

BULLETIN 1

PELLSTON ATHLETIC COMPLEX

2/18/2021

SPECIFICATIONS:

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SECTION 01100 - GENERAL REQUIREMENTS

PART ONE - FIELD ENGINEERING

1.01 CONSTRUCTION SURVEYS

A. The Owner's surveyor will provide a one-time centerline or off-set staking for roads and curb & gutter, and a one-time line and grade staking for each utility. Additional staking shall be paid for by the contractor, the amount of which will be deducted from the Contract amount. Bench marks will be set by the Owner's surveyor at no less than 1000 foot intervals.

B. The Contractor shall provide competent, suitably qualified personnel for layout of his own work and to be responsible for all lines, elevations, and measurements of all site improvements, utilities, and other work executed by him under the Contract.

C. The Contractor shall, immediately upon entering the site for the purpose of beginning Work, locate general reference points and Owner provided stakes and take such action as is necessary to prevent their destruction.

D. The Contractor must exercise proper precaution to verify figures on the drawings before laying out work and will be held responsible for any error resulting from his failure to exercise such precaution.

E. The Contractor shall be responsible for the preservation of survey corners, property line stakes, benchmarks, or datum points. If any are lost, displaced or disturbed through neglect of the Contractor, its agents, or employees, it shall pay the cost of restoration. Any survey corners, stake or points disturbed or destroyed by the contractor shall be replaced by the Owner's surveyor, the total cost of which will be deducted from the contract amount.

PART TWO - SPECIAL REQUIREMENTS, PROCEDURES AND CONTROLS

2.01 PROJECT COORDINATION

A. All notices, demands, requests, instructions, approvals, proposals and claims must be in writing. Any notice to or demand upon the Contractor shall be sufficiently given if delivered at the office of the Contractor stated on the signature page of the Agreement or, if deposited in the United States mail or other express mail company, sealed in a postage-prepaid envelope. All papers required to be delivered to the Owner shall, unless otherwise specified in writing to the Contractor, be delivered to Owner and Engineer.

B. The Contractor shall be responsible for the coordination of any and all utilities and structures which are to be installed simultaneous with the work of this contract, including but not limited to Electrical, Telephone, Cable TV and Natural Gas utility systems. Coordination shall include scheduling the work of this Contract to allow sufficient time for utility & structure installation and to allow for final grading and clean-up required in this contract to include miscellaneous grading and clean-up of utility contractor work.

2.02 PERMITS, FEES AND NOTICES

A. Permits or Certificates of Approval shall be obtained and paid for by the Contractor for the trade affected. The Contractor shall comply with all state and local rules, ordinances and regulations relating to buildings, employment and the preservation of public health and safety, use of streets, etc. If the Contractor performs any Work knowing it to be contrary to such laws, ordinances, rules and regulations, it shall bear all costs arising therefrom.

B. Where the Contract Documents require the Work to be above the standard required by the law, such Work shall be completed according to the Contract Documents.

2.03 SITE CONDITIONS

A. Before submitting proposals, bidders should visit premises, verify site conditions and conditions under which Work under this Contract must be conducted. Submission of proposal verifies that bidder has visited the site, has made said examinations and verifications, and is fully conversant with all said conditions. No claims for additional compensation will be considered or paid to any Contractor due to said Contractor's failure to be so informed.

B. The Contractor, before commencing Work, shall examine all surfaces and areas indicated on drawings to receive its Work, and shall report necessary corrections in writing immediately to Engineer. Do not proceed until corrections (if any required) have been made. Commencing Work verifies this Contractor's acceptance of said surfaces, areas and of job conditions.

C. Information pertaining to preliminary investigations such as location of utilities, existing structures and existing grades appears on drawings. While such data has been collected with reasonable care, there is no expressed or implied guarantee that conditions so indicated are entirely representative of those actually existing or that unforeseen developments may not occur. The Contractor must put its own interpretation of results of such investigation and shall satisfy itself as to materials to be excavated and materials upon which fill or other work may be placed.

D. The Contractor shall determine the exact location of all existing utilities before commencing work. The Contractor agrees to be fully responsible for any and all damages occasioned by its failure to locate and preserve any and all utilities.

2.04 CONTRACTOR'S USE OF PREMISES

A. The Contractor shall confine all storage of materials, equipment and apparatus to the area within the contract limits or in those additional areas designated by the Owner. The Owner will provide adequate access to such areas.

B. All Work shall be done in accordance with the regulations governing the institution and with minimum possible interferences with the proper functioning of the activities of the same. The Contractor will be held to have visited the site and checked with authorities regarding the working conditions, the methods of carrying out the Work, and to have included all costs for meeting such working conditions.

C. All construction operations, delivery and storage of material, and movement of equipment shall be governed by applicable building codes, traffic regulations, and fire regulations of local authorities.

D. The Contractor shall comply with all the ordinances and codes of the local government regarding access, signs, advertising, traffic, fires, explosives, danger signals and barricades.

2.05 JOB SITE ACCESS

A. The Owner, its authorized representatives and agents shall at all times have access to and be permitted to observe and review all Work, materials, equipment, operations.

