


**City
of
Milwaukee**
**Department
of
Public Works
Infrastructure
Services
Division
Facilities
Development
and
Management Section**

**AIR HANDLING UNIT INSTALLATION
POLICE RADIO REPAIR SHOP**

4733 West Vliet Street
Milwaukee, Wisconsin

July, 2011

Project Number RM5445139905
Official Notice No. 145

CITY OF MILWAUKEE, WISCONSIN
DEPARTMENT OF PUBLIC WORKS
INFRASTRUCTURE SERVICES DIVISION
FACILITIES DEVELOPMENT AND MANAGEMENT SECTION

PROJECT MANUAL
GOVERNING THE
AIR HANDLING UNIT INSTALLATION
MILWAUKEE POLICE DEPARTMENT
RADIO REPAIR SHOP
4733 WEST VLIET STREET
MILWAUKEE, WISCONSIN

Project No. RM5445139905

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CITY OF MILWAUKEE
GENERAL OFFICIAL NOTICE
TO CONTRACTORS

Separate sealed bids for each project will be received until 10:30 A.M. of the bid opening date at which time bids will be publicly opened and read for furnishing all material and doing all work for each project in accordance with the requirements of the respective Official Notice on the bid form furnished in accordance with plans, specifications, contract documents, and proposed form of contract on file in the office of the Department of Public Works, Municipal Building, 841 N. Broadway, Room 506, Milwaukee, Wisconsin, 53202.

PROSPECTIVE BIDDERS ARE TO CAREFULLY EXAMINE AND REVIEW ALL CONTRACT DOCUMENTS AND MATERIALS IN SAID OFFICE BEFORE SUBMITTING BID.

AFFIDAVITS OF NO INTEREST MUST ACCOMPANY THE BIDS, AND THE FAILURE OF PROSPECTIVE BIDDERS TO COMPLY WITH THESE REQUIREMENTS MAY DISQUALIFY THE BID.

THE CONTRACTOR/LESSEE AGREES TO COMPLY WITH ALL APPLICABLE REQUIREMENTS OF THE AMERICANS WITH DISABILITIES ACT OF 1990, 42 U.S.C. § 12101, ET. SEQ. THE TDD NUMBER FOR PUBLIC WORKS IS (414) 286-2025.

As part of the bid each bidder shall submit a list of anticipated subcontractors and the class of work to be performed by each, which list should not be added to nor altered without the written consent of the Commissioner of Public Works.

All contractor(s) and subcontractor(s) are required to furnish or have on file a certificate of insurance in accordance with the insurance provisions of the General Specifications.

All contractor(s) and subcontractor(s) are subject to the prevailing wage rates and hours of labor as prescribed by the Common Council of the City of Milwaukee consistent with provisions of Section 66.293 of the Wisconsin Statutes.

Copies of the actual work classifications and wage and fringe benefit rates enforced on this project are available in Room 506 of the Municipal Building.

Corporate surety will be required on performance and payment bonds for all projects listed in the following Official Notices. All applicable charter and Statutory provisions and ordinances, all the provisions of this official notice, invitation to bid, general and detailed specifications, special provisions, proposal, schedule of fixed prices, addendum and plans for this project and all other contract documents set forth in the invitation to bid will be incorporated and made part of the contract as if therein set forth in full.

Tie bids, when the lowest ones, will be decided by the Commissioner of Public Works.

The Commissioner of Public Works reserves the right to reject any or all bids.

Signed: GHASSAN KORBAN,
Special Deputy Commissioner of Public Works

Countersigned: W. MARTIN MORICS,
City Comptroller

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CITY OF MILWAUKEE
SPECIFIC OFFICIAL NOTICE NO. 145

Important Notice:

The Invitation to Bid, all bid documents and the Plans & Specifications for the project listed will be available electronically to prospective bidders via <http://www.mpw.net/bids/docs/145-2011>. Any required addenda or responses related to the listed projects will be posted on said website. Bidders are encouraged to utilize this electronic method of obtaining bid documents as the Department of Public Works intends to solely use this method for future projects. At this time however, a limited number of hard copies of the above documents will also be available at address listed below.

Sealed bids will be opened on Wednesday, August 17, 2011 at 10:30 A.M. for the **AIR HANDLING UNIT INSTALLATION MILWAUKEE POLICE DEPARTMENT**, located at Milwaukee Police Department, Radio Repair Shop, 4733 W Vliet Street, Milwaukee WI 53208.

Bid Security Required: Bond, Certified Check, Cashier's Check, or Cash to accompany bid: 10% of Contractor's Base Bid

Time for Completion: 90 Working Days.

Liquidated Damages, per diem: \$150.00

The EBE requirement for this project is 25% of the contract base bid.

The residency requirement for this project is 40% of all hours worked on the project.

The apprenticeship requirements for this project are: N/A

The contractor shall specifically note the EBE, residency, and apprenticeship forms for this project. If the forms are not filled out properly, it will be cause for rejection of the bid.

Plans and project manual will be furnished to the prospective bidders upon payment of a \$10.00 non-refundable fee in room 506, Frank P. Zeidler Municipal Building, 841 North Broadway, Milwaukee, Wisconsin 53202. For general questions call 414-286-3314.

A \$10.00 per set additional non-refundable fee is required to obtain bid documents by mail. Plans are sent via U.S. mail unless other arrangements are made by the contractor.

Contractor must comply with all provisions of the CITY OF MILWAUKEE GENERAL OFFICIAL NOTICE TO CONTRACTORS published herein and at http://www.mpw.net/services/bids_home

Pre-Bid Meeting: A Pre-Bid Meeting is scheduled for Wednesday, August 10, 2011, at 2:00 p.m. in Room 606 of the Frank P. Zeidler Municipal Building, 841 North Broadway, Milwaukee, Wisconsin. Bidder participation is urged to become familiar with all aspects of the project and bidding requirements.

Signed:

GHASSAN KORBAN
Special Deputy Commissioner of Public Works

PUBLISH SIX (6) TIMES INSERTION WITHOUT FAIL, Wednesday, August 03, 2011

SECTION 00100: INSTRUCTIONS TO BIDDERS

See also Instructions to Bidders in the "General Specifications" of the Department of Public Works, City of Milwaukee, Wisconsin, dated January 31, 1992, and all subsequent addenda.

BID FORM:

Submit a lump sum price for the work as indicated on the drawings and specified herein, complete in every respect.

Bids will not be accepted in any form except on the bid form included with this project manual.

The contractor must recognize and abide by the right of the Owner (City of Milwaukee) to accept or reject any or all bids in the best interests of the City.

ALLOWANCES:

Each bidder shall use the following allowance in arriving at the Base Bid. Allowances will not be used for contract modification purposes.

Allowance 1:

Allow the lump sum of \$5,000.00 to engage the services of a licensed structural engineer to provide the roof framing detail(s) for the installation of the new rooftop unit as required.

CONTRACT AWARD:

The Commissioner of Public Works will award the contract on the basis of the Base Bid only as funds permit.

BASE BID EXCLUSIONS:

The contractor shall exclude from their base bid the estimated dollar amount that they will be able to recoup from Wisconsin Focus on Energy grants/rebates and EPCAT 2005 tax incentives available to the City under this project. The City will sign-off on these grant/rebates going directly to the successful bidder.

Testing and balancing by others under a separate contract with the City.

All Electrical work is to be performed by the City with the exception of HVAC control wiring.

CONTRACT BREAKDOWN:

Shortly after the award of the contract, each contractor shall submit a list showing the cost breakdown of the items in his contract. This list will be used as a basis for estimates of work completed for partial payment.

SITE VISIT:

All contractors shall visit the site, consult the drawings and project manual, be familiar with the work of other contractors and determine for himself all conditions affecting the work.

Failure by a contractor to be familiar with the project shall not release him from any obligation under this contract to complete the work in strict conformity with the plans and project manual and all City, State and Federal Codes or regulations pertaining to the work.

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TIME FOR COMPLETION:

The time allowed for completion is stated in the Specific Official Notice and shall start with the date on the Notice to Proceed which will be sent to the contractor directly following the signing of the contract. The time allowed includes time required for fabricating and procuring material and doing the work at the building site.

ADDITIONAL PLANS/PROJECT MANUALS:

These will be available at: <http://www.mpw.net/bids/docs/145-2011>

SECTION 00700: GENERAL CONDITIONS1. SCOPE:A. Index:

1. Scope
2. DPW General Specifications
3. Definitions
4. Control of Work and Materials
5. Samples and Tests
6. Project Coordination
7. Supervision of Work
8. Technical Specifications and Drawings
9. Safety Regulations
10. Code Rules

2. Department of Public Works General Specifications:

Provisions of the Department of Public Works General Specifications dated January 31, 1992, and subsequent addenda except as may be modified or expanded upon in this project manual, shall apply to all contractors and subcontractors working on the project. Copies of the General Specifications may be obtained from http://www.mpw.net/services/bids_home.

3. Definitions:

- A. Owner: City of Milwaukee.
- B. Facilities Manager: The Facilities Manager of FACILITIES DEVELOPMENT AND MANAGEMENT SECTION.
- C. Project Inspector: The authorized representative of the Commissioner assigned to make detailed inspection of any or all portions of the work and materials thereof. These inspections are not a substitute to those required by the Department of Neighborhood Services for permit and code compliance.
- D. Addenda: Written or graphic instruments issued prior to the execution of the contract which modify or interpret the bidding documents, including drawings and project manual by additions, deletions, clarifications or corrections. Addenda will become part of the contract documents when the contract is executed.
- E. Contract Drawings: Drawings of the work to be done as listed hereafter in Section 00850 Drawing Schedule and/or Section 00870 Plans and Details.
- F. Utility: WE Energies.
- G. End User: City of Milwaukee.

4. Control of Work and Materials:

- A. Detail and Shop Drawings: Shop drawings and other additional drawings which may be required for each contract of the work shall be prepared by each respective contractor unless otherwise directed by the Facilities Manager. Prints shall be the same size as contract documents when practical. Prints of each drawing shall be submitted to the Facilities Manager

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for approval before proceeding with the work. Changes ordered by the Facilities Manager shall be made and revised prints submitted as above. The Facilities Manager's approval of drawings shall not relieve the contractor of responsibility for errors.

- B. Primary Lines and Grades: The City of Milwaukee will mark two building corners along a line and will establish a benchmark, with a relative elevation, within close proximity to the site. Once established by the City, the contractor shall preserve all points and benchmark as long as needed during construction. The contractor will bear all costs associated with re-establishing points and benchmark.
- C. Construction Lines and Grades: The contractor must bear sole responsibility for the correct transfer of all construction lines and grades from the primary lines and grades points. He shall take such measurements from existing work as may be necessary to insure the proper construction of his work.
- D. Material Orders and Shipping Statements: The contractor shall furnish to the Facilities Manager at least two (2) copies of all material orders and shipping statements. Itemized weights of the materials and individual units of finished work shall be shown.
- E. Weighing of Materials and Fabricated Units: The weighing of materials and fabricated units such as structural steel, casings, etc., when required, shall be done in the presence of the Commissioner's representative. The contractor shall be responsible for the satisfactory weighing of such materials and units.
- F. Consignment and Delivery of Materials: The materials for the work shall be consigned to the contractor and he shall be responsible for the delivery of all materials required for the completion of the contract.

5. Samples and Tests:

- A. Method of Sampling: Samples of the materials proposed or furnished for the work may be taken by the Commissioner at any time; at the point of manufacture, point of delivery or site of work. They will be selected, as far as practicable, in accordance with standard methods of sampling such materials as specified in the standard of the American Society for Testing Material. All sampling shall be done by authorized representatives of the Commissioner. Selections will be in an orderly and systematic manner, insuring samples representative of the lot.
- B. A.S.T.M. Standards: Wherever the abbreviation A.S.T.M. is used in connection with the number of a standard specification, the specification referred to shall be the Standard of the American Society for Testing Materials, designated by that number, including all revisions in effect on the date of award of the contract. Should a revised or amended standard be issued by the American Society for Testing Materials which, in the opinion of the Commissioner, conflicts with or causes undesirable changes in the standards referred to herein, the Commissioner reserves the right, by means of addenda to the project manual, to continue under the provisions of the pertinent standard referred to herein.
- C. Cost of Test Specimens and Samples: All test specimens of metals and all samples of non-metals required for tests shall be furnished by the contractor without cost to the City.
- D. Costs of Tests: All tests on test specimens of metals will be made at the expense of the contractor and the original test on samples of non-metals will be made at the expense of the City. In all cases, the testing procedure will be in accordance with Standard A.S.T.M. tests for such materials. Subsequent tests of non-metals requested by the contractor, when such tests

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are permitted by A.S.T.M. Specifications and approved by the Commissioner or subsequent tests ordered by the Commissioner will be made at the expense of the contractor.

6. Project Coordination:

- A. Contractors are required, so far as possible; to arrange work and to dispose of materials so as not to interfere with the work or storage of materials of other contractors or City forces engaged upon the work.
- B. Contractors shall give full cooperation to other trades and furnish any information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.
- C. Where the work of a contractor will be installed in close proximity to the work of other trades, or where there is evidence that the work of a contractor will interfere with the work of other trades, he shall assist in working out space conditions to make satisfactory adjustments.
- D. If a contractor installs work before coordinating it with other trades or so as to cause interference with work of other trades, he shall make necessary changes in his work to correct the condition without extra charge.
- E. Contractors are required to join their work to that of others in a proper manner, and in accordance with the spirit of the plans and project manual, and to perform the work in the proper sequence in relation to that of other contractors, and as may be directed by the Project Inspector.

7. Supervision of Work:

- A. Contractors shall furnish the services of an experienced engineer or superintendent.
- B. He shall be constantly in charge of the installation of the work together with all subcontractors, skilled workers, helpers, and labor required to unload, transfer, erect, connect up, adjust, start, operate and test each system.
- C. He shall be thoroughly acquainted with and be responsible for the various subcontractors' work so that it is properly coordinated and supervised to the satisfaction of the Commissioner of Public Works or his representative.
- D. Upon written notice to a contractor of the lack of such coordination and supervision, the Commissioner of Public Works may authorize such services as may be required and deduct the cost of this service at an hourly rate of \$60.00 per hour per worker from the contract for the work.

8. Technical Specifications and Drawings:

A. Governing order of Contract Documents:

- 1. The following provision modifies DPW General Specifications Item 2.1.3.1:

Anything mentioned in the Technical Specifications and not shown on the drawings or shown on the drawings and not mentioned in the Technical Specifications shall be as if shown on or mentioned in both. In case of difference between drawings and Technical Specifications, the Technical Specifications shall govern. In case of any discrepancy in drawings or Technical Specifications, the matter shall be immediately submitted to

FACILITIES DEVELOPMENT AND MANAGEMENT SECTION for decision. Said discrepancy shall not be adjusted by the contractor.

B. All contractors shall have complete sets of plans and project manuals on the job site at all times.

9. Safety Regulations:

All work shall be done in accordance with the safety requirements referenced in the International Building Code, as adopted and amended by the State of Wisconsin and OSHA standards.

10. Code Rules:

The rulings, regulations and laws of the following shall be complied with in the completion of this project:

- IBC Existing Building Code, as amended and adopted by the State of Wisconsin (Renovations/Remodeling)
- International Building Code, as amended and adopted by the State of Wisconsin (New Construction)
- Plumbing and Drainage Codes of the City of Milwaukee
- Ordinances of the City of Milwaukee
- National Board of Fire Underwriters
- OSHA
- NFPA
- FAA
- NEC
- IEEE
- UL

00821/1

SECTION 00821: INSPECTION CHARGES

The contractor will be charged a fee for inspection for each and every day such inspection is required after the time allowed for completion has expired.

The amount of the fee for inspection shall be \$325.00 per day.

The time allowed for completion is stated in the Specific Official Notice and shall start with the date on the Notice to Proceed which will be sent to the contractor directly following the signing of the contract. The time allowed includes the time required for fabricating and procuring material and doing the work at the building site.

PREVAILING WAGE RATE DETERMINATION

Issued by the State of Wisconsin
Department of Workforce Development
Pursuant to s. 66.0903, Wis. Stats.
Issued On: 01/14/2011
Last Amended On: 06/26/2011

DETERMINATION NUMBER: 201100110

EXPIRATION DATE: Prime Contracts MUST Be Awarded or Negotiated On Or Before 12/31/2011. If NOT, You MUST Reapply.

PROJECT NAME: ALL PUBLIC WORKS CONSTRUCTION PROJECTS SUBJECT TO SEC. 66.0903, STATS.-CITY OF MILWAUKEE

PROJECT LOCATION: MILWAUKEE CITY, MILWAUKEE COUNTY, WI

CONTRACTING AGENCY: CITY OF MILWAUKEE - DEPT OF PUBLIC WORKS

CLASSIFICATION:	Contractors are responsible for correctly classifying their workers. Either call the Department of Workforce Development (DWD) with trade or classification questions or consult DWD's Dictionary of Occupational Classifications & Work Descriptions on the DWD website at: dwd.wisconsin.gov/er/prevailing_wage_rate/Dictionary/dictionary_main.htm .
OVERTIME:	Time and one-half must be paid for all hours worked: <ul style="list-style-type: none">- over 10 hours per day on prevailing wage projects- over 40 hours per calendar week- Saturday and Sunday- on all of the following holidays: January 1; the last Monday in May; July 4; the 1st Monday in September; the 4th Thursday in November; December 25;- The day before if January 1, July 4 or December 25 falls on a Saturday;- The day following if January 1, July 4 or December 25 falls on a Sunday.
FUTURE INCREASE:	When a specific trade or occupation requires a future increase, you MUST add the full hourly increase to the "TOTAL" on the effective date(s) indicated for the specific trade or occupation.
PREMIUM PAY:	If indicated for a specific trade or occupation, the full amount of such pay MUST be added to the "HOURLY BASIC RATE OF PAY" indicated for such trade or occupation, whenever such pay is applicable.
APPRENTICES:	Pay apprentices a percentage of the applicable journey person's hourly basic rate of pay and hourly fringe benefit contributions specified in this determination. Obtain the appropriate percentage from each apprentice's contract or indenture.
SUBJOURNEY:	Subjourney wage rates may be available for some of the trades or occupations indicated below with the exception of laborers, truck drivers and heavy equipment operators. Any employer interested in using a subjourney classification on this project MUST complete Form ERD-10880 and request the applicable wage rate from the Department of Workforce Development PRIOR to using the subjourney worker on this project.
ELECTRONIC CERTIFIED: PAYROLL REPORTS: <div style="border: 1px solid red; padding: 2px; display: inline-block; color: red;">N/A</div>	Every contractor working on this project MUST file monthly certified payroll reports in an electronic format that meets the Wisconsin Department of Workforce Development's reporting requirements. These certified payroll reports must be filed by the 7th of the month following the month in which the contractor performed work on this project at the following website: http://dwd.wisconsin.gov/er/prevailing_wage_rate/default.htm.

This document **MUST BE POSTED** by the **CONTRACTING AGENCY** in at least one conspicuous and easily accessible place **on the site of the project**. A local governmental unit may post this document at the place normally used to post public notices if there is no common site on the project. This document **MUST** remain posted during the entire time any worker is employed on the project and **MUST** be physically incorporated into the specifications and all contracts and subcontracts. If you have any questions, please write to the Equal Rights Division, Labor Standards Bureau, P.O. Box 8928, Madison, Wisconsin 53708 or call (608) 266-6861.

The following statutory provisions apply to local governmental unit projects of public works and are set forth below pursuant to the requirements of s. 66.0903(8), Stats.

s. 66.0903 (1) (f) & s. 103.49 (1) (c) "PREVAILING HOURS OF LABOR" for any trade or occupation in any area means 10 hours per day and 40 hours per week and may not include any hours worked on a Saturday or Sunday or on any of the following holidays:

1. January 1.
2. The last Monday in May.
3. July 4.
4. The first Monday in September.
5. The 4th Thursday in November.
6. December 25.
7. The day before if January 1, July 4 or December 25 falls on a Saturday.
8. The day following if January 1, July 4 or December 25 falls on a Sunday.

s. 66.0903 (10) RECORDS; INSPECTION; ENFORCEMENT.

(a) Each contractor, subcontractor, or contractor's or subcontractor's agent performing work on a project of public works that is subject to this section shall keep full and accurate records clearly indicating the name and trade or occupation of every person performing the work described in sub. (4) and an accurate record of the number of hours worked by each of those persons and the actual wages paid for the hours worked.

s. 66.0903 (11) LIABILITY AND PENALTIES.

(a) 1. Any contractor, subcontractor, or contractor's or subcontractor's agent who fails to pay the prevailing wage rate determined by the department under sub. (3) or who pays less than 1.5 times the hourly basic rate of pay for all hours worked in excess of the prevailing hours of labor is liable to any affected employee in the amount of his or her unpaid wages or his or her unpaid overtime compensation and in an additional amount as liquidated damages as provided under subd. 2., 3., whichever is applicable.

2. If the department determines upon inspection under sub. (10) (b) or (c) that a contractor, subcontractor, or contractor's or subcontractor's agent has failed to pay the prevailing wage rate determined by the department under sub. (3) or has paid less than 1.5 times the hourly basic rate of pay for all hours worked in excess of the prevailing hours of labor, the department shall order the contractor to pay to any affected employee the amount of his or her unpaid wages or his or her unpaid overtime compensation and an additional amount equal to 100 percent of the amount of those unpaid wages or that unpaid overtime compensation as liquidated damages within a period specified by the department in the order.

3. In addition to or in lieu of recovering the liability specified in subd. 1. as provided in subd. 2., any employee for and in behalf of that employee and other employees similarly situated may commence an action to recover that liability in any court of competent jurisdiction. If the court finds that a contractor, subcontractor, or contractor's or subcontractor's agent has failed to pay the prevailing wage rate determined by the department under sub. (3) or has paid less than 1.5 times the hourly basic rate of pay for all hours worked in excess of the prevailing hours of labor, the court shall order the contractor, subcontractor, or agent to pay to any affected employee the amount of his or her unpaid wages or his or her unpaid overtime compensation and an additional amount equal to 100 percent of the amount of those unpaid wages or that unpaid overtime compensation as liquidated damages.

5. No employee may be a party plaintiff to an action under subd. 3. unless the employee consents in writing to become a party and the consent is filed in the court in which the action is brought. Notwithstanding s. 814.04 (1), the court shall, in addition to any judgment awarded to the plaintiff, allow reasonable attorney fees and costs to be paid by the defendant.

BUILDING OR HEAVY CONSTRUCTION

Includes sheltered enclosures with walk-in access for the purpose of housing persons, employees, machinery, equipment or supplies and non-sheltered work such as canals, dams, dikes, reservoirs, storage tanks, etc. A sheltered enclosure need not be "habitable" in order to be considered a building. The installation of machinery and/or equipment, both above and below grade level, does not change a project's character as a building. On-site grading, utility work and landscaping are included within this definition. Residential buildings of four (4) stories or less, agricultural buildings, parking lots and driveways are NOT included within this definition.

SKILLED TRADES

<u>CODE</u>	<u>TRADE OR OCCUPATION</u>	Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		
		<u>HOURLY BASIC RATE OF PAY</u> \$	<u>HOURLY FRINGE BENEFITS</u> \$	<u>TOTAL</u> \$
101	Acoustic Ceiling Tile Installer	31.38	18.16	49.54
102	Boilermaker	31.09	23.75	54.84
103	Bricklayer, Blocklayer or Stonemason Future Increase(s): Add \$1.95 6/06/2011	35.53	15.92	51.45
104	Cabinet Installer	28.31	14.91	43.22
105	Carpenter Future Increase(s): Add \$2.65 on 6/6/11	31.68	18.41	50.09
106	Carpet Layer or Soft Floor Coverer Future Increase(s): Add \$2.65 on 6/6/11	31.68	18.41	50.09
107	Cement Finisher	29.72	15.23	44.95
108	Drywall Taper or Finisher	28.17	15.39	43.56
109	Electrician Future Increase(s): Add \$1/hr on 6/1/2011. Add \$1.40/hr on 6/1/2012. Add \$1.60/hr on 6/1/2013.	31.10	20.39	51.49
110	Elevator Constructor	40.46	23.33	63.79
111	Fence Erector	22.50	3.65	26.15
112	Fire Sprinkler Fitter	36.82	19.03	55.85
113	Glazier Future Increase(s): Add \$2.10/hr on 6/1/2011; Add \$2.15/hr on 6/1/2012.	32.25	15.94	48.19
114	Heat or Frost Insulator	33.28	21.37	54.65
115	Insulator (Batt or Blown)	17.11	17.69	34.80
116	Ironworker	31.31	21.79	53.10
117	Lather	31.38	16.11	47.49

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
118	Line Constructor (Electrical)	31.66	13.94	45.60
119	Marble Finisher	29.40	14.31	43.71
120	Marble Mason	34.58	14.92	49.50
121	Metal Building Erector	13.00	6.86	19.86
122	Millwright	28.30	23.06	51.36
123	Overhead Door Installer	17.25	3.00	20.25
124	Painter Future Increase(s): Add \$2.10/hr on 6/1/2011; Add \$2.20/hr on 6/1/2012. Premium Increase(s): Add \$.20/hr for paperhanging; Add \$.35/hr for bridge, iron and drywall; Add \$.75/hr for spraying and sandblasting; Add \$.60/hr for EIFS work; Add \$1.00/hr for lead based paint removal.	28.47	16.74	45.21
125	Pavement Marking Operator	25.65	13.10	38.75
126	Piledriver Future Increase(s): Add \$2.65/hr on 6/6/11. Premium Increase(s): Add \$.65/hr for Piledriver Loftzman; Add \$.75/hr for Sheet Piling Loftzman.	28.11	23.76	51.87
127	Pipeline Fuser or Welder (Gas or Utility)	29.85	17.34	47.19
129	Plasterer	29.31	15.83	45.14
130	Plumber	37.42	17.02	54.44
132	Refrigeration Mechanic	34.41	17.59	52.00
133	Roofer or Waterproofer	28.85	14.60	43.45
134	Sheet Metal Worker	37.20	16.41	53.61
135	Steamfitter	37.21	19.04	56.25
137	Teledata Technician or Installer	24.65	15.17	39.82
138	Temperature Control Installer	35.81	16.98	52.79
139	Terrazzo Finisher	29.40	14.31	43.71
140	Terrazzo Mechanic	29.40	14.31	43.71
141	Tile Finisher	15.05	9.43	24.48
142	Tile Setter	29.95	15.64	45.59
143	Tuckpointer, Caulker or Cleaner Future Increase(s): Add \$1.95 06/06/2011	34.30	15.47	49.77

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
144	Underwater Diver (Except on Great Lakes)	32.31	14.91	47.22
146	Well Driller or Pump Installer Future Increase(s): Add \$1.60/hr on 6/1/11. Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate.	24.22	14.80	39.02
147	Siding Installer	36.60	15.48	52.08
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	26.88	13.71	40.59
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	27.66	0.00	27.66
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	17.00	8.50	25.50
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	25.44	0.00	25.44
154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	17.41	9.80	27.21

TRUCK DRIVERS

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
201	Single Axle or Two Axle	21.42	5.62	27.04
203	Three or More Axle	26.62	17.81	44.43
204	Articulated, Euclid, Dumptor, Off Road Material Hauler Future Increase(s): Add \$1.85/hr on 5/31/2011. Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate.	32.32	16.75	49.07
205	Pavement Marking Vehicle	20.85	11.02	31.87
207	Truck Mechanic	26.62	17.81	44.43

LABORERS

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
301	General Laborer Future Increase(s): Add \$2.25/hr on 6/1/2011. Premium Increase(s): Add \$.11 for mortar mixer, fork lift operator, air and electric equipment and power buggy operators; Add \$.22 for jackhammer operator, certified welder, gunite machineman.	27.17	15.01	42.18
302	Asbestos Abatement Worker	23.25	13.91	37.16
303	Landscaper Future Increase(s): Add \$1.00/hr on 6/1/2011; Add \$1.00/hr on 6/1/2012: Add \$1.00/hr on 6/1/2013; Add \$1.00/hr on 6/1/2014.	13.80	15.10	28.90
310	Gas or Utility Pipeline Laborer (Other Than Sewer and Water) Future Increase(s): Add \$1.00/hr. on 6/1/2011	18.74	14.93	33.67
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	15.00	3.09	18.09
314	Railroad Track Laborer	12.50	3.96	16.46

**HEAVY EQUIPMENT OPERATORS
SITE PREPARATION, UTILITY OR LANDSCAPING WORK ONLY**

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
501	Air Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Asphalt Milling Machine; Boring Machine (Directional, Horizontal or Vertical); Backhoe (Track Type) Having a Mfgr's Rated Capacity of 130,000 Lbs. or Over; Backhoe (Track Type) Having a Mfgr's Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Bulldozer or Endloader (Over 40 hp); Compactor (Self-Propelled 85 Ft Total Drum Width & Over, or Tractor Mounted, Towed & Light Equipment); Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Crane, Shovel, Dragline, Clamshells; Forklift (Machinery Moving or Steel Erection, 25 Ft & Over); Gradall (Cruz-Aire Type); Grader or Motor Patrol; Master Mechanic; Mechanic or Welder; Robotic Tool Carrier (With or Without Attachments); Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Tractor (Scraper, Dozer, Pusher, Loader); Trencher (Wheel Type or Chain Type Having Over 8 Inch Bucket). Future Increase(s): Add \$1.85/hr on 5/31/2011. Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate.	32.32	16.75	49.07

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
502	Backfiller; Broom or Sweeper; Bulldozer or Endloader (Under 40 hp); Environmental Burner; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Jeep Digger; Screed (Milling Machine); Skid Rig; Straddle Carrier or Travel Lift; Stump Chipper; Trencher (Wheel Type or Chain Type Having 8 Inch Bucket & Under).	33.24	17.61	50.85
503	Air Compressor (&/or 400 CFM or Over); Augers (Vertical & Horizontal); Compactor (Self-Propelled 84 Ft Total Drum Width & Under, or Tractor Mounted, Towed & Light Equipment); Crusher, Screening or Wash Plant; Farm or Industrial Type Tractor; Forklift; Generator (&/or 150 KW or Over); Greaser; High Pressure Utility Locating Machine (Daylighting Machine); Mulcher; Oiler; Post Hole Digger or Driver; Pump (3 Inch or Over) or Well Points; Refrigeration Plant or Freeze Machine; Rock, Stone Breaker; Skid Steer Loader (With or Without Attachments); Vibratory Hammer or Extractor, Power Pack. Future Increase(s): Add \$1.85/hr on 5/31/2011. Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate.	32.32	16.75	49.07
504	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	35.05	18.08	53.13
505	Work Performed on the Great Lakes Including Crane or Backhoe Operator; Assistant Hydraulic Dredge Engineer; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder; 70 Ton & Over Tug Operator. Premium Increase(s): Add \$.50/hr for friction crane, lattice boom or crane certification (CCO). On Sunday & holidays, pay two times the hourly basic rate.	37.45	19.45	56.90
506	Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or More); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery. Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate.	33.35	19.33	52.68
507	Work Performed on the Great Lakes Including Deck Equipment Operator, Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under); Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks - Great Lakes ONLY.	32.20	18.69	50.89

**HEAVY EQUIPMENT OPERATORS
EXCLUDING SITE PREPARATION, UTILITY, PAVING LANDSCAPING WORK**

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
508	Boring Machine (Directional); Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity of Over 4,000 Lbs., Crane With Boom Dollies; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Master Mechanic. Future Increase(s): Add \$2.10/hr on 6/1/11 Premium Increase(s): Crane Operators with CCO certification add \$.50/hr. Cranes with boom length over 200 ft. not exceeding 300 ft. OR lifting capacity over 200 ton not exceeding 300 ton add \$.50/hr. Over 300 ton OR 300 ft. add \$.01/hr. per foot OR ton whichever is greater. On Sunday & holidays, pay two times the hourly basic rate.	38.06	18.10	56.16
509	Backhoe (Track Type) Having a Mfgr's Rated Capacity of 130,000 Lbs. or Over; Boring Machine (Horizontal or Vertical); Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With A Lifting Capacity Of 4,000 Lbs. & Under; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Pile Driver; Versi Lifts, Tri-Lifts & Gantrys (20,000 Lbs. & Over). Future Increase(s): Add \$2.10/hr on 6/1/2011. Premium Increase(s): Crane Operators with CCO certification add \$.50/hr. On Sunday & holidays, pay two times the hourly basic rate.	37.56	18.10	55.66
510	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump (Over 46 Meter), Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Concrete Spreader & Distributor; Dredge (NOT Performing Work on the Great Lakes); Forklift (Machinery Moving or Steel Erection, 25 Ft & Over); Gradall (Cruz-Aire Type); Hydro-Blaster (10,000 PSI or Over); Milling Machine; Skid Rig; Traveling Crane (Bridge Type). Future Increase(s): Add \$2.10/hr on 6/1/11. Premium Increase(s): Crane Operators with CCO certification add \$.50/hr. On Sunday & holidays, pay two times the hourly basic rate.	37.06	18.10	55.16

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
511	<p>Air, Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Bulldozer or Endloader (Over 40 hp); Compactor (Self-Propelled 85 Ft Total Drum Width & Over, or Tractor Mounted, Towed & Light Equipment); Concrete Pump (46 Meter & Under), Concrete Conveyor (Rotec or Bidwell Type); Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Environmental Burner; Gantrys (Under 20,000 Lbs.); Grader or Motor Patrol; High Pressure Utility Locating Machine (Daylighting Machine); Manhoist; Material or Stack Hoist; Mechanic or Welder; Railroad Track Rail Leveling Machine, Tie Placer, Extractor, Tamper, Stone Leveler or Rehabilitation Equipment; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yd or More Capacity; Screed (Milling Machine); Sideboom; Straddle Carrier or Travel Lift; Tining or Curing Machine; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Trencher (Wheel Type or Chain Type Having Over 8-Inch Bucket).</p> <p>Future Increase(s): Add \$2/hr on 6/1/11.</p> <p>Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate.</p>	36.47	18.10	54.57
512	<p>Backfiller; Broom or Sweeper; Bulldozer or Endloader (Under 40 hp); Compactor (Self-Propelled 84 Ft Total Drum Width & Under, or Tractor Mounted, Towed & Light Equipment); Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Conveyor System; Concrete Finishing Machine (Road Type); Fireman (Pile Driver & Derrick NOT Performing Work on the Great Lakes); Grout Pump; Hoist (Tugger, Automatic); Industrial Locomotives; Jeep Digger; Lift Slab Machine; Mulcher; Robotic Tool Carrier (With or Without Attachments); Roller (Rubber Tire, 5 Ton or Under); Screw or Gypsum Pumps; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Stump Chipper; Trencher (Wheel Type or Chain Type Having 8-Inch Bucket & Under); Winches & A-Frames.</p> <p>Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate.</p>	29.82	17.96	47.78
513	<p>Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical & Horizontal); Boatmen (NOT Performing Work on the Great Lakes); Boiler (Temporary Heat); Crusher, Screening or Wash Plant; Elevator; Farm or Industrial Type Tractor; Fireman (Asphalt Plant NOT Performing Work on the Great Lakes); Forklift; Generator (&/or 150 KW or Over); Greaser; Heaters (Mechanical); Loading Machine (Conveyor); Oiler; Post Hole Digger or Driver; Prestress Machine; Pump (3 Inch or Over) or Well Points; Refrigeration Plant or Freeze Machine; Rock, Stone Breaker; Skid Steer Loader (With or Without Attachments); Vibratory Hammer or Extractor, Power Pack.</p> <p>Future Increase(s): Add \$2/hr on 6/1/11.</p> <p>Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate.</p>	29.44	18.10	47.54
514	Gas or Utility Pipeline, Except Sewer & Water (Primary Equipment).	34.89	19.68	54.57

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
<u>CODE</u>	<u>TRADE OR OCCUPATION</u>	\$	\$	\$
515	Gas or Utility Pipeline, Except Sewer & Water (Secondary Equipment). Future Increase(s): Add \$1.60/hr on 6/1/2011.	30.21	16.85	47.06
516	Fiber Optic Cable Equipment Future Increase(s): Add \$1.75/hr on 2/1/11.	24.39	15.45	39.84

SEWER, WATER OR TUNNEL CONSTRUCTION
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Includes those projects that primarily involve public sewer or water distribution, transmission or collection systems and related tunnel work (excluding buildings).

SKILLED TRADES

<u>CODE</u>	<u>TRADE OR OCCUPATION</u>	Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		
		<u>HOURLY BASIC RATE OF PAY</u> \$	<u>HOURLY FRINGE BENEFITS</u> \$	<u>TOTAL</u> \$
103	Bricklayer, Blocklayer or Stonemason	34.58	14.92	49.50
105	Carpenter	31.38	16.03	47.41
107	Cement Finisher	24.00	18.63	42.63
109	Electrician	32.53	18.34	50.87
111	Fence Erector	22.50	3.65	26.15
116	Ironworker	31.31	21.79	53.10
118	Line Constructor (Electrical)	31.66	13.94	45.60
125	Pavement Marking Operator	25.65	13.10	38.75
126	Piledriver Future Increase(s): Add \$2.65/hr on 6/6/11. Premium Increase(s): Add \$.65/hr for Piledriver Loftsman; Add \$.75/hr for Sheet Piling Loftsman.	28.11	23.76	51.87
130	Plumber	34.45	15.50	49.95
135	Steamfitter	31.65	15.04	46.69
137	Teledata Technician or Installer	24.09	14.48	38.57
143	Tuckpointer, Caulker or Cleaner	33.35	14.47	47.82
144	Underwater Diver (Except on Great Lakes)	32.31	14.91	47.22
146	Well Driller or Pump Installer	24.22	14.80	39.02
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	26.88	13.71	40.59
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	27.66	0.00	27.66
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	17.00	8.50	25.50
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	25.44	0.00	25.44
154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	17.41	9.80	27.21

TRUCK DRIVERS

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
201	Single Axle or Two Axle	21.42	5.62	27.04
203	Three or More Axle	17.03	12.89	29.92
204	Articulated, Euclid, Dumptor, Off Road Material Hauler Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate.	31.89	17.96	49.85
205	Pavement Marking Vehicle	20.85	11.02	31.87
207	Truck Mechanic	17.03	12.89	29.92

LABORERS

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
301	General Laborer Future Increase(s): Add \$1.67/hr on 6/6/2011; Add \$1.73/hr on 6/4/2012. Premium Increase(s): Add \$1.92 for bottomman; Add \$2.03 for concrete manhole builder, bracer, jointman, or pipelayer; Add \$4.83 for blaster. Add \$2.00 for all tunnel work under 15 lbs. compressed air; Add \$2.00 for 0-30 lbs. compressed air; Add \$3.00 for over 30 lbs. compressed air.	26.65	15.01	41.66
303	Landscaper	13.40	14.50	27.90
304	Flagperson or Traffic Control Person	19.83	15.65	35.48
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	12.50	0.00	12.50
314	Railroad Track Laborer	12.50	3.96	16.46

**HEAVY EQUIPMENT OPERATORS
SEWER, WATER OR TUNNEL WORK**

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
521	<p>Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. or Over; Caisson Rig; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity Of Over 4,000 Lbs., Crane With Boom Dollies; Master Mechanic; Pile Driver.</p> <p>Future Increase(s): Add \$1.90/hr on 6/6/2011; Add \$2.05/hr on 6/4/2012.</p> <p>Premium Increase(s): Add \$.25/hr for operating tower crane. On Sunday & holidays, pay two times the hourly basic rate except pump/generator operators when employed on non-productive projects.</p>	33.59	17.75	51.34
522	<p>Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Boring Machine (Directional); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump (Over 46 Meter), Concrete Conveyor (Rotec or Bidwell Type); Concrete Spreader & Distributor; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With a Lifting Capacity of 4,000 Lbs. & Under; Dredge (NOT Performing Work on the Great Lakes); Milling Machine; Skid Rig; Telehandler; Traveling Crane (Bridge Type).</p> <p>Future Increase(s): Add \$1.90/hr on 6/6/2011; Add \$2.05/hr on 6/4/2012.</p> <p>Premium Increase(s): Add \$.25/hr for operating tower crane. On Sunday & holidays, pay two times the hourly basic rate except pump/generator operators when employed on non-productive projects.</p>	32.81	17.75	50.56

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
523	<p>Air Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Boring Machine (Horizontal or Vertical); Bulldozer or Endloader (Over 40 hp); Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Concrete Pump (46 Meter & Under), Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Hydro-Blaster (10,000 PSI or Over); Manhoist; Material or Stack Hoist; Mechanic or Welder; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yd or More Capacity; Screed (Milling Machine); Sideboom; Straddle Carrier or Travel Lift; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Trencher (Wheel Type or Chain Type Having Over 8-Inch Bucket).</p> <p>Future Increase(s): Add \$1.90/hr on 6/6/2011; Add \$2.05/hr on 6/4/2012.</p> <p>Premium Increase(s): Add \$.25/hr for operating tower crane. On Sunday & holidays, pay two times the hourly basic rate except pump/generator operators when employed on non-productive projects.</p>	31.86	17.75	49.61
524	<p>Backfiller; Broom or Sweeper; Bulldozer or Endloader (Under 40 hp); Compactor (Self-Propelled 85 Ft Total Drum Width & Over, or Tractor Mounted, Towed & Light Equipment); Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Conveyor System; Concrete Finishing Machine (Road Type); Environmental Burner; Fireman (Pile Driver & Derrick NOT Performing Work on the Great Lakes); Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Hoist (Tugger, Automatic); Grout Pump; Jeep Digger; Lift Slab Machine; Mulcher; Power Subgrader; Pump (3 Inch or Over) or Well Points; Robotic Tool Carrier (With or Without Attachments); Roller (Rubber Tire, 5 Ton or Under); Screw or Gypsum Pumps; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Stump Chipper; Tining or Curing Machine; Trencher (Wheel Type or Chain Type Having 8-Inch Bucket & Under); Winches & A-Frames.</p> <p>Future Increase(s): Add \$1.90/hr on 6/6/2011; Add \$2.05/hr on 6/4/2012.</p> <p>Premium Increase(s): Add \$.25/hr for operating tower crane. On Sunday & holidays, pay two times the hourly basic rate except pump/generator operators when employed on non-productive projects.</p>	30.81	17.75	48.56

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
525	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical & Horizontal); Compactor (Self-Propelled 84 Ft Total Drum Width & Under, or Tractor Mounted, Towed & Light Equipment); Crusher, Screening or Wash Plant; Farm or Industrial Type Tractor; Fireman (Asphalt Plant NOT Performing Work on the Great Lakes); Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Loading Machine (Conveyor); Post Hole Digger or Driver; Refrigeration Plant or Freeze Machine; Rock, Stone Breaker; Skid Steer Loader (With or Without Attachments); Vibratory Hammer or Extractor, Power Pack. Future Increase(s): Add \$1.90/hr on 6/6/2011; Add \$2.05/hr on 6/4/2012. Premium Increase(s): Add \$.25/hr for operating tower crane. On Sunday & holidays, pay two times the hourly basic rate except pump/generator operators when employed on non-productive projects.	29.41	17.75	47.16
526	Boiler (Temporary Heat); Forklift; Greaser; Oiler. Future Increase(s): Add \$1.90/hr on 6/6/2011; Add \$2.05/hr on 6/4/2012. Premium Increase(s): Add \$.25/hr for operating tower crane. On Sunday & holidays, pay two times the hourly basic rate except pump/generator operators when employed on non-productive projects.	29.41	17.75	47.16
527	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	35.05	18.08	53.13
528	Work Performed on the Great Lakes Including 70 Ton & Over Tug Operator; Assistant Hydraulic Dredge Engineer; Crane or Backhoe Operator; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder.	35.05	18.08	53.13
529	Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or More); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery.	32.20	18.69	50.89
530	Work Performed on the Great Lakes Including Deck Equipment Operator; Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under), Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks - Great Lakes ONLY.	32.20	18.69	50.89

AIRPORT PAVEMENT OR STATE HIGHWAY CONSTRUCTION

Includes all airport projects (excluding buildings) and all projects awarded by the Wisconsin Department of Transportation (excluding buildings).

