverse direction through lane.
 - e. Backout.
 - f. Remote gate opening – origin of remote signal.
4. For each APM, indicate and display:
 - a. Lane status; open or closed.
 - b. Door status, open or closed.
 - c. Receipt paper supply.
 - d. Note and coin vault status.
5. Abnormal status conditions shall be flashed on monitor(s) and accompanied with an audible alarm. Display shall continue to flash until abnormal condition is corrected. Audible alarm shall continue until it is turned off by a command issued through monitoring computer(s). Acknowledgement and turning off of any alarm condition shall be able to be performed at any of workstation connected to FMS. It shall not be necessary to acknowledge alarm condition at every workstation. System shall record abnormal status condition and acknowledgement of alarm condition by time, workstation and operator.
6. Monitor electrical circuits and frequency of operational error in PARCS components to identify maintenance actions that would prevent later failure of a component.

G. Computer System For FMS:

1. FMS Computer System:

- a. Equipment: contractor shall furnish and install all computer equipment needed for PARCS. Equipment shall meet or exceed recommendations of software vendor and allow ability of access, monitoring and report generating as approved by password by the following:
 - 1) Parking Shift Supervisor
 - 2) Parking Systems Administrator
 - 3) Security office
- b. Performance: Equipment shall meet performance needs of software and accommodate for growth and expansion. Systems shall be capable of processing all required functions as specified for each task. Performance of any specified function shall not be slowed or delayed by performance of any other function or task. The following are minimum requirements:
 - 1) System back up in less than two hours.
 - 2) Report generation at a minimum of 25 pages per minute.
2. Security: FMS and all subsystem controllers shall have security protocols, password protection and reports to exception transaction log that prevent unauthorized access to and manipulation of data and reports, including individual transactions. All databases of transactions, ACS users, reports, etc shall be secured from unauthorized entry and tampering from either within or outside FMS.
3. Data Storage:
 - a. Data shall be stored as actual data, not in report format. Data shall be archived in a format readable by the report generator.
 - b. Archived every six months with the first archive after first 18 months, so that server always has most recent 12 months data.
 - c. On-line storage shall be redundant source such as RAID Technology.
 - d. Archive storage shall
 - 1) Be on industry standard media i.e. DLTs.
 - 2) Be redundant
 - 3) Archive or restore shall take less than one hour.
 - e. Transactions for various parking areas are projected to reach 100,000 RCS and 50,000 ACS annual volumes
4. FMS shall periodically or on demand download revenue reports in a flat ASCII file to Owner's financial department via remote dial-up modem to Owner's computer network.
5. All software shall have Graphical User Interface (e.g. Microsoft Windows).

2.5 EQUIPMENT PERFORMANCE SPECIFICATIONS

A. General Conditions

1. All devices shall have compatible communication ports with selectable baud rates for all communications and connections to all computer hardware.

2. Primary components shall incorporate a crystal controlled time clock/calendar that is updated at least once daily by FMS. Clock shall keep military time and be accurate to at least one minute per month.
3. All lane devices shall be ergonomically designed for ease of use by patrons.
4. Cabinets shall be fabricated of a material that is strong and durable such as, but not limited to, composite, stainless steel, aluminum alloy, or welded 12-gauge steel. Mounting holes shall only be accessible from inside of cabinet. All surfaces shall be corrosion resistant and exterior of cabinet shall be finished in a color chosen by Owner.
5. Internal components shall be modular and plugged for easy maintenance and replacement.
6. Control logic and communication relays shall be provided for required counts.
7. Corrosion resistant connection boxes shall be provided for all wiring connections.
8. Gates, entrance controllers, and exit controllers shall have:
 - a. Hinged door away from traffic lane.
 - b. 115 VAC grounded convenience outlet.
 - c. A heater with control switch and preset thermostat or a heater not thermostatically controlled which shall not damage other components or performance of unit.

B. Non-Cash Payment Options: RCS shall accept and process the following non-cash payment options: credit card, debit cards and smart cards.