2.06 OWNER OCCUPANCY

A. If before the final completion of the Work, any portion of the permanent construction has been satisfactorily completed and the same will be immediately useful to the Owner to use, occupy or gain access to other parts of the site, the Owner may, by written notice, advise the Contractor that it accepts such portion of the Work. Such action by the Owner shall in no way affect the obligations of the Contractor under the terms and provisions of the Contract with respect to any Work not so completed and accepted.

2.07 TRAFFIC REGULATION

A. The Contractor shall be responsible for the provisions, installation and maintenance of all temporary traffic control measures required by the Owner. The Contractor must abide by the Owner's rules and regulations.

B. Where work is performed in public right-of-ways, traffic control maintenance shall be the responsibility of the Contractor and shall conform with MDOT Specification 812 "Temporary Traffic Control For Construction Zone Operations", and local agency requirements. Unless otherwise agreed to, the cost of traffic control shall be incidental to the project. (See the Special Provisions)

2.08 TEMPORARY ACCESS ROADS

A. The Contractor shall construct and maintain adequate temporary access roads to provide uninterrupted access to adjacent buildings, offices, temporary offices, storage areas and work areas. The Owner, all contractors and subcontractors shall be allowed to use the temporary access roads for delivering material and equipment to the project site.

B. The Contractor shall remove all of it's temporary roads when directed and shall restore site areas of same to their original condition or in accordance with Contract Documents.

2.09 SECURITY

A. The Contractor shall provide a secured project site using fencing, locked gates, night and weekend watchmen and other means as necessary to properly and safely secure the site.

2.10 FIRST AID FACILITIES

A. The Contractor shall provide, at the site, such equipment and medical facilities as are necessary to supply first aid service to anyone who may be injured in connection with the Work.

B. The Contractor must promptly report in writing to the Engineer and Owner all accidents whatsoever arising out of, or in connection with, the performance of the Work, whether on or

adjacent to the site which caused death, personal injury or property damages, giving full details and statements of witnesses. In addition, if death or serious injuries or serious damages are caused, the accident shall be reported immediately by telephone or messenger to the Owner.

C. If any claim is made by anyone against the Contractor or any subcontractor on account of any accident, the Contractor shall promptly report the facts in writing to the Owner, giving full details of the claim.

2.11 WATER CONTROL

A. The Contractor shall be responsible for providing and maintaining for the duration of the Work adequate provisions for the prevention of the accumulation of surface water or other fluid (such as fuel oil and the like) in excavations. Should such conditions develop or be encountered, the water or other fluid shall be controlled and suitably disposed of by means of temporary pumps, piping, drainage lines, ditches, dams or other approved means.

2.12 EROSION CONTROL

A. The Contractor shall act as the agent for the Owner for soil erosion/sedimentation and shall be required to obtain from the appropriate enforcing agency the permit as required by Act No. 347, Public Acts of 1972, as amended by Act 197, Public Acts of 1974, Soil Erosion and Sedimentation Control Act, for construction of the project. See the Special provisions.

2.13 DUST CONTROL

A. When necessary, wet down materials or use other suitable methods to limit the amount of airborne dust and dirt created by site operations or materials. (See the Special Provisions)

2.14 PROTECTION OF THE ENVIRONMENT

A. Protection of the environment is of the essence. The Contractor is responsible to perform all work in order to preserve the environmental integrity of the project site and adjacent areas.

PART THREE - PROJECT MEETINGS

3.01 PRECONSTRUCTION CONFERENCES

A. Prior to commencement of Work, the Contractor shall meet with the Owner and Engineer to review and finalize all procedures relating to the Work. This meeting shall be arranged by the Engineer. Appropriate subcontractors will attend this meeting.

3.02 PROGRESS MEETINGS

A. Meetings of the representatives of the Contractor, subcontractors, various trades engaged upon the Work, and the Owner, shall be held as directed by the Owner.

B. Progress meetings shall be for the purpose of coordinating and expediting the Work. Representatives at these meetings shall be qualified and authorized to act on behalf of the Contractor.

PART FOUR - SUBMITTALS

4.01 CONSTRUCTION SCHEDULES

A. The Contractor, immediately after being awarded the Contract, shall prepare and submit for the Engineer's approval an estimated progress schedule for the Work. The progress schedule shall be related to the entire project to the extent required by the Contract Documents.

B. Submission of this schedule will be a requirement prior to the first payment. Revised schedules shall be submitted with each subsequent pay application.

4.02 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

A. The Engineer will review and approve shop drawings and samples with reasonable promptness so as to cause no delay, but only for conformance with the design concept of the project and with the information given in the Contract Documents. The Engineer's approval of a separate item shall not indicate approval of an assembly in which the item functions.

B. The Contractor shall make any corrections required by the Engineer and shall resubmit corrected copies of shop drawings or new samples until approved. The Contractor shall direct specific attention in writing or on re-submitted shop drawings to revisions other than the corrections required by the Engineer on previous submissions.