SKILLED TRADES

<u>CODE</u>	<u>TRADE OR OCCUPATION</u>	Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		
		<u>HOURLY BASIC RATE OF PAY</u> \$	<u>HOURLY FRINGE BENEFITS</u> \$	<u>TOTAL</u> \$
103	Bricklayer, Blocklayer or Stonemason	33.80	20.37	54.17
105	Carpenter	31.38	16.19	47.57
107	Cement Finisher Future Increase(s): Add \$1.86 on 6/1/11; Add \$1.86 on 6/1/12; Add \$1.87 on 6/1/13; Add \$1.87 on 6/1/14; Add \$1.87 on 6/1/15; Add \$1.75 on 6/1/16. Premium Increase(s): Effective 6/1/2011 for "Airport Pavement or State Highway Construction" project type only, add \$1.40/hr when the Wisconsin Department of Transportation or responsible governing agency requires that work be performed at night to avoid peak traffic volumes under artificial illumination with traffic control. The work is completed after sunset and before sunrise.	28.17	16.33	44.50
109	Electrician	31.64	21.45	53.09
111	Fence Erector	33.90	21.81	55.71
116	Ironworker	31.31	21.79	53.10
118	Line Constructor (Electrical)	31.66	13.94	45.60
124	Painter	26.54	13.40	39.94
125	Pavement Marking Operator	26.54	13.40	39.94
126	Piledriver	28.11	21.34	49.45
133	Roofer or Waterproofer	28.85	13.60	42.45
137	Teledata Technician or Installer	24.09	14.48	38.57
143	Tuckpointer, Caulker or Cleaner	33.35	14.47	47.82
144	Underwater Diver (Except on Great Lakes)	32.31	14.91	47.22
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	33.23	15.04	48.27
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	28.21	14.71	42.92
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	24.68	12.41	37.09
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	22.92	11.87	34.79

154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	26.75	10.29	37.04
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TRUCK DRIVERS

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked				
CODE	TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
		\$	\$	\$
201	Single Axle or Two Axle	21.00	14.51	35.51
203	Three or More Axle	25.09	13.60	38.69
204	Articulated, Euclid, Dumptor, Off Road Material Hauler Future Increase(s): Add \$1.95/hr on 6/1/11; Add \$2/hr on 6/1/12; Add \$2/hr on 6/1/13; Add \$1.75/hr on 6/1/14. Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate. For "Airport Pavement or State Highway Construction" project type only, add \$1.50/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	32.07	18.10	50.17
205	Pavement Marking Vehicle	20.06	11.55	31.61
206	Shadow or Pilot Vehicle	21.00	14.51	35.51
207	Truck Mechanic	25.09	13.60	38.69

LABORERS

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
301	General Laborer Future Increase(s): Add \$1.60/hr on 6/1/2011; Add \$1.60/hr on 6/1/2012; Add \$1.70/hr on 6/1/2013; Add \$1.60/hr on 6/1/2014. Premium Increase(s): Add \$.15/hr for air tool operator, joint sawer and filler (pavement), vibrator or tamper operator (mechanical hand operated), chain saw operator and demolition burning torch laborer; Add \$.35/hr for bituminous worker (raker and luteman), formsetter (curb, sidewalk and pavement) and strike off man; Add \$.50/hr for line and grade specialist; Add \$.65/hr for blaster and powderman; Add \$2.01/hr for topman; Add \$2.46/hr for bottomman; Add \$3.23/hr for pipelayer. "Airport Pavement or State Highway Construction" project type only, add \$1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	23.71	16.88	40.59
302	Asbestos Abatement Worker	23.25	13.91	37.16
303	Landscaper Future Increase(s): Add \$1.60/hr on 6/1/11; Add \$1.60/hr on 6/1/12; Add \$1.70/hr on 6/1/13; Add \$1.60/hr on 6/1/14. Premium Increase(s): Effective 6/1/09 for "Airport Pavement or State Highway Construction" project type only, add \$1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	23.71	16.88	40.59
304	Flagperson or Traffic Control Person Future Increase(s): Add \$1.60/hr on 6/1/2011; Add \$1.60/hr on 6/1/2012; Add \$1.70/hr on 6/1/2013; Add \$1.60/hr on 6/1/2014. Premium Increase(s): "Airport Pavement or State Highway Construction" project type only, add \$1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	20.20	16.88	37.08
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	15.00	3.09	18.09
314	Railroad Track Laborer	12.50	3.96	16.46

**HEAVY EQUIPMENT OPERATORS
AIRPORT PAVEMENT OR STATE HIGHWAY CONSTRUCTION**

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked				
CODE	TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
		\$	\$	\$
531	Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity Of Over 4,000 Lbs., Crane With Boom Dollies; Traveling Crane (Bridge Type). Future Increase(s): Add \$1.95/hr on 6/1/11; Add \$2/hr on 6/1/12; Add \$2/hr on 6/1/13; Add \$1.75/hr on 6/1/14. Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate. For "Airport Pavement or State Highway Construction" project type only, add \$1.50/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	33.07	18.10	51.17
532	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. or Over; Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With A Lifting Capacity Of 4,000 Lbs., & Under; Dredge (NOT Performing Work on the Great Lakes); Licensed Boat Pilot (NOT Performing Work on the Great Lakes); Pile Driver. Future Increase(s): Add \$1.95/hr on 6/1/11; Add \$2/hr on 6/1/12; Add \$2/hr on 6/1/13; Add \$1.75/hr on 6/1/14. Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate. For "Airport Pavement or State Highway Construction" project type only, add \$1.50/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	32.57	18.10	50.67

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
533	<p>Air Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Asphalt Heater, Planer & Scarifier; Asphalt Milling Machine; Asphalt Screed; Automatic Subgrader (Concrete); Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Bituminous (Asphalt) Plant & Paver, Screed; Boatmen (NOT Performing Work on the Great Lakes); Boring Machine (Directional, Horizontal or Vertical); Bridge (Bidwell) Paver; Bulldozer or Endloader; Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Conveyor System; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump, Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Concrete Spreader & Distributor; Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Crane With a Lifting Capacity of 25 Tons or Under; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Grout Pump; Hydro-Blaster (10,000 PSI or Over); Loading Machine (Conveyor); Material or Stack Hoist; Mechanic or Welder; Milling Machine; Post Hole Digger or Driver; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Shoulder Widener; Sideboom; Skid Rig; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Straddle Carrier or Travel Lift; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Trencher (Wheel Type or Chain Type); Tube Finisher; Tugger (NOT Performing Work on the Great Lakes); Winches & A-Frames.</p> <p>Future Increase(s): Add \$1.95/hr on 6/1/11; Add \$2/hr on 6/1/12; Add \$2/hr on 6/1/13; Add \$1.75/hr on 6/1/14.</p> <p>Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate. For "Airport Pavement or State Highway Construction" project type only, add \$1.50/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).</p>	32.07	18.10	50.17

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
534	<p>Belting, Burlap, Texturing Machine; Broom or Sweeper; Compactor (Self-Propelled or Tractor Mounted, Towed & Light Equipment); Concrete Finishing Machine (Road Type); Environmental Burner; Farm or Industrial Type Tractor; Fireman (Asphalt Plant, Pile Driver & Derrick NOT Performing Work on the Great Lakes); Forklift; Greaser; Hoist (Tugger, Automatic); Jeep Digger; Joint Sawyer (Multiple Blade); Launch (NOT Performing Work on the Great Lakes); Lift Slab Machine; Mechanical Float; Mulcher; Power Subgrader; Robotic Tool Carrier (With or Without Attachments); Roller (Rubber Tire, 5 Ton or Under); Self Propelled Chip Spreader; Shouldering Machine; Skid Steer Loader (With or Without Attachments); Telehandler; Tining or Curing Machine.</p> <p>Future Increase(s): Add \$1.95/hr on 6/1/11; Add \$2/hr on 6/1/12; Add \$2/hr on 6/1/13; Add \$1.75/hr on 6/1/14.</p> <p>Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate. For "Airport Pavement or State Highway Construction" project type only, add \$1.50/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).</p>	31.81	18.10	49.91
535	<p>Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical & Horizontal); Automatic Belt Conveyor & Surge Bin; Boiler (Temporary Heat); Concrete Proportioning Plant; Crusher, Screening or Wash Plant; Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Mudjack; Oiler; Prestress Machine; Pug Mill; Pump (3 Inch or Over) or Well Points; Rock, Stone Breaker; Screed (Milling Machine); Stump Chipper; Tank Car Heaters; Vibratory Hammer or Extractor, Power Pack.</p> <p>Future Increase(s): Add \$1.95/hr on 6/1/11; Add \$2/hr on 6/1/12; Add \$2/hr on 6/1/13; Add \$1.75/hr on 6/1/14.</p> <p>Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate. For "Airport Pavement or State Highway Construction" project type only, add \$1.50/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).</p>	31.52	18.10	49.62
536	Fiber Optic Cable Equipment.	22.79	15.30	38.09
537	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	35.05	18.08	53.13
538	Work Performed on the Great Lakes Including 70 Ton & Over Tug Operator; Assistant Hydraulic Dredge Engineer; Crane or Backhoe Operator; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder.	35.05	18.08	53.13

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
539	Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or More); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery.	32.20	18.69	50.89
540	Work Performed on the Great Lakes Including Deck Equipment Operator, Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under); Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks-Great Lakes ONLY.	32.20	18.69	50.89

LOCAL STREET OR MISCELLANEOUS PAVING CONSTRUCTION
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Includes roads, streets, alleys, trails, bridges, paths, racetracks, parking lots and driveways (except residential or agricultural), public sidewalks or other similar projects (excluding projects awarded by the Wisconsin Department of Transportation).

SKILLED TRADES

CODE	TRADE OR OCCUPATION	Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		
		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
		\$	\$	\$
103	Bricklayer, Blocklayer or Stonemason	34.58	14.92	49.50
105	Carpenter	31.38	16.29	47.67
107	Cement Finisher	27.12	16.07	43.19
109	Electrician Future Increase(s): Add \$1/hr on 6/1/2011. Add \$1.40/hr on 6/1/2012. Add \$1.60/hr on 6/1/2013.	31.10	20.39	51.49
111	Fence Erector	22.50	3.65	26.15
116	Ironworker	31.31	21.79	53.10
118	Line Constructor (Electrical)	31.66	13.94	45.60
124	Painter	27.82	15.39	43.21
125	Pavement Marking Operator	23.46	9.45	32.91
126	Piledriver	28.11	21.16	49.27
133	Rofer or Waterproofer	28.85	13.60	42.45
137	Teledata Technician or Installer	24.09	14.48	38.57
143	Tuckpointer, Caulker or Cleaner	33.35	14.47	47.82
144	Underwater Diver (Except on Great Lakes)	32.31	14.91	47.22
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	26.88	13.71	40.59
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	28.21	14.30	42.51
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	24.68	16.16	40.84
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	22.92	11.87	34.79
154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	29.06	15.39	44.45

TRUCK DRIVERS

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
201	Single Axle or Two Axle	21.42	5.62	27.04
203	Three or More Axle	13.00	13.60	26.60
204	Articulated, Euclid, Dumptor, Off Road Material Hauler Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate.	31.89	17.96	49.85
205	Pavement Marking Vehicle	20.85	11.02	31.87
206	Shadow or Pilot Vehicle	21.42	5.62	27.04
207	Truck Mechanic	13.00	13.60	26.60

LABORERS

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
301	General Laborer	23.34	17.30	40.64
303	Landscaper	22.00	5.20	27.20
304	Flagperson or Traffic Control Person	17.19	15.32	32.51
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	15.00	3.09	18.09
314	Railroad Track Laborer	12.50	3.96	16.46

**HEAVY EQUIPMENT OPERATORS
CONCRETE PAVEMENT OR BRIDGE WORK**

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
541	Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity Of Over 4,000 Lbs., Crane With Boom Dollies; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Master Mechanic.	31.97	16.96	48.93

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
542	<p>Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. or Over; Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With a Lifting Capacity of 4,000 Lbs. & Under; Crane, Tower Crane Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Dredge (NOT Performing Work on the Great Lakes); Licensed Boat Pilot (NOT Performing Work on the Great Lakes); Pile Driver.</p> <p>Future Increase(s): Add \$1.95/hr on 6/1/11; Add \$2/hr on 6/1/12; Add \$2/hr on 6/1/13; Add \$1.75/hr on 6/1/14.</p> <p>Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate. For "Airport Pavement or State Highway Construction" project type only, add \$1.50/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).</p>	32.57	18.10	50.67
543	<p>Air Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Automatic Subgrader (Concrete); Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Boring Machine (Directional, Horizontal or Vertical); Bridge (Bidwell) Paver; Bulldozer or Endloader; Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Conveyor System; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump, Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Concrete Spreader & Distributor; Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Crane With a Lifting Capacity of 25 Tons or Under; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Grout Pump; Hydro-Blaster (10,000 PSI or Over); Loading Machine (Conveyor); Manhoist; Material or Stack Hoist; Mechanic or Welder; Milling Machine; Post Hole Digger or Driver; Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Shoulder Widener; Sideboom; Skid Rig; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Straddle Carrier or Travel Lift; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Trencher (Wheel Type or Chain Type); Tube Finisher; Tugger (NOT Performing Work on the Great Lakes); Winches & A-Frames.</p>	30.97	16.98	47.95

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
544	Backfiller; Belting, Burlap, Texturing Machine; Broom or Sweeper; Compactor (Self-Propelled or Tractor Mounted, Towed & Light Equipment); Concrete Finishing Machine (Road Type); Environmental Burner; Farm or Industrial Type Tractor; Fireman (Pile Driver & Derrick NOT Performing Work on the Great Lakes); Forklift; Greaser; Jeep Digger; Joint Sawyer (Multiple Blade); Launch (NOT Performing Work on the Great Lakes); Lift Slab Machine; Mechanical Float; Mulcher; Power Subgrader; Robotic Tool Carrier (With or Without Attachments); Self Propelled Chip Spreader; Shouldering Machine; Skid Steer Loader (With or Without Attachments); Telehandler; Tining or Curing Machine. Future Increase(s): Add \$1.85/hr on 5/31/2011. Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate.	32.32	16.75	49.07
545	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Automatic Belt Conveyor & Surge Bin; Boiler (Temporary Heat); Concrete Proportioning Plant; Crusher, Screening or Wash Plant; Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Mudjack; Oiler; Prestress Machine; Pug Mill; Pump (3 Inch or Over) or Well Points; Rock, Stone Breaker; Screed (Milling Machine); Stump Chipper; Tank Car Heaters; Vibratory Hammer or Extractor, Power Pack. Future Increase(s): Add \$1.85/hr on 5/31/2011. Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate.	30.97	16.75	47.72
546	Fiber Optic Cable Equipment.	22.79	15.30	38.09
547	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	35.05	18.08	53.13
548	Work Performed on the Great Lakes Including 70 Ton & Over Tug Operator; Assistant Hydraulic Dredge Engineer; Crane or Backhoe Operator; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder.	35.05	18.08	53.13
549	Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or more); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery.	32.20	18.69	50.89
550	Work Performed on the Great Lakes Including Deck Equipment Operator; Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under); Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks - Great Lakes ONLY.	32.20	18.69	50.89

**HEAVY EQUIPMENT OPERATORS
ASPHALT PAVEMENT OR OTHER WORK**

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
551	Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self Erecting Tower Crane With a Lifting Capacity of Over 4,000 Lbs., Crane With Boom Dollies; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads and/or Jib Lengths Measuring 176 Ft or Over; Master Mechanic.	31.97	17.35	49.32
552	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. or Over; Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With a Lifting Capacity Of 4,000 Lbs. & Under; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Dredge (NOT Performing Work on the Great Lakes); Licensed Boat Pilot (NOT Performing Work on the Great Lakes); Pile Driver.	30.42	17.05	47.47
553	Air, Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Asphalt Heater, Planer & Scarifier; Asphalt Milling Machine; Asphalt Screed; Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Bituminous (Asphalt) Plant & Paver, Screed; Boring Machine (Directional, Horizontal or Vertical); Bulldozer or Endloader; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Conveyor System; Concrete Laser/Screed; Concrete Slipform Placer Curb & Gutter Machine; Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Crane With a Lifting Capacity of 25 Tons or Under; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Hydro-Blaster (10,000 PSI or Over); Loading Machine (Conveyor); Manhoist; Material or Stack Hoist; Mechanic or Welder; Milling Machine; Post Hole Digger or Driver; Railroad Track Rail Leveling Machine, Tie Placer, Extractor, Tamper, Stone Leveler or Rehabilitation Equipment; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Shoulder Widener; Sideboom; Skid Rig; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Trencher (Wheel Type or Chain Type); Tube Finisher; Tugger (NOT Performing Work on the Great Lakes); Winches & A-Frames. Future Increase(s): Add \$1.95/hr on 6/1/11; Add \$2/hr on 6/1/12; Add \$2/hr on 6/1/13; Add \$1.75/hr on 6/1/14. Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate.	31.52	17.75	49.27

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
554	Backfiller; Broom or Sweeper; Compactor (Self-Propelled or Tractor Mounted, Towed & Light Equipment); Concrete Finishing Machine (Road Type); Environmental Burner; Farm or Industrial Type Tractor; Fireman (Asphalt Plant, Pile Driver & Derrick NOT Performing Work on the Great Lakes); Forklift; Greaser; Hoist (Tugger, Automatic); Jeep Digger; Joint Sawyer (Multiple Blade); Launch (NOT Performing Work on the Great Lakes); Lift Slab Machine; Mechanical Float; Mulcher; Power Subgrader; Robotic Tool Carrier (With or Without Attachments); Roller (Rubber Tire, 5 Ton or Under); Self-Propelled Chip Spreader; Shouldering Machine; Skid Steer Loader (With or Without Attachments); Telehandler. Future Increase(s): Add \$1.95/hr on 6/1/11; Add \$2/hr on 6/1/12; Add \$2/hr on 6/1/13; Add \$1.75/hr on 6/1/14. Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate.	31.52	17.75	49.27
555	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical & Horizontal); Automatic Belt Conveyor & Surge Bin; Boiler (Temporary Heat); Crusher, Screening or Wash Plant; Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Mudjack; Oiler; Prestress Machine; Pug Mill; Pump (3 Inch or Over) or Well Points; Rock, Stone Breaker; Screed (Milling Machine); Stump Chipper; Tank Car Heaters; Vibratory Hammer or Extractor, Power Pack. Future Increase(s): Add \$1.95/hr on 6/1/11; Add \$2/hr on 6/1/12; Add \$2/hr on 6/1/13; Add \$1.75/hr on 6/1/14. Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate.	31.52	17.75	49.27
556	Fiber Optic Cable Equipment.	22.79	15.30	38.09

RESIDENTIAL OR AGRICULTURAL CONSTRUCTION

Includes single family houses or apartment buildings of no more than four (4) stories in height and all buildings, structures or facilities that are primarily used for agricultural or farming purposes, excluding commercial buildings. For classification purposes, the exterior height of a residential building, in terms of stories, is the primary consideration. All incidental items such as site work, driveways, parking lots, private sidewalks, private septic systems or sewer and water laterals connected to a public system and swimming pools are included within this definition. Residential buildings of five (5) stories and above are NOT included within this definition.

SKILLED TRADES

<u>CODE</u>	<u>TRADE OR OCCUPATION</u>	Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		
		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
		\$	\$	\$
101	Acoustic Ceiling Tile Installer	35.28	14.02	49.30
102	Boilermaker	31.09	21.82	52.91
103	Bricklayer, Blocklayer or Stonemason	23.56	13.33	36.89
104	Cabinet Installer	26.00	7.06	33.06
105	Carpenter	31.38	5.03	36.41
106	Carpet Layer or Soft Floor Coverer	18.00	0.00	18.00
107	Cement Finisher	23.50	17.24	40.74
108	Drywall Taper or Finisher	25.95	14.52	40.47
109	Electrician	23.10	11.03	34.13
110	Elevator Constructor	40.46	23.33	63.79
111	Fence Erector	17.00	1.19	18.19
112	Fire Sprinkler Fitter	36.82	19.03	55.85
113	Glazier	30.24	14.84	45.08
114	Heat or Frost Insulator	15.00	0.00	15.00
115	Insulator (Batt or Blown)	10.00	3.10	13.10
116	Ironworker	20.00	0.40	20.40
117	Lather	16.00	1.60	17.60
119	Marble Finisher	29.40	14.31	43.71
120	Marble Mason	34.58	14.92	49.50
121	Metal Building Erector	16.75	6.50	23.25
123	Overhead Door Installer	22.00	4.62	26.62
124	Painter	17.87	0.96	18.83
125	Pavement Marking Operator	25.65	13.10	38.75

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
129	Plasterer	25.00	0.00	25.00
130	Plumber	35.93	15.69	51.62
132	Refrigeration Mechanic	23.00	4.81	27.81
133	Roofer or Waterproofer	28.85	6.23	35.08
134	Sheet Metal Worker	27.83	14.28	42.11
135	Steamfitter	21.00	3.66	24.66
137	Teledata Technician or Installer	8.00	0.00	8.00
138	Temperature Control Installer	22.00	2.92	24.92
139	Terrazzo Finisher	29.40	14.31	43.71
140	Terrazzo Mechanic	29.40	14.31	43.71
141	Tile Finisher	18.00	0.92	18.92
142	Tile Setter	17.50	0.74	18.24
143	Tuckpointer, Caulker or Cleaner	32.50	2.44	34.94
146	Well Driller or Pump Installer	26.76	0.00	26.76
147	Siding Installer	16.00	0.00	16.00

TRUCK DRIVERS

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
201	Single Axle or Two Axle	16.00	2.25	18.25
203	Three or More Axle	18.00	1.25	19.25
205	Pavement Marking Vehicle	20.85	11.02	31.87
207	Truck Mechanic	15.00	15.00	30.00

LABORERS

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
301	General Laborer	23.50	6.22	29.72
302	Asbestos Abatement Worker	17.00	7.07	24.07
303	Landscaper	15.00	5.25	20.25

311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	15.00	3.09	18.09
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**HEAVY EQUIPMENT OPERATORS
RESIDENTIAL OR AGRICULTURAL CONSTRUCTION**

Fringe Benefits Must Be Paid On All Hours Worked

<u>CODE</u>	<u>TRADE OR OCCUPATION</u>	<u>HOURLY BASIC RATE OF PAY</u> \$	<u>HOURLY FRINGE BENEFITS</u> \$	<u>TOTAL</u> \$
557	Asphalt Heater, Planer & Scarifier; Asphalt Milling Machine; Asphalt Screed; Backhoe (Track Type); Backhoe (Mini, 15,000 Lbs. & Under); Bituminous (Asphalt) Plant & Paver, Screed; Boring Machine (Directional, Horizontal or Vertical); Bulldozer or Endloader; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Conveyor System; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump, Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Concrete Spreader & Distributor; Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Crane With a Lifting Capacity of 25 Tons or Under; Crane, Shovel, Dragline, Clamshells; Forestry Equipment, TImbco, Tree Shear, Tub Grinder, Processor; Grader or Motor Patrol; Grout Pump; Hydro-Blaster (10,000 PSI or Over); Loading Machine (Conveyor); Manhoist; Material or Stack Hoist; Mechanic or Welder; Milling Machine; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Shoulder Widener; Skid Rig; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Trencher (Wheel Type or Chain Type); Winches & A-Frames.	31.32	8.17	39.49
558	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Backfiller; Belting, Burlap, Texturing Machine; Boiler (Temporary Heat); Broom or Sweeper; Compactor (Self-Propelled or Tractor Mounted, Towed & Light Equipment); Concrete Finishing Machine (Road Type); Farm or Industrial Type Tractor; Forklift; Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Jeep Digger; Lift Slab Machine; Mulcher; Oiler; Post Hole Digger or Driver; Power Subgrader; Pump (3 Inch or Over) or Well Points; Robotic Tool Carrier (With or Without Attachments); Rock, Stone Breaker; Roller (Rubber Tire, 5 Tons or Under); Screed (Milling Machine); Self Propelled Chip Spreader; Shouldering Machine; Skid Steer Loader (With or Without Attachments); Stump Chipper; Telehandler; Vibratory Hammer or Extractor, Power Pack. Future Increase(s): Add \$1.85/hr on 5/31/2011. Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate.	32.32	16.75	49.07

***** END OF RATES *****

SECTION 00850: DRAWING SCHEDULE

The following listed drawings accompany and form a part of the project contract documents along with this project manual and generally illustrate the nature of the work.

<u>Sheet No.</u>	<u>Title</u>
T-1	Title Sheet
M-1	Second Floor HVAC Plan
M-2	HVAC Roof Plan
M-3	Symbols & Abbreviations, Mechanical Details, and Schedules
S-1	Existing Roof Framing Plan (Reference Only)

SECTION 01010: SUMMARY OF WORK:1. SCOPE:A. Index:

1. Scope
2. Project Description
3. Work by Others
4. Scheduling of Work

2. PROJECT DESCRIPTION:

- A. In general, the project includes all site and building work (unless otherwise noted) necessary for the Air Handling Unit Installation at the Milwaukee Police Department (MPD), Radio Repair Shop as described in the plans and as specified herein.
- B. This project includes a single base bid. The base bid shall complete all work associated with the installation of one rooftop unit (RTU-5) that shall serve as a replacement to the interior air conditioning unit. The existing interior unit (CRAC-1) shall function as a backup. New controls for the new roof top unit will be required for the base bid. The controls will extend monitoring status to the MPD's Police Administration Building near 8th and State Street in Milwaukee, WI.
- C. MPD will occupy Site and existing buildings during entire period of construction for conduct of normal operations. Cooperate with City during construction operation to minimize conflict and facilitate MPD's operations. Contractor shall, at all times, conduct operation to ensure least inconvenience to MPD, other contractors, general public, and operation of the Radio Repair Shop.
- D. The contractor must coordinate all work with the City, utilities, and all other work forces on site.
- E. It is also understood that the submittal of a proposal shall include furnishing all labor, materials, equipment, and incidentals necessary for completion of the work required, including that which may not be directly shown on the drawings or in the specifications, but are necessary for proper operation and approval.
- F. Examine Documents and Visit Site:
 1. Before submitting a bid proposal, bidders should carefully examine the drawings and project manual, visit the site of the work, fully inform themselves as to all existing conditions and limitations including those of labor, and shall include in the bid proposal a sum sufficient to cover the cost of all items contemplated by the construction documents.
 2. Each sub-bidder further represents that he has inspected the site of the proposed work to ascertain any obstacles that might be encountered and other matters and conditions relevant to this work.
 3. The nature of the work required demands thorough review of all drawings and the project manual, and diligent and careful site inspection by all prospective sub-bidders as a means of determining the extent of work and conditions under which the work is to be performed.
 4. Additional charges will not be as considered for work which, prior to bidding, could reasonably be inferred as appropriate by examination of the drawings and specifications, visiting the site, and closely reviewing the work as indicated above. No

representations as to subsurface conditions are made.

G. The following outline is intended to serve as a general guide only and not as a complete listing of work, operations, or materials. Consult the Table of Contents for complete listing of items included.

1. Install one rooftop unit. Extend utilities (condensate drain) to the new unit. Extend new supply and return ductwork to the new unit and space served including all related accessories. Provide new roof penetration and curb as required to set the new unit. Electrical work as outlined in the Division 16 specifications shall be provided by City of Milwaukee electricians.
2. Furnish new HVAC opening in existing roof deck, frame opening with steel beams. Engage the services of a Licensed Structural Engineer to determine beam sizes and location.
3. Provide DDC control system to operate new rooftop unit. System shall communicate to the Police Administration Building located at 8th & State Street in Milwaukee, WI. Direct Digital Controls equipment, wiring, and programming provided by The Trane Company, under this mechanical contract as a subcontractor (i.e.: furnish and install DDC for RTUs, etc; furnish and install thermostats/sensors; furnish control valves; furnish control dampers; furnish and install damper actuators) – Contact: Allan Lantz (414) 266-5222 or alantz@trane.com).
4. Provide all required penetrations through interior walls, exterior walls and floors where shown on plans. Provide curbs, curb adapters, and safing and seal air and water tight.
5. Contractor shall provide all taps for controls, chemical treatment, etc. Provide temporary piping for system circulation.
6. Provide warranty, start-up services, O & M manuals, record as-built drawings and all other specified documentation.
7. All required approvals and necessary permits and fees shall be obtained for this project.
8. Make all necessary connections to existing systems.
9. Coordinate with the Building Manager for all systems tie-ins.
10. All work of this project shall comply with City of Milwaukee and State of Wisconsin codes, NEC and the NFPA.
11. Attend regularly scheduled construction meeting until project completion.
12. Demolition, Removal, and Disposal:
 - a. Contractor shall be responsible for all costs associated with demolition, removal, and disposal of indicated equipment and material.
 - b. Contractor shall be responsible for repairing any damage caused to building or building components through demolition and removal process.
 - c. Contractor shall follow all Wisconsin Department of Natural Resources and Environmental Protection Agency, as well as any other state or national regulations, regarding disposal of equipment or materials removed from

building.

13. Contractors shall maintain any special security procedures that are in place at the site.
14. Due to the nature of the operation of the building, that building security is high.
15. All contractors working in the building will be escorted and accompanied by Milwaukee Police Department (MPD) personnel at all times. Pictures may be taken only with permission granted by MPD.
16. Contractors shall maintain access to parking lot at all times.
17. Contractor shall provide a list of workers including subcontractor's workers that will be on the job site. The list shall include company name, employee full name, race, sex and employee date of birth. MPD will do a background check on all workers.

3. WORK BY OTHERS:

- A. Testing and balancing of air flows shall be completed by others under separate contract with the City.
- B. Electrical Power wiring by City Electricians.

4. SCHEDULING OF WORK:

- A. All of the work on this project shall be accomplished between 7:00 AM and 5:00 PM on regular work days unless it will be disruptive to City personnel (excessive noise, welding, soldering, torching, domestic water shutdown, etc.) then it must be accomplished between 6:00 PM and 6:00 AM on workdays or on weekends. Work may also be scheduled on evenings and weekends as necessary to meet project schedule.
- B. This contractor shall protect existing equipment by covering, moving, and/or relocating this equipment from all construction debris.
- C. The contractor shall sign in and identify all personnel working at the site on a daily basis with the supervisor in charge at the site.
- D. Work is scheduled to be completed in the time shown on the Official Notice.
- E. The City reserves the right of not allowing the contractor to work when special events are scheduled for the building. These changes in work schedule shall be done at no additional cost to the City.
- F. Shut downs of existing equipment and connections to existing equipment must be arranged in advance with the Project Inspector from DPW, ISD - Facilities Development and Management Section. Power outages must be scheduled for Saturdays.
- G. Dispose of all removed materials in legal manner.

SECTION 01210: PROJECT MEETINGS

1. SCOPE:

A. Index:

1. Scope
2. Pre-Construction Meeting
3. Progress Meetings

2. PRE-CONSTRUCTION MEETING:

- A. Soon after the award of the contract and prior to the start of construction, the contractor shall attend a pre-construction conference with representatives of the City.
- B. The contractor shall have at the meeting responsible representatives from subcontractors who are to perform major work on the project.
- C. The purpose of the meeting is to discuss in detail the plans and specifications. The discussion shall include:
 1. Schedule
 2. Equipment/Delivery Dates
 3. Material Storage
 4. Inspection Requirements
 5. Protection Procedures for the structure
 6. Hours of Work
- D. The contractor shall submit the construction schedule to the architect/engineer at this meeting and a listing of subcontractors and their work. The contractor shall describe, in detail, when each portion of the work is expected to be accomplished. The subcontractors shall participate in the discussion. The architect/engineer will serve to interpret the contract documents should such questions arise.
- E. Any other questions that the contractor or his subcontractors have about the work or its scheduling shall be raised at these meetings.
- F. Requirements for contract administration and construction operations will be defined for participants.
- G. The architect/engineer will determine time, date, and place of the meeting.

3. PROGRESS MEETINGS:

- A. Bi-weekly meetings will be held for the purpose of coordinating and expediting the work.
- B. Attendance at project meetings by the contractor is mandatory. These meetings shall also be attended by representatives of each subcontractor who is either working at the site or is affected by work being done at the site. The contractor shall submit an updated construction schedule at these meetings and a short narrative should be written, describing the cause of any delays and intended action to remedy these delays.
- C. Contractors shall give a verbal report of progress on the project, discuss the work schedule for the coming period, and present all conflicts, discrepancies, or other difficulties for resolution.

SECTION 01300: SUBMITTALS/PERMITS

1. SCOPE:

A. Index:

1. Scope
2. Submittals
3. Permits
4. Inspection

2. SUBMITTALS:

A. Comply with the requirements of the General Conditions and as follows:

1. Forward Submittals not more than 20 calendar days after the Notice to Proceed date. No work, as indicated on any shop drawing, samples, hardware list, etc., shall be started until those submittals have been reviewed and work authorized.
2. All submittals must be thoroughly reviewed by the prime contractor for conformance to contract documents, prior to submission to the City, or its agents, for review. Shop drawings and catalog information shall be stamped "Reviewed By" and signed by the contractor's reviewer. The prime contractor shall review all subcontractor submittals prior to submittal to the City for compliance with contract documents and to coordinate all work.
3. Include with each submittal a transmittal letter signed and dated by the prime contractor containing the following:
 - a. Name of Contractor
 - b. Name of Project
 - c. List of Submittals
 - d. Name of Manufacturer or Supplier
 - e. Additional information as required for the items being provided.

B. Shop Drawings, Catalog Information, Calculations, and Samples:

1. Shop Drawings: Submit four blue/black line print review. The City will notify the contractor in writing and return one copy marked "REVIEWED - NO EXCEPTIONS TAKEN" with minor or no notations. The City will also notify the contractor in writing and return one copy, along with comments, when the drawings are marked either "REJECTED" or "REVISE AND RESUBMIT". For those shop drawings, the contractor will be responsible for resubmitting a new print.
2. Catalog Information and Calculations: Submit four copies for City's record and additional numbers of copies required for the contractor's purpose. The City will notify the contractor in writing and return the contractor's copies, with or without notation, marked either "REVIEWED - NO EXCEPTIONS TAKEN", "REVISE AND RESUBMIT", OR "REJECTED". Catalog information or calculations marked "REVISE AND RESUBMIT" or "REJECTED" must be resubmitted in the same quantities as originally required.

3. Samples: Submit two samples of requested materials for the City's records and additional samples, if desired, to be returned to the contractor. The City will notify the contractor in writing, whether the samples are approved or rejected. If they are rejected, new samples must be resubmitted as originally required.
 4. Corrections or comments made on the submittals during the review do not relieve the contractor from compliance with requirements of the contract documents. The check is only for review of general conformance with the design concept of the project and general compliance with the information given in the contract documents. Contractors are responsible for conforming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating their work with that of all other trades; and performing their work in a safe manner.
- C. "Or Equal": Whenever the words "or equal" or similar term is used, it shall mean as determined by the Commissioner of Public Works or agent. All drawings, data and bulletins necessary to make an "or equal" determination shall be submitted to the Facilities Manager of FACILITIES DEVELOPMENT AND MANAGEMENT SECTION. Such review shall apply to design only and shall in no way relieve the contractor from the responsibilities as outlined in Item 2B above. Evaluation of "or equal" products will be made at the time of shop drawing submission. Any change required in design and coordination between all contractors, subcontractors, or trades due to the use of "or equal" materials shall become the contractor's responsibility. Any costs for detailed engineering reviews and/or any costs to incorporate "or equal" products will be borne by the contractor.
3. PERMITS:
- A. The City of Milwaukee will provide the general construction and occupancy permits.
 - B. Contractors shall obtain, from the City of Milwaukee Department of City Development and/or other government or private agencies, all special permits as may be necessary in their work.
 - C. Contractors shall obtain all permits to occupy or work in the public way as may be necessary for their work.
 - D. Contractors shall notify the City and/or appropriate utilities when making utility connections as part of the project.
4. INSPECTION:
- A. FACILITIES DEVELOPMENT AND MANAGEMENT SECTION will provide daily inspection to verify compliance with contract documents, identify contractors and crews on the job, verify compliance with contract conditions (EBE, residency, wage requirements), and record job progress and conditions.
 - B. **Contractors shall arrange with the Department of Neighborhood Services/Construction Trades Division and permit issuing agencies for all code compliance inspections as required by all permits including, but not limited to, the general building and all special permits issued by that agency.**
 - D. **Contractors shall arrange with the appropriate City agency for compliance inspections, as required, for all permits including, but not limited to, curb and pavement cuts and patches, and public way occupancy and utility connections.**

SECTION 01500: JOB SITE UTILITIES, FACILITIES, AND SECURITY1. SCOPE:A. Index:

1. Scope
2. Milwaukee Police Department Security Procedures
3. Building Security
4. Temporary or Trial Usage
5. Occupancy During Construction
6. Temporary Hoists, Lifts
7. Scaffolding
8. Electrical Power
9. Water
10. Toilet Facilities
11. Bulletin Board
12. Construction Reference and Storage Area
13. Safety
14. Parking

2. MILWAUKEE POLICE DEPARTMENT SECURITY PROCEDURES:

All contractors, vendors and visitors who intend to do business at any Milwaukee Police Department site must have a background check performed by the Milwaukee Police Department prior to any access. This includes all District stations, substations, outposts, warehouses or offices occupied by the Police. In order to facilitate this directive and ensure the safety and security of our operations, the Milwaukee Police Department requests a two-week advance written notice before any work or "walk through" is scheduled.

- A. Once notice is received and approved by the Building Maintenance Manager in charge, the Facilities Services Section will notify the shift commander of each specific area involved.
- B. The Milwaukee Police Department further requires:
 1. The contractor or vendor supply basic contact information regarding the company or firm (address, telephone number, contact name and title, etc.)
 2. A 48-hour telephone or fax notice for all individuals expected to perform services so that background checks can be completed prior to the start of site work or "walk through".
 3. In order to facilitate the background check, provide the full name (including middle name) and date of birth of all individuals. If the name is common, (i.e. Jones, Smith, Johnson, etc.) the last four numbers of the individual's social security number must also be submitted.
- C. On all days of work, the scheduled employees shall report (during business hours) to the Main Police Office to obtain an identification badge and/or parking permit. Each individual must obtain and sign for their own badge/permit each day when they enter and exit the facility, and prominently display the identification badge while in police facilities. **NO BADGES OR PERMITS MAY LEAVE THE BUILDING OR BE KEPT BY ANY INDIVIDUAL.**
- D. Contractors/vendors who must respond for emergencies or for scheduled "after hours" work shall follow the same procedures noted above in subparagraph C.

3. BUILDING SECURITY:

A. General:

The Downtown Complex is open to the public from 8:00 AM until 4:45 PM, Monday through Friday, excluding holidays. Since most contracted work takes place outside normal business hours, it is essential that contractors and their City agents understand and abide by security policy.

B. Scope:

The following building security policy and procedure statement has been provided in this project manual for bid consideration and shall be distributed at the Pre-Construction Meeting. All City agents/officials responsible for engaging contractors, all contractors, and all subcontractors shall be held responsible for following the procedures.

C. City Agents/Officials:

1. Any City agents/officials who commission outside contractors to work in any of the facilities managed by FACILITIES DEVELOPMENT AND MANAGEMENT SECTION shall provide the following information no less than twenty-four (24) hours in advance of the work:

- a. The names of any contract or subcontract employees who will be present in the facilities (for the purpose of designing badges appropriate to their work area):

Green – Zeidler Municipal Building, 841 North Broadway
 Red – City Hall, 200 East Wells Street
 Yellow – 809 North Broadway
 Gold – Any outlying buildings

These names must be listed on a sign-in sheet available in the Zeidler Municipal Building, Room 602 (FACILITIES DEVELOPMENT AND MANAGEMENT SECTION support staff – Extension 8222). City agents/officials shall be responsible to ensure the sheet and badges are transported to the appropriate location where the work is to be completed (in the Downtown Complex it would go to the City Hall Information Center, for outlying buildings to the person responsible for controlling access in the facility) the day before work is to begin.

- b. A list of keys and/or access cards required for access only to the areas necessary for work involved in the project. The keys and card will be received from the Security Manager or his designee and signed out to the City agents/officials responsible for the contracted work. The City employee will take the keys and/or access cards to the City Hall Information Center or the person responsible for controlling access in the outlying building where they shall be logged under the name of the contractor's company. When a project is complete, the City agents/officials must retrieve the keys/cards and return them to FACILITIES DEVELOPMENT AND MANAGEMENT SECTION support staff in Room 602 of the Zeidler Municipal Building.
- c. The City agents/officials are responsible for communicating the security policy and procedures to contractors. The City agents/officials shall act as liaison for all communication between FACILITIES DEVELOPMENT AND MANAGEMENT SECTION and the contractor.

D. Contractors:

1. Contractors shall abide by City security policy and procedures at all times during the scope of their participation in a project. Failure to comply will result in the contracted employee being escorted from the premises and the resulting lost time and expense shall be deducted from the contractor's invoice or penalties of \$50.00 per occurrence as determined by the contracting City agent/official.

a. All access should be provided in advance through the City agent/official. Contractors shall enter and exit only through those doors designated by City agents/officials (the Market Street entrance to City Hall and the doors established by the person responsible for access at outlying buildings). All other exterior doors are locked and alarmed and are not to be used as delivery points unless the City agent/official has been provided 24 hour notification to provide additional security coverage at that point while the delivery is in progress.

b. All of the contractor's employees and all of the employees of any of his subcontractors shall wear at all times while on the site, in a clearly visible location, an identification card. The identification card is to have a minimum 1" x 1" color photo of the head and shoulders. The photo is to have been taken no more than one year previously. The card is to be laminated with clear plastic and is to contain the company name, employee's name, and the employee's signature, and is to be furnished by the contractor or respective subcontractor.

c. Effective October 1, 2004 – City of Milwaukee Policy Change

The following policy has been established to maintain control of City Property and to ensure the physical protection of the City Hall Complex.

Anyone signing out access cards and/or keys from the Information Center will be following the steps below.

- 1) Sign in on the sheet assigned to the project you are working on and pull that sheet and provide it to the Operator noting that you will need to sign out City property to access the building.
- 2) Provide the Operator your driver's license as collateral for the return of City property.
- 3) Sign out the property in the sign out book as per current policy.
- 4) The Operator will file your driver's license until such time as you sign in and return the City property at which time your license will be returned.
- 5) Sign out at the end of your workday on the sign out sheet.

Under NO circumstances will keys or cards be disbursed without the user signing for the property and providing the City Hall Operator their driver's license as collateral.

In the event that keys or cards are not returned daily the contractor in question will have a deduct (security violation) as per the contract. Individuals who loose or fail to return keys will be responsible for the cost of re-keying to the City.

Contractors will sign in on pre-approved forms and also wear the City identification badges (also to be worn at all times on the premises). Keys or access cards will be signed out as provided by the City agent/official and required for the work. These keys, cards, and badges must be returned at the end of each shift before signing out. Failure to do so will result in a \$50.00 penalty for each occurrence.

- d. Contractors shall not ask custodians or mechanics to unlock doors. All access should be provided in advance through the City agent/official. In the rare case where access is not provided, the City Hall Operator may be contacted to assist in providing access. The contractor shall cooperate with security personnel at all times. The contractor should be prepared to allow searches of equipment when leaving, and should remain only in the areas designated on the sign-in sheets. Security will question a contractor who has an identification badge that indicates a work area other than the area he or she is in.
- e. If the contractor requires use of the loading dock in Upper Parking, 24 hour advance notice shall be given to the City agent/official to make arrangements to provide additional security coverage while the delivery is in progress. The contractor or subcontractor shall meet the delivery driver and take delivery at that point. At no time shall a driver be allowed in the facilities without following the access procedure stated above.
- f. If after normal business hours work is required in the outlying buildings, all subcontractors and trades will arrange appropriate security measures and lock-up procedures with the contractor in writing. Any work completed at night shall be left "open" for City inspection of the work. The contractor shall notify the City agent/official 24 hours in advance of after-hours work in writing, indicating the type of work to be done and the security measures to be taken by the contractor.
- g. The contractor shall provide plywood door and window closures during construction to secure the structure from weather and damage from vandalism. The contractor is responsible to maintain the security of the space where they are working during construction.
- h. If proper notification is not provided to the contractor, the subcontractor or trades shall be liable for any subsequent damage/vandalism/inspection cost, etc., due to lack of security/inspection coordination.
- i. Use of City materials is strictly prohibited unless pre-arranged through the City employee contact.
- j. At no time shall any interior doors that control access or exterior doors be propped open.

4. TEMPORARY OR TRIAL USAGE:

The owner shall have the right to make temporary or trial usage of any mechanical device, machinery, apparatus, equipment, work, material or construction supplied under contract before final completion or acceptance of the work, and the same shall not be construed as evidence of acceptance of the work by the owner.

5. OCCUPANCY DURING CONSTRUCTION:

The owner will occupy the premises while work is in progress. Contractor is to coordinate his work as to not interfere with the owner's operation or compromise building security.

6. TEMPORARY HOISTS, LIFTS:

Contractors and subcontractors requiring hoists or lifts shall provide their own and remove upon completion of work.

7. SCAFFOLDING:

General Contractor shall provide protective sidewalk scaffolding and any additional measures as required to protect the public and allow safe use of this entrance into the facility during the entire construction period.

All scaffolding, swing stages and lifts as required to perform work defined in this contract document shall be provided and maintained by the General Contractor and shall be removed when no longer needed. The General Contractor is solely responsible for the design, safety and security of any scaffolding erected under this contract for this project. All scaffolding, swing stages and lifts shall be available with operators for access to the project for the Project Engineer, City Liaison and City Inspectors.

Exterior scaffolding access (up & down) shall be provided. Access through to the facility will be strictly limited. Adequate security must be provided by the General Contractor to limit the opportunity of unauthorized access of scaffolding.

Submittals for the scaffolding and egress protection shall be provided and reviewed before proceeding with erection. Scaffolding and egress protection submittals shall be stamped by a professional engineer. The scaffolding engineer shall design any foundations or anchoring points as required. The scaffolding system shall be properly grounded.

All anchors and other attachments into building shall be limited. All anchors and attachment shall be clearly indicated on submittals. All costs for scaffolding including installation of anchoring, foundation, erection and patching of all anchor and attachment points at the conclusion of the project shall be included in the base bid. Patching of all anchor or attachment points shall match existing façade materials. On site patching sample shall be provided and approved before proceeding with all patch work. Any damage to sidewalks, pavement or landscaped areas shall be restored to existing pre-construction conditions after the removal of the scaffolding.