1. Credit Card Approval System: Credit card reader with each APM and exit controller shall be connected to a server that is dedicated to credit card approval system. Information from each credit card transaction shall be transmitted to server that shall be in direct communication with authorizing agencies via T1 or DSL connection, to provide on line real-time approvals for each transaction. Phone lines are not required at each piece of equipment. All processes internal to the selected vendor's system shall be PCI-CISP compliant.
2. Authorization for credit card transactions from swipe to authorization shall not be greater than ten seconds. Contractor shall be responsible for confirming record formats required by Owner's financial institution that shall be determined.
3. Owner will negotiate with processor minimum fee requiring patron's signature. Receipts shall print with signature line only when greater than negotiated minimum fee or if credit card information was entered manually.
4. Each machine shall be equipped an automatic credit card reader used for processing credit card transactions. Fee computers shall also be equipped with a keypad for processing manual credit card transactions. A separate but connected device is acceptable. Credit card transactions shall accommodate as a minimum:
 - a. VISA
 - b. Master Card
 - c. American Express
 - d. Discover
 - e. Checking Account Debit Cards
5. Credit Card Out:

- a. Exit controller shall prompt the parker to insert their credit card. The data shall be sent to the FMS for comparison to the original entry data, fee calculation and authorization using the credit card approval system. Upon authorization, exit controller shall:
 - 1) Generate a receipt with date, time and location of entry, date, time and location of exit, last five digits of the credit card used, and fee charged
 - 2) Return credit card to parker
 - 3) Raise the gate.

- C. Entrance Controller: Independently and in concert with FMS, entrance controller shall have the following features:
 1. Operational Description for typical RCS Patron Entry:
 - a. Normal Transaction:
 - 1) In entry lanes which **do not** have ACS entry, presence of vehicle over detector loops in proper sequence shall cause entrance controller to automatically issue a time and date stamped ticket, encode machine readable ticket and place such information into memory of FMS. Upon removal of ticket, a pulse shall be sent to open entrance gate.
 - 2) In lanes that have ticket and ACS entry, ACS reader shall detect entry of ACS-equipped vehicles and automatically disable entrance controller until ACS device is identified and its validity for this system is confirmed. If an ID is not read or not valid for this system, ACS reader shall be temporarily disabled and vehicle shall be treated as a normal parker. Presence of vehicle over detector loops in proper sequence, as detected by loops, shall cause entrance controller to issue time and date stamped ticket, encode machine readable ticket and place such information into memory of FMS. Issuance of ticket shall automatically disable ACS system until current transaction is completed. An audible signal shall sound as ticket is issued and continue until ticket is removed. Upon removal of ticket, a pulse shall be sent to open entrance gate.
 - b. Backout and Ticket Taken: If ticket is removed from entrance controller, and loop sequence is violated revealing that vehicle backed out of entrance lane, an audible alarm shall sound at FMS. Ticket issued shall be reported as a stolen ticket to daily exception transaction log. System shall allow FMS to select operational mode in which stolen ticket may be processed as exception transaction or deny processing of stolen ticket and complete transaction as a lost ticket.
 - c. Backout But Ticket Not Taken: Provide a means of retracting a ticket left in throat of entrance controller during a previous back-out. Event shall also be posted to daily exception transaction log.
 - d. Full Status: When occupancy system considers lot as full, ticket issuing machine shall automatically be disabled until such time as occupancy

drops below a programmed lower threshold. Only ACS patrons shall be allowed access during full occupancy status.

2. Entrance controller shall issue a machine-readable ticket with lane, time and date in man-readable print on ticket. Ticket encoder module shall utilize machine-readable encoding method that is compatible with all other RCS components. Lane time and date of entry shall be encoded on ticket.
 3. Ticket printer shall be designed for easy ticket loading with minimum 5,000-ticket capacity. Ticket dispensing/printing mechanism(s) shall be removable as unit by not more than four bolts and one keyed connector plug. Dispensing mechanism shall have self-sharpening ticket-cutters or bursting mechanism.
 4. When entrance controller is low on tickets, an alarm shall be produced at FMS, notifying status and location.
 5. An easily readable "Please Take Ticket" sign shall be provided on approach side of dispenser, along with a programmable audible message instructing customer to take ticket with them.
 6. Including typical patron delays, ticket/gate control system shall be capable of maintaining a minimum processing rate of 400 transactions per hour for push-button operation and 500 transactions per hour for auto-dispensed locations. Entrance controller shall issue a ticket within three seconds after activation of inductive loops.
 7. Entrance controller shall employ a single-slot technology with read/write functions for tickets, credit cards and other card processing.
- D. Automated Pay Station: Each automated pay station shall be capable of reading encoded tickets issued by entrance controller, computing parking fees, accepting payment in cash or by credit card, and issuing machine readable ticket encoded for exit. Station shall operate automatically, completely unstaffed, 24 hrs/day with the following features:
1. Operational Description:
 - a. Patron will insert machine-readable ticket into automated pay station. If ticket is recognized as a valid ticket, fee shall be displayed to patron. Patron will insert notes and/or coin into acceptors and change shall be made by payment station. If payment is made by credit card, credit card acceptor shall be activated by inserting a credit card into station. Receipt shall be issued "on request" for every transaction. Completion of transaction shall cause amount, transaction number and other data to be printed on ticket and ticket reprogrammed for use as an exit ticket. All data shall also be sent to FMS.
 - b. Completion of transaction shall prompt the APM to audibly and on the message screen remind patrons to take validated ticket with them.
 - c. If machine cannot read ticket or it is otherwise identified as an exception transaction, unit shall return ticket and a message shall be displayed that transaction shall be processed using the lost ticket key or cannot be processed at this station and instructing patron to use intercom for assistance.
 2. Rate structure shall be programmable only from FMS, with ability to accommodate the following:

- a. At least six fee structures each of which have three rate increments or blocks for each of up to 60 fee segments. Each block is an amount to be charged, duration for that charge and number of times that duration and charge shall be repeated over each 24-hour period of stay.
 - b. Automatic adjustment for daylight savings time and leap year in fee calculations.
 - c. 24-hour maximums.
 - d. Grace time parameters at start of each 24-hour period.
3. APM shall have a minimum accuracy as defined below:
- a. Ticket read accuracy: 99.9%
 - b. Fee calculation accuracy: 99.9% (accurate calculations divided by all calculations).
 - c. Data transmission error rates: Less than one message re-transmission per hour. Data received and accepted by computer system as valid shall have 100% accuracy.
 - d. Transaction counts: 99.9% (accurate counts divided by all counts).
 - e. Exception counts: 99.9% (accurate counts divided by all counts).
4. Revenue amounts: 99.9% (accurate counts divided by all counts) APM shall comply with all applicable ADA requirements including but not limited to reach of all slots and verbal cues.
5. Construction of station shall be durable, weather resistant in accordance with environment indigenous to that in which it is placed and vandal resistant. Unit shall have lock system and appropriate alarm contacts for tampering.
6. APM shall have concise customer instructions with pictograms where appropriate for user-friendly operation.
7. APM shall be in on-line, real-time communication with FMS for monitoring of transaction data as well as alarm conditions such as door forcements, low change and low receipt levels.
8. Station shall accept and recycle coins in nickel, dime, quarter and half-dollar denominations. Only when coin storage rack for that denomination is full will coins be stored in coin safe. System shall also be capable of accepting one, five, 10, and 20-dollar bills in any combination. Dollar bill acceptor shall contain separate safe/vault.
9. Unit shall dispense change in notes and coins. Note dispenser shall dispense two denominations. Note dispenser shall be integral to unit. Change shall be dispensed in notes to nearest possible whole dollar and remainder in coin.
10. Machine shall contain necessary hardware and software to accept credit cards for payment of parking fees.
11. Including typical patron delays, machine shall be capable of maintaining a minimum-processing rate of 120 transactions per hour.
12. APM shall recognize origin of ticket and apply specific fee structure and grace time parameter for that facility. Grace times shall be programmable by facility.
- E. Exit controller: Unit shall be capable, independently and in concert with FMS, of reading tickets encoded for exit by APM, verifying that ticket is valid and time of exit is within grace period. Unit shall then send signal to control gate to open. Unit shall have the following features.