C. The Engineer will review all shop drawings and notate them with one (1) of the following:

1. "APPROVED" - Shop drawings thus marked indicate final action by the Engineer.
2. "APPROVED AS NOTED" - Shop drawings thus marked shall be released for shop work and fabrication in accordance with corrections noted. No re-submittal is required.
3. "REVISE AND RESUBMIT" - Drawings thus marked shall not be released for shop work. They shall be corrected and re-submitted. Correction shall be limited to items marked.
4. "NOT APPROVED - RESUBMIT" - Shop drawings thus marked indicate that the drawings are disapproved and new drawings shall be submitted to conform with requirements of the contract documents. Drawings thus marked shall not be released for any work.

D. "Or approved equal" when indicated in the specifications refers to equipment, apparatus, materials, or workmanship that performs the same function or intent, meets the specified collective operating function, passes the same tests, has the same properties, equals the appearance of, and fits into the mechanics of the construction as specified, all as proved equal by the Contractor to the Engineer. The burden of proof of equality of said materials or equipment shall rest with the Contractor. If substitute materials or equipment are accepted by the Engineer, the Contractor shall pay all extra costs created by the substitution of all trades involved, including the cost of revising the Engineer's drawings.

PART FIVE - QUALITY CONTROL

5.01 GENERAL

A. The Contractor is the primary party responsible for quality control of all construction to ensure

that the Work is in complete conformance with the Contract Documents.

B. The Contractor shall establish a quality control program and shall implement and report specific quality control requirements described in the specifications.

C. At the preconstruction meeting, the Contractor shall submit for review and comment a Quality Control Program for construction, including preliminary preplanned checklists to be used to verify acceptable construction and an organizational chart of project personal. Voids/honey combing in concrete curb and "blessing" (adding water) to concrete curb and sidewalk are specific areas of concern to the City and Concrete curb will be immediately rejected upon discovery of same.

5.02 OWNER'S TESTING AGENCY

A. The Owner shall employ and pay the cost of independent inspection and testing agencies to provide the quality control requirements deemed necessary by the Owner.

B. Work will be checked by representatives of the testing agencies as it progresses, but failure to detect any defective Work or product will not in anyway prevent later rejection when such defect is discovered, nor will it obligate the Owner to final acceptance. When it appears that the Work or product furnished is in non-conformance with the Contract Documents, the testing agency will direct the attention of the Engineer, Owner and Contractor to such non-conformance.

5.03 CONTRACTOR RESPONSIBILITIES

A. To facilitate the work of the Owner's testing agencies, the Contractor shall:

1. Provide facilities for access to the Work at all times for representatives of each testing agency and the Engineer so that the agency may properly perform its functions and the Engineer may observe these functions.
2. Secure for delivery to the testing agency, without charge, preliminary representative samples of the materials proposed to be used and which are required to be tested.
3. Furnish such casual labor as is necessary to obtain and handle samples at the project site or at the source of the materials to be tested.
4. Advise testing agency sufficiently in advance of operations to allow time for completion of prequalification tests and for the assignment of personnel.
5. Provide and maintain for the sole use of the testing agency for concrete materials, adequate facilities for the safe storage and proper curing of concrete test cylinders for the first 24 hour period of curing at the site.
6. Give the Engineer timely notice of the readiness of Work to be inspected, tested or approved. Failure on the part of the Contractor to give such timely notice will result in the required inspection, test or approval being ordered to be repeated, at no additional cost to the Owner.

B. Test Reports: When submittal of test reports made by an inspection and testing agency hired by the Contractor is called for in the specification sections, such reports shall be complete and factual, citing the methods used for obtaining samples, the test performed, the specified values for the

measured characteristics, and values obtained, the parts of the project involved, and similar pertinent data which indicates compliance or non-compliance with the specifications. Each test report shall be identified by name of testing agency, name of Contractor, date of inspection or test, specification section number-letter designation and title, and exact location of test.

PART SIX - CONSTRUCTION FACILITIES

6.01 TEMPORARY FIELD OFFICES - *NOT REQUIRED*

6.02 CONSTRUCTION ELECTRICITY (Not Applicable)

6.03 TEMPORARY TELEPHONE SERVICE (Not Applicable)

6.04 CONSTRUCTION WATER

A. The Contractor shall provide the means of conveying the water from the sources approved by the Owner to the locations requiring it. All costs for construction water shall be paid for by the Contractor.

6.05 SANITARY SERVICE

A. The Contractor shall furnish, install and maintain ample sanitary facilities for the workers. All such facilities and services shall be furnished in strict accordance with existing and governing health regulations, and paid for by the Contractor.

6.06 CONSTRUCTION AIDS

A. The Contractor shall provide and maintain for the duration of its contract all scaffolding, staging, runways, ramps, lifting devices and other construction equipment as may be required for the performance of its Contract. The Contractor shall provide temporary gravel drives and sidewalks per the direction of the City's inspector as a part of this contract at no additional charge to the City.