8. ELECTRICAL POWER:

Contractor may use existing outlets for power. Contractor to verify power available at site. Contractor is to supply his own lines. OSHA regulations require that employers use either ground fault circuit interrupters or an assured equipment grounding conductor program in addition to any other regulations for equipment grounding conductors. The cost of the current used will be paid for by the City.

9. WATER:

Water may be obtained from any existing fixture.

10. TOILET FACILITIES:

Designated toilet facilities will be available for contractor's use. Toilets shall be kept in a clean condition at all times.

11. BULLETIN BOARD:

The contractor to furnish and maintain a 4'-0" x 4'-0" bulletin board for the posting of wage rates, employment data, etc.

12. CONSTRUCTION REFERENCE AND STORAGE AREA:

The contractor is to provide desks or other suitable surfaces for himself, his subcontractors, and the City Project Inspector for the purpose of viewing plans, project manuals, and other construction related documents. The contractor is also to provide filing cabinets or document boxes or other suitable containers for himself, his subcontractors, and the City Project Inspector for the purpose of storing plans, project manuals, shop drawings, and other construction related documents that he is required by this contract to keep on site.

13. SAFETY:

Contractors will have proper safety equipment inclusive but not limited to safety glasses with side guards, hard hat, hearing protection, proper clothing, safety harness, and trade specific safety equipment; i.e., welding curtains, fire extinguishers, etc.

14. PARKING:

Parking on site is available.

SECTION 01505: CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 SCOPE:

- A. This section specifies requirements for salvaging, recycling and disposing of construction waste for purposes of protecting the environment and reducing project cost.

Requirements include the following:

1. Developing a Construction Waste Management Plan including waste management goals and provisions for waste reduction and recycling.
2. Implementing, monitoring and documenting the waste management plan.
3. Incorporating special programs.
4. Evaluating construction waste management.

1.2 RELATED DOCUMENTS AND SECTIONS:

- A. Drawings and general provisions of the Contract, including General Conditions and other Division 1 Specification Sections, apply to this Section.

B. Related documents include the following

1. Section 01010 "Summary of Work"
2. Section 01300 "Submittal & Permits"
3. Section 001500 "Utilities, Facilities, and Security" for environmental-protection measures during construction.

1.3 PRECONSTRUCTION MEETING:

- A. After award of Contract and prior to the commencement of the Work, schedule and conduct a meeting with the Owner and Architect to discuss the proposed Construction Waste Management Plan and to develop a mutual understanding regarding details of environmental protection.

1.4 CONSTRUCTION WASTE MANAGEMENT PLAN:

A. Construction Waste Management Plan

1. The purpose of the Construction Waste Management Plan is to identify construction wastereduction goals, identify targeted materials, and explain specific waste reduction actions to be taken, by whom, and when.
2. The Contractor shall develop a Construction Waste Management Plan for this Project within 15 working days after Contract award or prior to any waste removal. The Owner and the Architect will furnish the Contractor with information that will assist in the development of the Construction Waste Management Plan. Submit the Construction Waste Management Plan (include document/report form) to the Architect for approval prior to implementing the Plan.

B. The Plan, which should be entered into and generated by WasteCapTRACE, shall include the following:

1. **A list of the waste materials expected to be generated from the Project debris.**
 2. **A list of each material proposed to be salvaged, reused, recycled and discarded. Identify applicable markets for reuse and recycling. At a minimum, all materials required by state law to be recycled shall be recycled (e.g., cardboard, cans, bottles, office paper, fluorescent tubes, refrigerants, mercury, etc.) and scrap metal shall be recycled.**
 3. **Separation and materials handling procedures: Description of how waste materials identified above will be separated, cleaned (if necessary) and protected from contamination.**
 4. **Educational and Motivational Procedures: Meetings to be held and other proposed methods for educating construction personnel regarding waste reduction and recycling. Construction waste management requirements should be discussed at least monthly at project site meetings.**
 5. **Waste Auditing Procedures: Methods of monitoring and enforcing the Plan.**
 6. **Documentation Procedures: Methods of documenting materials leaving the Project site as waste, for the reuse or recycling to allow Summary of Waste Progress Reports to be submitted with Applications for Payment.**
 7. **The Lead contractor shall distribute copies of the Construction Waste Management Plan to DPW's Project manager.**
- C. Progress Documentation: Document solid waste disposal and diversion. Include the date of removal, type of waste removed, quantity by weight and volume, final destination and use (recycled, reused or landfilled), and net cost or income.
1. Document on the Form acceptable to the Owner and Architect.
 2. With each Application for Payment, submit updated documentation identifying solid waste disposal and diversion.
 3. With each Application for Payment, submit manifests, weight tickets, receipts and invoices identifying the Project and construction waste material.
- D. Record Submittals: Submit the following:
1. Summary of solid waste disposal and diversion. Submit on form acceptable to the Owner and Architect.
 2. End-of-Project recycling rates and landfill rates demonstrating the percentage of construction waste that was recycled or reused.

1.5 WASTE MANAGEMENT GOALS:

- A. Develop Construction Waste Management Plan that results in end-of-Project rates for the reuse/recycling of **100%** percent by weight or volume of total waste generated by the Project. Record the total construction waste reduction goal on the Construction Waste Management Plan Form.
- B. Reduce: The Project shall generate the least amount of waste and methods shall be used that minimize waste due to error, poor planning, breakage, mishandling, contamination, or similar factors. Promote the resourceful use of materials to the greatest extent possible.
- C. Reuse: The Contractor and Subcontractors shall reuse materials to the greatest extent possible. Reuse includes the following:
 1. Salvage reusable materials for resale, for reuse on this Project, or for storage for use on future projects.

2. Return reusable items (e.g., pallets or unused products) to the material suppliers.
- D. Recycle: As many of the waste materials not able to be eliminated in the first place or salvaged for reuse shall be recycled. Waste disposal in landfills shall be minimized to greatest extent possible.

1.6 MATERIALS HANDLING AND SORTING:

A. Handling:

1. Materials that are contaminated prior to placing in collection containers shall be properly cleaned. Deliver materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to recycling processes.
2. Cover materials with tarps and keep truckloads level so as to prevent spillage.
3. Arrange for collection by or delivery to the appropriate recycling or reuse facility.
4. Hazardous Waste and Hazardous Materials: Handle in accordance with applicable regulations. If encountered, such waste and materials shall be abated under separate contract.

B. The following sorting methods are acceptable:

1. Sorting recyclable materials at the Project site and transporting them to recycling markets directly from the Project site.
2. Employing haulers who make use of a materials-recovery facility or a transfer station where recyclable materials are sorted from the waste and recycled before disposing of the remainder. If using a hauler or recycling facility to sort out recyclables, verify that the hauler sorts out all construction waste loads and is not limited to those that are not acceptable at the landfill. Also, verify that the hauler or recycling facility recycles at least three types of materials.

1.7 WASTE MANAGEMENT PLAN IMPLEMENTATION:

- A. The Contractor shall designate a party (or parties) who shall be responsible for instructing construction personnel and overseeing and documenting results of the Construction Waste Management Plan.
- B. Distribution: The Contractor shall distribute copies of the Construction Waste Management Plan to the Project Foreman, each Subcontractor, the Owner, and the Architect
- C. Instruction: The Contractor shall provide on-site instruction regarding appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all construction personnel at the appropriate phases of the Project.
- D. Separation Facilities: The Contractor shall lay out and identify a specific area on the Project site to facilitate separation of materials for recycling, salvage, reuse, and return. Recycling and waste bin areas shall be kept neat and clean, and clearly marked to avoid contamination of materials. Materials for recycling include concrete, non-fibrous wallboard, paper, clean corrugated cardboard (no pizza boxes), non-treated wood, metals (steel, aluminum and copper), and glass bottles (no windows). Provide separate containers, preferably near the job trailer, with smaller containers located at convenient places throughout the job site. Empty smaller containers into larger containers every night or when full. Cover outdoor containers to keep out rain, snow, and wind-driven debris. Lock containers whenever site is not in use to prevent illegal dumping.
- E. Hazardous Waste: Hazardous waste shall be separated, stored, and disposed of according to applicable regulations.

- F. Application for Payments: With each Application for Payment, the Contractor shall submit a Summary of Waste generated by the Project. **This reporting shall take place using WasteCapTRACE, an online documentation system. There is a fee, to be included in the bid, of two cents per square foot of gross construction for use of WasteCapTRACE.** Failure to submit this information shall render the Application for Payment void, thereby delaying the Progress Payment. The Summary of Waste shall contain the following information:
1. The amount (in tons and/or cubic yards) of material landfilled from the Project, the identity of the landfill, and the related disposal cost. Include corresponding manifests, weight tickets, receipts, and invoices.
 2. For each material recycled from the Project, the amount (in tons and/or cubic yards), the date removed from the Project site, the receiving party, the transportation cost, the amount of any money paid or received for the recycled or salvaged material, and the net total cost or savings of recycling. Include corresponding manifests, weight tickets, receipts, and invoices.
 3. **Final Payment: Prior to application for Final Payment, the Lead Contractor shall submit a Final Summary of Waste: reuse and recycling results for all prime and subcontractors, including the quantity of each material recycled, reused, or salvaged, the receiving party and the applicable diversion rates. The final report will be generated by WasteCapTRACE based on information entered throughout the project by the Lead Contractor.**
- G. Implementing the Plan: The Contractor shall designate a party (or parties) responsible for implementing the Construction Waste Management Plan. This party (or parties) shall explain to Contractor's and Subcontractor's construction personnel, the Plan's goals and methods for achieving those goals.

1.8 SPECIAL PROGRAMS:

- A. The Contractor shall be responsible for final implementation of programs involving tax credits, rebates, or similar incentives related to recycling, if applicable to the Project. Revenues or other savings obtained for recycling or returns shall accrue to the Contractor.
- B. The Contractor shall be responsible for obtaining information packets related to the special programs prior to commencing Work.
- C. The Contractor shall document work methods, recycled materials, etc., as required for the tax credits, rebates, or other savings described above.

END OF SECTION

SECTION 01600: MATERIALS AND EQUIPMENT

1. SCOPE:

A. Index:

1. Scope
2. Materials
3. Equipment
4. Hazardous Material Requirements
5. Material Storage
6. Protection
7. Revisions

2. MATERIALS:

- A. Furnish materials of the type, qualities, and characteristics specified. The specification of a trade name and catalog number is intended to establish quality, type, character, and operating characteristics of the material required. Materials by other manufacturers of equal specifications will be accepted, excepting as may be specifically stated otherwise.
- B. Materials shall be delivered adequately protected, in merchantable condition, and in original unbroken packages if normally packaged. They shall be stored and handled so as to protect and maintain their merchantable condition.
- C. The Commissioner of Public Works or his representative shall have the right to reject material not in compliance with the project manual, as well as damaged material, and the contractor shall remove such material from the construction site when and as directed.

3. EQUIPMENT:

- A. Internal combustion engine and compressor shall be equipped with mufflers to reduce noise to a minimum and shall not be operated in enclosed areas without adequate ventilation.
- B. All materials and work procedures used shall be in accordance with all air pollution control regulations in effect at the work site.

4. HAZARDOUS MATERIAL REQUIREMENTS:

- A. The requirements set forth in the OSHA Hazard Communication Standard, 29CFR19101.1200, U.S. Environmental Protection Agency (EPA), and Wisconsin Department of Natural Resources in the Wisconsin Administrative Code NR600, shall be met by each on-site contractor.

1. Material Safety Data Sheets (M.S.D.S.):

- a. All contractors, which may/may not include the City of Milwaukee, shall provide the M.S.D.S. for all hazardous chemicals to which any person may be exposed at the work site.
- b. A master list will be kept in the office of the Project Supervisor/Construction Manager and updated as materials are delivered.

2. Container Labeling:

- a. Each container of hazardous material at the work site shall be clearly labeled with:
 - (1) Identity of the hazardous chemical(s).
 - (2) Appropriate hazard warning(s).
 - (3) Name and address of the manufacturer.

B. The City of Milwaukee reserves the right to stop the work of a contractor if compliance with OSHA regulations is inadequate. Work will not proceed until all applicable safety and health procedures are implemented by the contractor.

5. MATERIAL STORAGE:

- A. The storage areas shall be kept in good order and free of all rubbish and debris.
- B. Coordinate the delivery and storage of all materials and equipment with the FACILITIES DEVELOPMENT AND MANAGEMENT SECTION Project Inspector.
- C. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.
- D. Store and protect products in accordance with manufacturer's instructions.
- E. Store with seals and labels intact and legible.
- F. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- G. For exterior storage of fabricated products, place on sloped supports above ground.
- H. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- I. Prevent contact with material that may cause corrosion, discoloration, or staining.
- J. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- K. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

6. PROTECTION:

A. GENERAL:

- 1. The premises and the work shall be adequately protected from damage from the commencement of work to the date of final acceptance.
- 2. All construction work and traffic shall remain within the construction area.

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3. All damage shall be corrected or repaired by the contractor or contractors causing same at his or their own expense.
4. All open pipes, pipe threads, fittings, and insulation must be protected during construction.

7. REVISIONS:

The right is reserved to make modifications to a reasonable extent as building conditions may require, or as may be required to conform to code rulings, or manufacturer's standards without extra cost to the City.

SECTION 01700: CLEANING AND PROJECT CLOSE-OUT

1. SCOPE:

A. Index:

1. Scope
2. General
3. Safety Cleaning
4. Progress Cleaning
5. Disposal
6. Final Cleaning
7. Charges
8. Record Drawings
9. Operating Instructions & Maintenance Manuals
10. Guarantees

2. GENERAL:

Article 2.5.4 of the General Requirements of City of Milwaukee Department of Public Works shall be supplemented as specified hereinafter.

3. SAFETY CLEANING:

Safety cleaning: Each contractor is responsible for safety cleaning, which includes but is not limited to the following:

- A. Keep work areas, passageways, ramps, stairs, free of debris and scrap.
- B. Form and scrap lumber shall have nails withdrawn or bent over and lumber shall be stacked or removed.
- C. Remove spills of oil, grease, or other liquids immediately.
- D. Hazardous material shall be handled in accordance with Section 01600. Each container of hazardous material at the work site shall be clearly labeled with:
 - a. Identity of the hazardous chemical(s)
 - b. Appropriate hazard warning(s).

4. PROGRESS CLEANING:

- A. Prime Contractor and subcontractor shall remove his rubbish and debris from building site promptly upon its accumulation, and prior to the contractor's regular Friday general clean up. Contractor shall perform broom cleaning of all appropriate surfaces each Friday afternoon.
- B. Combustible waste shall be stored in fire resistive containers and disposed of regularly.
- C. Oily, flammable or hazardous wastes such as caustics, acids, harmful dusts, etc., shall be stored in appropriate covered containers.
- D. All solvents and cleaners used on this project must be rated as containing low or no volatile organic compounds (VOC's).

5. DISPOSAL:

- A. No burning of rubbish or debris will be allowed at site. No rubbish shall be thrown through opening or from heights without proper protection. Where dust will be generated or flying debris is likely to occur, provide dust tight chutes or other means to control dust.
- B. Containers: Contractor shall provide mobile industrial type waste containers in the number and size required, placed at adequate locations to handle debris or provide other methods of disposing of debris.
- C. Oil, flammable or hazardous wastes such as, but not limited to, caustics, acids, harmful dusts, etc., shall be placed in properly marked containers as necessary and disposed of at a site designed for such wastes.

6. FINAL CLEANING:

- A. Immediately prior to substantial completion.
- B. Contractors shall expedite or perform thorough cleaning, sweeping, washing and polishing of work to remove from work and equipment provided under his contract, all foreign matter, spots and soil, so as to put all such work and equipment, including finishes, in a complete and finished condition ready for acceptance and use intended.
- C. The contractor is responsible for final sweeping and dusting not covered by other subcontractors. This general cleaning shall include all areas and floors of the building, including the site outside the building.
- D. All solvents and cleaners used on this project must be rated as containing low or no volatile organic compounds (VOC's).

7. CHARGES:

- A. If prime contractor does not remove rubbish or clean building as specified above, the owner reserves right to have work done by others at contractor's expense.
- B. Employees or contracted services of the owner who are required to clean up any rubbish or to sweep any floors because prime contractor failed to do so will record all hours involved to complete such work. The cost incurred by the owner for this special cleaning and sweep-up work shall be charged against the contract price of the contractor as determined by owner.

8. RECORD DRAWINGS:

- A. If the completion of work and prior to final payment, the mechanical and electrical contractors shall provide FACILITIES DEVELOPMENT AND MANAGEMENT SECTION with three (3) marked up sets of prints showing all changes or variations from contract drawings, and not specified on change order drawings theretofore issued. Contractors providing buried or concealed piping, conduit, or similar items shall locate such items by dimensions and elevations. Additionally, provide one (1) electronic copy (pdf) of the record drawings,
- B. Other contractors shall provide one (1) marked up set of prints showing all changes or variations from contract drawings.
- C. Drawings shall show complete layout of revised piping, equipment, etc., as actually installed.

9. OPERATING INSTRUCTIONS AND MAINTENANCE MANUALS:

- A. The contractor shall, upon completion of all work, furnish the necessary skilled labor to instruct City personnel in the operation, adjustment, and maintenance of all equipment furnished.
- B. At termination of work, the contractor shall submit maintenance and operating manuals presenting full details of care and maintenance and operation of mechanical and electrical equipment of every nature. See specific requirements in relevant sections as applicable.
- C. The manual shall include manufacturer's instructions for maintenance and operation and shall be completely indexed, including the spare parts list. See specific requirements in relevant sections.
- D. Submit three (3) final copies in hard bound cover and one (1) electronic (pdf) to FACILITIES DEVELOPMENT AND MANAGEMENT SECTION.
- E. Contractor shall provide qualified personnel onsite to provide a minimum of four (4) hours of training to Owner's representatives.

10. GUARANTEES:

- A. Each contractor shall guarantee to replace or repair promptly at his own expense, as directed by the Commissioner of Public Works or his agent, all workmanship or materials in which defects may develop within one (1) year from the date of final acceptance of his work. This guarantee includes all damage done to the City due to faulty equipment, poor installation or poor construction.
- B. Guarantee periods other than the one year time period are indicated in specific specification sections.

SECTION 01820: TRAINING1. SCOPE:A. Index:

1. Scope
2. Training, Operations Instructions, and Maintenance Manuals

2. TRAINING, OPERATIONS INSTRUCTIONS, AND MAINTENANCE MANUALS:

A. This contractor shall, upon completion of the work, instruct City personnel in the operation, adjustment, and maintenance of the HVAC equipment, HVAC controls, fire protection, and life/safety (fire alarms) systems, and lighting controls (by City of Milwaukee).

1. Training for HVAC equipment.
2. Training for HVAC controls.
3. Training for fire protection and life/safety (fire alarms) systems.
4. Training for electrical lighting controls (by City of Milwaukee).

B. Training for HVAC Equipment:

Two levels of on-site training exist for the Downtown Complex Facilities Management staff. In addition to two levels of training, off-site training is appropriate for advanced subjects and particular employees. In total, there are three types of training. The number of training hours varies and is dependent on the scope of the project and complexity of the equipment.

1. On-Site Training:

- a. Factory certified trainer to provide training for managers, engineers, mechanics, electricians, and technicians.
- b. Service representative to provide operations and maintenance training.

2. Training Hours and Frequency (On-Site Training):a. Level I:

To be provided upon the completion of the project. Training will be a 1 day minimum. Use of O & M manuals is required. Training is administered in a classroom and field setting (no more than 4 hours at a given session). Reference manufacturer's course offerings for details. This project will require a minimum of 8 hours of training. Level I training is administered to managers, engineers, mechanics, electricians, technicians, and others who interact with HVAC equipment and facilities maintenance.

b. Level II:

Two hour segments, 1 time per year, 2nd shift only, 2 hours per year (depending in complexity) total. This training serves as both a review and a

systems development preview.

C. Training for HVAC Controls:

Two levels of on-site training exist for the Downtown Complex Facilities Management staff. In addition to the two levels of training, off-site training is appropriate for advanced subjects and particular employees. In total, there are three types of training. The number of training hours varies and is dependent on the scope of the project and complexity of the equipment.

1. On-Site Training:

- a. Factory certified trainer to provide training for managers, engineers, mechanics, electricians, technicians, and support staff.
- b. Service representative to provide operations and maintenance training.
- c. Training for switchboard operators and facility supervisors.

2. Off-Site Training:

- a. Off-site training is reserved for complex applications where the factory has a technical training schedule specific to troubleshooting, systems diagnostics, maintenance, and operations. Typically, there will be beginning, intermediate, and advanced level courses offered by the manufacturer. **The course will be selected by the Operations and Maintenance Manager.**

3. Training Hours and Frequency (On-Site Training):

a. Level I:

To be provided upon the completion of the project. Training will be a 1 day minimum. Use of O & M manuals is required. Training is administered in a classroom setting (no more than 4 hours at a given session). Reference manufacturer's course offerings for details. This project will require a minimum of 8 hours of training. Level I training is administered to managers, engineers, mechanics, electricians, technicians, support staff, and others who interact with equipment, hardware, software, and facilities maintenance.

b. Level II:

Two hour segment, 1 time per year, 2nd shift, 2 hours per year total. This training serves as both a review and a systems development preview.

D. Training for Fire protection and Life/Safety (Fire Alarm) Systems:

Two levels of on-site training exist for the Downtown Complex Facilities Management staff. In addition to the two levels of training, off-site training is appropriate for advanced subjects and particular employees. In total, there are three types of training. The number of training hours varies and is dependent on the scope of the project and complexity of the equipment.

1. On-site Training:

- a. Factory certified trainer to provide training for managers, engineers, mechanics, electricians, technicians, and support staff.
- b. Service representative to provide operations and maintenance training.
- c. Training for switchboard operators and facility supervisors.

2. Off-Site Training:

- a. Off-site training is reserved for complex applications where the factory has a technical training schedule specific to troubleshooting systems diagnostics, maintenance, and operations. Typically, there will be beginning, intermediate, and advanced level courses offered by the manufacturer. **The Operations and Maintenance Manager will select classes.**

3. Training Hours and Frequency (On-Site Training):

a. Level I:

To be provided upon the completion of the project. Training will be a 2 day minimum. Use of O & M manuals is required. Training is administered in a classroom setting (no more than 4 hours at a given session). Reference manufacturer's course offerings for details. This project will require a minimum of 8 hours training. Level I training is administered to managers, engineers, mechanics, electricians, support staff, and others who interact with equipment, hardware, software, and facilities maintenance.

b. Level II:

Two hour segment 1 time per year, 2nd shift and 3rd shift, 2 hours per year total. This training serves as both a review and a systems development preview.

E. Training for Electrical Lighting Controls (City of Milwaukee):

Provide two levels of on-site training for the Downtown Complex Facilities Management staff and tenants.

1. On-Site Training:

- a. Factory certified trainer to provide training for managers, engineers, mechanics, electricians, and technicians.
- b. Service representative to provide operations and maintenance training.

2. Training Hours and Frequency:

a. Level I:

To be provided upon the completion of the project. Training will be a 2 hour minimum administered on-site. Level I training is administered to the tenant, managers, engineers, mechanics, electricians, technicians, and others who interact with equipment, hardware, software, and facilities maintenance.

b. Level II:

Two hour segment once per year. This training serves as both a review and a systems development preview.

F. Verification and Validation of Training:

1. An outline of the training and test materials shall be provided to the City's facility O & M Manager two weeks prior to the training sessions. Corrections, additions, and deletions will be at the discretion of the O & M Manager within a week of receiving the test. All written materials, graphs, cue cards, trainer's notes, and phone numbers will accompany the outline for preview.
2. A ½ hour test shall be provided to the City's operations staff. This test shall be given after each of the HVAC equipment, HVAC controls, and fire protection and life/safety (fire alarms) systems Level I on-site training sessions. This test shall include written true and false, essay questions, and hands-on field work performance.

G. Materials:

1. An edited videotape of the training will be provided.
2. All prepackaged videotapes, training software, and textbooks from the manufacturer, specific to the training, will be provided.

H. At the submittal stage, the contractor shall submit maintenance and operating manuals presenting full details of care and maintenance and operation of mechanical and electrical equipment of every nature.

I. The manual shall include manufacturer's instructions for maintenance and operation and shall be completely indexed, including the spare parts list.

J. Submit three (3) final copies in hardbound cover and one (1) electronic copy (pdf) to DPW, ISD - Facilities Development and Management Section.

K. Contractor shall provide to the City a video recording (DVD) of all equipment installed under this contract. Tape shall be provided prior to the installation of any ceilings.

L. Contractor shall video record (DVD) one training session and turn over to the City for future reference.

**SECTION 15010
BASIC MECHANICAL REQUIREMENTS**

PART 1 -GENERAL

1.1 SECTION INCLUDES

A. Basic Mechanical Requirements specifically applicable to Division 15 Sections.

1.2 SCOPE OF WORK

A. The following is a general description of the HVAC work for this project. This work description is not all inclusive but is offered to give the Contractor a general idea of the scope of the project.

1. HVAC work includes but is not limited to the following:
 - a. Install one rooftop unit. Extend utilities (electricity and condensate drain) to the new unit. Extend new supply and return ductwork to the new unit and space served including all related accessories. Provide new roof penetration and curb as required to set the new unit. **Electrical work as outlined in the Division 16 specifications shall be provided by City of Milwaukee electricians.**
 - b. Provide DDC control system to operate the new rooftop unit. System shall communicate to MPD's Police Administration Building near 8th and State Street in Milwaukee, WI.

1.3 DEFINITIONS

A. The following words or phrases have special meaning when used in the articles of this division and in any other requirements applicable to this division:

1. "Exposed to View" or "Exposed" — shall have reference to and mean that the pipes, ducts, etc., insulated or otherwise, in the completed structure are visible within any normally occupied space, room or area.
2. "In Concealed Spaces", "Concealed" or "Not Exposed to View" — shall have reference to and mean that the pipes, duct, etc., insulated or otherwise are concealed and not exposed to view within furred spaces, above suspended ceilings, pipe chases, etc.
3. "Unfinished Spaces" or "Unfinished Rooms" — shall have reference to areas such as Machine Rooms, Equipment Rooms, or similar areas. Where the words "In Finished Areas" or "Finished Rooms" are used, it shall have reference to rooms or spaces, such as, Reading rooms, Offices, Public Corridors, etc.
4. "Finished Rooms or Spaces" shall refer to areas similar to offices, public corridors, and public toilet rooms.
5. "Provide" — shall be taken to mean "furnish and install" meaning to purchase and deliver to the job site and the installation thereof.
6. "Piping" — shall include, in addition to pipe all fittings, valves, hangers, and other

supports, expansion compensators, anchors, and accessories related to such piping including associated insulation.

7. "Ductwork" — shall include, in addition to ducts, all fittings, transitions, dampers, hangers and other supports, fire dampers, access panels, associated insulation and accessories related to such ductwork.
8. "Contractor" in Specifications and Drawing refers to respective Contractor performing that portion of work.
9. "Invert Elevation" (I.E.) means elevation of inside bottom of pipe or duct.
10. "Mechanical Work" is work in Division 15."

NOTE: The words "Contractor shall" are implied and shall be so understood wherever the directions "furnish," "install" or "provide" are used.

1.4 SPECIAL CONDITIONS

- A. Minor items and accessories or devices reasonably inferable as necessary to the complete and proper operation of any system shall be provided by the Contractor for such system whether or not they are specifically called for by the Specifications or Drawings.
- B. Where work specified in other sections of the specifications connects to equipment specified in Division 15 Sections, check the required connection to such equipment.

1.5 CODES AND STANDARDS

- A. The Work governed by this Division shall comply with the latest editions of the following applicable standard specifications and codes. For other standard specifications, if included by reference, see Division 1 of the Specifications.

AABC	Associated Air Balance Council
ADC	Air Diffusion Council
AIA	American Institute of Architects
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
ARI	Air-Conditioning and Refrigeration Institute
ASA	Acoustical Society of America
ASE	Association of Safety Engineers
ASHRAE	American Society of Heating Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASPE	American Society of Plumbing Engineers
ASTM	American Society for Testing Materials
AWS	American Welding Society
AWWA	American Water Works Association
CAGI	Compressed Air and Gas Institute
EPA	Environmental Protection Agency
FIA	Factory Insurance Association
FM	Factory Mutual Insurance Association
HYDI	Hydronics Institute
IBC	International Building Codes

IDPH	Illinois Department of Public Health
IEEE	Institute of Electrical and Electronics Engineers
MCAA	Mechanical Contractors Association of America
NBS	National Bureau of Standards
NEC	National Electric Code
NEMA	National Electrical Manufacturers Assoc.
NFPA	National Fire Protection Association
NSC	National Safety Council
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Act
SMACNA	Sheet Metal and Air Conditioning Contractor's Association
UL	Underwriter's Laboratories, Inc.

1.6 WORK BY CITY

A. The following work shall be by the City:

1. Testing and balancing by others under a separate contract with the City.
2. Electrical work as shown on drawings and outlined in the Division 16 specifications shall be provided by City of Milwaukee electricians. Contractor shall supply loose to the City motor starters and disconnect switches.

1.7 PROJECT/SITE CONDITIONS

- A. Install Work in locations shown on Drawings, unless prevented by Project conditions.
- B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of City before proceeding.

1.8 CONTRACTOR USE OF PREMISES

- A. Refer to Division 1.
- B. Limit use of site and premises to allow:
 1. City occupancy.
 2. Use of premises by City to conduct normal activities.
 - a. Tie-ins to existing systems must be done in manner so as not to interfere with City's operations. All shut downs of existing services require a three day notice minimum in writing.
- C. Schedule the Work to accommodate this requirement.
- D. Cooperate with City to minimize conflict and to facilitate City's operations.
- E. The City will be responsible for the identification and abatement of all hazardous materials and asbestos associated with the project. Although great care will be taken to eliminate any risks, the Contractor must be aware that hazardous materials may exist on site. Therefore, the Contractor shall immediately suspend work and notify the City if asbestos or other hazardous material is suspected in the work area of the project.

1.9 WORK SEQUENCE

- A. Install work in phases to accommodate City's occupancy requirements during the construction period. Coordinate mechanical schedule with other trades and other operations.

1.10 REFERENCE STANDARDS**A. Quality Assurance**

1. For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
2. Conform to reference standard by date of issue current on date of Contract Documents date for receiving bids date of City-Contractor Agreement when there are no Bid dates specified.
3. Obtain copies of standards when required by Contract Documents.
4. Maintain copy of applicable standard at job site during submittals, planning and progress of the specific work, until Substantial Completion.
5. Should specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.
6. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

B. Reference Standards and Specification Abbreviations

1. Refer to Division 1 and Division 15, Applicable Sections.

1.11 SUBMITTALS

- A. Shop drawings and samples shall be submitted in compliance with the Conditions of the Contract and General Requirements.
- B. Submittals shall contain outline dimensions, operating and maintenance clearances and sufficient engineering data to indicate compliance with the specifications. Each submittal shall be clearly labeled as indicated in the Conditions of the Contract and General Requirements.
- C. Each piece of equipment shall be identified by the number shown in the schedules and by specification article number pertaining to the item. Shop drawings shall as a minimum be ¼" equals 1'-0" scale, and shall be newly prepared by the Contractor and not reproduced from the Engineer's drawings. Layouts shall be made for all floor plans including all ductwork, piping, electrical distribution and other mechanical equipment. Layouts shall show clearances of piping, ducts, etc., above floor.
- D. Contractor shall obtain Engineer's approval on all the work before any equipment is purchased, or any work installed. Contractor shall also secure approval of the Governmental Authorities having jurisdiction on all equipment and on the layout of the complete system.
- E. The Engineer's review and approval of shop drawings is a gratuitous assistance and in no way does it relieve the Contractor from responsibility for errors or omissions which may exist on the shop drawings. Where such errors or omissions are discovered later, they must be made good

by the Contractor, without any additional cost to the City, irrespective of any approval by the Engineer.

1. The Contractor shall incorporate with his shop drawings, a letter indicating all deviations from the plans and/or specifications. If in the opinion of the Engineer, the deviations are not equal, the Contractor will be required to furnish the item as specified and as indicated on the drawings.
2. Record documents shall be submitted in compliance with the requirements of the Specifications.

F. Shop Drawings Submittal Procedures:

1. Submit eight (8) copies of manufacturer's certified shop drawings to Engineer for all equipment and controls.
2. Drawings shall include detailed dimensions, capacities, gauges, arrangement and operating clearances.
3. Incomplete submittals shall not be reviewed and Contractor will be held responsible for correction of work not having final approval.
4. Engineer shall review or take other appropriate action on Contractor submittals, such as certified shop drawings, product data, samples and other data, which Contractor is required to submit, but only for limited purpose of checking for conformance with design concept and Contract Documents.
5. This review shall not include review of accuracy or completeness of details, such as quantities, dimensions, capacities, weights or gauges, fabrication processes, construction means or methods, coordination of work with other trades or construction safety precautions, all of which are the sole responsibility of Contractor.
6. Engineer's review shall be conducted with reasonable promptness while allowing sufficient time in Engineer's judgment to permit adequate review.
7. Review of specific items shall not indicate that Engineer has reviewed entire assembly of which said item is a component.
8. Engineer shall not be responsible for any deviations from Contract Documents not submitted to Engineer in writing by Contractor.
9. Engineer shall not be required to review partial submissions or those for which submissions of correlated items have not been received.
10. Review of certified drawings does not relieve Contractor of responsibility of furnishing and install all system components, as per drawings and specifications for proper system operation with particular respect to BTU outputs, water and air flow capacities, minimum noise requirements and space limitations, nor from responsibility for errors or omissions of any sort in drawings.
11. Engineer assumes no responsibility for figured dimensions or exact quantities of materials on shop drawings.
12. Reviews by Engineer are subject to limitations of general conditions of the contract for construction.

13. Contractor shall thoroughly check all shop drawings prepared by subcontractors for materials or equipment suppliers with regard to measurements, size of members, materials and details to satisfy specifications and drawings.
14. Each drawing shall have a date of approval and signature of reviewer.
15. Furnish approved and corrected shop drawings to all other Contractors whose work is affected.

1.12 QUALITY CONTROL

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions and workmanship to product Work of specified quality.
- B. Comply fully with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
- D. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes or specified requirements indicate higher standards or more precise workmanship.
- E. Work to be performed by persons qualified to produce workmanship of specified quality.
- F. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.
- G. Manufacturers' Field Services and Reports
 1. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of installation, quality or workmanship, start-up of equipment, testing, adjusting and balancing of equipment and troubleshooting as applicable and to initiate instructions when necessary.
 2. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
 3. Submit report in duplicate within ten (10) days of observation to Engineer for review.

1.13 QUALITY ASSURANCE/CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, Products, services, site conditions and workmanship to produce Work of specified quality.
- B. Comply fully with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
- D. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes or specified requirements indicate higher standards or more precise workmanship.
- E. Work to be performed by persons qualified to produce workmanship of specified quality.

- F. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

1.14 MANUFACTURERS' FIELD SERVICES, FIELD TESTS AND REPORTS

- A. When specified in individual specification Sections, Contractor shall require material or Product suppliers, Subcontractors, or manufacturers to provide qualified staff personnel to observe site conditions; testing; conditions of installation; quality of workmanship; start-up of equipment; testing, adjusting and balancing of equipment and materials; and troubleshooting as applicable B and to initiate instructions when necessary. Submit report per paragraph C below, this section.
- B. Report observations and site decisions or instructions given to City, applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- C. Submit written report in duplicate within 10 days of observation, start-up, testing, etc. to Engineer for review.

1.15 CONTRACT CLOSEOUT

- A. Final Cleaning
 - 1. Refer to Division 1.
 - 2. Execute final cleaning prior to final inspection.
- B. Adjusting
 - 1. Adjust operating products and equipment to ensure smooth and unhindered operation.
- C. Project Record Documents
 - 1. Refer to Division 1.
 - 2. Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:
 - a. Field changes of dimension and detail.
 - b. Details not on original Contract Drawings.
 - 3. Delete Engineer's title block and seal from all documents.
 - 4. Submit documents to Engineer with claim for final application for payment.
- D. Provide Maintenance Manuals as follows:
 - 1. HVAC Contractor shall furnish to Engineer and City for approval, prior to installation of equipment three (3) bound copies of typewritten instructions covering complete maintenance and operation of said system and a complete set of drawings marked to show any and all deviations from original layout.
 - 2. Contractor shall verbally instruct City on care and operation of all parts of system. Engineer may be present at verbal instruction. Contractor shall make available to City, any of their subcontractors or equipment manufacturers deemed necessary.

3. At least one month before warranty period expires, Contractor shall again meet with City for a review of original maintenance manuals and operating instructions.
 4. Maintenance instructions shall include manufacturer's literature on all system equipment components.
 5. All maintenance instructions shall be explicit concerning time intervals for all servicing and preventive maintenance types and grades of oil and/or grease, packing materials, normal and abnormal clearance, methods of equipment adjustments and complete description of replacement parts and materials for wearing items.
 6. Maintenance instructions shall be required on all equipment and systems specified.
- E. Provide Record Drawings as follows:
1. Contractor shall maintain at project site for City, one (1) record copy of all Drawings, Specifications, Addenda, Change Orders and other Modifications, in good order and marked currently to record all changes made during construction and approved Shop Drawings, Project Data, and Samples.
 2. Record documents shall be available to Engineer and shall be delivered to Engineer for City upon completion of work.

1.16 TRAINING OF CITY PERSONNEL

- A. Instruct user agency personnel in the proper operation and maintenance of systems and equipment as provided as part of this project. Include not less than four hours of instruction, using the Operating and Maintenance Manual during this instruction. Demonstrate startup, operation and shutdown procedures for all equipment. All training shall be completed during normal working hours.

1.17 SPARE PARTS AND MAINTENANCE DATA

- A. Provide products, spare parts, maintenance and materials in quantities specified in individual specification sections.
- B. Deliver to project site and place in location as directed; obtain receipt prior to final payment.

1.18 WARRANTIES

- A. Provide one year warranty of workmanship and materials provided under this project.
- B. Provide five year warranty of workmanship and materials on all mechanical compressors provided under this project.
- C. Provide notarized copies.
- D. Execute and assemble documents from Subcontractors, suppliers and manufacturers.
- E. Provide table of contents and assemble in 3-D side ring binder with durable cover.
- F. Submit prior to final application for payment.
- G. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

1.19 REGULATORY REQUIREMENTS

- A. Conform to the International Building Code and the International Mechanical Code as amended and adopted by the State of Wisconsin, Ordinances of the City of Milwaukee and NFPA 13, latest editions.
- B. Obtain permits and request inspections from the City of Milwaukee Building Department and any other Authorities Having Jurisdiction (AHJ).
- C. Conform to all other governing agencies and authorities.

PART 2 -PRODUCTS

2.1 MATERIAL AND EQUIPMENT

- A. Refer to Division 1.
- B. Products
 - 1. Products: Means new material, machinery, components, equipment, fixtures and systems forming Work. Does not include machinery and equipment used for preparation, fabrication, conveying and erection of Work. Products may also include existing materials or components required for reuse.
 - 2. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.
 - 3. Provide interchangeable components of same manufacturer for similar components.
- C. Transportation and Handling
 - 1. Transport and handle products in accordance with manufacturer's instructions.
 - 2. Promptly inspect shipment to assure that products comply with requirements, quantities are correct and products are undamaged.

2.2 STORAGE AND PROTECTION

- A. Refer to Division 1.
- B. Store and protect products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight, climate-controlled enclosures.
- C. For exterior storage of fabricated products, place on sloped supports above ground.
- D. Provide off-site storage and protection when site does not permit on-site storage or protection.
- E. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation.
- F. Store loose granular materials on solid flat surfaces in a well-drained area. Provide mixing with foreign matter.
- G. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement or damage.
- H. Arrange storage of products to permit access for inspection. Periodically inspect to assure products are undamaged and are maintained under specified conditions.

2.3 PRODUCT OPTIONS

- A. Refer to Division 1.
- B. Products Specified by Reference Standards or by Description only: Any product meeting those standards or description.
- C. Products Specified by Naming One or More Manufacturers: Products of manufacturers named and meeting specifications; no options or substitutions allowed.
 - 1. Documents have been prepared utilizing a single manufacturer as the basis of design. Contractor shall be responsible for coordinating any varying requirements (e.g. space requirements, electrical requirement) when utilizing the other acceptable manufacturers.

PART 3 -EXECUTION

3.1 SCOPE

- A. Work included under Division 15, Mechanical Work, shall include all labor, services, materials and equipment and performance of all work required for installation of mechanical systems as shown on Drawings and as herein specified in following sections.

3.2 INTERPRETATION OF CONTRACT DOCUMENTS

- A. Should there be discrepancy or a question of intent, refer matter to Engineer for decision before ordering any equipment or materials or before starting any related work.
- B. Drawings and Specifications are to be taken together. Work specified and not shown or work shown and not specified shall be performed or furnished as though mentioned in both Specifications and Drawings. If there is discrepancy between Drawings and Specifications as to quantity or quality to be provided, the greater quantity or better quality shall be provided.
- C. Minor items and accessories or devices reasonably inferable as necessary to complete and proper installation and operation of any system shall be provided by Contractor for such system whether or not specifically called for by Specifications or Drawings.
- D. Engineer may change location of any equipment 5' and any piping, ductwork, conduit, etc. 10' in any direction without extra charge, provided such changes are made before installation.
- E. Locations of items not definitely fixed by dimensions are approximate only and exact locations necessary to secure the best conditions and results shall be determined at the site and shall be subject to review and approval by Engineer.
- A. Follow drawings in laying out work, check drawings of other trades to verify spaces in which work will be installed, and maintain maximum headroom and space conditions at all points.
 - 1. Where headroom or space conditions appear inadequate, notify Engineer or City's field representative before proceeding with installation.
 - 2. Duct and pipe rerouting and duct size changes shall be made at no additional cost to the City.
- B. Furnish advance information on locations and sizes of frames, boxes, sleeves and openings needed for the work, and also furnish information and shop drawings necessary to permit installation of other work without delay.

- C. Where there is evidence that parts of the Work specified in Division 15 will interfere with other work, assist in working out space conditions to make satisfactory adjustments, revise and submit coordinated shop drawings.
- D. After review and without additional cost to the City, make minor modifications in the work as required by structural interferences, by interferences with work of other sections or for proper execution of the work.
- E. Work installed before coordinating with other work so as to cause interference with other work shall be changed and corrected without additional cost to the City.
- F. Drawings are diagrammatic in nature and are a graphic representation of requirements and shall be followed as closely as actual building construction will permit. All changes from the plans necessary to make the work conform to the building as constructed and to fit the work of other trades or to conform to rules of the Governmental Authorities having jurisdiction, NFPA, OSHA and the City's Insurance Underwriters, shall be made by the Contractor without extra cost to the City.
- G. The layout of the piping, ductwork, equipment, etc., as shown on the drawings shall be checked and exact locations shall be determined by the dimensions of the equipment approved and the Contractor shall obtain approval for the revised layout before the apparatus is installed. The Contractor shall field measure or consult existing record Architectural and Structural Drawings if available for all dimensions, locations of partitions, locations and sizes of structural supports, foundations, etc.
- H. Omission in the Drawings and/or Specifications of any items necessary for the proper completion or operation of the work outlined in this specification shall not relieve the Contractor from furnishing same without additional cost to the City.
- I. The Equipment Shop Drawings will be furnished to the Contractor before roughing-in. Contractor shall not install any piping or ductwork for said equipment until he has received approved shop drawings for same.

3.3 PROJECT/SITE CONDITIONS

- A. Each Contractor shall visit the site prior to bid submission to determine all existing conditions that may affect his work and shall make appropriate allowances for such conditions in his bid. Failure to visit the site shall not be cause for a request for additional compensation later in the project during construction.
- B. Install Work in locations shown on Drawings, unless prevented by Project conditions.
- C. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of City and Engineer before proceeding.

3.4 ALTERATIONS IN PRESENT BUILDING AND SYSTEMS

- A. Contractor shall take particular note of the revisions and alterations to the existing systems, facilities and equipment due to the new construction as indicated on the Drawings and/or in Specification. Contractor shall remove, reroute or alter all services, ductwork, etc., as required or as indicated on the drawings.
 - 1. The Contractor shall maintain all services in the existing building. In case, where new

service connections are to be made to existing services and service interruptions can in no way be avoided, the service interruptions shall be with the minimum of inconvenience to the City and the work shall be done at such time of any day, Saturday and Sunday included, and only as directed by the City or the Engineer.

3.5 ERECTION & WORKMANSHIP

- A. Contractor is to be responsible for all work fitting into place in satisfactory, neat and workmanlike manner in every particular, to approval of Engineer.
- B. Unless explicitly stated to contrary, each Contractor shall furnish and install each item of equipment or material hereinafter specified, complete with all necessary fittings, supports, trim, piping, insulation, etc., as required for complete and operating installation.
- C. Equipment and materials shall be installed according to manufacturer's instruction unless otherwise specifically directed by Contract Documents
- D. Contractor shall provide all necessary OSHA approved rigging, scaffolding, tools, tackle, labor, etc., necessary for the complete installation of the equipment.
- E. Contractor shall adapt his work to job conditions and make such changes as required and permitted by the City and Engineer such as moving his work to clear beams, joints, light fixtures, etc., adjusting risers, etc. avoiding interferences with windows and openings, etc. raising or lowering his work to permit the passing of ductwork or the work of other trades, etc., all as required or as job conditions dictate, without any additional costs to the City.
- F. All appliances and equipment shall be installed and connected with best engineering practices and in accordance with the manufacturer's best instructions and recommendations.
- G. Work done by Contractor at the site in the execution of this Project shall be performed only by skilled mechanics, recognized as such in their respective trades in the direct employ either of the Contractor proper or of affiliate firms which have a longstanding and continuing formal agreement with the Contractor for providing the rendered services on similar work of this type.