1. Operational Description: After paying-on-foot, patron will retrieve vehicle and proceed to exit lane equipped with an exit controller. If lane is not equipped for ACS, or if it is but no ID device has been read, presence of vehicle over detector loops in proper sequence shall energize and allow for one operation. Patron will insert ticket into exit controller.
 - a. If grace period has not expired, a pulse shall be sent to open exit gate and data shall be sent to the FMS. Ticket shall be retracted into exit controller and retained for audit purposes. As vehicle leaves lane and passes closing loop, gate shall close.
 - b. If grace period has expired or ticket has not been validated as paid, machine shall prompt patron to pay remaining fee with a credit card (where machine accepts credit card) or patron will park vehicle and proceed to the APM (where a turnout lane or parking space is provided).
 2. Exit controller shall have the following:
 - a. Processed ticket vault.
 - b. An easily readable "Please Insert Ticket" sign on approach side of dispenser.
 3. Including typical patron delays, validator gate control system shall be capable of maintaining a minimum processing rate of 400 transactions per hour. Elapsed time from insertion of valid ticket into reader until gate is fully open shall not exceed three seconds.
 4. Grace times shall be field programmable and customized for each lot.
 5. Exit controller shall employ a single-slot technology with read/write functions for tickets, credit cards and other card processing
- F. Off-line Validator: Shall be a hand-held device capable of re-encoding tickets to a programmable flat rate or free. After being re-encoded, free tickets do not have to be validated in APM or fee computer. They can be used to exit at exit controller. Validator shall have a non-resettable counter for every use. It shall have a resettable counter for every use until fee has changed.
- G. ACS System
1. ACS system shall consist of readers and local controllers (as required by vendor's system architecture) which read access card number and transmit it to ACS controller for verification of authorization for access to system and/or recording of appropriate data regarding transaction. Distributive, networked or centralized processing may be employed, so long as required multi-lane control features such as anti-passback, occupancy and activity tracking are maintained.
 2. Operational Description:
 - a. ACS reader identifies that a vehicle equipped with an ID device has entered lane. Validity of vehicle for current authorization in this system shall be checked through ACS Controller and, if approved, a message sent to PARC system indicating a valid ID. A pulse shall then be sent to open gate.
 - b. Where ACS lanes are also equipped with entrance controllers or exit controllers, activation of reader shall automatically disable

- dispenser/verifier. Initiation of a ticket entry/exit validation transaction shall automatically disable ACS.
- c. If ACS access ID device is not valid for system or is not authorized for entry at that location and/or at that time, ACS controller shall send an invalid user attempt message to PARC system. Gate shall not open. An invalid ACS attempt alarm shall sound an audible alarm and display a message at FMS workstations. Invalid user ACS attempt shall also be posted to daily exception transaction log.
3. PROX Card Read System
 - a. Cards shall be read when presented within 12 inches of sensor.
 - b. Accuracy of card read shall be 99.9%.
 - c. Card system shall read and process card within 1.5 seconds of presentation to reader. Card/gate system shall be able to maintain processing rate of 500 transactions per hour for period of at least four continuous hours of operation, including normal patron delays.
 - d. System shall have checking protocol that identifies multiple reads of same card within a few seconds (due to users "waving" the card in front of reader) and corrects false anti-passback reads.
 - e. System shall have protection from common sources of interference. System shall neither affect nor be affected by neighboring electronic systems or electronically controlled devices.
 - H. "TAKE TICKET WITH YOU" Signs: These signs shall be single message LED. Signs shall be provided at all ticket entry lanes, mounted on entrance gate and oriented to be easily seen by driver when ticket is taken. Owner shall approve mounting location. Sign shall be activated automatically by FMS when a ticket is dispensed. Signs shall flash on and off during activation.
 - I. Lot Full Signs: Lot full signs shall be single message LED. Signs shall be provided at all ticket entry lanes and shall be post-mounted as shown on the drawings. Sign shall be activated automatically or manually by FMS.
 - J. Traffic Controller: Sign shall be provided at all designated entry and exit lanes as shown on the drawings. Sign shall be post-mounted as shown on drawings. Sign shall be activated automatically by FMS when a lane is opened or closed, or manually.
 - K. Safety Gate - gate system shall have safe guards to ensure that gates do not lower onto any vehicle or person regardless of size. Gate shall provide method of rising prior to contact with anything under gate arm, without causing any contact, damage or injury. Control gates, shall meet the following requirements independently and in concert with FMS.
 1. Operational Description for Gated Entry and Exit Lanes: As a vehicle pulls into a lane, it is detected by dual loops and a directional vehicle detector. A vehicle **shall** first be detected by loop A, then by loop B, and then by loops A and B simultaneously, for any revenue transaction (ticket issue, exit validation or fee collection) to be processed. Upon satisfactory completion of each transaction, gate shall automatically open. After vehicle has passed over detector loop C, gate shall automatically close. Circuitry shall be such that gate has closed after