END OF GENERAL REQUIREMENTS

SECTION 02110 - SITE PREPARATIONPART ONE - GENERAL**1.01 JOB CONDITIONS**

A. General

1. Protect from damage existing items indicated to remain by the erection of barriers or by other means approved by the Owner's representative.
2. All open depressions, excavations, pits and the like shall be barricaded. Adequate barricades shall be provided at all times. Barricades must conform to local safety regulations and must be acceptable to the Owner's representative. Remove barriers and fences when no longer required.
3. The Contractor shall maintain and keep public roads and highways in a condition satisfactory to local and/or state officials. All public roads and highways shall be kept clean of spillage at all times.

B. Utility Protection

1. Particular attention is called to the drawings for the location of the existing utilities. The Contractor shall protect these and all other existing utilities from damage resulting from its operations. Any damage to utilities resulting from insufficient protection shall be repaired or replaced to the satisfaction of the Owner, without cost to the Owner.
2. Call "Miss Dig" prior to excavation.

C. Tree Protection

1. Protect all trees to remain within the contract limit lines from damage or injury by any construction operation or equipment.
2. Where existing trees are vulnerable to damage by construction operations, the Contractor shall erect suitable barriers around trees to be protected.
3. Any damage to trees resulting from insufficient protection shall be repaired or replaced to the Owner's satisfaction, without cost to the Owner.
4. The Owner shall be compensated for the full value of trees damaged beyond repair.

D. Shoring and Bracing

1. Shore and brace excavations as required to prevent cave-ins. The Contractor shall assume full responsibility for adequate construction of shoring and bracing, and shall be responsible for the safety of all persons occupying excavated sites.

2. Prior to installation, make every effort to determine the presence of existing underground conditions not indicated. If unknown services or obstructions are discovered, the Contractor shall notify the Engineer before proceeding.

3. Remove all shoring and bracing prior to backfilling.

PART TWO - EXECUTION

2.01 CLEARING and GRUBBING

A. Clearing: Remove trees not indicated to remain, shrubs, plants, crops and other above-ground vegetation from the area enclosed by the contract limits.

B. Grubbing: Excavate stumps, roots, and other on-ground and below-ground vegetation or organic debris and remove to a minimum depth below existing grade of 36 inches for stumps and 8 inches for roots, and other vegetative or organic debris.

2.02 PAVEMENT and STRUCTURE DEMOLITION

A. Pavement and Other Site Work

1. Break up and remove existing hard surface pavements including concrete walks, curbs, slabs and bituminous pavements. Remove all base material within 12 inches of finish grade in areas outside of areas to receive new paving.

2. Saw cut the limits of all concrete paving and curbs to be removed when the pavement or curb does not terminate at an existing expansion joint. Saw cut limits of existing bituminous pavements where adjoining pavement is to remain. Protect and preserve all retaining walls adjacent to concrete which is to be removed.

3. Remove existing fences, posts, poles and other foundations embedded in the ground.

B. Structures shall be removed down to and include basement floor slabs and wall footings. All building debris shall be completely removed from the site.

2.03 UTILITY ADJUSTMENTS or ABANDONMENT

A. General

1. All cutting, blocking and discontinuance of utilities shall be done in a permanent and workmanlike manner to the full satisfaction of utility companies and the Owner's representative.

2. All utility companies involved shall be immediately notified by the Contractor so that demolition operations may proceed without danger to, or interruption of, said services for other property owners or liability to the Owner.

B. Abandonment of Manholes or Inlets

1. Existing manholes and inlets to be abandoned, as indicated on the drawings, shall first have the casting removed and either reused on this project or turned over to the Owner for salvage.
2. The cone shall be demolished and removed, the walls broken and removed to a depth necessary to accommodate new construction. Break up bottom to allow for drainage.
3. Plug all inlets and outlets with a minimum of a 12 inch brick and mortar or concrete plug. Any sewers that are to remain in use shall have correcting pipe placed between inlet and outlet, properly connected.
4. The manhole or inlet shall be backfilled with compacted granular material.

C. Adjustment of Existing Utility Covers

1. Tops of existing utility structures, covers, frames and grates shall be adjusted to meet future finished grade elevations.
2. Existing water valves and gas valves shall be adjusted as necessary to meet future finished grades.

2.04 CLEAN UP and DISPOSAL

- A. Remove all debris found on the site or accumulated during performance of the work. Spoil piles and other debris shall be removed from the site *on a daily basis* and will not be allowed to be left overnight. If spoil piles and debris are not removed, the City may have it removed with the cost deducted from the contract.
- B. Items to be removed shall become the property of the Contractor and shall be legally disposed of off the site, at no cost to the Owner.
- C. Debris or other materials shall not be offered for sale on the project site.
- D. Burning of debris, including trees, stumps, roots and branches, will not be permitted. Debris are to be disposed of off-site.

END OF SECTION 02110

SECTION 02200 - GRADING**PART ONE - GENERAL****1.01 REFERENCES**

A. All work shall comply with requirements of the current Michigan Department of Transportation "Standard Specifications for Construction", referred to as MDOT, unless otherwise specified herein.

B. Where referenced, work shall conform to American Society of Testing Materials series of Standard Specifications, referred to as ASTM.