3.6 PROTECTION FROM INJURY

- A. All pipes, fixtures, traps, equipment, and other parts of the Work shall be protected against injury by freezing or exposure to the weather during construction while stored or installed in place.

3.7 MECHANICAL AND ELECTRICAL WORK COORDINATION

- A. Refer to Division 1.
- B. Provide coordination for type of mechanical and electrical work required for this project for duration of work.
- C. Submittals
 - 1. Coordinate mechanical and electrical work of Divisions 15 and 16 with work of each other and of other Divisions.
 - 2. Coordinate progress schedules, including dates for submittals and for delivery of products.

3. Coordinate location and verify size of pipes, equipment, fixtures, conduit, ducts, openings, switches, outlets, fire sprinkler heads, fire hose cabinets, etc., in progress of the Work. Architectural Drawings shall take precedence over Mechanical and Electrical Drawings.
4. Participate in progress meetings. Report on progress of work to be adjusted under coordination requirements and any required changes in schedules. Transmit minutes of meetings and reports to concerned parties.

D. Coordination of Submittals

1. Review shop drawings, product data, and sample for compliance with Contract Documents and for coordination among work of all sections of Project Manual. Transmit to Engineer.
2. Check field dimensions and clearances and relationship to available space and anchors.
3. Check compatibility with equipment and work of other sections, electrical characteristics and operational control requirements.
4. Check motor voltages and control characteristics.
5. Coordinate controls, interlocks, wiring of pneumatic switches and relays.
6. Coordinate wiring and control diagrams.
7. Review effect of any changes on work of other sections.
8. Verify and coordinate maintenance of Record Documents.

E. Coordination of Substitutions and Modifications

1. Review proposals and requests from subcontractors.
2. Verify compliance with Contract Documents and for compatibility with work and products of other sections.
3. Submit to Engineer with recommendation for action.

F. Observation of Work

1. Observe work for compliance with Contract Documents.
2. Maintain list of observed deficiencies and defects; promptly submit to Engineer.

G. Documentation

1. Observe and maintain a record of tests. Record:
 - a. Specification section number, product, and name of subcontractor.
 - b. Name of testing agency and name of inspector.
 - c. Name of manufacturer's representative present.
 - d. Date, time, and duration of tests.

- e. Type of test, and results.
 - f. Retesting required.
2. Assemble background documentation for dispute and claim settlement by Engineer.
 3. Submit copies of documentation to Engineer upon request.

H. Equipment Start-Up

1. Verify utilities, connections and controls are complete and equipment is in operable condition.
2. Observe start-up and adjustments; record time and date of start-up and results.
3. Observe equipment demonstrations to City; record times and additional information required for Operation and Maintenance Manuals.

I. Inspection and Acceptance of Equipment

1. Prior to inspection, verify that equipment is tested and operational, and clean.
2. Assist Engineer with inspection. Prepare list of items to be completed and corrected.

3.8 CUTTING AND PATCHING

A. Refer to Division 1.

B. Submit written request in advance of cutting or alteration which affects:

1. Structural integrity of any element of Project.
2. Integrity of weather-exposed or moisture-resistant element.
3. Efficiency, maintenance, or safety of any operational element.
4. Visual qualities of sight-exposed elements.
5. Work of City or separate contractor.

C. Include in request:

1. Effect on work of City or separate contractor.
2. Written permission of affected separate contractor.
3. All items requested in Division 1.

D. Examination

1. Inspect existing conditions prior to commencing Work, including elements subject to damage or movement during cutting and patching.
2. After uncovering existing work, inspect conditions affecting performance of work.
3. Beginning of cutting or patching means acceptance of existing conditions.

E. Preparation

1. Provide temporary supports to ensure structural integrity of the Work. Provide devices and methods to protect other portions of Project from damage.
2. Provide protection from elements for areas which may be exposed by uncovering work.
3. Maintain excavations free of water.

F. Cutting and Patching

1. Cutting and patching required to access work in existing walls, in chases, above inaccessible ceilings, below floors, etc., shall be by the Contractor who requires the access, unless shown on the bid documents otherwise or noted otherwise.
2. The Contractor shall do all cutting, or fitting of the work as required to make its several parts fit together, or to receive the work of others, as shown or reasonably implied by the drawings or specifications, or as may be directed by Facilities Development and Management Section. Holes cut in exterior walls and/or roofs shall be waterproofed.
3. The Contractor who cuts shall also be responsible for patching. Where cutting and patching is required, the Contractor shall hire individuals skilled in such work to do cutting and patching.
4. The Contractor who removes or relocates building components which leaves a remaining opening shall be responsible for patching the opening.
5. Patching includes repairing openings to match adjacent construction and painting the surface to match existing. Painting means covering the entire wall where patching is to be done to nearest break point or corner unless indicated to be done by other trades.
6. Contractor shall not endanger any work by cutting, digging or otherwise and shall not cut or alter the work of others without their consent.
7. Do not pierce beams or columns without permission of Facilities Development and Management Section and then only as directed in writing. If any ductwork, piping, conduit, etc. is required through walls or floors where no sleeve has been provided, use a core drill or saw cut to prevent damage and structural weakening.
8. Wherever any material, finish, or equipment, is damaged, the skilled trade shall accomplish the repair or replacement, in that particular work and the cost shall be charged to the party responsible for the damage. Facilities Development and Management Section reserves the right to disallow any means and/or methods that, in the opinion of Facilities Development and Management Section, are harmful to and/or not in the best interest of preserving the improvements receiving the work.

G. Performance

1. Execute work by methods to avoid damage to other Work, and which will provide appropriate surfaces to receive patching and finishing.
2. Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.

3. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
4. Restore work with new products in accordance with requirements of Contract Documents.
5. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
6. At penetrations of fire-rated walls, partitions, ceiling, or floor construction, completely seal voids with fire-rated fire resistant material to full thickness of the penetrated element.
7. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

3.9 ACCESS PANELS

- A. Where control valves, shut-off valves, drip traps, heating coils, dampers, pull boxes or other specialties, which require service or adjustment, are installed above inaccessible type furred ceilings or within furred walls, Contractor whose equipment is involved shall furnish and install access panels as required.
- B. Access panels shall be of sufficient size to make possible servicing, adjustment, removal and replacement of concealed equipment through opening provided. Panels shall be sized as shown on drawings, or if sizes are not shown, shall be minimum of 16" x 24" in walls and 24" x 24" in ceilings.
- C. Contractor shall confer with other trades with respect to access panel locations, and shall wherever practical group valves, traps, dampers, etc. in such way as to be accessible from single panel and eliminate as many access panels as possible.
- D. Submit shop drawings for review before ordering panels. Where fire rating is required, furnish label doors compatible with fire rating of assembly.

3.10 SOUND CONTROL

- A. Conduits shall be grouted or sealed tightly in place.
- B. Piping, ductwork, etc. shall pass through sleeves. Pack sleeves tight with glass fiber or oakum and caulked on both sides with non-hardening acoustical sealant.

3.11 FIRE RATED PENETRATIONS

- A. Sleeves for pipes and ducts through fire rated and fire resistive floors and walls shall be constructed of materials classified by UL to provide fire stopping equal to time rating of construction being penetrated. Use asbestos free materials that comply with applicable codes and have been tested under positive pressure in accordance with UL 1479 or ASTM E 814.
- B. Install penetration seal materials in accordance with printed instructions of the UL Fire Resistance Directory and in accordance with manufacturer's instruction.
- C. Seal holes or voids made by penetrations to ensure an effective smoke barrier.
- D. Where floor openings without penetrating items are more than 4" in width and subject to traffic

or loading, install fire stopping materials capable of supporting same loading as floor.

- E. Protect materials from damage on surfaces subject to traffic.
- F. Examine penetration sealed areas to ensure proper installation before concealing or enclosing areas.
- G. Keep areas of work accessible until inspection by applicable code authorities.
- H. Perform under this section patching and repairing of fire stopping caused by cutting or penetration by other trades.
- I. Clean up spills of liquid components.
- J. Neatly cut and trim materials as required.
- K. Remove equipment, materials and debris, leaving area in undamaged, clean condition.

3.12 PROTECTION OF ELECTRICAL EQUIPMENT

- A. Contractor shall furnish and install sheet metal drain pans beneath piping that is routed above electrical equipment and/or above the 3' access space in front of such equipment. Electrical equipment, for the purpose of addressing drain pan requirements, shall be defined as free-standing or wall-mounted switchgear, transformers, distribution boards or motor control centers. Piping includes, but is not limited to, plumbing, fire protection, mains (not branch piping with sprinkler heads), hydronic heating or cooling, steam and condensate, and fuel systems.
 - 1. Drain pans shall be 20 gauge galvanized sheet metal with a minimum 4" high turned up edge. Bottom of drain pan shall slope to a single drainage point at $\frac{1}{8}$ " per foot. A 1" diameter clear plastic tube shall allow collected fluid to drain to the nearest open sight floor drain. Secure plastic tubing to building structure only.
 - 2. Drain pan shall be hung from building structure with angle iron trapeze hangers (no hanger shall penetrate the drain pan). Consider drain pan to be full of water for hanger load calculations.
 - 3. Drain pans shall include liquid detectors with alarms only if noted on the drawings.
- B. Provide sprinkler heads beneath drain pan only as required by NFPA.
- C. Contractor shall include provisions to adjust the local lighting layout, at no extra cost to City, in order to accommodate any detrimental effect the drain pan has on the illumination of the electrical equipment and access space.

3.13 STARTING SYSTEMS

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Engineer and City two days prior to start-up of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence or other conditions which may cause damage.
- D. Verify that tests, meter readings and specified electrical characteristics agree with those required by the equipment or system manufacturer.

- E. Verify wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of responsible manufacturer's representative or Contractors' personnel in accordance with manufacturers' instructions.
- G. When specified in individual specification sections, require manufacturer to provide authorized representative to be present at site to inspect, check and approve equipment or system installation prior to start-up and to supervise placing equipment or system in operation.
- H. Submit a written report in accordance with paragraph 1.14 previously specified that equipment or system has been properly installed and is functioning correctly.

3.14 TESTING, ADJUSTING AND BALANCING

- A. The City of Milwaukee shall appoint, employ and pay for services of independent firm to perform testing, adjusting and balancing.
- B. Independent firm will perform services specified in Division I, and Section 15990.
- C. Reports will be submitted by independent firm to Engineer indicating observations and results of tests and indicating compliance or non-compliance with specified requirements and with requirements of Contract Documents.

3.15 REMODELING PROJECT PROCEDURES

- A. Refer to Division 1.
- B. Demolition
 - 1. Contractor shall remove existing equipment and materials pertaining to his contract as specified or as required, whether shown on Drawings or not, to prepare for new work of all contracts.
 - 2. Where necessary, reroute piping, ducts, conduits, wiring, etc. from within walls, floors, ceilings, etc. being removed. Contractor involved with interrupted service shall be responsible for accomplishing required work whether shown on Drawings or not.
 - 3. Cap all abandoned or terminated piping, conduit, etc. below floor, behind wall surface, above ceiling, etc. as required to be completely concealed after new work is complete.
 - 4. In general, mechanical remodeling work is shown on Mechanical Drawings but carefully study all drawings for all contracts for "demolition" and "remodeling" work in existing building and field check to verify locations where such work is being done to determine exact extent of work required. No extra will be allowed for additional work required because of demolition or remodeling whether or not work is specifically noted, itemized or shown on Drawings.
 - 5. Contractor shall cap or plug all pipes, valves, fittings, etc. left open after demolition if they are not to be reused.

3.16 CLEANING, FLUSHING, INSPECTING

- A. General: Clean exterior surfaces of installed piping systems of superfluous materials and prepare for application of specified coatings (if any). Flush out piping systems with clean water

before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.

- B. Sufficient flushing water shall be introduced into the mains to produce a velocity of not less than 4' per second and this flow rate shall be continued until the discharge is clean and clear and does not show evidences of silt or foreign matter when a sample is visually inspected.
- C. Inspect pressure piping in accordance with procedures of ASME B31.

3.17 PIPING TESTS

- A. Test pressure piping in accordance with ASME B31.
- B. General: Provide temporary equipment for testing, including pump and gauges. Test piping systems before insulation is installed wherever feasible and remove control devices before testing. Test each natural section of each piping system independently, but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating. Fill each section with water and pressurize for indicated pressure and time.
 - 1. Test each piping system at 150% of operating pressure indicated, but not less than 25 psi test pressure.
 - 2. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 5% of test pressure.
- C. Repair piping systems sections which fail required piping test, by disassembly and re-installation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics or other temporary repair methods.
- D. Drain test water from piping systems after testing and repair work has been completed.

--END OF SECTION -

**SECTION 15060
MINOR MECHANICAL DEMOLITION FOR REMODELING**

PART 1 -GENERAL

1.1 SECTION INCLUDES

A. Mechanical demolition.

1.2 RELATED SECTIONS

A. Section 15010 -Basic Mechanical Requirements.

B. Section 15510 -Hydronic Piping.

C. Section 15781 – Packaged Rooftop Air Conditioning Units.

D. Section 15890 -Ductwork.

PART 2 -PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Refer to General Conditions and Division 1 and Section 15010.

B. Materials and equipment for patching and extending work: As specified in individual Sections.

PART 3 -EXECUTION

3.1 EXAMINATION

A. Refer to General Conditions and Division 1 and Section 15010.

B. Verify field measurements, equipment location, piping and ductwork sizes and arrangements as shown on Drawings.

C. Verify that abandoned piping, ductwork and equipment serve only abandoned facilities.

3.2 PREPARATION

A. Refer to General Conditions and Division 1 and Section 15010.

B. Disconnect mechanical systems in walls, floors and ceilings scheduled for removal.

C. Coordinate utility service shut-downs with the City and Utility Companies.

D. Provide temporary connections to maintain existing systems in service during construction.

E. Existing Mechanical Systems: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and new connections. Notify, Owner and Engineer at least 7 days before partially or completely disabling system. Minimize shut-down duration. Make temporary connections to maintain service in areas adjacent to work area.

3.3 DEMOLITION AND EXTENSION OF EXISTING MECHANICAL WORK

- A. Demolish and extend existing mechanical work under provisions of General Conditions, Division 1, Section 15010 and this Section.
- B. In general, mechanical remodeling work is shown on Mechanical Drawings but carefully study all drawings for all contracts for "demolition" and "remodeling" work in existing building and field check to verify locations where such work is being done to determine exact extent of work required. No extra will be allowed for additional work required because of demolition or remodeling whether or not work is specifically noted, itemized or shown on Drawings.
- C. Remove existing equipment and materials pertaining to contract as specified or as required, whether shown on Drawings or not, to prepare for new work of all contracts.
- D. Where necessary, reroute piping, ducts, etc. from within walls, floors, ceilings, etc. being removed. Contractor involved with interrupted service shall be responsible for accomplishing required work whether shown on Drawings or not.
- E. Cap all abandoned or terminated piping, etc. below floor, behind wall surface, above ceiling, etc., as required to be completely concealed after new work is complete.
- F. Cap or plug all pipes, valves, fittings, etc. left open after demolition if they are not to be reused.
- G. Maintain access to existing mechanical installations which remain active. Modify installation or provide access panel as appropriate.
- H. Extend existing installations using materials and methods compatible with existing mechanical installations, or as specified.

3.4 DISPOSITION OF REMOVED EQUIPMENT

- A. Where existing materials or equipment are specified to be removed from service, respective Contractor shall take possession of same, coordinate with Owner where items are to be stored or remove unwanted items from site promptly, except as specified below or unless otherwise noted on Drawings.
- B. All salvageable material and equipment, including but not necessarily limited to plumbing fixtures, heating units, air conditioning units, piping, valves, etc., shall be removed and maintained in as good condition as possible and turned over to Owner. However, if Owner decides any such materials are of no value to him, then they shall become property of Contractor who shall remove such discarded work from premises and dispose of same.
- C. Existing equipment or systems, etc. which are specified to be replaced by new equipment, or system etc. shall not be removed from service until the new equipment, materials, systems, etc. have actually arrived at project site.

3.5 INSTALLATION

- A. Install relocated materials and as indicated on drawings.

3.6 CLEANING AND REPAIR

- A. Refer to General Conditions and Division 1 and Section 15010.
- B. Clean and repair existing materials and equipment which remain or are to be reused.

--END OF SECTION -

SECTION 15140
SUPPORTS, ANCHORS AND SLEEVES

PART 1 -GENERAL

1.1 WORK INCLUDED

- A. Pipe and equipment hangers, supports and associated anchors.
- B. Duct hangers and supports.
- C. Equipment bases and supports (including roof curbs).
- D. Sleeves and seals.
- E. Vertical-piping clamps.
- F. Saddles and shields.
- G. Miscellaneous materials.
- H. Anchors.
- I. Flashing and sealing equipment and pipe stacks.

1.2 RELATED WORK

- A. Section 15010 -Basic Mechanical Requirements.
- B. Section 15242 -Vibration Isolation.
- C. Section 15250 -Thermal Insulation.
- D. Section 15510 -Hydronic Piping.
- E. Section 15515 -Hydronic Specialties.
- F. Section 15535 – Refrigerant Piping.
- G. Section 15781 – Packaged Rooftop Air Conditioning Units.
- H. Section 15910 -Ductwork Accessories.

1.3 REFERENCES

- A. ANSI/ASME B31.1 -Power Piping.
- B. AWS -Specifications for Qualification of Welding Procedures and Welders.
- C. ASTM A36 -Steel Plates, Shapes and Bars.
- D. ASTM C150 -Portland Cement.
- E. ASTM C404 -Uniformly Graded Natural Sand.
- F. ASTM E-814 -Fire Tests of Through-Penetration Fire Stops.
- G. AWWA -American Water Works Associations.

- H. BOCA -Basic/National Building Code.
- I. ICBO -Uniform Building Code.
- J. MSS -Manufacturers Standardization Society.
- K. NRB 243 -National Research Board Report Number.
- L. NFPA 13 -Standard for the Installation of Sprinkler Systems.
- M. NFPA 14 -Standard for the Installation of Standpipe and Hose Systems.
- N. NFPA 101 -Code for Safety to Life from Fires in Buildings and Structures.
- O. SBCCI -Standard Building Code.
- P. SMACNA -HVAC Duct Construction Standards, Metal and Flexible.
- Q. UL -Underwriters Laboratories.
- R. UL 1479 -Firestops, Fire Tests of Through-Penetration.
- S. FM -Factory Mutual.

1.4 QUALITY ASSURANCE

- A. Refer to General Conditions, Division 1 and 15010.
- B. UL and FM Compliance: Provide products which are UL listed and FM approved.
- C. MSS Standard Compliance:
 - 1. Provide pipe hangers and supports of which materials, design and manufacture comply with MSS SP-58.
 - 2. Select and apply pipe hangers and supports, complying with MSS SP-69.
 - 3. Fabricate and install pipe hangers and supports, complying with MSS SP-89.
 - 4. Terminology used in this section is defined in MSS SP-90.

1.5 SUBMITTALS

- A. Refer to General Conditions and Division 1 and Section 15010.
- B. Submit product data under provisions of Section 01300.
- C. Indicate hanger and support framing and attachment methods.

PART 2 -PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS -PIPE HANGERS AND SUPPORTS

- A. B-Line Systems, Inc.
- B. Fee and Mason Manufacturing Company
- C. ITT Grinnell Corporation
- D. Substitutions: Under provisions of Division 1.

2.2 PIPE HANGERS AND SUPPORTS (BASED ON B-LINE SYSTEMS, INC.)

A. Pipe Hangers

1. Hangers for Uninsulated Copper Pipe Sizes ½" to 4": Carbon steel, adjustable, clevis copper plated. Fig B3104CT.
2. Hangers for Steel Pipe Sizes ½" to 4" and Cold Pipe Sizes 5" and Over: Carbon steel, adjustable, clevis. Fig. B3102.
3. Hangers for Hot Pipe Sizes 4" and Over: Adjustable steel yoke, single hanger with iron roll. Fig. B3110.
4. Hangers for Plastic Pipe ½" to 4": Carbon steel, adjustable V-bottom clevis with plastic pipe trough. Fig. B3106.
5. Multiple or Trapeze Hangers: Structural steel channels with welded pipe spacers and hanger rods; cast iron roll and stand for hot pipe sizes 4" and over. Fig. B3122.

B. Wall Supports, Brackets, Pipe Rolls, U-bolts

1. Wall Support for Single Pipes to 4": Carbon steel straight one hole J-hook plain finish painted with one coat of rust-inhibiting primer. Fig. B3190.
2. Wall Support for Pipe Sizes 4" and Over: Welded steel wall bracket plain finish. Fig. B3066.
3. U-Bolts: Carbon steel with hex nuts to support, anchor or guide cold piping on wall brackets. Fig. B3188.
4. Roller Chair Pipe Support Assembly: Cast iron roll and carbon steel chair with bolts, hex nuts and plain galvanized finish to support hot piping on wall brackets. Fig. B3120.
5. Roller and Stand Pipe Support Assembly: Cast iron roll and adjustable stand with four tap screws and jamb nuts plain painted finish. Fig. B3118SL.

C. Vertical Supports and Riser Clamps

1. Standard Riser Clamp: Two formed carbon steel straps, bolts and nuts with plain painted finish. Fig. B3373.
2. Heavy Duty Riser Clamp: Two formed carbon steel straps with plain painted finish, bolts and nuts. Fig. B3131.
3. Offset Extended Riser Clamp: Two formed carbon steel straps with legs, plain painted finish, bolts and nuts. Fig. B3148.
4. Riser clamps for uninsulated copper pipes are to be copper plated.
5. Riser clamps for glass pipes are to be plastic coated.

D. Floor Supports

1. Floor Support for Pipe Sizes to 4" and All Cold Pipe Sizes: Cast iron adjustable pipe saddle, locknut nipple, floor flange and concrete pier or steel support. Fig. B3090.

2. Floor Support for Hot Pipe Sizes 5" and Over: Adjustable cast iron roller and stand (previously specified), steel screws and concrete pier or steel support.

E. Beam and Bar Joist Clamps

1. Standard Beam Clamp: Two formed carbon steel straps with plain painted finish, bolt and nut. Fig. B3050.

F. Pipe Insulation Shields

1. Shield for Piping 2" and Smaller: 16 gauge galvanized steel shield over insulation in 180 degree segments, minimum 12" long at pipe support. Fig. B3151.
2. Shield for Piping 2½" and Larger (Except Cold Water Piping): Carbon steel pipe covering protective saddles. Fig. B3160.
3. Shields for Cold Water Piping 2½" and Larger: Paraffin coated hard wood block saddles in 90 degree segments, 12" minimum length, block thickness same as insulation thickness.
4. Shield for Copper Tubing Sizes to 3": Galvanized 18 gauge x 12" long steel saddle with 4 lb density fiberglass insulation insert with vapor barrier jacket.

2.3 ACCEPTABLE MANUFACTURERS -STRUT PIPE SUPPORTS SYSTEMS

- A. B-Line Systems, Inc.
- B. ITT Grinnell -Powerstrut
- C. Unistrut Corporation
- D. Substitutions: Under provisions of Division 1.

2.4 STRUT PIPE SUPPORT SYSTEMS (BASED ON UNISTRUT)

- A. Multiple or Trapeze Hangers: Roll formed 12 gauge strip steel channel framing type trapeze hangers with green prime coat finish. Provide all necessary supporting steel rollers to keep pipe in alignment and allow for expansion. Series D-1000.
- B. Tunnel Pipe Supports
 1. General: Provide pipe supports, inserts, pipe rolls, etc., for support of piping in tunnel.
 2. Pipe Supports: Roll formed 12 gauge strip steel channel framing system with green prime coat finish and necessary accessories. Steel channels and spacing shall be suitable for the load the stresses imposed by piping systems. Series P-1000.
 3. Wall and Ceiling Inserts: Continuous galvanized steel channel type with all nuts, springs, etc. required to fasten pipe supports. Series P-3200.

2.5 DUCT HANGERS

- A. Duct hangers shall be strips of galvanized steel or round steel rod and shall comply with SMACNA -HVAC Duct Construction Standards, Metal and Flexible.

2.6 HANGER RODS

- A. Steel Hanger Rods: Threaded both ends.
- B. Duct hangers made of round steel rod are to be uncoated hot-rolled steel except where installation is in corrosive atmosphere, then hanger rods should be electro galvanized all thread rod or hot dipped galvanized rods with threads painted after installation.

2.7 INSERTS**A. Poured Concrete Slab**

- 1. After Concrete is Poured: Where supports in slabs are required after concrete has been poured, self-drilling expansion threaded inserts with conical plugs are to be provided and installed in accordance with manufacturer's recommendations.
- B. Precast Concrete with Concrete Topping or Roof Insulation: Support hangers from 4" x 4" x ¼" thick drilled steel plates set on deck over drilled holes before pouring of concrete topping or placing of roof insulation or from cinch anchors located in the precast deck.

2.8 FLASHING

- A. Metal Flashing: 26 gauge galvanized steel.
- B. Lead Flashing: 5 lb/sq ft sheet lead for waterproofing; one lb/sq ft sheet lead for soundproofing.
- C. Caps: Steel, 22 gauge minimum; 16 gauge at fire resistant elements.

2.9 EQUIPMENT CURBS

- A. Floor Mounted Equipment: Reinforced concrete pads shall be minimum 4" high and sized to match base of equipment.
- B. Roof Mounted Equipment: Curbs with 16 gauge galvanized press formed steel shell and base. Continuous weld on shell seams, internally reinforcing welded as required with factory installed wood (fir) nailer. Curbs shall be minimum 3½" wide by 12" high.

2.10 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors: Form with 18 gauge galvanized steel.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls and Footings: Form with standard weight steel pipe.
- C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls and Fireproofing: Prefabricated fire rated sleeves including seals, UL listed complying with ASTM E814. Fire penetrators manufactured by ProSet Systems.
- D. Sleeves for Round Ductwork: Form with 18 gauge galvanized steel.
- E. Sleeves for Rectangular Ductwork: Form with 18 gauge galvanized steel.
- F. Penetration Stuffing and Damming Materials
 - 1. Fire, Smoke and Fume Stops: Fiberglass batt insulation, mineral wool or backer block where damming is required.

2. Non-Fire Rated Penetrations: Fiberglass batt insulation or mineral wool.

G. Caulking

1. Fire, Smoke and Fume Stops
 - a. Cracks, voids or holes up to 4" diameter: Use putty or caulking, one-piece intumescent elastomer, non-corrosive to metal and capable of expanding 10 times when exposed to temperatures of 250F to 350F and have I.C.B.O., B.O.C.A.I. and S.B.C.C.I. (NRB243) and NFPA 101 approved ratings to three hours per ASTM E-814 (UL 1479). At contractor's option, Chase Foam CTC-PR-855 may be used, where approved by the governing agencies.
 - b. Opening 4" or greater: Use intumescent elastomer sealing system capable of passing 3-hour fire test in accordance with ASTM E-814 (UL 1479), consisting of wall wrap or liner, partitions and end caps capable of expanding 10 times when exposed to temperatures of 250F to 350F.
 - c. Materials shall be UL listed fire barrier caulk, wrap/strip, moldable putty and sheet forms.
 - d. Subject to compliance with requirements, provide fire barrier penetration seals by one of the following:
 - 3M Fire Protection Products
 - Chase Technology Corporation
 - Nelson; Unit of General Signal
 - e. Use proper UL through-penetration firestop systems required for materials passing through sleeves.

2.11 FABRICATION

- A. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- B. Design hangers without disengagement of supported pipe.
- C. Provide copper plated hangers and supports for copper piping. Insulated copper pipe will not require copper plated hangers and supports.
- D. Duct hangers shall comply with SMACNA -HVAC Duct Construction Standards, Metal and Flexible.

2.12 MISCELLANEOUS MATERIALS

- A. Metal Framing: Provide products complying with NEMA STD ML 1.
- B. Steel Plates, Shapes and Bars: Provide products complying with ASTM A 36.
- C. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by

volume, with minimum amount of water required for placement and hydration.

- D. Heavy Duty Steel Trapezes: Shop fabricate from structural steel shapes selected for loads required; weld steel in accordance with AWS standards.
- E. Pipe Guides: Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of bolted two-section outer cylinder and base with two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any) and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.
- F. Pipe Anchors: Shop fabricate from structural steel shapes selected for loads required; weld steel in accordance with AWS standards.

2.13 FINISH

- A. Prime coat exposed steel hangers, guides, anchors and supports. Hangers, guides anchors and supports located in crawl spaces, pipe shafts and suspended ceiling spaces are not considered exposed.

PART 3 -EXECUTION

3.1 INSERTS

- A. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- B. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4".
- C. Where concrete slabs form finished ceiling, provide inserts to be flush with slab surface.
- D. Where inserts are omitted, drill through concrete slab from below and provide thru-bolt with recessed square steel plate and nut flush with top of slab.
- E. In remodeled areas, provide expanding concrete anchors. Holes for expanding fasteners to be drilled either by carbide bit or by teeth on fastener itself. Expansion shield to be "set" by driving it into hole and expanding it with conical plug.

3.2 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as follows:

<u>PIPE SIZE MAX.</u>	<u>HANGER SPACING</u>	<u>HANGER DIAMETER</u>
1/2" to 1 1/4"	6'-6"	3/8"
1 1/2" to 2"	10'-0"	3/8"
2 1/2" to 3"	10'-0"	1/2"
4" to 6"	10'-0"	5/8"

- B. Install hangers to provide minimum 1/2" space between finished covering and adjacent work.
- C. Place a hanger within 12" of each change in direction of piping and at each vertical drop riser to equipment.
- D. Use hangers with 1 1/2" minimum vertical adjustment.
- E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.

- F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Pipes shall not be supported from ducts, electrical conduits or other piping.
- J. Support pipes such that piping is hung free of dependence on pipe sleeves for supports.
- K. Provide all auxiliary steel required for pipe supports.
- L. Threaded pipe, chains, wire and perforated straps will not be accepted. Stagger and distribute hangers on parallel piping to avoid overloading of existing or new construction.
- M. Roller type supports shall be used for pipes 4" and larger subject to axial movement (steam, condensate and hot water). They shall be braced so that movement occurs in roller rather than support rods.

3.3 DUCT HANGERS AND SUPPORTS

- A. Duct hanging system shall be at contractor's option. Comply with SMACNA HVAC Duct Construction Standards, Metal and Flexible and meet with approval of Engineer.
- B. Vertical Ducts Through Floor Slabs: Are to be supported on two sides by galvanized steel angles bolted to duct and resting on floor slab. Supporting angles are to be bolted to floor, ceiling or wall to prevent vibration.
- C. Vertical Ducts In Open Shafts: Provide additional galvanized structural steel members to span openings for support of ducts and angles at each floor.
- D. Ducts Along Walls: Are to have supports spaced not more than 8 feet apart.
- E. Provide hangers at the center of every ell or change in direction of horizontal ductwork.
- F. Wire strap or perforated hangers will not be permitted.

3.4 FLASHING

- A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors and roofs.
- B. Provide curbs for mechanical roof installations 12" minimum high above roofing surface. Flexible sheet flash and counterflash with sheet metal; seal watertight.

3.5 SLEEVES

- A. Set sleeves in position in formwork. Provide reinforcing around sleeves. All sleeves shall be set true to line, level, plumb and position.
- B. Where ducts or pipes which pass through sleeves are to be insulated, the sleeves shall be of sufficient size to permit the full specified thickness of insulation to pass through sleeves.
- C. Extend sleeves through floors 1" above finished floor level. Caulk sleeves full depth and provide floor plate. Floor sleeves in kitchen, laboratories or equipment rooms over habitable spaces shall extend 2" above finished floor.

- D. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping insulation and caulk seal air tight. Provide close fitting metal collar or escutcheon covers at both sides of penetration. All pipe penetrations shall be fire-stopped as necessary to restore the original fire rating of the floor or wall system. The annular void around the pipe shall not be filled with mineral wool, fiberglass insulation, cement, grout or similar non-rated materials that fail to expand when exposed to heat.
- E. Install chrome plated steel escutcheons at finished surfaces.
- F. The contractor shall not drill holes through, cut or otherwise damage any beam or column of the building's structural frame.
- G. Installation of Fire, Smoke and Fume Stopping Materials:
 - 1. Penetration shall be free of debris and dirt.
 - 2. Dam the penetration (when required) with an acceptable material.
 - 3. Apply material to the penetration. Use a caulking gun, putty knife or other normal trade tools per manufacturer's instructions.
 - 4. Provide proper material thickness to assure that fire rating is equal to or greater than floor or wall pipe is penetrating.

3.6 ADJUSTING AND CLEANING

- A. Hanger Adjustment: Adjust hangers so as to distribute loads equally on attachments.
- B. Support Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.
- C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.
- D. Clean sleeves with fire, smoke and fume stopping materials as follows.
 - 1. Remove damming materials where necessary after material has cured.
 - 2. Clean up adjacent surfaces with Xylene or other approved cleaning agent.

--END OF SECTION -

**SECTION 15170
MOTORS**

PART 1 -GENERAL

1.1 SECTION INCLUDES

- A. Three phase electric motors.

1.2 RELATED WORK

- A. Section 15010 -Basic Mechanical Requirements.
- B. Section 15781 -Packaged Roof Top Air Conditioning Units.

1.3 REFERENCES

- A. AFBMA 9 -Load Ratings and Fatigue Life for Ball Bearings.
- B. AFBMA 11 -Load Ratings and Fatigue Life for Roller Bearings.
- C. ANSI/IEEE 112B -Test Procedure for Polyphase Induction Motors and Generators.
- D. ANSI/NEMA MG 1 -Motors and Generators.
- E. ANSI/NFPA 70 -National Electrical Code, latest edition.

1.4 SUBMITTALS

- A. Refer to General Conditions and Division 1.
- B. Submit shop drawings and product data under provisions of Section 01300 and 15010.
- C. Submit manufacturer's certified sound power levels in dba.
- D. Submit manufacturer's installation instructions under provisions of Section 01300 and Section 15010.

1.5 OPERATION AND MAINTENANCE DATA

- A. Refer to General Conditions and Division 1.
- B. Submit operation and maintenance data under provisions of Sections 15010.
- C. Include assembly drawings, bearing data including replacement sizes and lubrication instructions.

1.6 QUALITY ASSURANCE

- A. Refer to General Conditions, Division 1 and 15010.

1.7 REGULATORY REQUIREMENTS

- A. Conform to applicable local and state electrical codes. All motors shall be UL or ETL listed and labeled and comply with NEMA standards for appropriate duty and use.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Refer to General Conditions and Division 1.
- B. Deliver products to site under provisions of Section 01600 and 15010.
- C. Store and protect products under provisions of Section 01600 and 15010.
- D. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering.

1.9 WARRANTY

- A. Refer to Section 15010.

PART 2 -PRODUCTS**2.1 MANUFACTURERS**

- A. Magnetek (Century)
- B. Baldor
- C. General Electric
- D. Westinghouse
- E. Lincoln Electric
- F. Magnetek (Louis Allis)
- G. Marathon
- H. Franklin Electric
- I. Reliance
- J. Substitutions: Under provisions of Division 1.

2.2 GENERAL CONSTRUCTION AND REQUIREMENTS

- A. Electrical Service: Refer to Division 16 for required electrical characteristics.
- B. Motors: Each motor shall be rated in accordance with NEMA Standards to carry its full nameplate load continuously with minimum service factor of 1.15 in accordance with listed data. Motors shall be of the general purpose NEMA Type B, with open drip-proof (ODP) or totally enclosed fan-cooled (TEFC) type enclosures and certified for a temperature rise of 40C.
- C. NEMA Class B insulation certified at 90C temperature rise, shall be used in areas with a potential ambient temperature up to 40C. NEMA Type Class F, insulation certified for a 115C temperature rise, shall be used in areas with an ambient temperature above 40C and up to 60C. All ratings from sea level to 3300 ft. altitude.
- D. Duty rating of motors shall be continuous duty and/or intermittent duty to fit the application. Motors shall be capable of not less than six (6) starts in a twenty-four (24) hour period.

- E. Motors not installed in horizontal position shall be provided with suitable ball-bearings.
- F. Where motor horsepowers are specified in connection with equipment drive, they are to be considered as minimum manufacturer's starting torque requirements with the characteristic power curve of the given equipment and in no case with the power nameplate rating of the motor furnished.
- G. Do not take advantage of service factors in selection of motors.
- H. Motors of windings for voltage other than specified but with nameplate ratings corresponding to specification requirements are not acceptable.
- I. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, Service Factor, Power Factor.
- J. Electrical Connection: Conduit connection boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.
- K. All motors and accessories shall comply in all respects with NEMA standards.
- L. Coordinate the NEMA type of each motor with the torque and inertia load of the equipment served and the inrush characteristics of the motor with the starter selection, so that all items furnished constitute a properly related package. No motor shall operate in the service factor range, defined as a brake horsepower at 15% over the nameplate rating.
- M. All motors located in ducted air streams or subject to outside air elements shall be totally enclosed fan cooled; others shall be open drip-proof design. Motors 1 hp or larger shall have encapsulated stator windings of the epoxy or silicone type.
- N. Fan motors shall be capable of accelerating their respective fans from nine revolutions per minute to design or synchronous revolutions per minute within a maximum of ten seconds.
- O. Motors ½ hp and larger shall operate on 480 or 208 volt, three-phase, 60 Hertz, alternating current, except as otherwise noted. Motors ⅓ hp and smaller shall operate on 120 volt, single-phase, 60 Hertz, alternating current, except as otherwise noted.
- P. Premium Efficiency Motors: Provide energy efficient motors, size 1 hp and larger, unless otherwise noted, with efficiencies in accordance with data listed in the schedules. Scheduled efficiencies are based on the 9/5/90 proposed NEMA Standard.

2.3 THREE PHASE POWER -SQUIRREL CAGE MOTORS

- A. Starting Torque: NEMA design B characteristics.
- B. Starting Current: Not to exceed six times full load current.
- C. Stall Conditions: 20 seconds cold stall, 12 seconds hot stall.
- D. Power Output, Locked Rotor Torque, Breakdown or Pullout Torque: NEMA Design B characteristics.

- E. Design, Construction, Testing and Performance: Conform to ANSI/NEMA MG 1 for Design B motors.
- F. Insulation System: NEMA Class B or better.
- G. Testing Procedure: In accordance with ANSI/IEEE 112, Test Method B. Load test motors to determine freedom from electrical or mechanical defects and compliance with performance data.
- H. Motor Frames: NEMA standard T-frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
- I. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension.
- J. Nominal Efficiency: Meet or exceed values in Schedules at full load and rated voltage when tested in accordance with ANSI/IEEE 112.
- K. Nominal Power Factor: Meet or exceed values in Schedules at full load and rated voltage when tested in accordance with ANSI/IEEE 112B.

PART 3 -EXECUTION

3.1 APPLICATION

- A. Motors drawing less than 250 Watts and intended for intermittent service may be germane to equipment manufacturer and need not conform to these specifications.
- B. Motors intended for use with variable frequency drives shall be rated for inverter duty.

3.2 NEMA ODP/TEFC MOTOR SERVICE FACTORS

<u>HP</u>	<u>3600 RPM</u>	<u>1800 RPM</u>	<u>1200 RPM</u>	<u>900 RPM</u>
1/6 - 1/3	1.35	1.35	1.35	1.35
1/2	1.25	1.25	1.25	1.15
3/4	1.25	1.25	1.15	1.15
1	1.25	1.15	1.15	1.15
1 1/2-150	1.15	1.15	1.15	1.15

3.3 PERFORMANCE SCHEDULE: THREE PHASE -PREMIUM EFFICIENCY, OPEN, DRIP-PROOF

HP	RPM (Syn)	NEMA Frame	Percent Efficiency	Guaranteed Minimum Percent Power Factor
1	1800	143T	85.5	84
1 1/2	1800	145T	86.5	85
2	1800	145T	86.5	85

3	1800	182T	89.5	86
5	1800	184T	89.5	88
7½	1800	213T	91.0	82
10	1800	215T	91.7	82
15	1800	254T	93.0	86
20	1800	256T	93.0	86

3.4 PERFORMANCE SCHEDULE: THREE PHASE -PREMIUM EFFICIENCY, TOTALLY ENCLOSED, FAN COOLED

HP	RPM (Syn)	NEMA Frame	Percent Efficiency	Guaranteed Minimum Percent Power Factor
1½	1200	182T	86.5	70
2	1200	184T	86.5	68
3	1200	213T	89.5	63
5	1200	215T	89.5	66
7½	1200	254T	91.7	74
10	1200	256T	91.7	75.0
15	1200	284T	92.4	72.0
20	1200	286T	93.0	76.0

--END OF SECTION -

**SECTION 15190
MECHANICAL IDENTIFICATION**

PART 1 -GENERAL

1.1 WORK INCLUDED

- A. Identification of mechanical products installed under Division 15.

1.2 RELATED WORK

- A. Section 15010 -Basic Mechanical Requirements.
- B. Section 15250 -Thermal Insulation.
- C. Section 15510 -Hydronic Piping.
- D. Section 15515 -Hydronic Specialties.
- E. Section 15545 -Pipe Cleaning, Flushing and Chemical Treatment.
- F. Section 15781 – Packaged Rooftop Air Conditioning Units.
- G. Section 15890 – Ductwork.
- H. Section 15910 – Ductwork Accessories.
- I. Section 15950 – Automatic Temperature Controls.

1.3 REFERENCES

- A. ANSI/ASME A13.1 -Scheme for the Identification of Piping Systems.

1.4 SUBMITTALS

- A. Refer to General Conditions and Division 1.
- B. Submit shop drawings product data under provisions of Section 01300 and 15010.
- C. Submit list of wording, symbols, letter size and color coding for mechanical identification.
- D. Submit valve chart and schedule, including valve tag number, location, function and valve manufacturer's name and model number.
- E. Submit manufacturer's installation instructions under provisions of Division 1 and Section 15010.

PART 2 -PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Brimar Industries
- B. Seton Nameplate
- C. W. H. Brady
- D. Substitutions: Under provisions of Division 1 .

2.2 MATERIALS

- A. Color: Unless specified otherwise, conform with ANSI/ASME A13.1.
- B. Plastic Nameplates: Laminated three-layer plastic with engraved black letters on light contrasting background color.
- C. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1½" diameter with smooth edges. Use ½" text size for numbering and ¼" text size for system identification.
- D. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and fluid being conveyed.
 - 1. Lettering to be 1-1/4" wide on piping 4" and under.
 - 2. Lettering to be 2" wide on piping over 4".
- E. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

PART 3 -EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces for stencil painting.

3.2 INSTALLATION

- A. Plastic Nameplates: Install with corrosive-resistant mechanical fasteners, or adhesive.
- B. Plastic Tags: Install with corrosive-resistant chain.
- C. Stencil Markers: Black or white for best contrast, wherever continuous color coded paint of piping is provided.
- D. Plastic Pipe Markers: Install in accordance with manufacturer's instructions.
- E. Plastic Tape Pipe Markers: Install complete around pipe in accordance with manufacturer's instructions.
- F. Equipment: Identify air handling units, fans, fan coil units, pumps, heat transfer equipment, tanks and water treatment devices with plastic nameplates.
- G. Controls: Identify control panels and major control components outside panels with plastic nameplates.
- H. Valves: Identify valves in main and branch piping with tags.
- I. Piping: Identify piping, concealed or exposed, with plastic pipe markers. Identify service, flow direction and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and "T", at each side of penetration of structure or enclosure and at each obstruction.

J. Ductwork:

1. Identify ductwork with stenciled painting. Identify as to air handling unit number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure and at each obstruction.
2. Access Doors: Provide stenciled signs on each access door in ductwork and housings, indicating purpose of access (to what equipment) and other maintenance and operating instructions and appropriate safety and procedural information.

K. All items used for identification shall be installed to match existing throughout building.

--END OF SECTION

SECTION 15242
VIBRATION ISOLATION

PART 1 -GENERAL

1.1 WORK INCLUDED

- A. Vibration isolation.

1.2 REFERENCES

- A. ASHRAE Handbooks.

1.3 QUALITY ASSURANCE

- A. Refer to Section 15010.
- B. Comply with product data under provisions of Division 1 and Section 15010.
- C. Maintain ASHRAE criteria for average noise criteria curves for all equipment at full load condition.
- D. All mechanical equipment is to be isolated from the building structure by means of noise and vibration isolators.
- E. All piping to be isolated according to this Section of the Specifications shall freely pass through walls and floors without rigid connections to building structures. Penetration points shall be sleeved or otherwise formed to allow passage of piping and maintain a minimum of 3/4" and maximum of 1 1/4" clearance around the outside surfaces. This clearance space shall be tightly packed to conform with Section 15140.
- F. The isolation materials manufacturer will be responsible for the proper selection of spring rates to accomplish the specified minimum static deflections for all spring and pad type isolators based on the weight distribution of equipment to be isolated.
- G. All outdoor equipment is to be provided with galvanized isolators and cadmium spring elements.