- preceding transaction before system shall accept transaction of another vehicle in same lane.
2. Gates shall provide an effective one-way barrier to vehicles in entrance and exit lanes. Barrier arms shall retract quickly in a vertical plane on command signal and return to lower position upon signal from detector beyond gate location. Gate shall have a 10-foot barrier arm, employing breakaway design that can be easily and inexpensively replaced when broken. Height of gate arm shall be approximately 36 inches from drive level when in DOWN position. Articulating arms shall be provided in areas of limited headroom.
 3. Gate shall incorporate in one housing all necessary components for functioning of unit. It shall have a heavy-duty gate motor and all other components circuit breaker protected. Stops or mechanism shall allow adjustment of gate arm travel. All parts shall be suitably treated to inhibit corrosion. Motor shall be able to withstand damage when blocked in any position. Electrical power shall be applied to torque motor at all times. Automatic gate reversal shall be provided.
 4. Controller for gate shall have the following features:
 - a. Separate momentary contact closures for each of the following counts: ACS patrons, RCS patrons, vehicle entries, and vehicle exits.
 - b. Directional logic with electronic outputs to alarms, counters and to report atypical lane activity to FMS.
 - c. Storage of at least three vend inputs and sequentially processing each vend. Gate arm shall remain up until stored vend input vehicles have cleared lane. This feature shall be selectable on/off from FMS.
 - d. Diagnostic mode to facilitate on-site testing of programming switches with LED indicator lights.
 - e. "AUTO-MANUAL" switch, and "ON-OFF" switch for gate. Gate control unit shall contain power supplies, dust-proof relays, and other circuit components to control gate as well as manual control switches.
 - f. Capability to integrate three loops within circuitry to provide directional logic.
- L. Vehicle Detectors: Vehicle detectors shall be intelligent detectors with directional logic where required herein. Detectors shall contain microprocessor logic to differentiate direction of traffic flow, and can send a violation alert signal when a vehicle backs out of lane. Detectors shall:
1. Automatically maintain peak sensitivity regardless of rain, snow or other environmental conditions. Different sensitivity settings shall be provided to allow tailgating vehicles of varying height and size to be optimally detected.
 2. Fit within entrance controller, gate housings or in remote lane/ramp controller.
 3. Have a light on front panel to indicate presence of vehicle.
 4. Modular plug-in construction or built in, and easily serviced.
 5. Be self-tuning and self-compensating, and tune to its loop environment, rather than relying upon conditioning to crystal controlled frequencies. Analog detectors that require periodic manual tuning are not acceptable.
 6. Require no tools or meters for setting unit that is completely automatic except for initial settings.
 7. Have a three-position frequency switch. No two frequencies shall be same, to prevent crosstalk or interference between loops in proximity of each other.

- M. Inductive Loops: Inductive loops shall be cut-in to paving surface:
1. Be formed by three to four turns of 16-gauge single-conductor wire.
 2. Not be spliced.
 3. Have loop leads which are:
 - a. Limited to a length of 100 feet.
 - b. Have a four-twist minimum per foot and located at a minimum of 18 inches from electrical power lines.
 - c. Be contained in separate conduit to prevent interference from electrical signals.
 4. Cut-in loops shall be placed in sawcuts 0.5 inch wide and 1.5 inches deep into paving surface and filled with sealant approved by Engineer/Architect.
- N. Intercom System:
1. Master intercom shall be provided in parking management office with sub-masters in Hotel Front Desk.
 2. Remote intercom call stations shall be furnished at all entrance controller, exit controller, APM, and ACS locations. Intercoms shall be mounted in entrance controller, APM or exit controller. In ACS-only lanes intercom shall be pole mounted. Stations shall be located so that they can be easily accessed from open window of standard passenger vehicle. Stations shall include "Press for Assistance" signs and visual verification that assistance has been requested, and that assistance has been dispatched. Intercom system shall comply with current Americans with Disabilities Act requirements.
 - a. Entire system shall operate without malfunction due to climatic conditions stated herein.
 - b. The intercom system shall use data communication lines to communicate to the master and sub-master intercoms in the parking office/hotel front desk.
 - c. The intercom system shall have a built in auto dialer that can dial a minimum of two different numbers, if first numbers do not answer or is busy.
 - d. The intercom system shall have the ability to call an outside phone, ring a local phone or alternate between the two.
 - e. The intercom system shall have the ability to forward calls and roll over calls based on the time of day or day of week. Intercom shall automatically switch contact number based on the time of day or day of week.
 - f. The intercom system shall have the ability to set calls in queues based on first come first serve basis, the next call in line is immediately connected. The system shall indicate location of incoming calls and for queued calls.
 - g. Intercom shall accommodate two way initiation of conversation.
 - h. The system shall have built in auxiliary outputs for activating devices when the system receives calls and when calls are answered.
 - i. The system shall have volume control for all remote and master units.
 3. The intercom shall include reports based on activation by device, response time from attendant, and a time and date stamp of all intercom calls.