1.03 SUBMITTALS

A. Certified Test Reports: Prior to construction, submit certified test reports for Contractor-supplied materials.

B. Manufacturer's Data: Submit manufacturers' descriptive literature, detailed specifications, performance data, instructions and recommendations for installation of proposed geotextile fabrics.

PART TWO - PRODUCTS**2.01 SOIL MATERIALS**

A. Soil materials shall be free of debris, roots, wood, scrap material, vegetative matter, refuse, soft unsound particles, frozen, deleterious or objectionable materials.

B. General site fill shall be friable soil without clods of clay. Maximum particle size shall be 3 inches in longest dimension.

C. Granular fill shall be clean, free draining sand, or sand and gravel obtained from natural deposits meeting the requirements of MDOT Class II granular material.

PART THREE - EXECUTION**3.01 INSPECTION**

A. Examine work in place on which this work is dependent. Defects which may influence satisfactory completion and performance of this work shall be corrected in accordance with the requirements of the applicable section of work prior to commencement of the work. Commencement shall be construed as work in place being acceptable for satisfying the requirements of this section.

3.02 STRIPPING and CONSERVATION of TOPSOIL

A. Remove heavy growth of grass, sod, decayed vegetation and other unsuitable material from the areas to be stripped.

B. Acceptable topsoil, *which has been inspected and approved by the Owner*, within the areas to be stripped shall be removed and stockpiled in a convenient area as approved by the Owner's representative. Topsoil stripped and stockpiled shall be without admixture of subsoil, free of plants and their roots, stones and other undesirable material. Topsoil shall be stored separately from other excavated materials.

3.03 EXCAVATION

A. Stockpiling: Stockpile excavated materials where directed until required for backfill or fill. Locate and retain fill materials away from edges of excavations.

B. Drainage and Dewatering: Ground adjacent to excavations shall be graded to prevent surface water from flowing into excavations. Remove water accumulating in excavations to prevent softening of foundation bottoms or soil changes detrimental to stability of the subgrade. Provide and maintain sufficient dewatering devices required to convey the water away from excavations.

C. Unauthorized Excavations: Excessive or unauthorized excavations shall be filled, at no cost to the Owner, with compacted fill material as directed by the Owner's representative.

D. Stability of Excavations: Slope the sides of excavations to comply with local codes and ordinances having jurisdiction. Sheet, shore and brace where sloping is not possible either because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.

E. Frost Protection: Protect trenches and bottoms of excavations against freezing by means of insulating materials and/or heat as approved.

3.04 FILL

A. Placing

1. Do not place fill material upon a frozen surface.

2. Place fill materials in successive horizontal layers over the entire width and breadth of the section under construction. Each layer shall not be over 8 inches thick, loose measurement. After dumping, spread the fill material by approved means.

3. As soon as practicable after commencement of a fill section, raise or crown the central portion thereof with grades not to exceed 5 percent so that the surface will drain freely. Maintain drainage grades throughout construction until completed to indicated levels and grades.

4. During fill material placing operations, remove roots, trash, debris and all stones larger than 3 inches in maximum dimension.
 5. Maintain the entire surface of a section under construction in such condition that construction equipment can travel on all parts of all sections. Fill ruts in surface before proceeding with compaction operations.
- B. Compaction of Fill Layers: Compact each layer of fill material at optimum moisture content to the density specified under Compaction Requirements. Prior to compaction operations, the layer of fill material shall be scarified, disked, harrowed or pulverized sufficiently to break down oversized clods.

3.05 GENERAL GRADING

- A. Grade excavated and filled sections, including transition areas, to provide positive drainage. Reshape graded areas over underground utilities, and areas rutted or otherwise disturbed during construction operations to obtain uniform transition to adjacent areas or finish grades as indicated.
- B. Grades not otherwise indicated shall be uniform levels or slopes between points where elevations are given, or between such points and existing grades. The finish surface shall be reasonably smooth, compacted and free from irregular surface changes. The degree of finish shall be plus or minus 1" from plan subgrade.
- C. Finish ditches so as to permit adequate drainage. Finish lawn areas to a smoothness suitable for the application of topsoil. Grade areas for paving and walks for proper drainage.

3.06 COMPACTION REQUIREMENTS

- A. Paved areas are defined as all areas below or within 5 feet of any proposed pavement or walk.
- B. Moisture-Density: The minimum compacted density at optimum moisture content as determined by moisture-density test specified by ASTM D1557, or One-Point Michigan Cone Test shall be:
1. 95 percent of maximum dry density for paved areas.
 2. 90 percent of maximum dry density for lawn areas.
- C. Moisture Control
1. Prior to compaction operations, provide the necessary equipment for adding moisture to the subgrade material and to each layer of backfill and fill material.
 2. If moisture is required to be added to the surface of the subgrade or layer of backfill or fill material, water shall be uniformly applied and accurately measured, and application of water shall be controlled so that free water will not appear on the surface during or subsequent to compaction operations.
 3. Material that is too wet to permit compaction to the specified density shall be permitted to

dry, assisted by disking, harrowing or pulverizing, if necessary, until the moisture content is reduced to within the maximum variation from optimum.