1.4 SUBMITTALS

- A. Refer to Division 1 and Section 15010.
- B. Submit product data under provisions of Section 15010.
- C. Indicate vibration isolator locations, with static and dynamic load of each, on shop drawings and described on product data.
- D. Furnish a complete set of final Shop Drawings of all mechanical equipment to receive vibration isolation devices to the vibration isolation materials manufacturer. These Drawings will be the basis upon which the selection of vibration isolators and design of supplementary bases will be completed. The Shop Drawings to be furnished shall include operating weight of the equipment to be isolated and the distribution of weight to the support points.
- E. Furnish a complete layout of piping to be isolated, including vertical risers, showing size or weight and support points of the piping system to the vibration isolation materials

manufacturer for selection and layout of isolation hangers.

- F. Submit scale drawings of hangers showing swing capability of 30 degree arc.
- G. Submit manufacturer's installation instructions under provisions of Division 1 and Section 15010.

1.5 CERTIFICATES

- A. Refer to Division 1 and Section 15010.
- B. Submit manufacturer's certificate under provisions of Section 15010 that isolators are properly installed and properly adjusted to meet or exceed specified requirements.

PART 2 -PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS -BASES AND VIBRATION ISOLATORS

- A. Mason Industries
- B. Peabody Noise Control
- C. Vibro-Acoustics
- D. Vibration Mountings & Controls

2.2 VIBRATION ISOLATOR SELECTION

- A. Noise and vibration isolator types, minimum operating static deflections and supplemental bases shall be provided for individual mechanical equipment units according to selection criteria delineated in Schedule incorporated as part of this specification.
- B. Isolator types are scheduled to establish minimum standards. At the Contractor's option, labor saving accessories can be an integral part of isolators supplied to provide initial lift of equipment to operating height, hold piping at fixed elevations during installation and initial system filling operations and similar installation advantages, provided isolators supplied incorporate and specified isolator type and do not degrade the noise and vibration isolation of equipment mounted.

2.3 BASES

- A. Option B -Base:
 - 1. Structural steel channel rails arranged to form rigid support, with mounting provisions for required vibration isolator. Type R manufactured by Mason Industries.
- B. Option J -Base:
 - 1. Factory fabricated roof mounted equipment support curbs.

2.4 VIBRATION ISOLATORS

- A. Option H -Hangers:
 - 1. Vibration hangers with steel hanger box, steel spring and double deflection neoprene element in series. Spring diameter and hanger box lower hole to be large enough to permit hanger rod to swing through 30 degree arc before contacting box. Spring

diameter to be no less than 0.8 of spring operating height with minimum additional travel to 50% of rated deflection before going solid. Type 30N manufactured by Mason Industries.

B. Option I -Hangers:

1. Vibration hangers to be same as described for Option H above but precompressed to deflection rate to keep piping or equipment at fixed elevation during installation. Hangers to have deflection scale and release mechanism to free spring after installation is complete and hanger is subjected to full load with deflection clearly indicated on scale.
2. Type PC30N manufactured by Mason Industries.

2.5 ACCEPTABLE MANUFACTURERS -OPTION N -FLEXIBLE BRAIDED HOSES

- A. Mason Industries
- B. Flexonics
- C. Hyspan
- D. Metraflex
- E. Keflex
- F. Robertshaw-Fulton
- G. U.S. Flexible Metallic Tubing
- H. Twin City Hose

2.6 FABRICATION

- A. Provide pairs of neoprene side snubbers or restraining springs where side torque or thrust may develop.
- B. Color code spring mounts.
- C. Select springs to operate at $\frac{2}{3}$ maximum compression strain, with $\frac{1}{4}$ " ribbed neoprene pads.

PART 3 -EXECUTION

3.1 INSTALLATION

- A. Install vibration isolators for motor driven equipment.
- B. Provide spring isolators on piping connected to isolated equipment as follows: Up to 4" diameter, first three points of support; 5" to 8" diameter, first four points of support; 10" diameter and over, first six points of support. Static deflection of first point shall be twice deflection of isolated equipment.
- C. Horizontal Pipe Isolation
 1. The first three pipe hangers in the main lines near the mechanical equipment shall be as described for Option I. Horizontal runs in all other locations throughout the building shall be isolated by hangers as described for Option H. All Option I

hangers as noted above, will have the same static deflection as specified for the mountings under the connected equipment. (Note: If piping is connected to equipment located in basements and hangs from ceiling under occupied spaces, the first three hangers shall have 0.75" deflection for pipe sizes up to and including 3". All other hangers and mounts will have a minimum steel spring deflection of 0.75". Hangers shall be located as close to the overhead supports as practical.

- D. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation.
- E. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end.
- F. On completion of installation of all isolation materials and before start up of isolated equipment all debris shall be cleared from areas surrounding and from beneath all isolated equipment, leaving equipment free to move on the isolation supports.
- G. No rigid connections between equipment and building structure shall be made that degrade the noise and vibration isolation system herein specified. Electrical conduit connections to isolated equipment shall be looped to allow free motion of isolated equipment.
- H. Refer to Section 15535 for refrigerant piping flexible connectors.

3.2 INSPECTION

- A. The Contractor shall consult with the local representative of the materials manufacturer, prior to installing any devices, in order to obtain guidance for this project's specific installation requirements.
- B. The local representative of the materials manufacturer shall conduct periodic inspections of the installation of materials herein specified and shall report in writing to the Contractor any deviations from good installation practice observed.
- C. On completion of installation of all noise and vibration isolation devices herein specified, the local representative of the materials manufacturer shall inspect the completed system and report in writing any installation errors, improperly selected isolation devices, or other fault in the system that could affect the performance of the system.

3.3 SCHEDULE

	Basement or Slab on Grade			Upper Floors		
	Inertia Base Option	Vibration Isolator Option	Min Static Deflec	Base Option	Isolator Option	Min Static Deflec
ISOLATED EQUIPMENT						
Roof Top Equipment						
Roof Top Units with Internal Isolation	-	-	-	J	-	-

--END OF SECTION --

**SECTION 15250
THERMAL INSULATION**

PART 1 -GENERAL

1.1 SCOPE OF WORK

A. Products furnished and installed under this section:

1. Insulation.
2. Protective coverings.
3. Accessories.
4. Repairs to all existing insulation cut or damaged by work performed under this Contract.

B. Products furnished but not installed under this section: None.

C. Products installed but not furnished under this section: None.

D. Services provided:

1. Design -None.
2. Training -None.
3. Obtain permits -None.

1.2 DEFINITIONS

- A. Piping Insulation: Thermal insulation applied to prevent heat transmission to or from a piping system (temperature range of -100F to +1500F).
- B. Ductwork Insulation: Thermal insulation applied to prevent heat transmission to or from a duct system (temperature range of -100F to +1500F).
- C. Equipment Insulation: Thermal insulation applied to prevent heat transmission to or from a piece of equipment that is part of a plumbing, heating or cooling system (temperature range of -100F to +1500F).
- D. Jacket: Protective covering over insulation; may be factory applied such as "all service jacket" or field applied to provide additional protection; of such materials as canvas, polyvinyl chloride (PVC), aluminum or stainless steel.
- E. Vapor Retarder Jacket: Insulation jacket material which impedes the transmission of water vapor.
- F. Insert: Spacer placed between the equipment support system and the equipment to allow for the space required for insulation.
- G. Insulation Shield: Buffer material placed between the equipment support system and the insulation to prevent the insulation material from crushing.

1.3 CODES AND STANDARDS

- A. ASTM A167 -Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- B. ASTM B209 -Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (ASTM B209M -Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate).
- C. ASTM C177 -Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus.
- D. ASTM C195 -Standard Specification for Mineral Fiber Thermal Insulating Cement.
- E. ASTM C449/C449M -Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
- F. ASTM C518 -Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- G. ASTM C534 -Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- H. ASTM C547 -Standard Specification for Mineral Fiber Preformed Pipe Insulation.
- I. ASTM C449 -Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement.
- J. ASTM C553 -Mineral Fiber Blanket and Felt Insulation (Industrial Type).
- K. ASTM C612 -Mineral Fiber Block and Board Thermal Insulation.
- L. ASTM C795 -Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- M. ASTM C921 -Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- N. ASTM D1784 -Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
- O. ASTM E84 -Standard Test Method for Surface Burning Characteristics of Building Materials.
- P. ASTM E96 -Standard Test Methods for Water Vapor Transmission of Materials.
- Q. Midwest Insulation Contractors Association (MICA) -Commercial and Industrial Insulation Standards.
- R. North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.
- S. NFPA 255 -Standard Method of Test of Surface Burning Characteristics of Building Materials.
- T. National Insulation and Abatement Contractors Association (NIACA) -Guide to Insulation Product Specifications.
- U. UL 723 -Standard for Test for Surface Burning Characteristics of Building Materials.
- V. NFPA-90A -Installation of Air Conditioning and Ventilation Systems.
- W. NFPA-90B -Warm Air Heating and Air-Conditioning Systems.

- X. ASHRAE Standard 90.1-1989 Energy Efficient Design of New Buildings Except New Low-Rise Residential Buildings.

1.4 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.
- B. Installer: Company specializing in performing the work of this section with minimum five years documented experience.
- C. Products: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84 or NFPA 255 or UL 723.
- D. No insulation product shall support or promote mold or fungus growth.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01300 and Section 15010.
- B. Product Data: Provide a schedule, listing each type of insulation, thickness, density, type of protective covering, etc., and the work and service to which each type of insulation is to be applied. The schedule shall be submitted in quantities consistent with that required in the Conditions of the Contract. No insulation shall be purchased or installed until the schedule is reviewed by the Engineer.
- C. Manufacturer's Installation Instructions: Indicate specific installation instructions per the manufacturers of the various products and indicate how the system (combination of products) will be assembled. Highlight critical environmental factors such as drying time, etc., as well as any variations between the manufacturer's installation instructions and the specified installation instructions along with a reason for the difference.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site under provisions of Section 01600.
- B. Deliver products to site in containers with manufacturer's stamp or label affixed showing fire hazard indexes of products.
- C. Protect products against dirt, water, chemical and mechanical damage before, during and after installation. Do not install damaged or wet insulation; remove from project site. Damage to products prior to final acceptance of the Work shall be repaired or replaced at no additional cost to City.
- D. Where existing insulation has been removed or disturbed, due to new connections and/or alterations, repair and replace existing insulation using materials that match existing, except where existing insulation includes asbestos material.
- E. Existing insulation containing asbestos materials (or thought to contain asbestos materials) must be removed by City, either totally or in part, in strict accordance with OSHA Regulations utilizing OSHA approved Contractors. Repair and/or replacement of existing insulation containing asbestos shall be with new products as specified herein.

F. Maintain ambient conditions required by the manufacturer of each product.

1.7 SPARE PARTS

A. A. Six rolls of tape to be used for sealing penetrations in vapor retarder jackets.

1.8 WARRANTY

A. A. One year warranty on products and complete installation commencing at the time of Substantial Completion.

1.9 MAINTENANCE

Not Applicable

PART 2 -PRODUCTS

2.1 INSULATION

A. Acceptable Manufacturers:

1. Schuller International, Inc. (formerly Johns-Manville)
2. Owens-Corning Fiberglas
3. Knauf Fiberglass
4. Armstrong
5. Certainteed Corp.
6. Rock Wool Manufacturing

B. Type GFP: Glass fiber pipe insulation; ANSI/ASTM C547, rigid molded, for use to 850F; thermal conductivity ('k' value) of 0.23 (Btu)/(hr ft² °F) at 75F mean temperature, k=0.29 at 200F, k=0.43 at 400F; noncombustible factory-applied white kraft paper bonded to aluminum foil and reinforced with glass fibers (ASJ) (vapor permeability shall not exceed .02 perms) that has a self-sealing longitudinal lap which provides positive closure without the use of tools, staples, adhesives, ties or tape at ambient temperatures between 25F and 110F shall be provided as a vapor retarder.

C. Type GFFB: Glass fiber flexible blanket insulation; ASTM C553; for use to 450F; 'k' value of .28 at 75F mean temperature; commercial grade; ¾ lb/cu ft minimum density; noncombustible factory-applied foil-scrim kraft (FSK) jacket (vapor permeability shall not exceed .02 perms). OR vinyl vapor retarder.

D. Type GFRB: Glass fiber rigid board insulation; ASTM C612; for use to 1000F; 'k' value of .28 at 75F mean temperature Class 2; 3 lb/cu ft minimum density; noncombustible factory-applied foil-scrim kraft (FSK) jacket (vapor permeability shall not exceed .02 perms). OR all service jacket (ASJ).

E. Type FEP: Flexible elastomeric plastic insulation; ANSI/ASTM C534; 'k' value of 0.27 at 75F mean temperature.

2.2 PIPE PROTECTIVE COVERINGS

A. Acceptable Manufacturers:

1. Childers (metal)
2. Knauf (metal)
3. Schuller International, Inc. (PVC)
4. Proto (PVC)

B. Interior Applications:

1. Vapor Retarder Jackets: Integral to glass fiber insulation as specified above.
2. PVC Jackets: One piece pre-molded high impact PVC fitting covers with fiberglass inserts and accessories, to include elbows, tee/valves, end caps, mechanical line couplings, specialty fittings, jacketing, tacks and PVC tape.

C. Exterior Applications:

1. PVC Jackets: Provide PVC jacketing/fitting covers on all new exterior refrigerant piping insulation. PVC jacket shall be UV-resistant with 20 mils thickness.

2.3 PIPE ACCESSORIES

A. Acceptable Manufacturers:

1. Foster
2. Minnesota Mining
3. Chicago Mastic

B. Insulating Cement: ANSI/ASTM C195; hydraulic setting mineral wool; compatible with the insulation and protective coverings.

C. Finishing Cement: ASTM C449; compatible with the insulation/fitting covers/jackets.

D. Adhesives and Tapes: Compatible with insulation and protective coverings.

E. Metal Jacket Bands: ½" wide; 0.016" thick aluminum.

2.4 DUCT/EQUIPMENT PROTECTIVE COVERINGS

A. Acceptable Manufacturers:

1. Childers (metal)
2. Knauf (metal)
3. Schuller International, Inc. (PVC)

B. Indoor Jacket: Glass fabric mastic: Two coats mastic required with 10 x 10 glass fabric.

2.5 DUCT/EQUIPMENT ACCESSORIES

A. Acceptable Manufacturers:

1. Foster

2. Minnesota Mining
 3. Chicago Mastic
- B. Adhesives: Waterproof fire-retardant type.
 - C. Lagging Adhesive: Fire resistive to ASTM E84 or NFPA 255 or UL 723.
 - D. Joint Tape: Glass fiber cloth, open mesh.
 - E. Bedding Compounds: Non-shrinking, permanently flexible, compatible with insulation.
 - F. Vapor Retarder Coating: Non-flammable, fire resistant, polymeric resin, compatible with insulation.
 - G. Insulating Cement: ANSI/ASTM C195, hydraulic setting mineral wool.
 - H. Impale Anchors: Galvanized steel, 12 gauge, self-adhesive pad.
 - I. Tie Wire: Annealed steel, 16 gauge.
 - J. Wire Mesh: Corrosive-resistant metal; hexagonal pattern.

PART 3 -EXECUTION

3.1 EXAMINATION

- A. Install products only after piping, ductwork and equipment have been tested and approved.
- B. Verify that surfaces are clean and dry with any and all foreign material removed.
- C. Provide drop cloths or other means of protecting all equipment from drops, spattering, etc. which may be caused by the application of insulating products.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's and NAIMA instructions.
- B. Whenever insulated pipes or ducts pass through sleeves or openings, the full specified thickness of the insulation shall pass through the sleeve or opening, except for sleeves located in fire rated partitions or floors. Space between pipe and sleeve located in fire rated partition or floor shall be sealed.
- C. Contractor shall note that all adhesives shall be applied as specified, in continuous bands for complete coverage. The "spot" application of adhesives is not permitted.
- D. Neatly finish insulation at supports, protrusions and interruptions.
- E. Contractor shall coordinate with support and firestopping requirements as noted elsewhere in the Contract Documents.

3.3 APPLICATION (PIPING)

A. Schedule

	<u>INSULATION TYPE</u>	<u>OPERATING TEMP (F)</u>
<u>Heating Systems (Hot Water) and Other Hot Fluid Lines</u>		
Heating Water Supply and Return	GFP	200
<u>Cooling Systems (Refrigerant), and Other Cold Fluid Lines</u>		
Refrigerant (Suction)	FEP	45
Cooling Coil Condensate Drain Piping	GFP	50

B. Insulation thickness shall be as follows:

Fluid Design Operating Temperature Range, F	Nominal Pipe Diameter (in.)				
	1" and less	1½" and less	2" to 4"	5" & 6"	8" & up
201-250	1.5	2.0	2.0	2.0	3.5
141-200	1.5	1.5	1.5	1.5	1.5
105-140	1.0	1.0	1.5	1.5	1.5
40-104	1.0	1.0	1.5	1.5	1.5
Up to 39	1.5	1.5	2.0	2.0	2.0

Use maximum fluid temperature for those systems where fluid temperature is above ambient temperature, minimum fluid temperature for those systems where fluid temperature is below ambient temperature.

C. Indoor, Exposed Pipe

1. For pipe exposed in mechanical equipment rooms or in finished spaces, insulate pipe, fittings, joints and valves the same as for concealed applications.
2. Locate insulation and cover seams in least visible locations on exposed piping systems.

D. Exterior Pipe

1. Insulate the same as for "Indoor, Concealed Pipe."
2. Cover pipe and fittings with PVC jacket with seams located at 2 o'clock side of horizontal piping. Overlap jacket 90 degrees. Overlap jacket ends (do not butt together) along the length of the pipe. Install following manufacturer recommendations.

3.4 APPLICATION (DUCTWORK)

- A. Flexible ductwork insulation (Type GFFB) (1½" thick) shall be applied to all concealed (above ceiling, within shafts, etc.) supply ductwork.

1. Insulation shall be wrapped around and secured to ducts by means of the butt joint method of application along the duct length (longitudinal seam) and the butt joint method of application along the duct perimeter at the joints (longitudinal seam). Overlapping flap shall be at least 2" wide.
2. All edges of insulation shall be butted snugly together. Provide 4" wide tape on ducts at all joints, seams, edges, breaks, mechanical pin penetrations, etc.
3. Insulation shall be further secured to the bottom of horizontal ductwork or to all four sides of a vertical duct with approved type welded mechanical pins. These pins shall be applied on 12" centers to all surfaces of ductwork as follows:

<u>Horizontal Duct Width</u>	<u>Vertical Duct Dimensions</u>	<u>Minimum Rows of Pins</u>
Up to 11"	Up to 11"	No pins required
12" to 23"	12" to 23"	One
24" to 35"	24" to 35"	Two
36" to 47"	36" to 47"	Three
48" to 59"	48" to 59"	Four
60" to 71"	60" to 71"	Five
72" to 83"	72" to 83"	Six
84" to 95"	84" to 95"	Seven

4. Contractor shall install all insulation without sag.
5. All round ductwork shall be insulated same as specified above except no pins are required.

B. Rigid ductwork insulation (Type GFRB) (1½" thick unless otherwise noted) shall be applied to:

1. All outdoor air intakes, supply fan housings and supply plenums, from the point of entry into the building to the fan or supply AHU discharge. Outdoor intakes shall be insulated with 2" thick type GFRB insulation.
2. Exhaust ducts from exhaust damper to outside.
3. All unconcealed supply ductwork within the building.
4. All supply air, outside air, exhaust/return air and exhaust/recirculating air ductwork and housings within equipment rooms and garage shall be insulated.
5. Insulation shall be secured to all four sides of ductwork with approved type welded mechanical pins. These pins shall be applied on 12" centers to all surfaces of ductwork as follows:

<u>Duct Dimension</u>	<u>Minimum Rows of Pins</u>
Up to 11"	No pins required
12" to 23"	One
24" to 35"	Two
36" to 47"	Three
48" to 59"	Four
60" to 71"	Five

72" to 83"	Six
84" to 95"	Seven

6. Insulation shall be secured by applying Foster No. 85-20 adhesive in 4" wide continuous bands on 12" centers. Press/impale insulation into place, butting all edges together snugly.
7. Contractor shall install all insulation without sag.
8. After boards are impaled, the welded pins shall be cut to extend 1/8" beyond face of board. A self-locking cap shall be pushed onto the pin after coating with Foster No. 30-35. All insulation edges, butt joints breaks and mechanical pin penetrations shall be sealed with joint sealing tape. Tape used to seal joints at exterior corners must be 5" wide. Tape shall be pressure sealing type requiring no separate adhesive, installed in accordance with manufacturer's instructions.

C. All 100% exhaust system ductwork shall not be insulated.

D. Insulation at access panels shall be removable with metal corner beads.

3.5 ADJUSTING

Not Applicable

3.6 CLEANING

- A. All empty cartons, containers, etc. which have contained insulating materials shall be removed from the site and premises by the Contractor as soon as possible after their contents have been removed.

--END OF SECTION -

**SECTION 15510
HYDRONIC PIPING**

PART 1 -GENERAL

1.1 WORK INCLUDED

- A. Pipe and pipe fittings.
- B. Valves and cocks.
- C. Heating water piping system.
- D. Equipment drains and overflows.

1.2 RELATED WORK

- A. Section 15010 -Basic Mechanical Requirements.
- B. Section 15060 -Minor Mechanical Demolition for Remodeling.
- C. Section 15140 -Supports, Anchors and Sleeves.
- D. Section 15190 -Mechanical Identification.
- E. Section 15242 -Vibration Isolation.
- F. Section 15250 -Thermal Insulation.
- G. Section 15515 -Hydronic Specialties.
- H. Section 15980 -Instrumentation.

1.3 REFERENCES

- A. ANSI/ASME -Boiler and Pressure Vessel Code.
- B. ANSI/ASME Sec 9 -Welding and Brazing Qualifications.
- C. ANSI/ASME B16.3 -Malleable Iron Threaded Fittings Class 150 and 300.
- D. ANSI/ASME B16.4 -Cast Iron Threaded Fittings Class 125 and 250.
- E. ANSI/ASME B16.5 -Steel Pipe Flanges and Flanged Fittings.
- F. ANSI/ASME B16.15 -Cast Bronze Threaded Fittings.
- G. ANSI/ASME B16.18 -Cast Bronze Solder Joint Pressure Fittings.
- H. ANSI/ASME B16.22 -Wrought Copper and Bronze Soldered Joint Pressure Fittings.
- I. ANSI/ASME B16.23 -Cast Copper Alloy Solder Joint Drainage Fittings -DWV.
- J. ANSI/ASME B16.24 -Bronze Flanges and Flanged Fittings.
- K. ANSI/ASME B31.9 -Building Services Piping.
- L. ANSI/AWS A5.8 -Brazing Filler Metal.

- M. ANSI/AWS D1.1 -Structural Welding Code.
- N. ASTM A53 -Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- O. ASTM A193 -Flange Bolts.
- P. ASTM A234 -Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- Q. ASTM B32 -Solder Metal.
- R. ASTM B88 -Seamless Copper Water Tube.

1.4 REGULATORY REQUIREMENTS

- A. Conform to ANSI/ASME B31.9.

1.5 SUBMITTALS

- A. Refer to Division 1 and Section 15010.
- B. Submit shop drawings and product data under provisions of Section 01300.
- C. Include data on pipe materials, pipe fittings, valves and accessories.
- D. Include welders certification of compliance with State and Local Codes.
- E. Shop Drawings: Submit scaled layout drawings of pipe and fittings including, but not necessarily limited to, pipe sizes, locations, elevations and slopes of horizontal runs, wall and floor penetrations, and connections. Show interface and spatial relationship between piping and proximate equipment. Submit scaled layout drawings of piping systems.

1.6 QUALITY ASSURANCE

- A. Refer to Section 15010.
- B. Pipe: Each length of pipe shall be legibly identified at mill by paint, stenciling or raised symbols identifying manufacturer and class type or schedule of pipe. Copper pipe shall be identified at 3 foot intervals.
- C. Fittings: To be identified by the manufacturer by permanently attached tags, imprints, or other approved means, indicating the class of wall thickness and material.
- D. Valves: Manufacturer's name and pressure rating marked on valve body.
- E. Welding Materials and Procedures: Conform to ANSI/ASME SEC 9 and applicable state labor regulations.
- F. Welders Certification: In accordance with ANSI/ASME SEC 9, ANSI/AWS D1.1 and provisions of the State and Local Codes.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Refer to Division 1 and Section 15010.
- B. Deliver products to site under provisions of Section 01600.
- C. Store and protect products under provisions of Division 1 and Section 01600.

D. Deliver and store valves in shipping containers with labeling in place.

PART 2 -PRODUCTS

2.1 HEATING WATER PIPING, ABOVE GROUND

A. Steel Pipe: ASTM A53, Schedule 40, black.

1. Fittings: ANSI/ASTM B16.3, malleable iron or ASTM A234, forged steel welding type fittings.
2. Joints: Screwed, or ANSI/AWS D1.1, welded.
3. Fittings: ANSI/ASME B16.4, screwed, cast iron 125psig class black.
4. Flanges: ANSI/ASME B16.1, 125 psig raised face, cast iron flanged fittings. Welding neck flanges 150 psig forged steel. Slip-on steel flanges to be used on straight runs of piping only.
 - a. Flanges to match those on valves and equipment.
 - b. Bolts: ASTM A-193

B. Copper Tubing: ASTM B88, Type L hard drawn

1. Fittings and Joints
 - a. ANSI/ASME B16.22 solder wrought copper fittings, ASTM B32, soldered joints, Grade 95TA
 - b. ANSI/ASME B16.15 screwed fittings and joints may be used at valves and equipment connections where required.

2.2 EQUIPMENT DRAINS AND OVERFLOWS

A. Copper Tubing: ASTM B88, Type K hard drawn.

1. Fittings: ANSI/ASME B16.29 solder wrought copper
2. Joints: ASTM B32, solder, Grade 95TA.

2.3 FLANGES, UNIONS AND COUPLINGS

- A. Pipe Size 2" and Under: 150 psig ANSI/ASME B16.3 malleable iron unions for threaded ferrous piping; ANSI/ASME B16.15 bronze unions for copper pipe, soldered joints. 300 psig ANSI/ASME B16.3 malleable iron, screwed brass to iron seat ground joint air tested.
- B. Pipe Size Over 2": 150 psig ANSI/ASME B16.5 forged steel welding neck and slip-on flanges for ferrous piping; (slip-on flanges to be used on straight runs of pipe only) ANSI/ASME B16.24 bronze flanges for copper piping; 1/16" thick preformed neoprene ring type, 300 psig forged steel welding neck flanges conforming to ANSI specifications B16.5.
- C. Flanges to match those on valves and equipment.
- D. Flange Bolts: ASTM A-193.

E. Dielectric Connections:

1. Flanged or union type: Gaskets to conform to manufacturer's recommendations for the intended service, rated at minimum temperature of 200F (or higher as dictated by service) for continuous duty.
2. Union type: galvanized or plated steel-threaded end; copper-solder end; water impervious isolation barrier.
3. Fittings provided shall meet ANSI B16.8 and be capable of isolating stray electrical currents up to 600 volts minimum.
4. Acceptable Manufacturers: B&K Industries, Inc.; Eclipse, Inc.; EPCO Sales Inc.; Capital Manufacturing Company, Division of Harsco Corporation; Watts Regulator Company.

2.4 ACCEPTABLE MANUFACTURERS -BALL VALVES

- A. Apollo
- B. Hammond
- C. Jamesbury
- D. Milwaukee
- E. Substitutions: Under provisions of Division 1.

2.5 BALL VALVES

- A. Up to 2-1/2": 600 psi, bronze two-piece body, chrome plated brass standard port ball, teflon seats and stuffing box ring, lever handle and balancing stops, soldered ends. Model BA-100-S manufactured by Milwaukee.
- B. Ball valves mounted in insulated pipes shall have extended stems to clear pipe covering.

PART 3 -EXECUTION**3.1 PREPARATION**

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Field test all piping before start-up of systems.
- E. After completion, clean, flush, and treat systems. Refer to Section 15545.

3.2 INSTALLATION

- A. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- B. Route piping in orderly manner, plumb and parallel to building structure, and maintain gradient.
- C. Install piping to conserve building space and not interfere with use of space and other work.

- D. Group piping whenever practical at common elevations. Space piping to permit applying full insulation, painting and servicing of valves.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Provide clearance for installation of insulation and access to valves and fittings.
- G. Slope water piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- H. Provide sleeves when penetrating floors and walls. Refer to Section 15140.
- I. Seal pipe and sleeve penetration to achieve fire resistance equivalent to fire separation required.
- J. Where pipe support members are welded to structural building framing, scrape, brush clean and apply one coat of zinc rich primer to welding.
- K. Install valves with stems upright or horizontal, not inverted.
- L. In general, all piping, ductwork and similar items shall be installed concealed from view above ceiling, in partitions, shafts, or chases, unless otherwise indicated.
- M. Where pipes are in partitions, furred out spaces and chases, obtain information as to their exact location and size and install work so as to be entirely concealed in allotted space. If conflicts arise making this impossible, obtain instructions from Engineer before proceeding with work.
- N. Furnish advance information on locations and sizes of frames, boxes, sleeves and openings needed for work and also furnish information and shop drawings necessary to permit installation of other work without delay.
- O. Where there is evidence that parts of Mechanical Work will interfere with other work, assist in working out space conditions and/or structure, make necessary adjustments to accommodate work.
- P. Mechanical Work installed before coordinating with other work so as to cause interference with other work to be changed to correct such condition without additional cost to City.
- Q. Appliances and equipment to be installed and connected with best engineering practices and in accordance with manufacturer's instructions and recommendations. Piping, valves, connections and other like items recommended by manufacturer or as required for proper operation to be provided without additional cost to City.
- R. In no case will any pipe, conduit or duct be installed where it is supported on or suspended from another pipe, conduit or duct.
- S. Follow manufacturers' directions in installation and operation of all equipment and materials.
- T. Accessibility:
 - 1. Install Mechanical work to permit removal (without damage to other parts) of coils, heat exchangers, pumps, fan shafts and wheels, belt guards, sheaves and drives and other parts requiring periodic replacement or maintenance.
 - 2. Arrange pipes, ducts and equipment to permit ready access to valves, cocks, traps, starters, motors, dampers, control components and to clear the openings of swinging

and overhead doors and of access panels.

3. Provide access panels in equipment, ducts and like items for inspection of interiors and proper maintenance.
- U. Indirect waste lines, cooling coil drain pan lines, overflow pipes, relief valve discharge pipes, etc. shall have ends beveled at 45 degree angle to minimize splashing.

3.3 APPLICATION

- A. Install unions downstream of valves and at equipment or apparatus connections.
- B. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.
- C. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- D. Install ball valves for throttling, bypass, or manual flow control services.
- E. Provide reducers/increasers at all valves, devices, and equipment if required.
- F. Use combination balancing and shutoff valves for balancing services.
- G. Provide ¾" ball drain valves at all high points in system for venting, main shut-off valves, low points of piping, bases of vertical risers and at equipment. Plug with nipple and cap.
- H. Provide manual air vents where shown on drawings and all high point of water systems.

3.4 FIELD TESTS

- A. Furnish all labor, material, instruments, supplies and services and bear all costs for the accomplishment of tests herein specified. Correct all defects appearing under test and repeat the tests until no defects are disclosed; leave the equipment clean and ready for use.
- B. Tests of piping systems shall be conducted before connections to equipment are made and before piping is covered, buried or otherwise concealed.
- C. Perform all tests other than herein specified which may be required by legal authorities or by agencies to whose requirements this work is to conform.
- D. Furnish all necessary testing apparatus, make all temporary connections and perform all testing operations required, at no additional cost to City.
- E. No work shall be insulated, painted, backfilled or concealed until authorized by City's representative.
- F. Inform City's representative 48 hours prior to when work is ready for test.
- G. Systems found to have leaks shall be subjected to further tests when faulty joints have been repaired or replaced.
- H. Welded joints shall be subjected to a hammer test while under pressure. For additional test requirements see welding specification.
- I. Hydronic systems shall be hydrostatically tested for minimum of four hours at 1½ times design pressure or 100 psig minimum, whichever is greater, unless otherwise specified.

- J. Temperature control piping shall be tested pneumatically for minimum of eight hours/10% drop at 30 psig.
- K. Test pressures shall be increased if necessary to comply with applicable codes.

--END OF SECTION -

**SECTION 15515
HYDRONIC SPECIALTIES**

PART 1 -GENERAL

1.1 WORK INCLUDED

- A. Air vents.
- B. Strainers.
- C. Manual Calibrated Balance Valve.
- D. Control Valves.
- E. Inline pump.

1.2 RELATED WORK

- A. Section 15010 -Basic Mechanical Requirements.
- B. Section 15250 -Thermal Insulation.
- C. Section 15510 -Hydronic Piping.
- D. Section 15545 -Pipe Cleaning, Flushing and Chemical Treatment.
- E. Section 15980 -Instrumentation.
- F. Section 15990 -Testing, Adjusting and Balancing.

1.3 REFERENCES

- A. ANSI/ASME -Boilers and Pressure Vessels Code.

1.4 REGULATORY REQUIREMENTS

- A. Conform to ANSI/ASME Boilers and Pressure Vessels Code Section 8D for manufacture of tanks.

1.5 QUALITY ASSURANCE

- A. Refer to Section 15010.
- B. Manufacturer: For each product specified, provide components by same manufacturer throughout.

1.6 SUBMITTALS

- A. Refer to Division 1 and Section 15010.
- B. Submit shop drawings and product data under provisions of Section 01300.
- C. Include component sizes, rough-in requirements, service sizes and finishes. Include product description, model.
- D. Submit manufacturer's installation instructions under provisions of Division 1 and Section 15010.

1.7 OPERATION AND MAINTENANCE DATA

- A. Refer to Section 15010.
- B. Include installation instruction, assembly views, lubrication instructions and replacement parts list.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Refer to Division 1 and Section 15010.
- B. Deliver products to site under provisions of Section 01600.
- C. Store and protect products under provisions of Division 1, Section 01600 and Section 15010.

PART 2 -PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS -AIR VENTS

- A. Amtrol
- B. Armstrong
- C. Bell and Gossett
- D. Taco
- E. Substitutions: Under provisions of Division 1.

2.2 AIR VENTS

- A. Manual Type: Short vertical sections of 2" diameter pipe to form air chamber, with 1/8" brass needle valve at top of chamber.

2.3 ACCEPTABLE MANUFACTURERS -STRAINERS

- A. Armstrong Machine Works
- B. Keckley
- C. Metraflex
- D. Spirax Sarco
- E. Substitutions: Under provisions of Division 1.

2.4 STRAINERS

- A. Size 2" and Under: Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32" stainless steel perforated screen.
- B. Size 2 1/2" to 4": Flanged iron body for 175 psig working pressure, Y pattern with 3/64" stainless steel perforated screen.

2.5 ACCEPTABLE MANUFACTURERS -MANUAL CALIBRATED BALANCE VALVES

- A. Armstrong
- B. Illinois

- C. Sarco
- D. Tour Andersen
- E. Substitutions: Under provisions of Division 1.

2.6 MANUAL CALIBRATED BALANCE VALVES

- A. Up to 2": Globe style, precise flow measurement, precision flow balancing, positive shutoff with no drip seat and teflon disc, drain connection with cap, handwheel with four 360 degree turn adjustments, hidden memory, tamper-proof balancing setting, screwed connections and factory pre-molded insulation. Model CBV-I manufactured by Armstrong.
- B. 2" and Over: Globe style, precise flow measurement, precision flow balancing, positive shutoff with no drip teflon disc, handwheel with eight, twelve or sixteen 360 degree turn adjustments, hidden memory, tamper-proof balancing setting, flanged connections and factory pre-molded insulation. Model CBV-II manufactured by Armstrong.

2.7 CONTROL VALVES

- A. The Trane Company, shall furnish control valves for installation by the mechanical contractor.

2.8 INLINE PUMPS

- A. Type: Horizontal, system lubricated, direct connected, with resiliently mounted motor for in-line mounting, 150 psig maximum working pressure, 240 deg. F maximum operating temperature.
- B. Casing: Cast iron. Rotor sheathed in stainless steel.
- C. Impeller: Noryl.
- D. Bearings: Two, carbon bearings.
- E. Shaft: Ceramic shaft.
- F. Motor: Non-overloading, built-in impedance and thermal protection.

PART 3 -EXECUTION

3.1 INSTALLATION AND APPLICATION

- A. Install pumps, control valves and specialties in accordance with manufacturer's instructions to permit intended performance.
- B. Provide manual air vents at system high points and as indicated.

--END OF SECTION -

**SECTION 15535
REFRIGERATION PIPING AND SPECIALTIES**

PART 1 -GENERAL

1.1 SECTION INCLUDES

- A. Piping.
- B. Refrigerant.
- C. Moisture and liquid indicators.
- D. Valves.
- E. Flexible connections.

1.2 RELATED SECTIONS

- A. Section 15010 -Basic Mechanical Requirements
- B. Section 15250 -Thermal Insulation.

1.3 1.3. REFERENCES

- A. ANSI/ARI 710 -Liquid Line Dryers.
- B. ANSI/ASHRAE 15 -Safety Code for Mechanical Refrigeration.
- C. ANSI/ASHRAE 34 -Number Designation of Refrigerants.
- D. ANSI/ASME B16.22 -Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- E. ANSI/ASME B16.26 -Cast Copper Alloy Fittings For Flared Copper Tubes.
- F. ANSI/ASME B31.5 -Refrigeration Piping.
- G. ANSI/ASTM B32 -Solder Metal.
- H. ANSI/ASTM B88 -Seamless Copper Water Tube.
- I. ANSI/AWS A5.8 -Braze Filler Metal.
- J. ARI 750 -Thermostatic Refrigerant Expansion Valves.
- K. ARI 760 -Solenoid Valves for Use With Volatile Refrigerants.
- L. ASTM A234 -Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- M. ASTM B280 -Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- N. MIL-I-631C -(Construction at Solenoid Valve Coils)
- O. MIL-V-23450C -Valves, Expansion, Thermostatic, Refrigerant 12 and Refrigerant

1.4 SUBMITTALS

- A. Submit shop drawings under provisions of Division 1 and Section 15010.

- B. Submit shop drawings indicating schematic layout of system, including equipment, critical dimensions, and sizes. Shop drawings shall be submitted on the following:
 - 1. Piping and fittings
 - 2. Refrigerant
 - 3. Valves
 - 4. Flexible Connectors
- C. Submit product data under provisions of Division 1 and Section 15010.
- D. Submit product data indicating general assembly of specialties, including manufacturer's catalogue information.
- E. Submit manufacturer's installation instructions under provisions of Division 1 and Section 15010.
- F. Submit design data as a submittal under provisions of Division 1 and Section 15010
- G. Submit data indicating pipe sizing.
- H. Submit Test reports indicating results of leak test, acid test.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit documents under provisions of Division 1 and Section 15010.
- B. Accurately record exact locations of equipment and refrigeration accessories on record drawings.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Division 1.
- B. Deliver and store piping and specialties in shipping containers with labeling in place.
- C. Store and protect products under provisions of Division 1.
- D. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.

PART 2 -PRODUCTS

2.1 2.1. PIPING

- A. Copper Tubing: ASTM B280, Type ACR hard drawn.
 - 1. Fittings: ANSI/ASME B16.22 wrought copper.
 - 2. Joints: ANSI/ASTM B32, solder Grade 95TA.
- B. Copper Tubing to 7/8" OD: ANSI/ASTM B88, Type K, annealed.
 - 1. Fittings: ANSI/ASME B16.26 cast copper.
 - 2. Joints: Flared.

2.2 REFRIGERANT

- A. Refrigerant: ANSI/ASHRAE 34; R-410A.
- B. Contractor shall provide a full refrigerant charge for all new and modified systems.

2.3 MOISTURE AND LIQUID INDICATORS

- A. Indicators: Single port type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator and plastic cap; for maximum working pressure of 430 psi, and maximum temperature of 200F.

2.4 VALVES

- A. Diaphragm Packless Valves: UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, solder or flared ends, with positive backseating; for maximum working pressure of 500 psi and maximum temperature of 275F.
- B. Packed Angle Valves: Forged brass, forged brass seal caps with copper gasket, rising stem and seat, molded stem packing, solder or flared ends; for maximum working pressure of 500 psi and maximum temperature of 275F.
- C. Packed Ball Valves: Two piece forged brass Body with teflon ball seals and copper tube extensions, brass seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi and maximum temperature of 300F.

2.5 FLEXIBLE CONNECTORS

- A. Up to 2-1/8" diameter -Corrugated bronze hose with single layer of stainless steel exterior braiding, minimum 9" long with copper tube sweat connections, silver soldered each end; for maximum working pressure 450 psi. at 70 F. Series 401M by Flexonics.

PART 3 -EXECUTION**3.1 PREPARATION**

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

- A. Install refrigeration specialties in accordance with manufacturer's instructions.
- B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.
- C. Install piping to conserve building space and not interfere with use of space.
- D. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.
- E. Provide non-conducting dielectric connections when joining dissimilar metals.

- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Provide clearance for installation of insulation and access to valves and fittings.
- H. Provide access to concealed valves and fittings.
- I. Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer to welding.
- J. Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting.
- K. Insulate piping; refer to Section 15250.
- L. Install flexible connectors at right angles to axial movement of compressor.
- M. Fully charge completed system with refrigerant after testing.

3.3 APPLICATION

- A. Provide line size liquid indicators in main liquid line leaving condenser.
- B. Provide permanent filter-driers in systems utilizing hermetic compressors.
- C. Provide refrigerant charging (packed angle) valve connections in liquid line between receiver shut-off valve and expansion valve.
- D. Utilize flexible connectors at or near compressors where within piping configuration does not absorb vibration.

3.4 FIELD QUALITY CONTROL

- A. Test refrigeration system in accordance with ANSI/ASME B31.5.
- B. Pressure test piping with dry nitrogen for a proof test of 450 psig and a leak test of 300 psig. Perform final tests at 27" vacuum and 300 psig using electronic leak detector. Test to no leakage.

--END OF SECTION -

SECTION 15545
PIPE CLEANING, FLUSHING AND CHEMICAL TREATMENT

PART 1 -GENERAL

1.1 SECTION INCLUDES

A. Cleaning of piping systems.

1.2 RELATED SECTIONS

A. Section 15010 -Basic Mechanical Requirements.

B. Section 15510 -Hydronic Piping.

1.3 SUBMITTALS

A. Submit reports indicating start-up of treated systems have been completed and are operating properly.

B. Submit reports indicating analysis of system water after cleaning and after treatment.

1.4 OPERATION AND MAINTENANCE DATA

A. Refer to General Conditions, Division 1 and Section 15010.

B. Include step by step instructions on test procedures including target concentrations.

1.5 REGULATORY REQUIREMENTS

A. Conform to applicable code for addition of non-potable chemicals to building mechanical systems and for discharge to public sewage systems.

PART 2 -PRODUCTS

2.1 MANUFACTURERS

A. H-O-H Chemical

B. Nalco Chemical

C. Dearborn

D. Substitutions: Under provisions of Division 1.

2.2 MATERIALS

A. All materials proposed must be compatible with existing treatment systems and chemicals.

B. System Cleaner:

1. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products.

2.3 EQUIPMENT

None Required.

PART 3 -EXECUTION**3.1 PREPARATION**

- A. Systems shall be operational, filled, started and vented prior to cleaning. Use water meter to record capacity in each system.
- B. Place terminal control valves in OPEN position during cleaning.

3.2 CLEANING SEQUENCE

- A. Add cleaner to closed systems at concentration as recommended by manufacturer.
- B. Hot Water Heating Systems: Apply heat while circulating, slowly raising temperature to 160F and maintain for 12 hours minimum. Remove heat and circulate to 100F or less; drain systems as quickly as possible and refill with clean water. Circulate for 6 hours at design temperatures, then drain. Refill with clean water and repeat until system cleaner is removed.
- C. Remove, clean and replace strainer screens.
- D. Inspect, remove sludge and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with City's present practice and as directed by City.

3.4 FIELD INSPECTION AND REPORT

- A. Provide report, in accordance with Section 15010, prepared by manufacturer's representative, stating that systems installed and services provided under this Section are in accordance with manufacturer's recommendations and are properly operating.

– END OF SECTION –

**SECTION 15781
PACKAGED ROOF TOP AIR CONDITIONING UNITS**

PART 1 -GENERAL

1.1 SECTION INCLUDES

- A. Packaged roof top unit.
- B. Unit controls.
- C. Remote panel.
- D. Roof mounting frame and base or curb adapter.
- E. Maintenance service.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Section 15975 -Direct Digital Control Systems: Installation of wiring, thermostats and other control components.
- B. Section 16180 -Equipment Wiring Systems: Installation and wiring of thermostats and other controls components.
- C. Section 16180 -Equipment Wiring Systems: Final connection of wiring from unit terminal strip to remote panel.

1.3 RELATED SECTIONS

- A. Section 15010 -Basic Mechanical Requirements.
- B. Section 15140 -Supports, Anchors and Sleeves.
- C. Section 15170 -Motors: Evaporator and condenser fan motors.
- D. Section 15242 -Vibration Isolation.
- E. Section 15250 -Thermal Insulation.
- F. Section 15950 -Automatic Temperature Controls: Wiring, thermostats and other control components.
- G. Section 16180 -Equipment Wiring Systems: Electrical supply to units. Wiring of thermostats and other control components.