4. Contractor shall supply all necessary network equipment and conduit/wiring required for the intercom system.
5. The intercom system shall have the ability to manually vend a gate in any lane from a master or sub-master intercom station, land line or cell phone.
6. Approved manufacturer shall be Commend or Approved Equal.

2.6 SUBSTITUTIONS

- A. It is recognized that there are variations in equipment between manufacturers and that some manufacturers may not be able to meet all specifications in manner specified. Others provide extra features within standard unit. With submittal of Bid, submit letter summarizing any different approaches to providing specified features and/or any extra features that are provided as part of basic unit. This letter may be accompanied by catalog sheets, brochures, technical specifications, etc.

PART 3 - EXECUTION

3.1 PROJECT COORDINATION

- A. General: Meet with Owner, Engineer/Architect, and PARCS Contractor within 30 days of contract award to verify all details of PARCS. Schedule, as related to Work done under General Contract, shall be achieved with adequate time for hookup, testing, and trial period as specified herein.
- B. Submittals: Provide those responsible for related work with:
 1. Installation diagrams, details and templates for setting mounted equipment.
 2. Templates and cast-in inserts to anchor freestanding equipment to curbs and bases.
 3. Electrical wiring diagrams and details.
 4. Electrical installation requirements.
 5. Electrical power requirements.
- C. Meetings: Meet with Electrical Contractor, before any rough-in work begins.
 1. To review building plans as they relate to PARCS equipment
 2. To explain details or precautions necessary to assure that all parking and revenue control equipment shall work properly
 3. To determine that all required conduits and wiring are properly laid out.
- D. Additional Wiring: Provide all additional conduit and wiring which is needed for total system performance but which was not noted on Contract Documents. There shall be no additional cost to Owner for these items.

3.2 INSPECTION OF WORK BY OTHERS

- A. Upon written notice from Contractor that entire work or an agreed portion thereof is complete, Owner representative(s) and Contractor shall make final inspection of Work. Owner and/or Owner's representative will then notify Contractor in writing of all particulars in which Work has been found incomplete or defective. Contractor shall immediately take such measures as are necessary to remedy such deficiencies.

3.3 INSTALLATION OF PARCS

- A. Install PARCS in accordance with manufacturer's recommendations and approved Shop Drawings.
- B. Installation and Start-Up: Contractor shall be responsible for installation of all control and communication wiring and Contractor supplied equipment and its interfacing and interconnection with Owner supplied equipment. Contractor shall authorize and accept responsibility for application of power to equipment and initiation of operation, be responsible for running all initial diagnostics and system generation programs necessary to provide complete working system.

3.4 TEST AND ACCEPTANCE PROGRAM

- A. General: schedule and format for all system acceptance testing shall be submitted to Engineer/Architect and Owner and shall be approved prior to start of Installation Tests. Provide a checklist of testing of each lane of equipment for all functions.
- B. Inspections and Testing: Inspections and tests observed by Owner and Engineer/Architect shall not relieve Contractor of responsibility for providing hardware, software and documentation in accordance with this Specification.
- C. Installation Test Demonstrations: Upon installation of each lane of equipment or each piece of pay-on-foot or office equipment, an installation test shall be performed. This test shall exercise equipment in accordance with specific test procedures document required in Part 1 of this Specification as well as test every function of equipment. An Owner's representative may witness tests. Contractor shall notify Owner and Engineer/Architect in writing at least one week prior to each official test session. In event that first test is not successful, Contractor shall correct noted deficiencies and notify Owner and Engineer/Architect, at least two days in advance that test session is ready to resume. Contractor shall promptly correct all problems encountered at Contractor's expense.
- D. Substantial completion includes the following:
 - 1. All PARC equipment included in project or phase has passed installation test.
 - 2. All communications from equipment to FMS and workstations has passed installation test.
 - 3. FMS produces all required reports and has passed installation test.
 - 4. All UPSs have passed installation test.
 - 5. All electronic signage is complete and has passed installation test.
 - 6. All spare parts, stock and manuals are on site and have been approved.
 - 7. All training is complete to Owner's satisfaction.