3.07 SPECIAL EARTHWORK REQUIREMENTS

A. Unsuitable Material: Material found unsuitable for compaction shall be removed to a depth as determined by the testing agency and replaced with suitable material, as directed by the Owner's representative.

3.08 SEDIMENTATION and SOIL EROSION CONTROL

A. The Contractor shall comply with all requirements of the City soil erosion and sedimentation control permit, and the requirements shown on the drawings and in Section 02800 of these specifications. A Soil Erosion and Sediment Control permit is **required** and is obtainable from the City DPW at no cost to the contractor.

3.09 DISPOSAL of SURPLUS or UNSUITABLE MATERIAL

A. Material unsuitable for filling or grading operations shall be disposed of off-site by the contractor at the contractor's expense.

B. Surplus excavated fill not required for backfilling or filling shall be disposed of off-site by the contractor at the contractor's expense.

C. If the City wants parts of the surplus soils, the designated soils to be saved shall be delivered by the contractor to a location as designated by the City, at no additional cost to the City.

END OF SECTION 02200

SECTION 02210 - EARTHWORK FOR UTILITIESPART ONE - GENERAL**1.01 REFERENCES**

- A. All work shall comply with requirements of the 2012 Michigan Department of Transportation "Standard Specifications for Construction", referred to as MDOT, unless otherwise specified herein.
- B. Where referenced, work shall conform to American Society of Testing Materials series of Standard Specifications, referred to as ASTM.

1.02 SUBMITTALS

- A. Certified Test Reports: Prior to construction, submit certified test reports for all Contractor-supplied materials.

1.03 SITE CONDITIONS

A. Use of Explosives

1. The use of explosives is not permitted without prior approval of the Owner. When the use of explosives is approved, the Contractor shall be responsible for any and all measures necessary for the protection of people and property. Explosives may be used only by personnel trained and certified in their use and the Contractor's insurance shall cover any and all claims. The Owner shall be indemnified and held harmless for any and all losses and damages.

2. Prior to any and all blasts the Contractor shall perform Notification of Blasting procedures per the requirements of the Owner; however, the Owner's requirements will in no way relieve the contractor of total responsibility for safety.

B. Protection of Persons and Property

1. Barricade open excavations occurring as part of this work per Section 02110 - 1.01 A.
2. Protect utilities, pavements and other facilities from damage which may be caused by settlement, lateral movement, undermining, wash-out and other hazards created by excavation operations.

PART TWO - MATERIALS**2.01 SOIL MATERIALS**

- A. Soil materials shall be free of debris, roots, wood, scrap material, vegetative matter, refuse, soft and/or unsound particles, frozen, deleterious or objectionable materials.
- B. Granular bedding and backfill shall be clean natural sand, gravel or crushed stone meeting the requirements of MDOT Class II granular material. For sanitary sewers, gradation shall be modified to comply with the maximum particle sizes as defined in ASTM D2321 and AWWA C605.

2.02 CASING PIPES

A. 12" Diameter or Larger: Shall be steel pipe, ASTM A53, Type E or S, Grade B, with minimum yield strength of 35,000 psi. All joints shall be full penetration, continuous welds ground smooth inside and outside and shall have a minimum wall thickness of 0.25 inches.

B. 10" Diameter or Smaller: Shall be PVC pipe, ASTM 1785 Schedule 80. All joints shall be solvent welded.

PART THREE - EXECUTION

3.01 SHORING and SHEETING

A. Provide temporary shoring, bracing, cribbing or sheeting as required to prevent undermining of structures, utilities, pavements and slabs, and to provide a safe work area in accordance with OSHA safety regulations. The Contractor is responsible for the design of all shoring and sheeting including utility supports.

3.02 DE-WATERING (IF REQUIRED)

A. Include in de-watering the collection and disposal of all forms of surface and subsurface water that are encountered in the course of construction. The Contractor shall operate the de-watering system continuously, 24 hours per day, 7 days per week, until such a time as construction work below existing water levels is complete, unless otherwise directed. After placement of backfill, the water level may rise, but at no time higher than 1 foot below the prevailing level of backfill. Slope all top of excavations to drain rain water runoff away from excavation.

B. The bid item for de-watering shall include only areas where, *in the opinion of the Engineer*, full-time pumping with a 4" diameter or larger pump or the use of specialized de-watering wells is required. All costs for minor de-watering and/or stone placement for trench stabilization shall be incidental.

3.03 EXCAVATION

A. Shall be to the elevations and dimensions indicated or otherwise specified. Keep excavations free from water while construction is in progress. Notify the Owner immediately if it becomes necessary to remove hard, soft, weak or wet material to a depth greater than indicated.

B. Excavate large rock, boulders or hard material to an overdepth at least 6 inches below the bottom of the pipe, conduit, duct and appurtenances unless otherwise indicated or specified.

C. Refill overdepths to the proper grade and place in 6 inch maximum layers. The excavations must be cut to an overdepth of not less than 6 inches and refilled with bedding material to the required grade as specified.