1.4 REFERENCES

- A. ANSI/NFPA 90A -Installation of Air Conditioning and Ventilation Systems.
- B. ARI 210 -Unitary Air-Conditioning Equipment.
- C. ARI 270 -Sound Rating of Outdoor Unitary Equipment.

1.5 SUBMITTALS

- A. Refer to Division 1 and Section 15010.

- B. Submit product data under provisions of Division 1 and Section 015010.
- C. Submit product data for manufactured products and assemblies required for this project.
- D. Indicate electrical service and duct connections on product data.
- E. Submit manufacturer's installation instructions under provisions of Division 1 and Section 15010.

1.6 OPERATION AND MAINTENANCE DATA

- A. Refer to Division 1 and Section 15010.
- B. Submit operation and maintenance data under provisions of Division 1 and Section 15010.
- C. Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data and parts listing.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Refer to Division 1 and Section 15010.
- B. Deliver products to site under provisions of Division 1 and Section 15010.
- C. Store and protect products under provisions of Division 1 and Section 15010.]
- D. Protect units from physical damage by storing off site until roof mounting frames or curb adapters are in place, ready for immediate installation of units.

1.8 WARRANTY

- A. Refer to Section 15010.
- B. Warranty: Include coverage of refrigeration compressors. and heat exchangers.

1.9 MAINTENANCE SERVICE

- A. Furnish complete service and maintenance of packaged roof top units for one year from Date of Substantial Completion.
- B. Provide maintenance service with a two month interval as maximum time period between calls. Provide 24-hour emergency service on breakdowns and malfunctions.
- C. Include maintenance items as outlined in manufacturer's operating and maintenance data, including minimum of six filter replacements, minimum of one fan belt replacement and controls check-out, adjustments and recalibrations.
- D. Submit copy of service call work order or report and include description of work performed.

1.10 EXTRA MATERIALS

- A. Provide two sets of filters under provisions of Section 15010.

PART 2 -PRODUCTS

2.1 MANUFACTURERS

- A. Trane Model THC or equal.

2.2 2.2 MANUFACTURED UNITS

- A. Provide roof-mounted units having electric refrigeration and dehumidification (Hot Gas Reheat).
- B. Unit shall be self-contained, packaged, factory assembled and prewired, consisting of cabinet and frame, supply fan, powered exhaust fan, controls, air filters, phase loss protection, refrigerant cooling coil and compressor, condenser coil and condenser fan.

2.3 FABRICATION

- A. Cabinet: Galvanized steel with baked enamel finish, access doors or removable access panels with quick fastening locking door handle type. Provide hinged access doors for the filter, evaporator, supply fan, compressor and control sections. Structural members shall be minimum 18 gauge, with access doors or removable panels of minimum 20 gauge.
- B. Insulation: 1" thick foil faced glass fiber on surfaces where conditioned air is handled. Protect edges from erosion.
- C. Supply and Powered Exhaust Fan: Forward curved centrifugal type, resiliently mounted with V-belt drive, adjustable variable pitch motor pulley, and rubber isolated hinge mounted motor. Isolate complete fan assembly. Motors shall be of the premium efficient type as specified in section 15170.
 - 1. Provide powered exhaust fan that shall maintain better building pressurization when using the economizer.
- D. Air Filters: 2" thick MERV 13 disposable media cartridge filters. Provide two sets.
- E. Roof Mounting Frame or Curb Adapter: 14" high galvanized steel, channel frame with gaskets, nailer strips. Curb shall match up with existing roof curb.

2.4 EVAPORATOR COIL

- A. Provide copper tube aluminum fin coil assembly with galvanized drain pan and connection.
- B. Provide capillary tubes or thermostatic expansion valves for units of 6 tons capacity and less; provide thermostatic expansion valves and alternate row circuiting for units 7.5 tons cooling capacity and larger.

2.5 COMPRESSOR

- A. Provide hermetic, scroll type compressor(s), 3600 rev/min maximum, resiliently mounted with positive lubrication, crankcase heater, high and low pressure safety controls, motor overload protection, suction and discharge service valves and gauge ports and filter drier. Provide dual compressors where indicated on schedule.
- B. Five minute timed off circuit shall delay compressor start.
- C. Outdoor thermostat shall energize compressor above 57 F ambient.
- D. Provide step capacity control by cycling compressors.

2.6 CONDENSER

- A. Provide copper tube aluminum fin coil assembly with subcooling rows.

- B. Provide direct drive propeller fans, resiliently mounted with fan guard, motor overload protection, wired to operate with compressor.
- C. Provide refrigerant pressure switches to cycle condenser fans.

2.7 PHASE LOSS PROTECTION

- A. Provide electrical phase protection for all motors and compressors.
- B. Protection shall be automatic reset type and shall perform automatic unit shutdown when an electrical phase loss, phase imbalance, or phase reversal is detected.
- C. Provide an LED indicator to signify “on” and “fault” statuses.

2.8 SUPPLY/RELIEF CASING

- A. Dampers: Provide outside, return and relief dampers with damper operator and control package to automatically vary outside air quantity. Outside air damper shall fail to closed position. Relief dampers may be gravity balanced.
- B. Gaskets: Provide tight fitting dampers with edge gaskets, maximum leakage 5% at 2” pressure differential.
- C. Damper Operator: 24 volt with gear train sealed in oil, with spring return on units 7.5 ton cooling capacity and larger.
- D. Mixed Air Controls: Maintain selected supply air temperature and return dampers to minimum position on call for heating and when ambient air enthalpy exceeds return air enthalpy.

2.9 OPERATING CONTROLS

- A. Unit shall come complete with it’s own microprocessor control package including contactors for compressors, evaporator and condenser fans and modulating control of mixed air dampers for economizer control. Refer to Section 15950, Automatic Temperature Controls and Section 15985, Sequence of Operation.
- B. Unit shall be complete with self contained low voltage control circuit protected by a resettable circuit breaker on the 24-volt transformer side.
- C. Unit shall incorporate a solid-state compressor protector which provides anti-cycle reset capability should any of the following standard safety devices trip and shut off compressor.
 - 1. Compressor over temperature, over current.
 - 2. Loss-of-charge/low-pressure switch.
 - 3. Freeze-protection thermostat, evaporator coil.
 - 4. High pressure switch.
 - 5. Automatic reset motor thermal overload protector.
 - 6. High-temperature limit switches for the heating section.
- D. The RTU DDC system shall include output relay contacts for connection to a separate DDC Building Management System. These contacts shall open on a failure of the unit’s supply fan,

or cooling system.

- E. Provide manual reset supply and return air smoke detectors that will shut down the unit if smoke is detected.

2.10 PERFORMANCE

- A. Rated cooling capacity is based on 95F condenser ambient air.
- B. Rated heating capacity is based on -7 DB and -8 WB outdoor air temperature.
- C. Supply and return air is corrected to 692 feet altitude.

PART 3 -EXECUTION

3.1 EXAMINATION

- A. Verify that roof is ready to receive work and opening dimensions are as indicated on shop drawings.
- B. Verify that proper power supply is available.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Mount units on factory built roof mounting frame or curb adapter providing watertight enclosure to protect ductwork and utility services. Install roof mounting frame or curb adapter level.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Provide initial start-up and shut-down during first year of operation, including routine servicing and check.

3.4 FIELD INSPECTION AND REPORT

- A. Provide report, in accordance with Section 15010, prepared by manufacturer's representative, stating that systems installed and services provided under this Section are in accordance with manufacturer's recommendations and are properly operating.

3.5 SCHEDULE

- A. Refer to schedule on drawings.

--END OF SECTION -

**SECTION 15890
METAL AND FLEXIBLE DUCT**

PART 1 -GENERAL

1.1 SCOPE OF WORK

A. Duct and duct-associated materials and procedure in this section include:

1. Sheet metal materials
2. Single-wall rectangular ducts and fittings
3. Single-wall round ducts and fittings
4. Flexible ducts
5. Sealants and gaskets
6. Hangers and supports

B. Products/material specified under other Divisions but installed under this section:

1. Duct-mounted smoke detectors

1.2 DEFINITIONS

A. Duct Size: Duct sizes indicated herein or on associated drawings shall be the inside clear dimensions of actual air path for both unlined and lined ducts.

B. Pressure Class: A "SMACNA -HVAC Duct Construction Standards, Metal and Flexible" pressure classification system designating static pressure values (in inches w.g.) equal to the maximum operating pressure to which the ductwork can safely be subjected.

1.3 CODES AND STANDARDS

A. ASTM A 36/A 36M-97a: Specification for Carbon Structural Steel

B. ASTM A 366/A 366M-97: Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality

C. ASTM A 480/A 480M-98a: Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

D. ASTM A 653/A 653M-99a: Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

E. ASTM B 209-96: Specification for Aluminum and Aluminum-Alloy Sheet and Plate

F. ASTM C 411-97: Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation

G. ASTM C 534-94: Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form

H. ASTM C 916-85 (Reapproved 1996): Specification for Adhesives for Duct Thermal Insulation

- I. ASTM C 920-98: Specification for Elastomeric Joint Sealants
- J. ASTM C 1071-98: Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material)
- K. ASTM E 84-00a: Test Method for Surface Burning Characteristics of Building Materials
- L. NFPA 90A-99: Installation of Air Conditioning and Ventilating Systems (ANSI)
- M. NFPA 90B-99: Installation of Warm Air Heating and Air Conditioning Systems (ANSI)
- N. NFPA 96-98: Ventilation Control and Fire Protection of Commercial Cooking Operations (ANSI)
- O. NAIMA AH124-98: Fibrous Glass Duct Liner Standard
- P. SMACNA: Duct Cleanliness for New Construction, 2000
- Q. SMACNA: HVAC Air Duct Leakage Test Manual, 1985
- R. SMACNA: HVAC Duct Construction Standards-Metal and Flexible, 1995 (excluding all amendments and proposed revisions).
- S. UL 181-96 (Rev. 98): Factory-Made Air Ducts and Air Connectors
- T. UL 723-96 (Rev. 98): Test for Surface Burning Characteristics of Building Materials

1.4 QUALITY ASSURANCE

- A. Construct ductwork to NFPA 90A standards.
- B. Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall, at a minimum, comply with SMACNA's "HVAC Duct Construction Standards -Metal and Flexible," excluding all amendments and proposed revisions, and performance requirements and design criteria indicated.
 - 1. All further references to conformance with the requirements of SMACNA's "HVAC Duct Construction Standards -Metal and Flexible" shall always mean with the exclusion of all amendments and proposed revisions.
 - 2. Where the requirements of this specification exceed the requirements of the SMACNA's "HVAC Duct Construction Standards -Metal and Flexible," the specifications shall govern.
- C. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.
- D. Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards -Metal and Flexible."

1.5 SUBMITTALS

- A. Product Data: Submit for each type of the following products:
 - 1. Liners and adhesives.
 - 2. Sealants and gaskets: submit manufacturer's data sheets including performance data,

pressure ratings, surface burning characteristic and installation instruction.

B. Duct Testing Submittals and Reports:

1. Submit duct pressure testing plan with duct shop drawings, including list of ducts to be tested and duct testing schedule.
2. Submit documentation of duct performance testing and submit performance testing result reports within two weeks of testing.
3. Contractor shall be responsible for any corrective action required due to a failed duct leakage test.

C. Manufacturer's Installation Instruction: Submit manufacturer's installation instructions for all manufactured ductwork.

D. Field record drawings:

1. During the construction process, the Contractor shall maintain a set of drawings showing the exact routing and location of duct systems being installed. The drawings shall be updated neatly by hand on a daily basis and account for routing modifications made in the field. Contractor shall use these drawings as a basis for generating the project as-built drawings.

E. As-built drawings:

1. Upon completion of project, Contractor shall furnish as-built drawings showing in scale the exact routing and locations of all newly installed ductwork systems. Submit in both hard-copy and electronic AutoCAD format.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Protect new duct interiors from moisture, construction debris and dust, and other foreign materials. If inside of new duct becomes dirty, Contractor shall clean duct per Duct Cleaning specifications.
- B. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

1.7 WARRANTY

- A. One year warranty on products and complete installation commencing at the time of Substantial Completion.

PART 2 -PRODUCTS

2.1 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards -Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
 1. Galvanized Sheet Steel: Comply with ASTM A 653. Lock forming quality with G-90 galvanized coating designation (not less than 1.25 oz. of zinc on each side of

each square foot of sheet).

2. Paint Grip Steel; mill-phosphatized "Paintgrip" or "Zincgrip" finish suitable for field painting.
3. Minimum ducts gauges shall be in accordance with the following table. This table shall be used in conjunction with SMACNA table for application of appropriate reinforcement in accordance with proper pressure class.

(1) Galvanized steel -rectangular duct:

Maximum Duct Dimension (in.)	Minimum Duct Gauge	Comments
Up to 10	26	pressure class 2" w.g.
Up to 10	24	pressure class greater than 2" w.g.
12 through 29	24	
30 through 53	22	
54 through 84	20	
Over 84	18	
Duct located out-of-doors	18	

(2) Galvanized steel -round duct:

Maximum Duct Dimension (in.)	Minimum Duct Gauge	
Up to 10	26	pressure class 2" w.g.
Up to 10	24	pressure class greater than 2" w.g.
11 thru 17	24	
18 thru 27	22	
28 thru 35	20	
35 thru 52	18	

2.2 SINGLE WALL RECTANGULAR DUCTS AND FITTINGS (SHOP AND FACTORY FABRICATED)

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Lindab Inc.
 2. McGill AirFlow LLC.
 3. SEMCO Incorporated.
 4. Shop fabricated duct is acceptable for ducts with a pressures class rating of 6" w.g. or less provided compliance with the requirements herein are met.
- B. General Fabrication Requirements:

1. Comply with SMACNA's "HVAC Duct Construction Standards -Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
 2. Comply with SMACNA's "Industrial Duct Construction Standards" where indicated.
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards -Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards Metal and Flexible" except as otherwise noted.
1. No duct shall be constructed to less than 2" w.g.
- D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards -Metal and Flexible," Figure 1-5, "Longitudinal Seams Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards -Metal and Flexible," except as otherwise noted:
1. Button Punch Snap Lock is not acceptable.
- E. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards -Metal and Flexible," except as otherwise noted.

2.3 SINGLE-WALL ROUND DUCTS AND FITTINGS (FACTORY AND SHOP-FABRICATED)

- A. Acceptable Manufacturers:
1. Lindab Inc.
 2. McGill AirFlow LLC.
 3. SEMCO Incorporated.
 4. Shop fabricated ducts are acceptable for all positive pressure ducts and negative pressure ducts with ratings of -1" w.g. to -4" w.g.
- B. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards -Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
1. All round ducts must utilize spiral lock seam except:
 - a. Ducts up to and including 12" diameter with a positive pressure class of 2" w.g. and less may utilize longitudinal lock seam construction.
- C. SMACNA's "HVAC Duct Construction Standards -Metal and Flexible," Figure 3-2, "Transverse Joints -Round Duct," for static-pressure class, applicable sealing requirements, and materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards -Metal and Flexible."

1. Transverse joints in ducts larger than 60" in diameter shall be flanged.
- D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards -Metal and Flexible," Figure 3-1, "Seams -Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards -Metal and Flexible."
1. Fabricate round ducts larger than 48" in diameter with butt-welded longitudinal seams.
- E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards -Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards -Metal and Flexible."

2.4 FLEXIBLE DUCTS

- A. Acceptable Manufacturers:
1. Buckley Associates, Inc.
 2. Flexmaster USA
 3. McGill AirFlow LLC.
 4. Thermaflex
- B. Quality Assurance:
1. Factory fabricated UL listed under UL-181 as Class 1 duct, meeting requirements of NFPA 90A with a flame spread rating of 25 or less and smoke development rating of 50 or less, unless otherwise noted.
 2. Only factory-insulated flexible duct is acceptable. No field-insulated flexible duct is allowed.
- C. Flexible Duct Connectors:
1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a quick-release worm-gear action, to suit duct size. Nylon or other nonmetallic draw bands are not acceptable.

2.5 SEALANT AND GASKETS

- A. Acceptable Manufactures for Duct Sealant:
1. Hardcast
 2. United McGill
 3. Ductmate
- B. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

C. Duct Sealant:

1. Water-based non hardening, water resistant, mold and mildew resistant sealant classified compounded specifically for sealing joints and seams in ductwork.
 - a. Maximum Static-Pressure Class: 10" w.g., positive and negative.
 - b. Service: Indoor or outdoor.
 - c. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets for specific applications.
2. Duct tapes are not allowed.

D. Flanged Joint Sealant: Comply with ASTM C 920. General: Single-component, acid-curing, silicone, electrometric. Type S, Grade NS, Class 25, Use O.

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

1. Gaskets used in chemical, laboratory, or process exhaust duct systems shall be suitable for exposure to substances in the air stream. Contractor shall verify the compatibility with Engineer prior to installation.

2.6 HANGERS AND SUPPORTS

A. Hanger Rods for Dry or Non-corrosive Environments: Cadmium-plated steel rods and nuts.

B. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

C. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 -EXECUTION

3.1 APPLICATION

A. Install duct with duct material for pressure class as per the following table:

Duct System and Location	Material	Pressure Class
VAV supply system: duct from RTU discharge to inlet of air terminal units	Galvanized steel (G90)	+4"
VAV supply system: duct downstream of air terminal units	Galvanized steel (G90)	+2"
Constant volume supply: all duct	Galvanized steel (G90)	+3"
Outside air and exhaust plenums	Galvanized steel (G90)	-2"
Return system with air terminal units: duct from air terminal units to inlet of return fan	Galvanized steel (G90)	-4"
Return system with air terminal units: duct from return grille to terminal unit	Galvanized steel (G90)	-2"
Return system with no air terminal units: all duct	Galvanized steel (G90)	-2"
Air relief and transfer	Galvanized steel (G90)	+2"

B. Utilize the following flexible ducts for the applications as outlined below:

Duct System and Location	Flexible Duct Type
VAV supply system: duct from RTU discharge to inlet of air terminal units	Insulated corrugated metal flexible duct
Return system with no air terminal units: all duct	Noninsulated aluminum laminate flexible duct

3.2 INSTALLATION

A. General

1. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Where interferences develop in field, offset or reroute ductwork as required for clearing such interference.
2. Contactor shall modify specified duct sizes as required to fit. Modified duct size shall have cross-sectional area and pressure drop equivalent to that of the specified duct size.
3. All ducts shall be airtight and free from pulsation and vibration at normal operating conditions.
4. Contractor shall submit sheet metal shop drawings to the Test and Balance Contractor for review, and provide any additional volume dampers that the Test and Balancing Contractor needs to perform final balancing.
5. Install round ducts in maximum practical lengths.

6. Install ducts with fewest possible joints.
7. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
8. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
9. Install ducts with a minimum clearance of 1", plus allowance for insulation thickness.
10. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
11. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
12. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1½".
13. Where ducts pass through fire and smoke rated interior partitions and exterior walls, install fire, smoke, and/or combination fire/smoke dampers. Contractor shall obtain a copy of architectural drawings showing the fire and smoke rated partitions and exterior walls at the time of bid and provide the appropriate damper (at all ducts penetrating fire and smoke rated partitions and walls whether shown on mechanical plans or not). Comply with requirements in Division 15 Section "Duct Accessories" for fire and smoke dampers.
14. Provide openings in ducts where required to accommodate thermometers and controllers. Provide pitot tube openings where required for testing of systems, complete with metal cap with spring device or screw to ensure against air leakage. Where openings are provided in insulated ducts, install insulation material inside a metal ring.
15. Fabricate continuously welded medium and high pressure round duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard. Joints shall be minimum 4" cemented slip joint, brazed or electric welded. Prime coat welded joints.
16. Install duct-mounted smoke detectors.
17. Where ducts of different metals meet, joint shall use a gasket, seal or compound to prevent the two different metals from coming in contact.
18. Galvanized surfaces altered or damaged (including the damage due to welding) shall be painted with a galvanized paint.
19. For paint grip steel ducts, place identification stickers in side ducts off of the surface to be painted.
20. Gaskets shall not protrude into airstream.
21. Elbows:

- a. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards -Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - (1) For supply duct:
 - (a) Use Radius Type RE 1 with minimum 1.5 radius-to diameter ratio.
 - (b) If space does not allow the use of a Radius Type RE1, provide a square-throated elbow with turning vanes. Turning vanes shall comply with the requirements of Division 15 Section "Duct Accessories".
 - (2) For return and exhaust duct:
 - (a) Use Radius Type RE 1 with minimum 1.5 radius-to diameter ratio.
 - (b) If space does not allow the use of a Radius Type RE1, provide a square throated elbow with vanes. Turning vanes shall comply with the requirements of Division15 Section "Duct Accessories."
- b. Round Duct, excluding laboratory (fume handling) exhaust duct: Comply with SMACNA's "HVAC Duct Construction Standards -Metal and Flexible," Figure 3-3, "Round Duct Elbows."
 - (1) Use minimum 1.5 radius-to-diameter ratio.
 - (a) 12" and Smaller in Diameter: Stamped (pleated not acceptable)
 - (b) 14" and Larger in Diameter: Standing seam or welded five-piece 90 degree turning elbows (three-piece elbows not acceptable for 90 degree elbow).
 - (c) 45 degree elbows shall meet the requirements for 90 degree elbows and shall be die stamped up to 12" and three piece construction of sized greater than 12".

22. Branch Configurations:

- a. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards -Metal and Flexible," Figure 2-6, "Branch Connections."
 - (1) Rectangular main to rectangular branch: 45-degree entry.
 - (2) Rectangular main to round branch: Bellmouth connection; spin in connections are allowed only on supply duct downstream of air terminal units and return ducts upstream of air terminal units.
 - (3) No straight tap, butt flange or cinch lock is allowed
- b. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards -Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees."
 - (1) Provide 45-degree lateral tap; conical taps are allowed only on supply duct downstream of air terminal units and return ducts upstream of

- air terminal units.
- (2) Saddle taps are permitted only for new connection in existing duct.
 - (3) No 90 degree taps are allowed.
23. Offsets and transitions: Comply with SMACNA's "HVAC Duct Construction Standards -Metal and Flexible," Figure 2-7, "Offsets and Transitions."
- a. Transitions:
 - (1) Increase duct sizes gradually, not exceeding 15 degrees on each side for a concentric transition or 30 degrees on one each side for an eccentric transition.
 - (2) Decrease duct sized not exceeding 22.5 degrees on each side for a concentric transition or 45 degrees on one side for an eccentric transition.
 - b. Offsets:
 - (1) Provide smooth radius offset with the radius equal to the duct dimension.
 - (2) Mitered offset Type 2 is acceptable provided the offset angle no greater that 15 degrees.
24. Easements for obstructions:
- a. Provide easements where ductwork conflicts with piping and structure.
 - b. Where easements exceed 10% duct area, split into two ducts maintaining original duct area.
25. Seam and joint sealing:
- a. For all new ducts, all transverse joints, longitudinal seams and connections shall be sealed in conformance with SMACNA Class A sealing requirements as defined in the 1995 SMACNA HVAC Duct Construction Standards -Metal and Flexible, Second Edition.
26. Hangers and supports: Comply with SMACNA's "HVAC Duct Construction Standards -Metal and Flexible," Chapter 4, "Hangers and Supports."
- a. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - (1) Where practical, install concrete inserts before pouring concrete.
 - b. Support ducts using traverse steel and threaded rods or 1" wide straps of 16 gauge galvanized steel. Wire or perforated straps of any kind are not acceptable.
 - c. No hangers and supports shall be attached to ducts with sheet metal screws that penetrate any part of ducts.

- d. Round duct shall be suspended on prefabricated circular single loop or two-piece bands completely encircling ducts.
 - e. Hanger Spacing: Except where requirements herein exceed, comply with SMACNA's "HVAC Duct Construction Standards -Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct,"
 - (1) Provide duct supports at a maximum of 6 foot intervals, within 24" of each elbow, and within 24" of each branch intersection.
 - (2) Provide vertical ducts supports at a maximum of 10 foot intervals.
 - f. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
27. Flexible Duct:
- a. Aluminum Laminate or Acoustic CPE Flexible Duct (Insulated or Noninsulated):
 - (1) Connect diffusers to low pressure ducts with a maximum of five feet of flexible duct.
 - (2) Each connection shall be a single piece of flexible duct. No splicing is allowed.
 - (3) Support flexible duct at a maximum of 2 feet on center, with no portion lying on suspended ceiling system or other horizontal surface.
 - (4) Flexible ducts shall not pass through any partition, wall, floor or ceiling.
 - (5) Connect fabric type flexible ducts to diffuser collars or duct with stainless steel draw bands with quick release. Position draw bands behind collar beads if applicable. Connection shall be airtight; seal if required for airtight connection.
 - b. Corrugated Metal Flexible Duct Installation:
 - (1) Terminal units may be connected to medium pressure duct mains directly or with a maximum of one foot of Insulated Corrugated Metal Flexible Duct.
 - (2) Do not use Corrugated Metal Flexible Duct to change direction.
 - (3) Connect Corrugated Metal Flexible Duct with sealant and clamps; connection shall be airtight.
 - c. For all insulated flexible ducts, pull back insulation and connect internal duct to collar with stainless steel draw band. Then pull insulation and vapor barrier jacket over liner connection and secure with a second draw band.

Tape insulation end with three wraps of compatible vapor barrier tape to seal insulation.

- d. For termination of flexible duct at externally insulated duct, secure flexible duct jacket to duct insulation with three wraps of compatible vapor barrier tape.

-- END OF SECTION --

**SECTION 15910
DUCTWORK ACCESSORIES**

PART 1 -GENERAL

1.1 SCOPE OF WORK

A. Accessories addressed in this section include:

1. Manual volume dampers
2. Control dampers
3. Insulated low leakage control dampers
4. Turning vanes
5. Duct access doors
6. Flexible connectors

1.2 DEFINITIONS

Not Applicable

1.3 CODES AND STANDARDS

- A. AMCA 500 -Test Methods for Louvers, Dampers and Shutters.
- B. AMCA 511 -Certified Ratings Program for Air Control Devices.
- C. NFPA 90A -Installation of Air Conditioning and Ventilating Systems, 2002
- D. SMACNA -HVAC Duct Construction Standards-Metal and Flexible, 1995

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
- B. Ductwork specialties shall be designed and manufactured to conform to the same pressure class as the duct in which they are located, unless otherwise indicated to exceed.

1.5 SUBMITTALS

- A. Product Data: Provide manufacturer's literature and illustrations for all components indicating materials, construction, quantities, size, dimensions and configuration.
- B. Submit a request for substitution if not providing the listed Acceptable Manufacturers for any given product.
- C. Shop Drawings: Provide details of equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection for all products.
- D. Submit operation and maintenance data under provisions of Section 15010.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site under provisions of Section 01600.
- B. Deliver products to site in containers with manufacturer's and UL stamp affixed.
- C. Protect products against dirt, water, chemical and mechanical damage before, during and after installation. Damage to products prior to final acceptance of the Work shall be repaired or replaced at no additional cost to the City.

1.7 WARRANTY

- A. Provide one year warranty.

PART 2 -PRODUCTS

2.1 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, except where otherwise indicated to exceed the requirements of the Standard.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation. For uninsulated ducts with surfaces exposed to view, provide paint grip steel; mill-phosphatized "Paintgrip" or "Zincgrip" finish suitable for field painting.
- C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- D. Tie Rods: Galvanized steel, ¼" minimum diameter for tie rod lengths of 36" or less; 3/8" minimum diameter for tie rod lengths longer than 36".

2.2 MANUAL VOLUME DAMPERS

- A. Acceptable Manufacturers:
 - 1. Air Balance, Inc.
 - 2. Nailor Industries, Inc.
 - 3. Ruskin Company
 - 4. Vent Products Company, Inc.
- B. Quality Assurance:
 - 1. Include leakage, pressure drop, and maximum pressure data with submittals.
 - 2. Damper pressure drop ratings shall be based on tests and procedures performed in accordance with AMCA500.
 - 3. Field or shop fabricated manual volume dampers are not acceptable.
- C. Standard Manual Volume Damper:
 - 1. Factory fabricated, rectangular or round damper with required hardware and accessories. Single-blade or multiple-opposed-blade design, with linkage outside airstream, and suitable for horizontal or vertical applications.

2. Performance data:
 - a. Capacity: Demonstrate damper capacity to withstand HVAC system operating conditions.
 - (1) Closed position: Maximum pressure of 3" w.g.
 - (2) Open position: Maximum air velocity of 1,500 fpm.
 - b. Pressure drop:
 - (1) Rectangular dampers: Maximum 0.10" w.g. at 1,500 fpm across a 24" x 24" damper.
 - (2) Round dampers: Maximum 0.02" w.g. at 1,500 fpm across a 20" diameter round damper.
 3. Rectangular Damper Construction:
 - a. Frame: Hat-shaped, galvanized sheet steel channels, minimum 16 gauge (0.064" thick), with mitered and welded corners; frames with flanges where required for attaching to walls and flangeless frames for installing in ducts.
 - b. Blades: Minimum 16 gauge (0.064" thick), galvanized steel. For ducts 10" in height and less, single blade dampers are acceptable. For ducts over 10" in height, provide multiple blades of 8" maximum width.
 - c. Basis of Design: Ruskin Company Model: MD35.
 4. Round Damper Construction:
 - a. Frame: Minimum 0.036" thick galvanized steel with flanges where indicated for attaching to walls.
 - b. Blades: Minimum 20 gauge (0.040" thick) galvanized steel, maximum 16" diameter.
 - c. Basis of Design: Ruskin Company Model MDRS25.
- D. Jackshaft: 1" diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.
- E. Damper Hardware:
1. Hand-Operated Damper Regulator:
 - a. For all manual dampers provide a locking type hand quadrant operator with lever handle, position indicator and lock nut for all dampers.
 - b. Provide a minimum of a 2" hand-quadrant stand-off elevated platform where damper is located in insulated ducts.

2. Remote-Operated Damper Regulator:

- a. Where manual dampers are located in inaccessible areas, provide remote type operator complete with stainless steel cable in copper tubing, geared mechanism, and indicator dial for "Open" and "Closed," brushed chrome wall plate and knob and deep wall box. Model 700 manufactured by Young Regulator.

2.3 CONTROL DAMPERS

- A. Control dampers are furnished by the Temperature Control Contractor and are specified under Specification 15950 – Automatic Temperature Controls.

2.4 INSULATED LOW LEAKAGE CONTROL DAMPERS

- A. Insulated low leakage control dampers are furnished by the Temperature Control Contractor and are specified under Specification 15950 – Automatic Temperature Controls.

2.5 TURNING VANES

A. Acceptable Manufacturers:

1. Aero/Dyne Industries
2. Ductmate Industries, Inc.
3. Carlisle Harcast, Inc

B. Quality Assurance:

1. Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible" for vanes and vane runners or provide Aero/Dyne HEP vanes. Vane runners shall automatically align vanes.
2. Vanes shall be factory fabricated on common base rail. Field fabricated vanes are not acceptable.

C. Construction:

1. 2" or 4½" double-vane, curved blades of galvanized sheet steel set ¾" on center; support with bars perpendicular to blades set a maximum of 2" on center; and set into vane runners suitable for duct mounting.
2. Minimum 24 gauge vanes for ducts less than 30" wide.
3. Minimum 22 gauge vanes for ducts 30" wide and greater.

2.6 FLEXIBLE CONNECTORS

A. Acceptable Manufacturers:

1. Duro Dyne Corp.
2. Ventfabrics, Inc.

- B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

- C. Metal-Edged Connectors: Factory fabricated with a fabric strip minimum 4" wide attached to two strips of 2¾" wide, 24 gauge (0.028" thick), galvanized sheet steel or 0.032" thick aluminum sheets. Select metal compatible with ducts.
- D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz/sq yd.
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3. Service Temperature: -40F to +200F.

2.7 DUCT ACCESS DOORS

A. Acceptable Manufacturers:

- 1. Air Balance, Inc.
- 2. FlexmasterUSA
- 3. Greenheck
- 4. McGill AirFlow Corporation
- 5. Nailor Industries, Inc.

B. Access Door Construction:

- 1. General: Fabricate doors airtight and suitable for duct pressure class.
- 2. Doors shall be rectangular, close-fitting doors of galvanized steel with sealing gaskets, edge protection and quick fastening locking devices suitable for duct pressure class. Access doors with sheet metal screw fasteners are not acceptable.
- 3. Access doors located in insulated ductwork shall be double wall with insulation fill. Provide a minimum thickness of 1½" insulation fill or thicker insulation as necessary to match the insulation thickness on duct in which the access door is located.
- 4. Provide number of hinges and locks as follows:
 - a. Up to 18" square: Two hinges and two sash locks.
 - b. Up to 24" x 48": Three hinges and two compression latches with outside handles.
 - c. Sizes 24" x 48" and larger: One additional hinge.
- 5. Provide viewing port for all access doors 24" x 48" and larger and where indicated.

PART 3 -EXECUTION

3.1 APPLICATION AND INSTALLATION

A. General

- 1. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards – Metal and Flexible" except where otherwise noted to exceed the requirements of this Standard.

2. Provide duct accessories of materials suited to duct materials; use galvanized steel accessories in galvanized-steel, paint grip steel accessories in paint grip steel ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
3. Install accessories in accordance with manufacturer's instructions.

B. Manual Volume Dampers

1. Utilize standard volume dampers for:
 - a. supply airflow balancing downstream of terminal units,
 - b. return and exhaust airflow balancing applications further than 30 feet from the return or exhaust fan.
2. Provide manual volume dampers for balancing at all points on supply, return and exhaust systems where branch ducts are taken from larger ducts and at duct or flexible take-offs to supply and return diffusers or registers.
3. Install at a minimum of two duct widths from branch takeoff.
4. When installing volume dampers in ducts with liner; avoid damage to and erosion of duct liner.
5. When installing volume dampers in insulated duct, install regulator with elevated platform such that damper is accessible and adjustable without imparting damage to the insulation.
6. Close duct penetrations for damper components to seal duct consistent with pressure class.
7. Provide remote operated volume control dampers regulator(s) for inaccessible volume dampers.

C. Control Dampers

1. Install control dampers (furnished by the Temperature Control Contractor and specified under Specification 15950 – Automatic Temperature Controls) per manufacturer's instructions.

D. Insulated Low Leakage Control Dampers

1. Install insulated low leakage control dampers (furnished by the Temperature Control Contractor and specified under Specification 15950 – Automatic Temperature Controls) per manufacturer's instructions.

E. Turning Vanes

1. Utilize 2" radius double wall airfoil vanes in:
 - a. Supply distribution ductwork located downstream of air terminal units that is less than or equal to 18" wide.
 - b. Return exhaust distribution ductwork less than or equal to 18" wide.
 - c. Toilet and general exhaust distribution ductwork less than or equal to 18"

wide.

2. Utilize 4½" double wall airfoil vanes in:
 - a. Supply distribution ductwork located downstream of air terminal units and greater than 18" wide.
 - b. All supply ductwork located upstream of air terminal units.
 - c. Return distribution ductwork greater than 18" wide.
 - d. Toilet and general exhaust distribution ductwork greater than 18" wide.
3. Install turning vanes for all rectangular square throat elbows, except in transfer air ducts. Install in accordance with SMACNA Standards and manufacturer's recommendations.
4. Install tuning vanes tangential to airflow.

F. Flexible Connectors

1. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators. Installed width shall be not less than 4".
2. For fans developing static pressures of 5" w.g. and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

G. Duct Access Doors

1. Review locations prior to fabrication.
2. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows and anywhere that provisions for maintenance or service of duct-mounted equipment is required
 - a. Before and after filters.
 - b. Before and after coils, including reheat coils. Where a reheat coil is provided integral with a terminal unit, provide an access door after terminal unit coil.
 - c. Downstream from, motorized control dampers and turning vanes.
3. Provide duct access doors sufficient for required inspecting, adjusting and maintenance but not less than the dimension shown below (the duct dimension given is that in which the access door is to be located):
 - a. For duct dimension up to 12": 8"x8"
 - b. For duct dimension 14 " to 21": 12"x12"
 - c. For duct dimension 22" to 48": 18"x18"
 - d. For ducts over 48": 2 doors at 18"x18"

H. Instrument Test Holes

1. Provide duct test holes where indicated and required for testing and balancing

purposes.

2. Provide only factory fabricated instrument test holes in ductwork with a pressure rating greater than 2" or less than -2" .
3. Install visible above insulation.

3.2 TESTING, INSPECTIONS AND ADJUSTING

A. Manual Volume Dampers

1. Operate manual control dampers to verify full range of movement is possible. Correct any situation in which dampers cannot travel their full range of movement.
2. Adjust final positioning of manual-volume dampers as specified in Section 15990, "Testing, Adjusting, and Balancing."
3. Operate remote manual volume damper operators to verify full range of movement of operator and damper.

B. Turning Vanes

1. Inspect turning vanes for proper and secure installation.

C. Duct Access Doors

1. Inspect locations of access doors and verify that purpose of access door can be performed.

--END OF SECTION--

**SECTION 15936
AIR INLETS AND OUTLETS**

PART 1 -GENERAL

1.1 SCOPE OF WORK

A. Products covered in this section include:

1. Registers/grilles.

1.2 REFERENCES

- A. ADC 1062 - Certification, Rating and Test Manual.
- B. AMCA 500 - Test Method for Louvers, Dampers and Shutters.
- C. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- D. ARI 650 - Air Outlets and Inlets.
- E. ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.
- F. SMACNA - HVAC Duct Construction Standards, Metal and Flexible.

1.3 QUALITY ASSURANCE

- A. Test and rate performance of air outlets and inlets in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.
- B. Test and rate performance of louvers in accordance with AMCA 500.

1.4 REGULATORY REQUIREMENTS

- A. Conform to ANSI/NFPA 90A.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.
- C. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

PART 2 -PRODUCTS

2.1 REGISTERS/GRILLES

- A. Acceptable Manufacturers:

1. Titus
2. Price
3. Carnes
4. Hart & Cooley (Tuttle & Bailey)
5. Krueger
6. Metalaire

B. General:

1. Formed and individually adjustable blades, with $\frac{3}{4}$ " maximum spacing with friction pivot, spring or other device to set blades, horizontal face, single deflection as indicated on drawings; Series 600 as scheduled and manufactured by Price or Series 300 as manufactured by Titus.
2. Fabricate $1\frac{1}{4}$ " border with countersunk screw mounting and gasket.
3. Fabricate of steel with 20 gauge minimum frames and 22 gauge minimum blades, steel and aluminum with 20 gauge minimum frame, or aluminum extrusions, with factory baked enamel finish.
4. Provide integral, gang-operated opposed blade dampers with removable key operator, operable from face.

C. Supply Registers/Grilles:

1. Formed and individually adjustable blades, with $\frac{3}{4}$ " maximum spacing with friction pivot, spring or other device to set blades, horizontal face, single deflection as indicated in schedule on drawings.
2. Fabricate $1\frac{1}{4}$ " border with countersunk screw mounting and gasket.
3. Fabricate of steel with 20 gauge minimum frames and 22 gauge minimum blades, steel and aluminum with 20 gauge minimum frame, or aluminum extrusions, with factory baked enamel finish.
4. Provide integral, gang-operated opposed blade dampers with removable key operator, operable from face.

D. Return Registers/Grilles:

1. Formed blades, mounted vertical or horizontal on $\frac{3}{4}$ " spacing, with single deflection as scheduled on drawings.
2. Fabricate $1\frac{1}{4}$ " border with countersunk screw mounting.
3. Fabricate of steel with 20 gauge minimum frames and 20 gauge minimum blades, with factory white baked enamel finish.
4. Where not individually connected to exhaust fans, provide integral, gang-operated opposed blade dampers with removable key operator, operable from face.

PART 3 -EXECUTION

3.1 INSTALLATION

- A. Install items in accordance with manufacturers' instructions.
- B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry and lighting arrangement.
- C. Install diffusers to ductwork with air tight connection.
- D. Provide balancing dampers on duct take-off to diffusers and grilles and registers, regardless of whether dampers are specified as part of the diffuser, or grille and register assembly.

--END OF SECTION--

SECTION 15950
AUTOMATIC TEMPERATURE CONTROLS

1. SCOPE

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section.
- B. Work in this section includes Direct Digital Control (DDC) panels, main communication trunk, software programming, and other equipment and accessories necessary to constitute a completely coordinated Direct Digital Control (DDC) system, interfaced with pneumatic/electric controls utilizing Direct Digital Control signals to operate pneumatic and electrically actuated control devices to meet, in every respect, all operational and quality standards.
 - 1. Scope
 - 2. Related Work
 - 3. Quality Assurance
 - 4. Submittal
 - 5. Material Delivery and Storage
 - 6. General
 - 7. Facility Management System
 - 8. Networking/Communications
 - 9. Direct Digital Controls
 - 10. Digital (DDC) Panels
 - 11. System Software Features
 - 12. Local Control Panels
 - 13. DDC Application Specific Controllers
 - 14. Operator Work Station
 - 15. DDC Interoperability
 - 16. Automatic Valves
 - 17. Automatic Valve Operators
 - 18. Control Dampers
 - 19. Insulated Low Leakage Control Dampers
 - 20. Output Field Devices
 - 21. Input Field Devices
 - 22. Installation
 - 23. Electrical Wiring

24. Commissioning
25. Training
26. Spare Parts

2. **RELATED WORK**

A. Section 15010 – Basic Mechanical Requirements

3. **QUALITY ASSURANCE**

A. Manufacturer:

1. A firm regularly engaged in the manufacture of DDC control equipment similar to the specified equipment and has been in satisfactory similar service for not less than 10 years.

B. Installer:

1. A firm specializing and experienced in DDC control system installation for no less than 8 years. All work shall be done by qualified mechanics in the direct employ of this manufacturer, or of an authorized representative of that manufacturer. Where installing contractor is an authorized representative of the control equipment manufacturer, submit written confirmation of such authorization. Indicate in letter of authorization that the installing contractor has successfully completed all necessary training required for the installation and commissioning of equipment and systems to be provided for the project, and that such authorization has been in effect for a period of not less than three years.

C. Response Time:

1. During warranty period, four (4) hours or less, 24 hours/day, 7 days/week.

D. Electrical Standards:

1. Provide electrical products, which have been tested, listed and labeled by Underwriters' Laboratories (UL) and comply with NEMA standards.

E. DDC Standards:

1. DDC manufacturer shall provide written proof with shop drawings that the equipment being provided is in compliance with FCC rules governing the control of interference caused by Digital Electronic Equipment to Radio Communications (1979 Amendment to Part 15, Subpart J).

F. Expansion/Flexibility:

1. Allow for 15% control system and panel expansion/flexibility.

G. Coordination:

1. The temperature controls contractor shall coordinate their installation with the Trane Company to allow for information exchange between the buildings' BAS and the information shared with the Trane Supervisory Controller. Any questions regarding the existing controls or the interface shall be directed to Allan Lantz of the Trane

Company at 414 266-5222.

4. SUBMITTALS

- A. Refer to Section 15010 for general submittal requirements. The temperature controls contractor shall also adhere to the following requirements:
- B. Product Data:
1. Submit manufacturer's specifications for each control device furnished, including installation instructions and start up instructions. General catalog sheets showing a series of the same device is not acceptable unless the specific model is clearly marked. Annotated software program documentation shall be submitted for system sequences, along with descriptive narratives of the sequence of operation of the entire system involved. Submit wiring diagram for each electrical control device along with other details required to demonstrate that the system has been coordinated and will function as a system.
- C. Maintenance Data:
1. 1. Submit maintenance data and spare parts lists for each control device. Include this data in maintenance manual.
- D. Record Drawings:
1. 1. Prior to request for final payment provide complete composite record drawings to incorporate all changes in the DDC control system.

5. MATERIAL DELIVERY AND STORAGE

- A. Provide factory-shipping cartons for each piece of equipment and control device. This contractor is responsible for storage of equipment and materials inside and protected from the weather.

6. GENERAL

- A. Provide DDC control products in sizes and of capacities as required, conforming to manufacturer's standard materials and components as published in their product information, designed and constructed as recommended by the manufacturer and as required for application indicate.
- B. All DDC Controllers shall be UL or CSA listed.
- C. All wiring to comply with the requirements of applicable portions of Division 16 and all local and national electric codes.
- D. City of Milwaukee to provide an Ethernet Jack for controls connection at transformer panels and mechanical rooms if required.

7. FACILITY MANAGEMENT SYSTEM

- A. The FMS shall be a complete system designed for use on Intranets and the Internet. This functionality shall extend into the equipment rooms. Primary nodes located in equipment rooms and similar shall be fully IT compatible devices that mount and communicate directly on the IT infrastructure existing in the facility. Contractor shall be responsible for coordination with the City's IT staff to ensure that the FMS will perform in the City's environment without

disruption to any of the other activities taking place on that LAN.