8. Owner has been given all test checklists.

E. Thirty-Day Operational Test and Final Acceptance: Upon completion of all installation tests, demonstrations and training required herein, Owner or its agents shall operate complete system for test period of thirty days. When installation is phased, completion of all installation tests, demonstrations and training of each phase shall be designated at beginning of thirty-day test period. Contractor shall have a qualified and experienced technician on site eight hours per day during 30-day test. When not on site, technician shall be on call with a one-hour response time to an emergency call. During this period, the following performance standard shall be met in order for final acceptance to be issued:

1. All mechanical components shall be operational without downtime. For each downtime period of four hours or more, one working day will be added to acceptance cycle.
2. All electronic components shall be operational without downtime or programming problems for complete monthly reporting cycle. For each downtime period of more than one hour but less than eight hrs or programming problem that delays report cycle, two working days will be added to acceptance cycle.
3. All test reports shall correlate 100% with cash receipts in each APM and fee computer for test period.

3.5 TRAINING PROGRAM

- A. Contractor shall develop and implement a comprehensive training program for Owner's personnel. Such training program shall be implemented through use of formal classroom training and/or other forms of training that Contractor shall propose. Contractor shall document this training program in a comprehensive Training Plan per paragraph titled Submittals.
- B. Curriculum shall be designed so that each group of trainees shall be trained in full repertoire of system commands that they may have to use in course of performing their designated functions. The trainees shall receive training no more than two weeks prior to their use of the equipment. Training shall be accomplished through use of lectures, visual presentations, hands-on operation of equipment and any materials necessary to perform job. Each student shall be provided with a complete set of training materials and operating manuals during training session, which he/she shall retain for use on job at completion of training.
- C. Contractor shall conduct required training at times and locations coordinated by Owner. Owner/Operator shall make personnel available to receive training. Class size shall be no more than can benefit from training materials at once. Full complement of training courses shall be conducted over a five-day period, as required to accommodate shift personnel. Additional schedule for delivery of all training courses shall be included in submittal. Training shall include, but not be limited to, the following groupings of staff (with an estimated student population as shown):

Labor Category	# To Be Trained	# Of Class Hrs. Per Class
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Supervisors	3	10
Maintenance Personnel	1	12
System Managers/Administrators	2	16

- D. At conclusion of maintenance training session(s), Contractor shall submit to Owner a list naming qualified Owner/Operator maintenance personnel. List shall detail level of maintenance/repair functions each of Owner/Operator personnel are qualified to perform.
- E. Training shall consist of the following:
1. Supervisors: Supervisors shall be trained to:
 - a. Perform primary maintenance on PARCS components (trouble shoot/replenish supplies).
 - b. Understand any and all system messages provided by FMS, including but not limited to alarm messages, indications of attempts to compromise PARCS and explanations of atypical lane activity displayed by count system, revenue control system.
 - c. Be able to correlate tickets issued with vehicles present, time parked with revenue generated.
 - d. Be able to understand purpose and data contained within any and all reports produced by FMS.
 - e. Be able to operate FMS.
 - f. Be able to process exception transactions occurring at exit controllers.
 - g. Be able to load and remove coins and bills, clear note jams, and trouble shoot automated pay station.
 2. Maintenance personnel: Maintenance personnel shall be trained to perform primary maintenance on all major components of system. Additionally, maintenance personnel shall be trained to:
 - a. Replenish all system supplies.
 - b. Clear ticket and other paper jams.
 - c. Reset system after a power failure.
 - d. Replace internal elements such as circuit boards.
 - e. Lubricate and clean internal components.
 - f. Remove and replace gate arms and adjust gate arm travel.
 - g. Be certified by contractor to trouble shoot all systems and perform primary maintenance.
 3. System Administrators: System Administrators shall have same basic training as Supervisors. In addition to such training, System Administrators shall be trained to operate FMS and to understand statistical reports which reveal trends in revenue generation, facility utilization, and based on information available from FMS, to perform checks and balances over actions of Supervisors and their subordinates. Three and six months after Final Acceptance, System Administrators shall have one day's additional training.

END OF SECTION 11152

Project Name: Eddy Street Commons
Project Number: 13-2834.30

Construction Documents
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