D. Grade bottom of trenches accurately to provide uniform bearing and support for each section of pipe, conduit, duct or structure on undisturbed soil, or bedding material as indicated or specified at every point along its entire length except for portions where it is necessary to excavate for bell holes and for making proper joints. Dig bell holes and depressions for joints after trench has been graded and dimension as required for properly making the particular type of joint to ensure that the bell does

not bear on the bottom of the excavation.

3.04 ROCK EXCAVATION (IF REQUIRED)

A. Definition: Rock excavation is defined as excavation material that requires blasting before it can be removed by generally available excavation equipment.

B. Rock such as boulders or fractured rock pieces 1 cubic yard or less in volume, or weathered rock or hardpan that can be removed by a ripper powered by a D-8 tractor or comparable, 2 cu. yd. backhoe with a rock bucket or other generally available excavation equipment shall not be classified as rock excavation.

C. Blasting, if approved by the Owner, shall be done with explosives of such quantity and power, and fired in such sequence and locations, as not to injure personnel, damage or crack rock against which concrete will be placed, or damage property or adjacent work, or both. Explosives are not to be stored on the Owner's property. Blasting shall be performed by skilled operators in accordance with state and local ordinances. Damage caused by blasting operations shall be the sole responsibility of the Contractor.

D. To the extent possible, when blasting in the vicinity of occupied spaces the area to be blasted shall be covered with sand to minimize the launching of projectiles.

3.05 BEDDING and BACKFILLING

A. Surround pipes, conduits, ducts with bedding and backfill as indicated. Ensure that backfill is placed completely under pipe haunches. No frozen backfill is to be used. Ensure that no damage is done to structures or protective coatings thereon. Provide uniform and continuous support for each section of structure except at bell holes or depressions necessary for making proper joints.

B. Place granular backfill in 6 inch maximum loose lifts to 1 foot above pipe or other utility unless otherwise specified. Bring up evenly on each side and for the full length of the structure.

C. In wet areas, crushed stone shall be required for stabilization purposes. The cost shall be **incidental** to the project.

D. At 1 foot above the pipe or other utility, place granular backfill in 8 inch maximum loose lifts unless otherwise specified.

E. Compact each loose lift as specified below before placing the next lift.

F. Do not backfill in freezing weather where the material in the trench is already frozen or is muddy, except as authorized.

G. Where unacceptable settlements occur in trenches and pits due to improper compaction, excavate to the depth necessary to rectify the problem, then backfill and compact the excavation as specified herein and restore the surface to the required elevation.

H. Coordinate backfilling with testing of utilities. Testing for water distribution and sanitary sewer systems shall be complete before final backfilling.

3.07 COMPACTION

A. Use hand-operated plate-type vibratory or other suitable hand tampers in areas inaccessible to larger rollers or compactors. Be careful to avoid damaging utilities and protective coatings. Compaction shall be in accordance with the following unless otherwise specified.

1. Compaction of bedding shall be to 95 percent of ASTM D1557 or One-Point Michigan Cone Test maximum density.
2. Compaction of granular backfill to 1 foot above pipes, cables, conduits or ducts shall be to 95 percent of ASTM D1557 or One-Point Michigan Cone Test maximum density.
3. Compaction of granular backfill from 1 foot above pipes, cables, conduits or ducts shall be to 90 percent of ASTM D1557 or One-Point Michigan Cone Test maximum density.

3.08 SPECIAL EARTHWORK REQUIREMENTS

A. Piping or Utilities Under Embankment: Construct the embankment to 6 inches above the elevation of the top of the pipe. Excavate the trench through the constructed embankment as specified in Excavation.

B. Manholes and Other Appurtenances: Provide at least 12 inches clear from outer surfaces to the embankment or shoring. Remove unstable soil that is incapable of supporting the structure to an overdepth of 1 foot and refill with compacted bedding material to the proper elevation.

C. Roads, Streets, Walkways and Other Areas to be Paved: Place backfill in 6 inch maximum loose lifts. Compact bedding and granular backfill surrounding pipes, ducts, conduits and other structures as specified above. Backfill in a manner to permit the rolling and compacting of the completed excavation with the adjoining material to provide the specified density so that paving of the area can proceed immediately after backfilling has been completed.

D. Boring and Jacking: The Contractor shall be allowed to bore and jack casing pipes or conduits under existing roadways. All materials and procedures shall be submitted for review and approval, and shall be in accordance with rules and regulations of the utility company and road owner.

3.09 FINISH OPERATIONS

A. Grading shall conform to Section 02200 - 3.05. In addition, existing grades which are to remain, but are disturbed by the Contractor's operations, shall be graded as directed.

B. Surplus or unsuitable material for backfill shall be removed and disposed of off-site by the contractor at the contractor's expense.

C. Protect newly graded areas from traffic, erosion and settlements that may occur. Repair or reestablish damaged grades, elevations or slopes.