- B. All points of user interface shall be on standard PCs that do not require the purchase of point of interface on these PCs will be a standard Web Browser such as Internet Explorer. Where necessary and as dictated elsewhere in these Specifications, Servers shall be used for the purpose of providing a location for archiving system configuration data, and historical data such as trend data and operator transactions. All data stored will be through the use of a standard data base platform: Microsoft Data Engine (MSDE) or Microsoft SQL Server as dictated elsewhere in this specification.
- C. The work of the single FMS Contractor shall be as defined individually and collectively in all Sections of this Division specifications together with the associated Point Sheets and Drawings and the associated interfacing work as referenced in the related documents as are listed in Part 1 of this Section.
- D. The FMS work shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, verification, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items as Specified in these Division documents which are required for the complete, fully functional and commissioned FMS.
- E. Provide a complete, neat and workmanlike installation. Use only manufacturer employees who are skilled, experienced, trained, and familiar with the specific equipment, software and configurations to be provided for this Project.
- F. Manage and coordinate the FMS work in a timely manner in consideration of the Project schedules. Coordinate cooperatively with the associated work of other trades so as to assist the progress and not impede or delay the work of associated trades.
- G. The FMS as provided shall incorporate, at minimum, the following integrated features, functions and services:
 - 1. Operator information, alarm management and control functions at any Operator's console without the need to purchase special software from the FMS manufacturer for those consoles.
 - 2. Enterprise-level information and control functions.
 - 3. Information management including monitoring, transmission, archiving, retrieval, and reporting functions.
 - 4. Diagnostic monitoring and reporting of FMS functions.
 - 5. Offsite monitoring and management
 - 6. Energy management
 - 7. Indoor Air Quality monitoring and control

8. NETWORKING/COMMUNICATIONS

- A. The FMS shall be designed entirely for use on intranets and internets. All networking

technology used at the Tier 1 level shall be off the shelf, industry standard technology fully compatible with other City provided networks in the facility.

- B. All aspects of the user interface, whether to servers or to Tier 1 solid-state devices, shall be via browsers. Any PCs used as operator interface points shall not require the purchase of any special software from the manufacturer in order to provide the complete user interface as described herein.
- C. The user interface will be complete as described herein, providing complete tool sets, operational features, multi-panel displays, and other display features. Systems which merely provide HTML based web pages as the operator interface will not be acceptable.
- D. The primary components of the system will be the Primary Application Nodes and Servers located at the highest level of the network architecture. Both will use the same user interface and provide the same level of accessibility via the network. The only distinction between the user interface used on servers as compared to Primary Application Nodes will be select menu items used for accessing long term storage features on the servers or on their respective archive devices (CD/RW, etc.)
- E. The FMS shall consist of a number of Nodes and associated equipment connected by industry standard network practices. All communication between Nodes shall be by digital means only.
- F. The FMS network shall at minimum comprise of the following:
 - 1. Operator PCs – fixed or portable.
 - 2. Network processing, data storage and communication equipment including file servers.
 - 3. Routers, bridges, switches, hubs, modems and like communications equipment.
 - 4. Active processing Nodes including field panels.
 - 5. Intelligent and addressable elements and end devices.
 - 6. Third-party equipment interfaces.
 - 7. Other components required for a complete and working FMS.
- G. All FMS features shall be accessible via Enterprise Intranet and Internet browser with equivalent FMS access control for user access.
- H. The FMS shall support auto-dial/auto-answer communications to allow FMS Nodes to communicate with other remote FMS Nodes via standard telephone lines. Refer to drawings for type of line to be used, DSL or voice grade. Where no preference is indicated, DSL is the preferred grade.
- I. The PC Workstations, File servers and principal network equipment shall be standard products of recognized major manufacturers available through normal PC vendor channels. "Clones" are not acceptable.
- J. Provide licenses for all software residing in the FMS system and transfer these licenses to the City prior to completion.
- K. The FMS shall incorporate a primary Tier 1 network. At the Contractor's option, the FMS may

also incorporate integrated secondary Tier 2 and tertiary Tier 3 networks.

- L. The FMS Network shall utilize an open architecture capable of all of the following:
1. Utilizing standard Ethernet communications and operate at a minimum speed of 10/100 Mb/sec
 2. Connecting via BACnet at the Tier 1 level in accordance with as per ANSI/ASHRAE Standard 135-2001.
 3. Connecting via the BACnet Protocol at the Tier 2 level.
 4. Connecting via LonMark as per ANSI/EIA 709 (LonWorks) to LonMark FTT-10 transceivers at the Tier 2 level.
 5. The FMS network shall support both copper and optical fiber communication media.

9. DIRECT DIGITAL CONTROLS

- A. System to be capable of integrating multiple building functions, including equipment supervision and control, alarm management, energy management, and trend data collection.
- B. DDC to consist of Digital Panels, stand alone Application Specific Controllers (ASCs), and Operators Terminals.
- C. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, ASCs, and operator devices.
- D. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

10. DIGITAL (DDC) PANELS

- A. Digital panels shall be microprocessor-based, multi-tasking and digital control processors.
- B. Each digital panel shall have sufficient memory to support its own operating system and data bases including:
 1. Control processes
 2. Energy management application
 3. Alarm management
 4. Trend data
 5. Maintenance support applications
 6. Operator I/O
 7. Dial-up communications
 8. Manual override monitoring
- C. The system shall be modular in nature, and shall permit easy expansion through the addition of field controllers, sensors, and actuators.
- D. Digital panels shall provide at least two RS-232C serial communication ports for simultaneous

operation of multiple operator I/O devices, such as laptop computers, personal computers, and video display terminals.

- E. Digital panels shall monitor the status of all overrides and include this information in the logs and summaries to inform the operator that automatic control has been inhibited.
- F. Each digital panel shall continuously perform self-diagnostics, communications diagnostics, and diagnostics of all subsidiary equipment. Digital panels shall provide both local and remote annunciation of any detected component failures, or repeated failure to establish communication. Indication of the diagnostic results shall be provided at each digital panel.
- G. Isolation shall be provided at all network terminations, as well as all field point terminations, to suppress induced voltage transients consistent with IEEE Standard 5871980. Isolation levels shall be sufficiently high to allow all signal wiring to be run in the same conduit as high voltage wiring acceptable by electrical code.
- H. In the event of the loss of normal power, there shall be an orderly shutdown of the digital panel to prevent the loss of data base or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data, and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.
- I. Upon restoration of normal power, the digital panel shall automatically resume full operation without manual intervention.
- J. Should digital panel memory be lost for any reason, the user shall have the capability of reloading the digital panel via the local RS-232C port or telephone line dial-in.

11. SYSTEM SOFTWARE FEATURES

- A. All necessary software to form a complete operating system, as described in this specification, shall be provided as an integral part of the digital panel, and shall not be dependent upon higher level computer for execution.
- B. Control software shall include a provision for limiting the number of times each piece of equipment may be cycled within any one-hour period.
- C. The system shall provide protection against excessive demand situations during start up periods by automatically introducing time delays between successive start commands to heavy electrical loads.
- D. Digital panels shall have the ability to perform any or all of the following energy management routines:
 - 1. Time of day scheduling
 - 2. Calendar based on scheduling
 - 3. Holiday scheduling
 - 4. Optimal start
 - 5. Optimal stop
 - 6. Demand limiting
 - 7. Load rolling

8. Heating/cooling interlock
- E. All programs to be executed automatically without the need for operator intervention, and be flexible enough to allow user customization. Programs shall be applied to building equipment described in Section 15985B.
 - F. Digital panels shall be able to execute configured processes defined by the user to automatically perform calculations and control routines.
 - G. It shall be possible to use any of the following in a configured process:
 1. Any system-measured point data or status
 2. Any calculated data
 3. Any results from other processes.
 4. Boolean logic operators (and, or)
 - H. Configured processed may be triggered based on any combination of the following:
 1. Time of day
 2. Calendar date
 3. Other processes
 4. Events (e.g., point alarms)
 - I. A single process shall be able to incorporate measured or calculated data from any and all other ASCs.
 - J. A single process shall be able to issue commands to points in any and all other ASCs on the local network.
 - K. Alarm management shall be provided to monitor, buffer, and direct alarm reports to operator devices and memory files. Each digital panel shall perform distributed, independent alarm analysis and filtering to minimize network traffic and prevent alarms from being lost. At no time shall the ability of digital panels to report alarms be affected by either operator activity at the local I/O device or communications with other ASCs on the network.
 - L. All alarm or point change reports shall include the English language description of each point and the time and data of the occurrence.
 - M. The user shall be able to define the specific system reaction for each point. Alarms shall be prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of three priority levels shall be provided. Users shall have the ability to manually inhibit alarm reporting for each point.
 - N. The user shall also be able to define conditions under which point changes need to be acknowledged by an operator and/or logged for analysis at a later date.
 - O. Alarms reports and messages shall be directed to an operator device.
 - P. In addition to the point's descriptor and the time and date, the user shall be able to print, display, or store a 60 character alarm message to more fully describe the alarm condition or

direct operator response.

- Q. Each digital panel shall be capable of storing a library of at least 100 messages. Each message may be assignable to any number of points in the panel.
- R. A data collection utility shall be provided to automatically sample, store, and display system data.
- S. Measured and calculated analog and binary data shall be assignable to user definable trends for the purpose of collecting operator specified performance data over extended periods of time. Sample intervals of 1 minute to 24 hours, in one minute or one hour intervals, shall be provided. Each digital panel shall have a dedicated buffer for trend data and shall be capable of storing 16 trend logs. Each trend log shall have up to four points trended at 48 data samples each. Data shall be stored at the digital panel and uploaded to floppy disk storage when archiving is desired.
- T. Digital panels shall automatically accumulate and store runtime hours for binary input and output points.
- U. Digital panels shall automatically sample, calculate and store consumption totals on a daily, weekly, or monthly basis, user defined, for user-selected analog and binary pulse input type points.
- V. Totalization shall provide calculation and storage accumulations of up to 9,999,999 units (e.g., KWH, gallons KBTU, tons, etc.).
- W. The totalization routine shall have a sampling resolution of one minute.
- X. The user shall have the ability to define a warning limit. Unique, user specified messages shall be generated when the limit is reached.
- Y. The information available from pulse totalization shall include, but not be limited to the following:
 - 1. Peak demand with date and time stamp
 - 2. 24 hour demand log
 - 3. Accumulated KWH for day
 - 4. Sunday through Saturday KWH usage
 - 5. Demand KW annual history for past 12 periods.
 - 6. KWH annual history for past periods
- Z. Digital panels shall have the ability to count events, such as the number of times a pump or fan system is cycled on and off.
- AA. The event totalization feature shall be able to store the records associated with a minimum of 9,999,999 events before reset.

12. LOCAL CONTROL PANELS

- A. Use control panels with suitable mounting brackets for each supply fan system. Locate panel adjacent to system served.

- B. Fabricate panels of 14 gauge furniture grade steel of 6063-T5 extruded aluminum alloy, totally enclosed on six sides, hinged door and keyed lock, with manufacturer's standard shop painted finish and color.
- C. Network controllers can be mounted on Din rail in plastic enclosures.
- D. Provide UL listed cabinets for use with line voltage devices.
- E. All conduit shall be bonded and grounded.
- F. Provide control panels for all DDC Controllers, ASCs and associated function modules. All controls to be in panels without exception.
- G. Permanently label all controls; tag all pneumatic tubing and control wiring.

13. DDC APPLICATION SPECIFIC CONTROLLERS

- A. Each Standalone DDC panel shall be able to extend its performance and capacity through the use of remote Application Specific Controllers (ASCs).
- B. Standalone controller capable of performing its specified control responsibilities independently of other controllers in the network. Microprocessor-based, multi-tasking, real-time digital control processor.
- C. Memory: Sufficient to support its own operating system and databases including:
 - a. Control Processes
 - b. Energy Management Applications
 - c. Operator I/O
- D. Operator interface: Through any network-resident PC workstation, or any PC or portable operator's terminal connected to any DDC panel in the network.
- E. Directly support the use of a portable/permanent terminal. Terminal shall have the following capabilities:
 - a. Display temperatures
 - b. Display status setpoints
 - c. Display control parameters.
 - d. Override binary output control and analog setpoints.
 - e. Modification of gain and offset constants.
- F. Powerfail Protection: Store all system setpoints, proportional bands, control algorithms, and any other programmable parameters such that a power failure of any duration does not necessitate reprogramming the controller.
- G. Configuration and Download: Receive configuration and program loading by the following:
 - a. Locally, via a direct connect portable laptop service tool.
 - b. Over the network, from the portable laptop service tool.

- c. From the Operator workstation, via the communication networks.
- H. Continuous Zone Temperature Histories: Maintain a history for the past 24 hours (minimum of two samples per hour).
- I. Alarm Management: Perform its own limit and status monitoring and analysis to maximize network performance by reducing unnecessary communications.
- J. Configured using an intuitive configuration tool. Standard, pre-tested, HVAC applications will be "built in" the tool. It is the intent that a non-programmer, fluent with HVAC systems, and not necessarily with computer programming, be capable of using the configuration tool with minimal training.

14. OPERATOR WORK STATION

- A. **Web browsers and Server are existing** for command entry, information management, network alarm management, and database management.
- B. All real time control functions shall be resident in the stand-alone DDC panels to facilitate greater fault tolerance and reliability.
- C. Workstation shall perform all the functions described in this specification.
- D. Dynamic Color Graphic Displays: Color graphic system schematics for each air handling unit affected by this project shall be provided to optimize system performance analysis and speed alarm recognition.
 - 1. System Selection/Penetration: The operator interface shall allow users to access the various system schematics via a graphical penetration scheme, menu selection, or text-based commands.
 - 2. Dynamic Data Displays: Dynamic temperature values, humidity values, flow values, and status indication shall be shown in their actual respective locations, and shall automatically update to represent current conditions without operator intervention.
 - 3. Windowing: The windowing environment of the PC Operator Workstation shall allow the user to simultaneously view several graphics at the same time to analyze total building operation, or to allow the display of a graphic associated with an alarm to be viewed without interrupting work in progress.
 - 4. Graphics Definition Package: Graphic generation software shall be provided to allow the user to add, modify, or delete system graphic displays.
 - a. The FMS contractor shall provide libraries of pre-engineered screens and symbols depicting standard air handling unit components (e.g., fans, cooling coils, filters, dampers, etc.), complete mechanical systems (e.g., constant volume-terminal reheat, VAV, etc.) and electrical symbols.
 - b. The graphic development package shall use a mouse or similar pointing device in conjunction with a drawing program to allow the user to perform the following:
 - 1) Define symbols
 - 2) Position and size symbols

- 3) Define background screens
 - 4) Define connecting lines and curves
 - 5) Locate, orient and size descriptive text
 - 6) Define and display colors for all elements
 - 7) Establish correlation between symbols or text and associated system points or other displays.
- c. Graphical displays can be created to represent any logical grouping of system points or calculated data based upon building function, mechanical system, building layout, or any other logical grouping of points which aids the operator in the analysis of the facility. To accomplish this, the user shall be able to build graphic displays that include point data from multiple DDC panels, including application specific controllers used for DDC control.

15. DDC INTEROPERABILITY

- A. The Facility Management System (FMS) shall be capable of interoperating with multiple building systems supplied by different manufacturers. The FMS shall be able to receive, react to, and in some cases, return information from multiple building systems.
- B. Point inputs and outputs from the third-party controllers shall have real-time interoperability with FMS software features such as: Control Software, Energy Management, Custom Process Programming, Alarm Management, Historical Data and Trend Analysis, Totalization, and Dial-Up and Local Area Network Communications, as mentioned earlier in the specification.
- C. Networking/Communications:
1. The FMS shall support any combination of third-party controllers (if more than one third-party manufacturer is being integrated) on a single network.
 2. A minimum of 100 third-party controllers shall be supported on a single network.
 3. Integration shall be by BACnet, Lon, RS-232 or RS-485 technologies.
- D. Diagnostics/Verification:
- E. The installer/operator shall have the ability to verify, and diagnose communication messages and point information between third-party controllers and the Facility Management System.
- F. Product Integrator Interface
1. The FMS system shall include appropriate hardware equipment and software to allow two way data communications between the FMS system and the product manufacturer's product control panel.
 2. It shall be the responsibility of the FMS Contractor to coordinate with the product manufacturer to provide a functional data communications connection.
 3. All data supported by the product communication protocol shall be mapped into the supervisory DDC controller's database and shall be displayed on a product data screen at the Operator Workstation and shall be transparent to the operator.

4. The FMS Contractor shall furnish either the OSP or BACnet communications interface as required by the product manufacturer.
5. The FMS Contractor shall provide all communications and power wiring and gateway panel installation for the DDC system. The product manufacturer shall provide all hardware for connection of the manufacturer's processor.
6. The FMS Contractor shall provide all hardware and software required for the product manufacturer's gateway interface.

16. AUTOMATIC VALVES

- A. Furnish factory fabricated automatic 2 way control valves of the type, body materials, and pressure class indicated. (JCI VG series ,or equivalent by Belimo, for 4" and smaller, butterfly acceptable for greater than 4")
- B. Where type or body material is not indicated, provide selection as determined by manufacturer for installation requirements and pressure class, based on maximum pressure and temperature in the piping system.
- C. Water service valves shall be sized for a 4 psi maximum pressure drop.
- D. Valves shall be installed by the mechanical contractor.

17. AUTOMATIC VALVE OPERATORS

- A. Automatic valve operators shall be of the electric/electronic type and shall be sized to operate their respective automatic valves with sufficient reserve power to provide smooth modulating action or two-position action as specified.
- B. Automatic valve operators serving shall be equipped with spring return for primary heating to position valves to their fully open position. Chilled water valve operators to be spring return only where called for in sequence of operation section.
- C. Automatic valve operators shall be JCI M9000 Series, analog modulation, or equivalent by Belimo, for DDC applications.

18. CONTROL DAMPERS

- A. Furnish control dampers shown on the plans and as required to perform the specified functions.
- B. Acceptable Manufacturers of air dampers are Ruskin model CD-50 or equivalent Johnson Controls, Air Balance, Advanced Air, Cesco, American Warming and Ventilating, Vent Products Company Inc., Greenheck or Arrow damper products.
- C. Use only factory fabricated, low leakage type dampers with replaceable resilient blade seals, stainless steel jamb seals and with entire assembly suitable for the maximum temperature and air velocities encountered in the system.
- D. All dampers for shut-off or isolation service to be UL 555S Class 2 leakage rated at 250°F. Damper leakage not to exceed 8.0 cfm/S.F. @ 4" W.G. pressure differential.
- E. Dampers used for mixing of airstreams to be parallel blade type, sized for air velocity of 1800 to 2000 fpm. Dampers used for throttling or modulating applications other than air stream mixing to be opposed blade type. Two position dampers may be parallel or opposed blade type.

- F. Dampers for applications other than fume exhaust to have frames of not less than 16 gauge galvanized steel or 12 gauge extruded aluminum. Blades to be not less than 16 gauge galvanized steel for single thickness, 22 gauge galvanized steel for double thickness, or 14-gauge aluminum, with steel rod, bronze or nylon bearings. Maximum allowable blade width is 8 inches. Use zinc plated steel linkage hardware.
- G. Maximum damper width is 48 inches; where required width exceeds 48 inches, use multiple dampers. Minimum size for duct-mounted dampers is 90% of duct size.
- H. Damper operators shall be Belimo or Johnson Controls, Inc. electric type compatible with the DDC control system. Use direct mount, synchronized operating, bi-directional, fail-safe operators. Provide operators with linkages and brackets for mounting on device served as required.
- I. Size operators for smooth and positive operation of devices served, and with sufficient capacity to provide tight shutoff against system temperatures and pressure encountered. Equip operators with spring return for applications involving fire, freeze protection, moisture protection or specified normally open/closed operation. Provide operators with linkages and brackets for mounting on device served. Automatic operators shall be JCI M9000 Series, or equivalent by Belimo, modulating or 2-pos as required.

19. INSULATED LOW LEAKAGE CONTROL DAMPERS

- A. TAMCO Series 9000 SC severe cold thermally insulated damper.
- B. Extruded aluminum 6063T5 damper frame shall not be less than .080" thickness. Damper frame shall be 4" deep and shall be insulated with styrofoam on three sides for installation in ductwork.
- C. Blades to be extruded aluminum (6063T5), internally insulated with expanded polyurethane foam and shall be thermally broken. Complete blade shall have an insulating factor of R-2.29 and a temperature index of 55.
- D. Blade and frame seals shall be of extruded silicone and be secured in an integral slot within the aluminum extrusions.
- E. Bearings are to be composed of a celcon inner bearing fixed to a 7/16" (11.11mm) aluminum hexagon blade pin, rotating within a polycarbonate outer bearing inserted in the frame.
- F. Linkage hardware shall be installed in the frame side and be constructed of aluminum and corrosion-resistant, zinc-plated steel, complete with cup-point trunnion screws for slip-proof grip.
- G. Dampers to be designed for operation in temperatures ranging between -40°F (-40°C) and 212°F (100°C).
- H. Dampers shall be available with opposed blade action.
- I. Air leakage through a 48" x 48" damper shall not exceed 4.12 cfm/ft.2 against 4" w.g. differential static @ standard air. Standard air leakage data to be certified under the AMCA certified ratings program.
- J. Leakage shall not exceed 4.9 cfm/ft.2 against 4" w.g. differential static pressure @ -40°F.
- K. Pressure drop of a fully open 48" x 48" damper shall not exceed .03" w.g. at 1000 fpm.

- L. Dampers shall be made to size required without blanking off free area.
- M. Installation of dampers shall be in accordance with manufacturer's installation guidelines.
- N. Install insulated low leakage dampers at all outside air and relief air locations.

20. OUTPUT FIELD DEVICES

A. Control Relays:

1. Interposing control relays shall be rated for the application, have a minimum of two sets of Form C contacts, and be enclosed in dust proof enclosure. The coils shall be equipped with transient suppression devices to limit transients.
2. Provide hands-off automatic override switches for DDC binary outputs where necessary.

21. INPUT FIELD DEVICES

A. Temperature Sensor:

3. Use nickel wire RTD type temperature sensing elements constructed so that the accuracy and life expectancy is not affected by moisture or other conditions that exist in each application. Normal range to be 35 degrees F to 100 degrees F with accuracy of +0.5 degrees Fahrenheit and a base resistance of 1000 ohms at 77 degrees Fahrenheit. Provide sensors in occupied spaces with covers to match those specified thermostats.
4. Room sensors shall have digital display of room temperature, ICI TMZ series or equivalent by Trane or Carrier.
5. Provide limited range or extended range sensors if required to sense the range expected for a respected point.
6. Use averaging elements on duct sensors.
7. Use element on sensors in piping systems compatible with installation in separable wells.
8. Check and verify location of thermostats, water sensors, and other exposed control sensors with plans and room details before installation. Locate room thermostats 48 inches above floor. Align with light switches.
9. Any room thermostats mounted on an exterior wall shall be mounted on a thermally insulated sub-base.
10. Provide guards on thermostats in entrance hallways, other public areas, or in locations where thermostat is subject to physical damage.
11. Coordinate locations with City prior to installation.

B. Pump flow status by differential water pressure switch or current switch.

- C. Differential pressure type switches (water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 enclosure, with scale range and differential suitable for intended application, or as specified.

- D. Fan status shall be by current switch: Do not use DP switches across fans as fan status input points into the DDC panel. Instead use current sensors (current transformers) on one phase of the fan motors, sensitive enough to detect a broken belt, i.e., motor running but not the fan.
- E. Current-operated switches shall be self-powered, solid state with adjustable trip current. The switches shall be selected to match the current of the application and output requirements of the DDC system. Approved manufacturers: Veris Industries.
- F. Electronic pressure sensors shall be: Direct acting or reverse acting, unidirectional or bi-directional type. Output signal: 0 to 5vdc DC Range: Smallest possible, which will cover the range, required for normal operating conditions. End-to-end (full scale) accuracy: +1% of full scale.

22. INSTALLATION

- A. Install equipment as indicated to comply with manufacturer's written instructions.
- B. Install software in DDC control units and Operator Workstation. Implement all features of programs to specified requirements and appropriate to sequence of operation.
- C. Connect and configure equipment and software to achieve the sequence of operation specified.
- D. Verify location of thermostats, temperature and humidity sensors, and other exposed control sensors with plans and room details before installation. Locate 48 inches above floor.
- E. Connect manual reset limit controls, such as low limit thermostats, and high limit pressure controls directly (hard-wired) to motor starters (or variable frequency drives); connect limit controls to stop the fans or pumps in both the "Hand" and the "Auto" selector switch positions.
- F. Provide guards on thermostats in the following locations:
 - 1. Entrances.
 - 2. Public areas.
 - 3. Where indicated.
- G. Install damper motors on outside of duct in warm areas, not where exposed to outside air temperatures. Damper motors can be installed inside cold outside air ducts if the control air piping is short and is not trapped within the cold space.
- H. Install labels and nameplates to identify control components according to Division 15 Sections specifying mechanical identification.
- I. Refer to Division 15 Section "Hydronic Piping" for installation of hydronic instrument wells, valves, and other accessories.
- J. Refer to Division 15 Section "Duct Accessories" for installation or automatic control dampers.
- K. Coordinate equipment selections with Division 16 Sections to achieve compatibility with the fire alarm system.

23. ELECTRICAL WIRING

- A. General: Power and control wiring shall be run in a neat and workmanlike manner, parallel and perpendicular to the building structure, concealed wherever possible, without slices between

terminal points, and properly supported from the structure.

- B. Install power and control wiring and conduit according to the requirements of Division 16 Sections, and as follows:
- C. Line Voltage Wiring (Over 30 Volts): Run within electric metallic tubing.
- D. Low Voltage Wiring (Under 30 Volts):
 - 1. Wiring Exposed to View, or Inaccessible: Run wiring within electric metallic tubing where exposed to view or where subject to physical damage, such as in mechanical equipment rooms; and where inaccessible, such as in concrete walls or floors, in furred walls, or above ceilings with no access.
 - 2. Wiring Accessible, and Concealed: Wiring may be run without electric metallic tubing where accessible and concealed, such as within instrument panels or above suspended ceilings with easy access, may be run without conduit. Such wiring shall be neatly run, bundled and sheathed, with a maximum unsupported length of 36 inches.
- E. Bundle and harness multi conductor instrument cable in place of single cables where a number of cables follow a common path.
- F. Fasten flexible conductors, bridging cabinets and doors, neatly along hinge side; protect against abrasion. Tie and support conductors neatly.
- G. Number-code or color-code conductors, except local individual room controls, for future identification and servicing of control system.
- H. Connect electrical components to wiring systems and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening requirements specified in UL 486A.

24. COMMISSIONING

- A. Manufacturer's Field Services: Provide the services of a factory-authorized service representative to start control systems.
- B. Test and adjust controls and safeties.
- C. Replace damaged or malfunctioning controls and equipment.
- D. Start, test, and adjust control systems.
- E. Demonstrate compliance with requirements.
- F. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.
- G. The Contractor shall completely check out, calibrate and test all connected hardware and software to insure that the system performs in accordance with the approved specifications and sequences of operation submitted. A witnessed validation demonstration shall be provided if requested.

25. TRAINING

- A. The manufacturer shall provide training for the City's building personnel in procedures for start-up, testing and operating the Automatic Control System. Schedule training with 7 days advance notice. During the commissioning phase of the installation and at such time as acceptable performance of the overall system's hardware and software has been established, the contractor shall provide on-site operator instruction for the City's operating personnel.
- B. Operator instruction relevant to the automatic control system shall include, but not be limited to the overall operational program, equipment functions (both individually and as part of the total integrated system), commands, system generation, advisories, and appropriate operator intervention required in responding to the automatic control system operation, a description of the chronological information flow from field sensors, contacts and devices and an overview of the automatic control system communication network explaining the interplay between initiating devices, field data-gathering panels, system communications and their importance within the operating system.
- C. Provide on-site operator instruction during normal working hours. Instruction shall be performed by experienced factory trained technical representatives familiar with the overall system's software, hardware and accessories. Provide a minimum of eight (8) hours of on-site training for City's designated operating personnel. Training shall be 4 hours in length.
- D. Training shall not start until the following events have occurred two weeks prior:
 - 1) Approval of the Operation and Maintenance Manuals by the City's Facilities Development and Management – Mechanical Planning and Design Unit.
 - 2) Approval of the Test and Balance Reports by the City's Facilities Development and Management – Mechanical Planning and Design Unit
 - 3) Turn over of as-built drawings and schematics to the City's Facilities Development and Management – Mechanical Planning and Design Unit

26. SPARE PARTS

- A. Provide the spare part for each ten supplied under the contract of the following:
 - 1) Terminal Automatic Valves.
 - 2) Room Temperature Sensors.

--END OF SECTION--

**SECTION 15980
INSTRUMENTATION**

PART 1 -GENERAL

1.1 SECTION INCLUDES

- A. Pressure gauges and pressure gauge taps.
- B. Thermometers and thermometer wells.
- C. Static pressure and filter gauges.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Section 15510 -Hydronic Piping
- B. Section 15781 – Packaged Rooftop Air Conditioning Units
- C. Section 15890 -Ductwork

1.3 REFERENCES

- A. ANSI/ASME B40.1 -Gauges -Pressure Indicating Dial Type -Elastic Element.
- B. ASME MFC-3M -Measurement of Fluid Flow in Pipes Using Orifice, Nozzle and Venturi.
- C. ASTM E1 -Specification for ASTM Thermometers.
- D. ASTM E77 -Verification and Calibration of Liquid-in-Glass Thermometers.
- E. AWWA C701 -Cold Water Meters -Turbine Type for Customer Service.
- F. AWWA C702 -Cold Water Meters -Compound Type.
- G. AWWA C706 -Direct Reading Remote Registration Systems for Cold Water Meters.
- H. AWWA M6 -Water Meters -Selection, Installation, Testing and Maintenance.

1.4 SUBMITTALS

- A. Refer to General Conditions Division 1 and Section 15010.
- B. Product Data: Include list which indicates use, operating range, total range and location for manufactured components.
- C. Submit manufacturer's installation instructions under provisions of General Conditions Division 1 and Section 15010.

1.5 PROJECT RECORD DOCUMENTS

- A. Refer to General Conditions Division 1 and Section 15010.
- B. Accurately record actual locations of instrumentation.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 -PRODUCTS**2.1 ACCEPTABLE MANUFACTURERS -PRESSURE GAUGES AND THERMOMETERS**

- A. Marshalltown
- B. Ashcroft
- C. Marsh Instruments
- D. Moeller
- E. Weksler
- F. Taylor
- G. Trerice
- H. Weiss Instruments
- I. Substitutions: Under provisions of Division 1 and Section 15010.

2.2 PRESSURE GAUGES

- A. ANSI/ASME B40.1, 4½" 6" diameter black aluminum case, phosphor bronze bourdon tube, rotary stainless steel movement, brass socket, with front recalibration adjustment, black scale on white background, 1% mid-scale accuracy, scale calibrated in psi. Series 500X manufactured by Trerice.

2.3 PRESSURE GAUGE ACCESSORIES

- A. Gauge Cock: Tee handle, brass for maximum 150 psig. Series 865-manufactured by Trerice.
- B. Impulse Dampener: Impulse dampener, brass with ¼" connections. Series 870 manufactured by Trerice.

2.4 STEM TYPE THERMOMETERS

- A. ASTM E1, 7" scale, adjustable angle, red appearing mercury, lens front tube, cast aluminum case with blue/black metallic finish and clear glass window, 3½" or 6" brass stem, cast aluminum adjustable joint with positive locking device, 2% of scale accuracy to ASTM E77, scale calibrated in degrees F. Model A401 manufactured by Trerice.
- B. ASTM E1, 7" scale, adjustable to any angle, red appearing mercury, lens front tube, cast aluminum case with metallic blue/black finish, reversible mounting flange and clear glass window, 12" brass stem, perforated aluminum bulb guard, cast aluminum adjustable joint with positive locking device, 2% of scale accuracy to ASTM E77, scale calibrated in degrees F. Model A013 manufactured by Trerice.

2.5 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions as required and with cap and chain.
- B. Flange: 3" outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.6 STATIC PRESSURE GAUGES AND FILTER GAUGES

- A. Inclined manometer, red liquid on white background with black figures, front recalibration adjustment, range as scheduled on drawings. Model 200 manufactured by Dwyer.
- B. Accessories: Vent valves Surface mounting bracket, static pressure taps with integral compression fittings, 1/4" aluminum tubing, plastic vent valves.

PART 3 -EXECUTION**3.1 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install pressure gauges with impulse dampeners. Provide gauge cock to isolate each gauge.
- C. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2 1/2" for installation of thermometer sockets.
- D. Install thermometers in air duct systems on flanges.
- E. Install thermometer sockets adjacent to controls system thermostat, transmitter, or sensor sockets.
- F. Locate duct mounted thermometers minimum 10 feet downstream of mixing dampers, coils, or other devices causing air turbulence.
- G. Coil and conceal excess capillary on remote element instruments.
- H. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- I. Install gauges and thermometers in locations where they are easily read from normal operating level.
- J. Locate test plugs where indicated.

3.2 FIELD INSPECTION AND REPORT

- A. Provide report, in accordance with Section 15010, prepared by manufacturer's representative, stating that systems installed and services provided under this Section are in accordance with manufacturer's recommendations and are properly operating.

--END OF SECTION--

**SECTION 15985
SEQUENCE OF OPERATION**

PART 1 -GENERAL

1.1 SECTION INCLUDES

- A. This section includes a written sequence of operation for all HVAC equipment. Included are the following topics:
 - 1. Scope
 - 2. Related Work
 - 3. Packaged Rooftop Air Conditioning Unit – RTU-5

1.2 RELATED WORK

- A. Section 15010 – Basic Mechanical Requirements.
- B. Section 15871 – Packaged Rooftop Air Conditioning Units.
- C. Section 15950 – Automatic Temperature Controls.
- D. Section 16480 – Motor Controls.

1.3 SUBMITTALS

- A. Refer to General Conditions and Division 1.
- B. Submit shop drawings and product data under provisions of Division 1 and 15010.

1.4 OPERATION AND MAINTENANCE DATA

- A. Refer to General Conditions and Division 1.
- B. Submit operation and maintenance data under provisions of Sections 15010.
- C. Include assembly drawings, bearing data including replacement sizes and lubrication instructions.

1.5 QUALITY ASSURANCE

- A. Refer to General Conditions, Division 1 and 15010.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Refer to General Conditions and Division 1.
- B. Deliver products to site under provisions of Division 1 and 15010.
- C. Store and protect products under provisions of Division 1 and 15010.

1.7 WARRANTY

- A. Refer to Section 15010.
- B. Store and protect products under provisions of Division 1 and 15010.

PART 2 -PRODUCTS

- A. Not Used.

PART 3 -SEQUENCE OF OPERATION**3.1 GENERAL**

- A. The prime contractor is responsible for providing controls. The Trane Company shall be the vendor for computerized controls.
- B. The Trane Company shall furnish the control valves, valve actuators, damper actuators, low limit thermostats and local loop controls.
- C. The prime contractor shall install the control valves, valve actuators, damper actuators, low limit thermostats, etc. furnished by The Trane Company.
- D. The Trane Company shall provide transmitters, digital controller and related wiring.
- E. Provide DDC controls for the new RTU. Controller shall be manufactured by Trane.
- F. All points shall be addressable at the MPD's Police Administration Building near 8th and State Street in Milwaukee, WI.

3.2 PACKAGED ROOFTOP AIR CONDITIONING UNITS RTU-5

- A. All sequences described below shall be programmed and controlled from the Building Management System unless otherwise noted. All setpoints shall be operator adjustable.
- B. Packaged air conditioning unit shall have a microprocessor-based controller that shall monitor and control the RTU in a stand-alone mode or as directed by the building automation system (BAS). The RTU control panel shall have a human interface panel with a clear English LCD display and keypad for monitoring, setting, editing and controlling.
- C. The BAS shall perform the following RTU control strategies, provide the points listed on the point list and provide the specified monitoring and diagnostics.
- D. Occupied Mode (CRAC-1 shall be disabled).
 1. RTU shall run continuously during occupied mode. The outside air and return dampers shall modulate to the minimum outside air position. DX cooling, and economizer operation shall be enabled. Minimum on/off timing of the mechanical cooling shall be used to prevent rapid cycling.
 2. If all hardwired safety interlocks allow operation, the supply fan shall start.
 3. Upon proof of supply fan operation, the space air temperature shall be maintained at 72°F (adjustable) by controlling the return and outdoor air dampers, and stages of DX cooling, depending on the operating mode the system is in.
 4. The power exhaust fan is controlled based on outside air damper position.
 5. The RTU shall be controlled from the DDC system to maintain the space air temperature setpoint of 72°F (adjustable). The stages of return and outdoor air dampers, and the stages of DX cooling shall be controlled in sequence to maintain

the space setpoint. Whenever the space temperature is above the setpoint, the following shall occur in sequence: When the economizer sequence is enabled, the economizer outside air damper and return air dampers will be modulated together in sequence to maintain space temperature setpoint. When the outside air economizer damper is completely open, or the economizer sequence is not enabled, the stages of DX cooling shall be controlled to maintain the space temperature setpoint. When the space temperature is below setpoint the reverse shall occur. .

6. Economizer Operation -The air handling unit shall be capable of economizer operation given the following conditions.
 - a. When the outside air enthalpy is less than the return air enthalpy, the economizer outside air and return dampers shall be controlled to maintain the space temperature setpoint.
 - b. When the space temperature setpoint cannot be satisfied from outside air cooling, control the stages of DX cooling compressors to maintain the space temperature setpoint. Hot Gas Bypass (Hot Gas Reheat) shall be utilized to maintain space air temperature.
 - c. RTU economizer switchover shall be by enthalpy comparison. When the outside air enthalpy is greater than the return air enthalpy, the outside air damper shall be closed to the minimum position and the return air and relief air dampers shall be open. The stages of DX cooling compressors shall be controlled to maintain the space temperature setpoint.
 7. Dehumidification (Hot Gas Reheat)
 - a. Allow for increased outdoor air ventilation.
 - b. Reduces humidity levels while increasing comfort level in the air space.
 - c. Cooling can operate without a demand for dehumidification.
 - d. Hot gas reheat coil is designed to deliver maximum reheat temperatures and pivot to allow for easy access cleaning
 8. Electric Reheat
 - a. A single stage electric reheat shall be energized as the temperature decreases below the room temperature setpoint.
 9. Low Ambient Cooling Operation
 - a. Low ambient cooling down to 0°F
 1. Low ambient enabled.
 - a. Continuous fan operation, crankcase heaters, thermal expansion valves, frostat.
- E. Unoccupied Mode (CRAC-1 shall be enabled).
1. When the BAS initiates unoccupied mode the RTU shall shut down. If the room temperature drops below the unoccupied heating setpoint of 60F, the RTU and the

stages of electric heat shall be controlled to maintain the heating setpoint (when CRAC-1 is Disabled or in failure). The RTU outside air damper shall be fully closed and the return damper shall be fully open during unoccupied operation. Mechanical cooling and economizer operation shall be locked out. When the zone is above the unoccupied heating shutdown setpoint of 65F, the RTU shall shut off.

F. Alarms

1. Dirty Filter Alarm: An alarm shall be created at the RTU and sent to the BAS. The unit shall continue to operate as normal.
2. Fan Failure Alarm: An alarm shall be created at the RTU and sent to the BAS. The start signal to the unit shall be maintained.
3. Low DAT Alarm: An alarm shall be created at the RTU and sent to the BAS. A hardwired interlock shall shut down the RTU. Alarm shall require manual reset.
4. Room Temperature Alarm: If BAS detects that zone temperature is more than 3F from its setpoint (during occupied operation) an alarm shall be generated at the BAS. The unit shall continue to operate as normal.
5. Smoke Alarm: Integral smoke detector shall shut down the RTU and create an alarm at the BAS. Alarm shall require manual reset.
6. Phase Loss, Imbalance, or Reversal Alarm: An alarm shall be created at the RTU and sent to the BAS. A hardwired interlock shall shut down the RTU. Alarm shall automatically reset upon phase correction.

G. The following are the control fail-safe conditions upon failure of the respective DDC system controller or loss of control power.

1. The supply air fan shall fail OFF and the powered exhaust fan shall fail OFF.
2. The DX cooling stages shall fail OFF.
3. The electric heating stages shall fail OFF.
4. The outside air dampers shall close.
5. The return air damper shall open.
6. Any hardwired safeties shall override the specified fail-safe positions indicated above.

H. Provide the following alarms at the central DDC system computer:

1. High Humidity
2. Low Humidity
3. Supply Fan Failure
4. Electric Heat Failure
5. DX Cooling Failure
6. High Space Temperature
7. Change Filter

I. Through the central DDC system computer, provide the following digital indications for this system (High limit/operating point/low limit):

1. Return Air Temperature
2. Outside Air Temperature
3. Mixed Air Temperature
4. Discharge Air Temperature
5. Electric Heat Stage Status
6. DX Cooling Stage 1 Status
7. DX Cooling Stage 2 Status
8. DX Cooling Stage 3 Status
9. Powered Exhaust Fan Status
10. Supply Fan Status
11. Zone Temperature

J. The Point List for the RTU's are as follows:

Point Type	General Description
Digital Outputs (DO)	Supply Fan Start/Stop
	Gas Heat Stage 1 Command
	DX Cooling Stage 1 Command
	DX Cooling Stage 2 Command
	DX Cooling Stage 3 Command
Digital Inputs (DI)	
	Powered Exhaust Fan Status (via current switch)
	Supply Fan Status (via current switch)
	Freezestat Status
	Gas Heat Stage 1 Status
	DX Cooling Stage 1 Status
	DX Cooling Stage 2 Status
	DX Cooling Stage 3 Status
	Phase Loss
Analog Outputs (AO)	Economizer Outside Air Damper
	Return Air Damper
Analog Inputs (AI)	Outside Air Temperature
	Return Air Temperature
	Mixed Air Temperature
	Discharge Air Temperature
	Filter Differential Pressure
	Space Temperature

--END OF SECTION--

SECTION 15990
TESTING, ADJUSTING AND BALANCING

PART 1 -GENERAL

1.1 SECTION INCLUDES

- A. Testing, adjustment and balancing of air systems.
- B. Testing, adjustment, and balancing of hydronic systems.
- C. Measurement of final operating condition of HVAC systems.

1.2 RELATED SECTIONS

- A. Section 15010 – Basic Mechanical Requirements
- B. Section 15515 -Hydronic Specialties.
- C. Section 15545 – Pipe Cleaning, Flushing and Chemical Treatment.
- D. Section 15781 -Packaged Roof Top Air Conditioning Units.
- E. Section 15890 -Ductwork.
- F. Section 15910 -Ductwork Accessories.

1.3 REFERENCES

- A. AABC -National Standards for Field Measurement and Instrumentation, Total System Balance.
- B. ASHRAE -1995 HVAC Applications Handbook: Chapter 34, Testing, Adjusting and Balancing.
- C. NEBB -Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.
- D. TABB -International Standards for Environmental Systems Balance.

1.4 SUBMITTALS

- A. Submit test reports as a submittal under provisions of Section 15010.
- B. Submit test reports under provisions of Section 15010.
- C. Prior to commencing work, submit draft reports indicating adjusting, balancing and equipment data required.
- D. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Engineer and for inclusion in operating and maintenance manuals.
- E. Provide reports in soft cover, letter size, three-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
- F. Include detailed procedures, agenda, sample report forms prior to commencing system balance.

1.5 REPORT FORMS

A. Submit reports on AABC National Standards for Total System Balance or NEBB forms.

B. Forms shall include the following information:

1. Title Page:
 - a. Company name
 - b. Company address
 - c. Company telephone number
 - d. Project name
 - e. Project location
 - f. Project Engineer
 - g. Project Contractor

2. Instrument List:
 - a. Instrument
 - b. Manufacturer
 - c. Model
 - d. Serial number
 - e. Range
 - f. Calibration date

3. Air Moving Equipment:
 - a. Location
 - b. Manufacturer
 - c. Model
 - d. Air flow, specified and actual
 - e. Return air flow, specified and actual
 - f. Outside air flow, specified and actual
 - g. Total static pressure (total external), specified and actual
 - h. Inlet pressure
 - i. Discharge pressure
 - j. Fan RPM

4. Return Air/Outside Air/Relief Air Data:
 - a. Identification/location
 - b. Design air flow
 - c. Actual air flow
 - d. Design return air flow
 - e. Actual return air flow
 - f. Design outside air flow
 - g. Actual outside air flow
 - h. Return air temperature
 - i. Outside air temperature
 - j. Required mixed air temperature
 - k. Actual mixed air temperature
 - l. Design outside/return air/relief air ratio
 - m. Actual outside/return air/relief air ratio

5. Electric Motors:

- a. Manufacturer
 - b. HP/BHP
 - c. Phase, voltage, amperage; nameplate, actual, no load.
 - d. RPM
 - e. Service factor
 - f. Starter size, rating, heater elements
6. V-Belt Drive:
- a. Identification/location
 - b. Required driven RPM
 - c. Driven sheave, diameter and RPM
 - d. Belt, size and quantity
 - e. Motor sheave, diameter and RPM
 - f. Center to center distance, maximum, minimum, and actual
7. Duct Traverse:
- a. System zone/branch
 - b. Duct size
 - c. Area
 - d. Design velocity
 - e. Design air flow
 - f. Test velocity
 - g. Test air flow
 - h. Duct static pressure
 - i. Air temperature
 - j. Air correction factor
8. Air Distribution Test Sheet:
- a. Air terminal number
 - b. Room number/location
 - c. Terminal type
 - d. Terminal size
 - e. Area factor
 - f. Design velocity
 - g. Design air flow
 - h. Test (final) velocity
 - i. Test (final) air flow
 - j. Percent of design air flow
9. Air Cooled Condenser:
- a. Identification/number
 - b. Location
 - c. Manufacturer
 - d. Model
 - e. Entering DB air temperature, design and actual
 - f. Leaving DB air temperature, design and actual
 - g. Number of compressors

10. Cooling Coil Data:
 - a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Air flow, design and actual
 - f. Entering air DB temperature, design and actual
 - g. Entering air WB temperature, design and actual
 - h. Leaving air DB temperature, design and actual
 - i. Leaving air WB temperature, design and actual
 - j. Air pressure drop, design and actual

11. Heating Coil Data:
 - a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Air flow, design and actual
 - f. Entering air temperature, design and actual
 - g. Leaving air temperature, design and actual
 - h. Air pressure drop, design and actual

1.6 PROJECT RECORD DOCUMENTS

- A. Submit record documents under provisions of Section 15010.
- B. Accurately record actual locations of balancing valves and rough setting.

1.7 QUALITY ASSURANCE

- A. Agency shall be company specializing in the adjusting and balancing of systems specified in this Section with minimum three years documented experience. Perform Work under supervision of AABC Certified Test and Balance Engineer or a NEBB Certified Testing, Balancing and Adjusting Supervisor or registered Professional Engineer.
- B. Total system balance shall be performed in accordance with AABC National Standards for Field Measurement and Instrumentation, Total System Balance. ASHRAE -1984 Systems Handbook and NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

1.8 SEQUENCING AND SCHEDULING

- A. Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.

1.9 PRE-INSTALLATION CONFERENCE

- A. Convene a conference one week prior to commencing work of this Section.

PART 2 -PRODUCTS

2.1 Not Used

PART 3 -EXECUTION

3.1 EXAMINATION

A. Before commencing work, verify that systems are complete and operable. Ensure the following:

1. Equipment is operable and in a safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Correct fan rotation.
7. Fire and volume dampers are in place and open.
8. Coil fins have been cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage has been minimized.
12. Hydronic systems have been flushed, filled, and vented.
13. Service and balance valves are open.

B. Report any defects or deficiencies noted during performance of services to Engineer.

C. Promptly report abnormal conditions in mechanical systems or conditions which prevent system balance.

D. If, for design reasons, system cannot be properly balanced, report as soon as observed.

E. Beginning of work means acceptance of existing conditions.

3.2 PREPARATION

A. A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

B. B. Provide additional balancing devices as required.

3.3 TOLERANCES

A. Adjust main ducts in air handling systems to $\pm 5\%$ of design parameters for supply and exhaust/return systems. Adjust individual terminals and branches to $\pm 7.5\%$ of design conditions for supply and exhaust/return systems.

B. Adjust hydronic systems to $\pm 5\%$ of design parameters.

3.4 ADJUSTING

- A. Recorded data shall represent actually measured, or observed condition.
- B. Permanently mark settings of valves, dampers and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by City.
- F. Check and adjust systems approximately six months after final acceptance and submit report.

3.5 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return and exhaust air quantities.
- B. Make air quantity measurements in ducts by pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50% loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air and exhaust dampers for design conditions.
- J. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

3.6 WATER SYSTEM PROCEDURE

- A. Adjust water systems to provide required or design quantities.
- B. Use calibrated or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

- C. Effect system balance with automatic control valves fully open to heat transfer elements.
- D. Effect adjustment of water distribution systems by means of balancing cocks, valves and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

3.7 SCHEDULE

Equipment	Air Balance	Hydronic Balance
Pkgd Roof Top Htg/Clg Units	X	
Air Inlets and Outlets	X	

END OF SECTION

SECTION 16010
BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Applicable provisions of Division 1 shall govern all work under this Section.

1.2 SCOPE

A. Basic Electrical Requirements, which are applicable to all Division 16 sections. This section includes information common to two or more technical specification sections or items that are of a general nature, not conveniently fitting into other technical sections.

1.3 SECTION INCLUDES

PART 1 – GENERAL

- Related Documents
- Scope
- Sections Includes
- Reference Standards
- Regulatory Requirements
- Quality Assurance
- Continuity of Existing Services and Systems
- Approved Electrical Testing Laboratories
- Sealing and Firestopping
- Intent
- Omissions
- Submittals
- Project/Site Conditions
- Work Sequence and Scheduling
- Work by Other Trades
- Salvage Materials
- Certificates and Inspections
- Operating and Maintenance Instructions
- Record Drawings

PART 2 – PRODUCTS

- Identification
- Sealing and Firestopping

PART 3 – EXECUTION

- Equipment Access
- Coordination
- Sleeves Sealing and Firestopping
- Housekeeping and Clean Up

1.4 REFERENCE STANDARDS

A. Abbreviations of standards organizations referenced in this and other sections are as follows:

ANSI	American National Standards Institute
ETL	Electrical Testing Laboratories, Inc.
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association
UL	Underwriters Laboratories Inc.

1.5 REGULATORY REQUIREMENTS

- A. All work and materials are to conform in every detail to applicable rules and requirements of the Wisconsin State Electrical Code Volumes 1 and 2, the National Electrical Code (ANSI/NFPA 70), other applicable National Fire Protection Association codes and present manufacturing standards (including NEMA).
- B. All Division 16 work shall be done under the direction of a currently certified State of Wisconsin Certified Master Electrician.

1.6 QUALITY ASSURANCE

- A. All materials shall be listed by and shall bear the label of an approved electrical testing laboratory. If none of the approved electrical testing laboratories has published standards for a particular item, then other national independent testing standards, if available, applicable, and approved by CITY, shall apply and such items shall bear those labels.

1.7 CONTINUITY OF EXISTING SERVICES AND SYSTEMS

- A. No outages shall be permitted on existing systems except at the time and during the interval specified by the CITY's project representative. Any outage must be scheduled when the interruption causes the least interference with normal business routines.
- B. This Contractor shall restore any circuit interrupted as a result of this work to proper operation as soon as possible.

1.8 APPROVED ELECTRICAL TESTING LABORATORIES

- A. The following laboratories are approved for providing electrical product safety testing and listing services as required in these specifications:

Underwriters Laboratories Inc.

Electrical Testing Laboratories, Inc.

1.9 SEALING AND FIRESTOPPING

- A. Sealing and firestopping of sleeves/openings between conduits and the structural or partition opening shall be the responsibility of the contractor whose work penetrates the opening. The contractor responsible shall hire individuals skilled in such work to do the sealing and firestopping. These individuals hired shall normally and routinely be employed in the sealing and fireproofing occupation.

1.10 INTENT

- A. The Contractor shall furnish and install all the necessary materials, apparatus, and devices to complete the electrical equipment and systems installation herein specified, except such parts as are specifically exempted herein.
- B. If an item is either called for in the specifications or shown on the plans, it shall be considered sufficient for the inclusion of said item in this contract. If a conflict exists within the Specifications or exists within the Drawings, the Contractor shall furnish the item, system, or workmanship, which is the highest quality, largest, or most closely fits the CITY's intent (as determined by the CITY Project Manager).
- C. It must be understood that the details and drawings are diagrammatic. The Contractor shall verify all dimensions at the site and be responsible for their accuracy.
- D. Materials and labor shall be new (unless noted or stated otherwise), first class, and workmanlike, and shall be subject at all times to the CITY's and/or Engineer's inspections, tests and approval from the commencement until the acceptance of the completed work.

1.11 OMISSIONS

- A. No later than six (6) days before bid opening, the Contractor shall call the attention of the CITY to any materials or apparatus the Contractor believes to be inadequate and to any necessary items of work omitted.

1.12 SUBMITTALS

- A. Submit for all equipment and systems as indicated in the respective specification sections, marking each submittal with that specification section number. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number, as indicated in the contract documents. Do not use highlighters for identification. Failure to do this may result in the submittal(s) being returned to the Contractor for correction and resubmission. Failing to follow these instructions does not relieve the Contractor from the requirement of meeting the project schedule.
- B. On request from the CITY, the successful bidder shall furnish additional drawings, illustrations, catalog data, performance characteristics, etc.
- C. Submittals shall be grouped to include complete submittals of related systems, products, and accessories in a single submittal. Mark dimensions and values in units to match those specified. Include wiring diagrams of electrically powered equipment.
- D. The submittals must be approved before fabrication is authorized.
- E. Submit sufficient quantities of submittals to allow the following distribution:

Site Field Office

1 copy

City	2 copies
Engineer	1 copy
O&M Manuals	2 copies
Electrical Contractor	Remaining copies

1.13 PROJECT/SITE CONDITIONS

- A. Install Work in locations shown on Drawings, unless prevented by Project conditions.
- B. Tools, materials and equipment shall be confined to areas designated by the CITY.

1.14 WORK SEQUENCE AND SCHEDULING

- A. Install work in phases to accommodate City’s occupancy requirements. During the construction period coordinate electrical schedule and operations with CITY’s Construction Representatives.

1.15 WORK BY OTHER TRADES

- A. Electrical details on drawings for equipment to be provided by others is based on preliminary design data only. This Contractor shall lay out the electrical work and shall be responsible for its correctness to match equipment actually provided by others.

1.16 SALVAGE MATERIALS

- A. No materials removed from this project shall be reused except as specifically noted on the drawings. Materials demolished shall become the property of and shall be disposed of by the Contractor, except for items specifically requested by the City.

1.17 CERTIFICATES AND INSPECTIONS

- A. Obtain and pay for all required inspections. Deliver originals of these certificates to the CITY’s Project Representative. Include copies of the certificates in the Operating and Maintenance Instructions.

1.18 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Assemble material in three-ring or post binders, using an index at the front of each volume and tabs for each system or type of equipment. In addition to the data indicated in the General Requirements, include the following information:

- Copies of all approved submittals.
- Manufacturer's wiring diagrams for electrically powered equipment
- Records of tests performed to certify compliance with system requirements
- Certificates of inspection by regulatory agencies
- Parts lists for manufactured equipment
- Preventive maintenance recommendations
- Warranties
- Additional information as indicated in the technical specification sections

1.19 RECORD DRAWINGS

- A. The Contractor shall maintain at least one copy each of the specifications and drawings on the job site at all times.
- B. The CITY will provide the Contractor with a suitable set of contract drawings on which daily records of changes and deviations from contract shall be recorded. Dimensions and elevations on the record drawings shall locate all concealed conduit, or similar items.
- C. The daily record of changes shall be the responsibility of Contractor's field superintendent. No arbitrary mark-ups will be permitted.
- D. At completion of the project, the Contractor shall submit the marked-up record drawings to the CITY prior to final payment.

PART 2 PRODUCTS**2.1 SEALING AND FIRESTOPPING****A. FIRE AND/OR SMOKE RATED PENETRATIONS:**

Manufacturers: 3M, STI/SpecSeal, Tremco, Hilti or approved equal.

All firestopping systems shall be by the same manufacturer.

Submittals: Contractor shall submit product data for each firestop system. Submittals shall include product characteristics, performance and limitation criteria, test data, MSDS sheets, installation details and procedures for each method of installation applicable to this project. For non-standard conditions where no UL tested system exists, submit manufacturer's drawings for UL system with known performance for which an engineering judgement can be based upon.

Product: Firestop systems shall be UL listed or tested by an independent testing laboratory.

Use a product that has a rating not less than the rating of the wall or floor being penetrated.

Contractor shall use firestop putty, caulk sealant, intumescent wrapstrips, intumescent firestop collars, firestop mortar or a combination of these products to provide a UL listed system for each application required for this project. Provide mineral wool backing where specified in manufacturer's application detail.

B. NON-RATED PENETRATIONS:

Conduit Penetrations: At conduit penetrations of non-rated interior partitions, floors and exterior walls above grade, use urethane caulk in annular space between conduit and sleeve, or the core drilled opening.

PART 3 EXECUTION**3.1 EQUIPMENT ACCESS**

- A. Install all conduit and accessories to permit access to equipment for maintenance. Coordinate the exact location of wall and ceiling access panels with the General Contractor, making sure that access is available for all equipment and specialties.

3.2 COORDINATION

- A. The Contractor shall cooperate with other trades and CITY's personnel in locating work in a proper manner. Should it be necessary to raise or lower or move longitudinally any part of the electrical work to better fit the general installation, such work shall be done at no extra cost to the CITY, provided such decision is reached prior to actual installation. The Contractor shall check location of electrical outlets with respect to other installations before installing.
- B. Coordinate all work with other contractors prior to installation. Any installed work that is not coordinated and that interferes with other contractor's work shall be removed or relocated at the installing contractor's expense.

3.3 SLEEVES

- A. In existing wet area floor penetrations, core drill sleeve openings large enough to insert schedule 40 sleeve and grout the area around the sleeve. If a pipe clamp resting on the sleeve supports the pipe penetrating the sleeve, weld a collar or struts to the sleeve that will transfer weight to the existing floor structure. Wet areas for this paragraph are rooms or spaces containing air handling unit coils, pumps, and similar waterside equipment.
- B. Pipe penetrations in existing concrete floors that are not in wet areas may omit the use of schedule 40 sleeve and use the core drilled opening as the sleeve.

3.4 SEALING AND FIRESTOPPING

- A. Fire and/or Smoke Penetrations: Install approved product in accordance with the manufacturer's instructions where conduit penetrates a fire rated barrier.
- B. Non-Rated Surfaces: When the opening is through a non-fire rated wall, floor, ceiling or roof the opening must be sealed using an approved type of material.
 - a. Use galvanized sheet metal sleeves in hollow wall penetrations to provide a backing for the sealant. Grout area around sleeve in masonry construction.
 - b. Install escutcheons or floor/ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces for this paragraph include only those rooms with finished ceilings and the penetration occurs below the ceiling.

3.5 HOUSEKEEPING AND CLEAN UP

- A. The Contractor shall clean up and remove from the premises, on a daily basis, all debris and rubbish resulting from its work and shall repair all damage to new and existing equipment resulting from its work. When job is complete, this Contractor shall remove all tools, excess material and equipment, etc., from the site.

END OF SECTION

**SECTION 16111
CONDUIT**

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Applicable provisions of Division 1 shall govern all work under this Section.

1.2 SCOPE

A. Raceways shall be installed as a complete system continuous from service to outlet or equipment, mechanically and electrically connected, constituting a continuous ground system.

1.3 SECTION INCLUDES

PART 1 – GENERAL

Related Documents
Scope
Section Includes
Related Work

PART 2 –PRODUCTS

Intermediate Metal Conduit and Fittings
Electrical Metallic Tubing and Fittings
Rigid Metal Conduit and Fittings
Flexible Metal Conduit and Fittings
Liquid-tight Flexible Metal Conduit and Fittings
Conduit Supports
General

PART 3 – EXECUTION

Conduit Sizing, Arrangement and Support
Conduit Installation
Conduit Installation Schedule

1.4 RELATED WORK

A. Section 16190 -Supporting Devices.

PART 2 PRODUCTS

2.1 INTERMEDIATE METAL CONDUIT (IMC) AND FITTINGS

- A. Conduit: Galvanized steel, threaded.
- B. Fittings and Conduit Bodies: Use all steel threaded fittings and conduit bodies.

2.2 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

- A. Conduit: Steel, galvanized tubing.
- B. Fittings: All steel, set screw, water tight, concrete tight. No push-on or indenter types permitted.
- C. Conduit Bodies: All steel threaded conduit bodies.

2.3 RIGID METAL CONDUIT AND FITTINGS

- A. Conduit: Heavy wall, galvanized steel, schedule 40, threaded.
- B. Fittings and Conduit Bodies: Use all steel threaded fittings and conduit bodies.

2.4 FLEXIBLE METAL CONDUIT AND FITTINGS

- A. Conduit: steel, galvanized, spiral strip.
- B. Fittings and Conduit Bodies: All steel, galvanized, or malleable iron (except as allowed in specification 16500).

2.5 LIQUID-TIGHT FLEXIBLE METAL CONDUIT AND FITTINGS

- A. Conduit: steel, galvanized, spiral strip with an extruded PVC jacket.
- B. Fittings and Conduit Bodies: All steel, galvanized, or malleable iron (except as allowed in specification 16500).

2.6 CONDUIT SUPPORTS

See section 16190.

2.7 GENERAL

- A. All steel fittings and conduit bodies shall be galvanized.
- B. No cast metal, split or gland type fittings permitted.
- C. Condulets larger than 2 inch (50 mm) not permitted except as approved or detailed.
- D. All conduit covers must be fastened to the conduit body with screws and be of the same manufacture.
- E. Wireways and gutters shall not be used in lieu of pull boxes and condulets.

PART 3 EXECUTION**3.1 CONDUIT SIZING, ARRANGEMENT, AND SUPPORT**

- A. EMT is permitted to be used in sizes 4" (50 mm) and smaller. See CONDUIT INSTALLATION SCHEDULE below for other limitations for EMT and other types of conduit.
- B. Size power conductor raceways for conductor type installed. Conduit size shall be 3/4 inch (13 mm) minimum except as specified elsewhere.
- C. Size conduit for all other wiring, including but not limited to control, fire alarm, etc. shall be sized per number of conductors pulled and their cross-section. 40% fill shall be maximum for all new conduit fills.
- D. Arrange conduit to maintain headroom and present a neat appearance.
- E. Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and adjacent piping.
- F. Maintain minimum 6 inch (150 mm) clearance between conduit and piping. Maintain 12 inch (300 mm) clearance between conduit and heat sources such as flues, steam pipes, and heating

appliances.

- G. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized pipe straps, conduit racks (lay-in adjustable hangers), clevis hangers, or bolted split stamped galvanized hangers.
- H. Group conduit in parallel runs where practical and use conduit rack (lay-in adjustable hangers) constructed of steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit.
- I. Do not fasten conduit with wire or perforated pipe straps. Before conductors are pulled, remove all wire used for temporary conduit support during construction.
- J. Support and fasten metal conduit at a maximum of 8 feet (2.4 m) on center.
- K. Supports shall be independent of the installations of other trades, e.g. ceiling support wires, HVAC pipes, etc., unless so approved or detailed.
- L. In general, all conduit shall be concealed except where noted on the drawings or approved by the Engineer. Contractor shall verify with Engineer all surface conduit installations except in mechanical rooms.
- M. Changes in direction shall be made with symmetrical bends, cast steel boxes, stamped metal boxes or cast steel conduit bodies.
- N. No continuous conduit run shall exceed 100 feet (30 meters) without a junction box.

3.2 CONDUIT INSTALLATION

- A. Cut conduit square using a saw or pipecutter; de-burr cut ends.
- B. Conduit shall not be fastened to the corrugated metal roof deck.
- C. Bring conduit to the shoulder of fittings and couplings and fasten securely.
- D. All conduit terminations (except for terminations into conduit bodies) shall use connectors or conduit hubs with one locknut or shall use double locknuts (one each side of box wall) and insulating bushing. Provide bushings for the ends of all conduits not terminated in box walls.
- E. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2 inch (50 mm) size unless sweep elbows are required.
- F. Install expansion-deflection joints where conduit crosses building expansion joints. Note: expansion-deflection joints are not required where conduit crosses building control joints if the control joint does not act as an expansion joint.
- G. Avoid moisture traps where possible. Where moisture traps are unavoidable, provide junction boxes with drain fittings at conduit low points.
- H. Where conduit passes between areas of differing temperatures such as into or out of unheated and heated spaces, buildings, etc., provide Listed conduit seals to prevent the passage of moisture and water vapor through the conduit.
- I. Route conduit through roof openings for piping and ductwork where possible.
- J. Identify conduit under provisions of Section 16195.

3.3 CONDUIT INSTALLATION SCHEDULE

- A. Conduit other than that specified below for specific applications shall not be used.
- B. Exposed Outdoor Locations: Rigid steel conduit.
- C. Concealed Dry Interior Locations: Intermediate metal conduit. Electrical metallic tubing.
- D. Exposed Dry Interior Locations: Intermediate metal conduit. Electrical metallic tubing.
- E. Motor and equipment connections: Flexible metal conduit (dry locations only) Use Liquid-tight flexible metal conduit (exterior or wet locations). Minimum length shall be one foot (300 mm), maximum length shall be three feet (900 mm). Conduit must be installed perpendicular to direction of equipment vibration to allow conduit to freely flex.

END OF SECTION

SECTION 16123
WIRE AND CABLE (Below 600 Volts)

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Applicable provisions of Division 1 shall apply to all work under this Section.

1.2 SCOPE

A. Furnishing and installing required wiring including pulling, terminating and splicing.

B. Grounding and bonding conductors.

1.3 SECTION INCLUDES

PART 1 –GENERAL

Related Documents

Scope

Section Includes

Related Work

Project Conditions

PART 2 – PRODUCTS

General

Building Wire

Wiring Connectors

PART 3 –EXECUTION

General Wiring Methods

Wiring Installation In Raceways

Wiring Connections and Terminations

Wire Color

Branch Circuits

Equipment Grounds

1.4 RELATED WORK

A. Section 16111 -Conduit.

B. Section 16130 -Boxes.

C. Section 16195 -Identification.

1.5 PROJECT CONDITIONS

A. Verify that field measurements are as shown on Drawings.

B. Conductor sizes are based on copper.

C. Wire routing shown on Drawings is approximate unless dimensioned. Route wire as required to meet Project Conditions.

- D. Where wire routing is not shown, and destination only is indicated, determine exact routing and lengths required.

PART 2 PRODUCTS

2.1 GENERAL

- A. All wire shall be new, delivered to the site in unbroken cartons and shall be less than one year old out of manufacturer's stock.
- B. All conductors shall be copper.
- C. Insulation shall have a 600 volt rating.
- D. In mechanical rooms and other high temperature applications, the insulation shall be rated 90 degrees C. Other areas shall use insulation rated 75 degrees C unless stated otherwise in other parts of these specifications and drawings.
- E. All conductors must be suitable for the application intended. Conductors #10 and larger must be stranded. Conductors #12 and smaller may be solid or stranded with the following requirements or exceptions:
- F. All conductors terminated with crimp type devices must be stranded.
- G. Stranded conductors may only be terminated with UL OR ETL Listed type terminations or methods: e.g. stranded conductors may not be wrapped around a terminal screw but must be terminated with a crimp type device or must be terminated in an approved back wired method.

2.2 BUILDING WIRE

- A. Description: Single conductor insulated wire.
- B. Insulation: Type THHN/THWN, XHHW-2 insulation for feeders and branch circuits.

2.3 WIRING CONNECTORS

- A. Split Bolt Connectors: Not acceptable.
- B. Solderless Pressure Connectors: High copper alloy terminal. May be used only for cable termination to equipment pads or terminals. Not approved for splicing.
- C. Spring Wire Connectors: Solderless spring type pressure connector with insulating covers for copper wire splices and taps. Use for conductor sizes 10 AWG and smaller.
- D. All wire connectors used in exterior pull boxes shall be gel filled twist connectors or a connector designed for damp and wet locations.
- E. Mechanical Connectors: Bolted type tin-plated; high conductivity copper alloy; spacer between conductors; beveled cable entrances.
- F. Compression (crimp) Connectors: Long barrel; seamless, tin-plated electrolytic copper tubing; internally beveled barrel ends. Connector shall be clearly marked with the wire size and type and proper number and location of crimps.

PART 3 EXECUTION

3.1 GENERAL WIRING METHODS

- A. All wire and cable shall be installed in conduit.
- B. Do not use wire smaller than 12 AWG for power circuits or 14 AWG for control wiring greater than 60 volts, all sizes subject to NEC 725 requirements.
- C. All conductors shall be sized to prevent excessive voltage drop at rated circuit ampacity. As a minimum use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 100 feet (30 m), and for 20 ampere, 208 volt branch circuit home runs longer than 200 feet (61 m).
- D. Splice only in junction or outlet boxes.
- E. Identify ALL low voltage, 600v and lower, wire per section 16195.
- F. Neatly train and lace wiring inside boxes, equipment, and panelboards.

3.2 WIRING INSTALLATION IN RACEWAYS

- A. Pull all conductors into a raceway at the same time. Use Listed wire pulling lubricant for pulling 4 AWG and larger wires and for other conditions when necessary.
- B. Place all conductors of a given circuit (this includes phase wires, neutral, and ground conductor) in the same raceway.

3.3 WIRING CONNECTIONS AND TERMINATIONS

- A. Splice only in accessible junction boxes.
- B. Wire splices and taps shall be made firm, and adequate to carry the full current rating of the respective wire without soldering and without perceptible temperature rise.
- C. All splices shall be so made that they have an electrical resistance not in excess of two feet (600 mm) of the conductor.
- D. Use solderless spring type pressure connectors with insulating covers for wire splices and taps, 10 AWG and smaller.
- E. Use mechanical or compression connectors for wire splices and taps, 8 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of conductor.
- F. Thoroughly clean wires before installing lugs and connectors.
- G. At all splices and terminations, leave tails long enough to cut splice out and completely re-splice.

3.4 WIRE COLOR

- A. General:
 - 1. For wire sizes 10 AWG and smaller -Wire shall be colored as indicated below.
 - 2. For wire sizes 8 AWG and larger -Identify wire with colored tape at all terminals, splices and boxes. Colors to be as indicated below.
 - 3. In existing facilities, use existing color scheme.

- B. Neutral Conductors: White for 120/208V systems. Where there are two or more neutrals in one conduit, each shall be individually identified with the proper circuit.
- C. Feeder Circuit Conductors Branch Circuit Conductors: Three or four wire home runs shall have each phase uniquely color coded.
- D. : Each phase shall be uniquely color coded.
- E. Ground Conductors: Green for 6 AWG and smaller.

3.5 BRANCH CIRCUITS

- A. The use of multi-wire branch circuits with a common neutral feeding loads is not permitted.
- B. All branch circuits shall be furnished and installed with an individual accompanying neutral, sized the same as the phase conductor.

3.6 EQUIPMENT GROUNDS

- A. The entire electrical system must be grounded.
- B. Provide bonding conductors as required to ground electrical equipment enclosures.
- C. Provide cable, bus bar, clamps and other miscellaneous equipment to properly ground the system and the equipment.
- D. Grounding of the electrical system shall be provided first in accordance with the NEC by providing a continuous metallic raceway to every electrical device installed and solidly grounding the entire system to the building principal ground point.
- E. Grounding of the electrical system shall be provided second by installing a separate ground wire with each feeder circuit or branch circuit whether or not shown on plans.
- F. A separate green grounding conductor must be installed in flexible conduits regardless of circuit ampacity.
- G. The grounding conductor shall be green insulated or in larger wire sizes where green insulation is not readily available, provide green tape for not less than 6" at every point of access to the wire.
- H. Where grounding conductors are pulled, they shall be electrically bonded to the equipment enclosure at the source of power, to each enclosure through which it passes and to the apparatus being served by the electrical supply.
- I. The minimum size for copper equipment grounding conductors shall be in accordance with 2005 NEC, Article 250-Table 250-122.

END OF SECTION

SECTION 16130
BOXES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Applicable provisions of Division 1 shall apply to all work under this Section.

1.2 SCOPE

A. Wall outlet boxes, pull and junction boxes for power, low voltage, and fire alarm. Included are the following topics:

1.3 SECTION INCLUDES

PART 1 – GENERAL

Related Documents
Scope Section Includes
Submittals
Related Work

PART 2 –PRODUCTS

General
Outlet Boxes
Pull and Junction Boxes

PART 3 –EXECUTION

Coordination of Box Locations
Outlet Box Installation
Pull and Junction Box Installation

1.4 SUBMITTALS

- A. Submit product data under provisions of Division 1 and Section 16010.
- B. Provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.

1.5 RELATED WORK

A. Section 16140 -Wiring Devices

PART 2 PRODUCTS

2.1 GENERAL

A. All boxes shall be of sufficient size to provide free space for all conductors enclosed in the box and shall comply with NEC requirements.

2.2 OUTLET BOXES

A. Sheet Metal Outlet Boxes: galvanized steel, with stamped knockouts.

- B. Equipment Supporting Boxes: Rated for weight of equipment supported; include 3/8 inch male fixture studs where required.

2.3 PULL AND JUNCTION BOXES

- A. Pull boxes and junction boxes shall be minimum 4 inch square (100 mm) by 2 1/8th inches (54 mm) deep for use with 1 inch (25 mm) conduit and smaller. On conduit systems using 1 1/4 inch (31.75 mm) conduit or larger, pull and junction boxes shall be sized per NEC but not less than 4 11/16 inch square (117 mm).
- B. Sheet Metal Boxes: code gauge galvanized steel, screw covers, flanged and spot welded joints and corners.
- C. Sheet Metal Boxes Larger Than 12 Inches (300 mm) in any dimension shall have a hinged cover or a chain installed between box and cover.
- D. Box extensions and adjacent boxes within 48" of each other are not allowed for the purpose of creating more wire capacity.
- E. Junction boxes 6" x 6" or larger size shall be without stamped knock-outs.
 - 1. Wireways shall not be used in lieu of junction boxes.
- F. Boxes installed inside air handling units shall be plenum rated with gasketed covers.

PART 3 EXECUTION

3.1 COORDINATION OF BOX LOCATIONS

- A. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.
- B. Electrical box locations shown on Contract Drawings are approximate unless dimensioned.
- C. No outlet shall be located where it will be obstructed by other equipment, piping, etc.
- D. Boxes shall not be fastened to the metal roof deck.
- E. It shall be the Contractor's responsibility to study drawings pertaining to other trades, to discuss location of outlets with workmen installing other piping and equipment and to fit all electrical outlets to job conditions.
- F. In case of any question or argument over the location of an outlet, the Contractor shall refer the matter to the Engineer and install outlet as instructed by the Engineer.
- G. The proper location of each outlet is considered a part of this contract and no additional compensation will be paid to the Contractor for moving outlets which were improperly located.
- H. Locate and install boxes to allow access to them. Where installation is inaccessible, coordinate locations and provide 18 inch (450 mm) by 24 inch (600 mm) access doors.
- I. Locate and install to maintain headroom and to present a neat appearance.
- J. Install boxes to preserve fire resistance rating of partitions and other elements, using approved materials and methods.

3.2 OUTLET BOX INSTALLATION

- A. Provide knockout closures for unused openings.
- B. Support boxes independently of conduit except for cast boxes that are connected to two rigid metal conduits, both supported within 12 inches (300 mm) of box.
- C. Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes. Provide non-metallic barriers to separate wiring of different voltage systems.
- D. Surface wall outlets shall be 4 inch (100 mm) square with raised covers for one and two gang requirements.

3.3 PULL AND JUNCTION BOX INSTALLATION

- A. Locate pull boxes and junction boxes above accessible ceilings, in unfinished areas or furnish and install CITY approved access panels in non-accessible ceilings where boxes are installed.
- B. Support pull and junction boxes independent of conduit.

END OF SECTION

**SECTION 16140
WIRING DEVICES**

PART 1 -GENERAL

1.1 SCOPE

- A. The work under this section includes receptacles, device plates and box covers. Included are the following topics:

PART 1 –GENERAL

Scope
Related Work
Submittals

PART 2 –PRODUCTS

Receptacles
Device Plates and Box Covers

PART 3 –EXECUTION

Installation
Field Quality Control
Adjusting

1.2 RELATED WORK

- A. Applicable provisions of Division 1 govern work under this Section.

1.3 SUBMITTALS

- A. Provide product data showing model numbers, configurations, finishes, dimensions, and manufacturer's instructions.
- B. Manufacturer's Instructions:
1. Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

PART 2 -PRODUCTS

2.1 RECEPTACLES

- A. Convenience and Straight-blade Receptacles: NEMA Type 5-20R, ivory nylon or high impact resistant face. Receptacles shall be UL498 Listed and meet Federal Specification WC-596. All duplex receptacles shall be heavy duty Specification Grade, 20 amp rated. All receptacles shall be back and side wired, screw clamp type, suitable for solid or stranded wire up to #10 AWG, with a separate green ground screw. Receptacles shall be Leviton model 5362-S, Hubbell model CR5362, Pass & Seymour model CRB5362, Cooper model 5362C, or approved equal.
- B. Generally, all receptacles shall be duplex convenience type unless otherwise noted.
- C. GFCI Receptacles: Duplex convenience receptacle, Specification Grade, with integral ground

fault current interrupter meeting the requirements of UL standard 943 Class A and UL standard 498. GFCI receptacles shall be Leviton model 8899, Hubbell model GRF5352, Pass & Seymour model 2094 or approved equal.

2.2 DEVICE PLATES AND BOX COVERS

- A. Surface Cover Plate: Raised galvanized steel.

PART 3 -EXECUTION

3.1 INSTALLATION

- A. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface-mounted outlets.
- B. Install devices and wall plates flush and level.
- C. Receptacles shall have a bonding conductor from grounding terminal to the metal conduit system. Self-grounding receptacles using mounting screws as bonding means are not approved.

3.2 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects.
- B. Verify that each receptacle device is energized.
- C. Test each receptacle device for proper polarity.
- D. Test each GFCI receptacle device for proper operation.

3.3 ADJUSTING

- A. Adjust devices and wall plates to be level.
- B. Mark all conductors with the panel and circuit number serving the device with a machine generated label, at the device.

END OF SECTION

**SECTION 16190
SUPPORTING DEVICES**

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Applicable provisions of Division 1 shall apply to all work under this section.

1.2 SCOPE

A. Conduit and equipment supports, straps, clamps, steel channel, etc, and fastening hardware for supporting electrical work. Included are the following:

1.3 SECTION INCLUDES

PART 1 –GENERAL

Related Documents

Scope

Section Includes

Quality Assurance

PART 2 –PRODUCTS

Material

PART 3 –EXECUTION

Installation

1.4 QUALITY ASSURANCE

A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

PART 2 PRODUCTS

2.1 MATERIAL

A. Support Channel: Galvanized.

B. Hardware: Corrosion resistant.

C. Minimum sized threaded rod for supports shall be 3/8".

D. Conduit clamps, straps, supports, etc., shall be steel or malleable iron. One-hole straps shall be heavy duty type. All straps shall have steel or malleable backing plates when conduit is installed on the interior or exterior surface of any exterior building wall.

PART 3 EXECUTION

3.1 INSTALLATION

A. Fasten hanger rods, conduit clamps, outlet, junction and pull boxes to building structure using beam clamps, expansion anchors, or spring steel clips (interior metal stud walls only).

- B. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in sheet metal studs and wood screws in wood construction.
- C. Do not use powder-actuated or plastic anchors.
- D. File and de-bur cut ends of support channel and spray paint with cold galvanized paint to prevent rusting.
- E. Do not fasten supports to piping, ductwork, mechanical equipment, cable tray or conduit.
- F. Do not drill structural steel members unless approved by CITY.
- G. Fabricate supports from galvanized structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.
- H. Install surface-mounted cabinets and panels with minimum of four anchors. Provide steel channel supports to stand cabinet one inch (25 mm) off wall.
- I. Furnish and install all supports as required to fasten all electrical components required for the project, including free standing supports required for those items remotely mounted from the building structure, walkways etc.

END OF SECTION

**SECTION 16195
ELECTRICAL IDENTIFICATION**

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Applicable provisions of Division 1 shall apply to all work under this Section.

1.2 SCOPE

A. This section describes the products and execution requirements relating to labeling of power, general wiring, and fire alarm.

1.3 SECTION INCLUDES

PART 1 –GENERAL

- Related Documents
- Scope
- Section Includes
- Related Work
- Submittals

PART 2 –PRODUCTS

- Materials

PART 3 –EXECUTION

- General
- Junction and Pullbox Identification
- Power and Control Wire Identification
- Nameplate Engraving
- Panelboard Directories

1.4 RELATED WORK

A. Section 16123 -Wire and Cable (Below 600 Volts)

1.5 SUBMITTALS

- A. Submit shop drawings under provisions of Division 1 and Section 16010.
- B. Include schedule for nameplates.
- C. Prior to installation, the Contractor shall provide samples of all label types planned for the project. These samples shall include examples of the lettering to be used. Samples shall be mounted on 8 1/2" x 11" sheets annotated, explaining their purposed use.
- D. Provide listing of text for each label. Obtain approval of City or Engineer before fabrication.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Labels: All labels shall be permanent, and machine generated. NO HANDWRITTEN OR NON-PERMANENT LABELS ARE ALLOWED.
- B. Label size shall be appropriate for the conductor or cable size(s). All labels shall be self-laminating, white/transparent vinyl and be wrapped around the cable or sheath. Flag type labels are not allowed. The labels shall be of adequate size to accommodate the circumference of the cable being labeled and properly self-laminate over the full extent of the printed area of the label.
- C. Nameplates: Engraved three-layer laminated plastic, black letters on a white background.
- D. Tape (phase identification only): Scotch #35 tape in appropriate colors for system voltage and phase.
- E. Outlet covers. Identify panel and circuit using portable label maker, printing on clear adhesive tape.

PART 3 EXECUTION

3.1 GENERAL

- A. All branch circuit and panels must be identified with the same symbol used in circuit directory of the source panelboard.
- B. Clean all surfaces before attaching labels with the label manufacturer's recommended cleaning agent.
- C. Install all labels firmly as recommended by the label manufacturer.
- D. Labels shall be installed plumb and neatly aligned on all equipment.
- E. Install nameplates parallel to equipment lines.
- F. Secure nameplates to equipment fronts using screws or adhesive tape. Secure nameplate to inside of recessed panelboards in finished locations.
- G. Embossed tape will not be permitted for any application.

3.2 POWER AND CONTROL WIRE IDENTIFICATION

- A. Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identify with branch circuit or feeder number for power circuits, and with control wire number as indicated on schematic and interconnection diagrams or equipment manufacturer's shop drawings for control wiring.
- B. All wiring shall be labeled within 2 to 4 inches of terminations. Each end of a wire or cable shall be labeled as soon as it is terminated including wiring used for temporary purposes.

3.3 NAMEPLATE ENGRAVING

- A. Provide nameplates of minimum letter height as scheduled below.
- B. Panelboards: 1 inch (25 mm); identify equipment designation. 1/2 inch (13 mm); identify voltage rating, source and room location of the source.
- C. Equipment Enclosures: 1 inch (25 mm); identify equipment designation.

- D. Circuit Breakers in Panelboards: 1/2 inch (13 mm); identify circuit and load served, including location.
- E. Disconnect Switches: 1/2 inch (13 mm); identify source and load served.
- F. Junction boxes: 1 inch (25 mm); identify system source(s) and load(s) served. Junction boxes may be neatly identified using a permanent marker.

3.4 PANELBOARD DIRECTORIES

- A. Update directories for panels modified. Replace existing directory with new.

END OF SECTION

SECTION 16200
FUSES

PART 1 -GENERAL

1.1 SCOPE

- A. The work under this section includes 250 volt fuses. Included are the following topics:

PART 1 –GENERAL

Scope
Related Work
Submittals
Regulatory Requirements
Extra Materials

PART 2 –PRODUCTS

250 Volt Fuses

PART 3 –EXECUTION

Installation

1.2 RELATED WORK

- A. Applicable provisions of Division 1 govern work under this Section.

1.3 SUBMITTALS

- A. Provide device dimensions, nameplate nomenclature, and electrical ratings.
B. Submit manufacturer's product data sheets.

1.4 REGULATORY REQUIREMENTS

- A. Listed by Underwriter's Laboratories, Inc., and suitable for specific application.

1.5 EXTRA MATERIALS

- A. Provide three (3) spares of each size and type fuse.

PART 2 -PRODUCTS

2.1 250 VOLT FUSES

- A. Fuses 600 Amperes and Less: Dual element, time delay, 250 volt, UL Class RK 5. Interrupting Rating: 200,000 rms amperes.

PART 3 -EXECUTION

3.1 INSTALLATION

- A. Fuses shall not be installed until equipment is ready to be energized.
B. Turn over spare fuse storage enclosure to CITY at completion of work

END OF SECTION

SECTION 16410
SAFETY AND DISCONNECT SWITCHES

PART 1 -GENERAL

1.1 SCOPE OF WORK

A. This Section includes the following:

1. Equipment disconnects.
2. Motor-circuit disconnects.

1.2 DEFINITIONS

Not Applicable

1.3 CODES AND STANDARDS

- A. NEMA KS-1 – Enclosed Switches
- B. NFPA 70 (NEC)

1.4 QUALITY ASSURANCE

- A. Comply with codes for components and installation.
- B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 1. The Terms “Listed” and “Labeled”: As defined in the National Electrical Code, Article 100.
 2. Listing and Labeling Agency Qualifications: A Nationally Recognized Testing Laboratory (NRTL) as defined in OSHA Regulation 1910.7.
- C. Single-Source Responsibility: All enclosed switches shall be the product of a single manufacturer.

1.5 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for switches and accessories specified in this Section.
- C. Descriptive data and time-current curves for protective devices and let-through current curves for those devices with current-limiting characteristics. Include coordination charts and tables, and related data.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.
- B. Where recommended by the equipment supplier, deliver equipment in fully enclosed vans after specified environmental conditions have been permanently established in spaces where

equipment is to be placed. The products accepted on the site shall be wrapped in factory packing and shall be inspected for damage prior to acceptance.

- C. Store equipment in clean, dry with non-condensing environments that are controlled within manufacturer's ambient tolerances for non-operating equipment. Protect from weather, dirt, fumes, water, construction debris, and physical damage.
- D. Handle equipment carefully to prevent damage, breaking, and scoring. The contractor shall not install damaged units or components; replace with new.
- E. Equipment furnished by others. The contractor shall be responsible for receiving, uncrating, inspecting, storing, and installing of Division 16 equipment listed as furnished by others.

1.7 SPARE PARTS

Not Applicable

1.8 WARRANTY

- A. Motor and circuit disconnects shall be warranted for a minimum period of one year after project completion, or longer if manufacturer's warranty allows.

1.9 MAINTENANCE

Not Applicable

PART 2 -PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide enclosed switches by one of the following:

1. Safety Switches:
 - a. General Electric
 - b. Square D
 - c. Cutler-Hammer

2.2 GENERAL

- A. Disconnect and Safety Disconnect Switches:

1. General: Provide heavy duty surface-mounted safety switches for motors and equipment unless otherwise indicated, of types, sizes, and electrical characteristics as indicated on the electrical drawings and equipment schedules.
2. Switch Interiors: Switches shall have switch blades which shall be fully visible in the off position when the enclosure door is open. Current carrying parts shall be plated copper and switch contacts shall be silver-tungsten. Lugs shall be removable and shall be UL-listed for 75 degrees C, copper wire.
3. Switch Operator: Switches shall be quick-made, quick-break type. The operating

handle shall be an integral part of the enclosure base and shall be padlockable in the off position. The handle position shall indicate whether the switch is in the on or off position.

4. Interlock Contacts: Provide two Form C auxiliary, 10 ampere, 300V rated contacts. The contacts shall provide for two normally open and two normally closed contacts for switch open or closed position.

2.3 ENCLOSURES

- A. NEMA 3R: Provide NEMA 3R general purpose enclosures for outdoor installation unless otherwise indicated on the drawings. Enclosure cover shall be attached with pin type hinges and shall be lockable in the open position. NEMA 3R enclosures shall be manufactured from galvanized steel. Enclosures shall have a gray baked enamel finish, electrodeposited on cleaned, phosphatized steel. Provide rainproof bolt-on hubs.

2.4 RATINGS

- A. General: Provide heavy duty safety switches with ampere rating as shown on the drawings.
- B. Horsepower-Rated: Safety switches shall be horsepower-rated for 250, 480, and 600V, AC and DC, and shall be rated for the motor driven loads supplied by the switch.

2.5 IDENTIFICATION

- A. Each disconnect switch shall have an engraved, laminated bakelite nameplate attached to the outside of the enclosure. The nameplate shall include the switch or breaker designation and the equipment it serves. Attach the nameplate by screws or rivets. See Division 16, Section 16195.

2.6 ELECTRICAL INTERLOCKS

- A. Provide electrical interlock switches on disconnects as specified herein. The interlock switches shall open prior the opening of the power switch and close only after the power switch has been enclosed. Provide two sets normally open (NO) and normally closed (NC) switches for each disconnect.
- B. Provide the necessary control wiring to the interlock switch to disconnect the control circuit from the motor controller.

PART 3 -EXECUTION

3.1 INSTALLATION

- A. Install enclosed switches in locations as indicated, according to manufacturer's written instructions. Comply with all applicable requirements of electrical installations and for the seismic zone of this project.
- B. Install enclosures level and plumb.
- C. Install wiring between enclosed switches and control/indication devices as required.
- D. Connect switches, enclosures, and components to wiring system and to equipment ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws

and bolts, according to equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

- E. Mounting: Mount enclosures on building structures adjacent to equipment unless otherwise noted. Enclosures shall not be mounted on equipment served, unless it is a part of a preassembled control panel. If building structure is not adjacent to the equipment, provide a separate unistrut rack with supports, clear of equipment, for mounting of switch and breaker enclosure. Conduits shall not be used for the support means.
- F. Location:
 - 1. Disconnect enclosures shall be readily accessible and shall not interfere with removal of equipment parts or with standard maintenance. Disconnect enclosures shall be installed with their top at 5½ feet above the floor unless otherwise noted on the drawings.

3.2 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will employ and pay an independent testing agency to perform specified field quality-control testing.

3.3 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, and abrasions.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel on procedures and schedules for start-up and shutdown, troubleshooting, servicing, and preventive maintenance.
- B. Review data in the "Operating and Maintenance Manual."
- C. Schedule training with Owner through the Architect with at least 7 days' advance notice.

--END OF SECTION--