END OF SECTION 02210

SECTION 02720 - STORM SEWERSPART ONE - GENERAL

1.01 REFERENCES

A. Performance and material requirements shall meet specific reference standards as referred to herein as:

AASHTO - American Society of State Highway and Transportation Officials

ACPA - American Concrete Pipe Association

ASTM - American Society of Testing and Materials

B. Excavation, backfill, laying and bedding, and jointing of pipe shall be done in accordance with the standards of workmanship, and methods as outlined in the ACPA's Concrete Pipe Handbook, latest edition.

1.02 SUBMITTALS

A. Certification of Pipe: All pipe delivered to the job site shall be accompanied by certification papers showing that the pipe has been tested in accordance with applicable specifications and that the pipe meets the specifications for this project.

B. Joint Details: Furnish proposed details of the pipe joints for consideration and approval before ordering any pipe.

PART TWO - MATERIALS

2.01 PIPE MATERIALS

A. Reinforced Concrete Pipe: Reinforced concrete pipe conforming to ASTM C76, Class IV, Wall "B". Joints shall be modified tongue and groove with rubber gasket in conformance with ASTM C433. Precast concrete end sections shall be the same as specified for adjoining pipe.

B. Corrugated Polyethylene Pipe: Corrugated polyethylene pipe and fittings conforming to ASTM F 405. Large diameter corrugated polyethylene pipe and fittings conforming to ASTM F 667.

C. Corrugated Steel Pipe: Corrugated steel pipe and pipe arches conforming to AASHTO M36. Connections to be hugger type banded connections with O-ring gaskets.

2.02 DRAINAGE STRUCTURES

A. General: Drainage structures shall be of precast reinforced concrete, block or brick construction, to the dimensions and profiles shown on the drawings. Provide metal frames, covers or gratings, and fixed steps as shown.

B. Precast Concrete Structures

1. Precast concrete structures shall comply with ASTM Specifications for "Precast Reinforced Concrete Manhole Risers and Tops", C478.
2. All precast manhole tops shall be the eccentric cone type.
3. Storm sewer manhole joints may be plain tongue and groove with cold mastic sealer. These joints shall also be pointed inside and outside. Lifting holes shall be plugged and mortared to a smooth surface finish.

C. Brick or Block Structures

1. Brick shall be grade MA conforming to the requirements of the "Standard Specifications for Sewer Brick", ASTM C32.
2. Concrete brick for use in manhole construction shall conform to the requirements of ASTM Specification for "Concrete Building Brick", C55, Grade A.
3. Concrete block for use in manhole construction shall conform to the requirements of ASTM Specification for "Concrete Masonry Units for Construction of Catch Basins and Manholes", C139. These blocks shall be at least eight inches thick and shaped so as to conform with the inside radius of the structure.

D. Base Slab for Structures: Precast reinforced concrete base slabs and poured-in-place slabs are permissible. Base slabs shall be of the required diameter and not less than 8 inches thick.

E. Mortar for coating structures

1. Brick and block structures shall be completely mortared to a thickness of at least 1/2 inch on the exterior surface. The mortar shall be composed of one part of a combination of Portland cement and hydrated lime, and two parts of fine aggregate by volume.
2. The combination of cement and lime shall consist of 90 percent cement and 10 percent lime by volume. In lieu of the above combination of cement and lime, a standard brick mortar cement may be used if approved by the Landscape Architect/Engineer. Retempering of mortar will not be permitted.

F. Mortar for laying brick or block

1. Mortar for laying brick or block for structures shall comply with ASTM specification "Mortar for Unit Masonry", C270, Type M.
2. Mortar shall be composed on one part Portland cement and two-and-one-half parts natural or manufactured sand. Sand shall comply with ASTM specification, "Aggregate for Masonry Mortar", C144.

3. All brick and concrete work shall be properly cured and protected from freezing for a minimum of 72 hours. When the temperature is 40 degrees F., and falling, brick mortar and concrete shall be heated to a minimum temperature of 70 degrees.

G. Concrete

1. Any concrete used in the construction of structures shall be MDOT Grade 35S.
2. Concrete for backfill and bedding shall be MDOT Grade X.

H. Castings

1. Manhole steps: Cast iron manhole steps shall be castings meeting the requirements of ASTM Specification for "Gray Iron Castings", A48, Class No. 35B. The steps shall be approximately 10 x 10 x 3 inches and shall be East Jordan Works No. 8500 (No. 8503 for block construction) or as approved. Steps in precast manhole sections shall be cast in place at the plant.
2. Manhole frames and covers: Cast iron manhole frames and covers shall conform to the requirements of ASTM A48, Class No. 30B. They shall be heavy duty with a perforated cover for storm sewers with type as shown on drawings. Solid manhole covers shall have the name of the utility served (i.e., Storm) cast on the cover.
3. Catch basin and inlet frames and covers: All castings for catch basins shall conform to the requirements of ASTM A48, Class 30B. Standard pavement catch basin frames and covers shall be heavy duty with type as shown.

I. Bedding and Backfill Material: See Section 02210, Earthwork for Utilities.

PART THREE - EXECUTION

3.01 INSPECTION

- A. Before any sewer work is started, the Contractor shall uncover the existing sewer at each point of connection and shall determine the actual location and elevation of the sewer.
- B. If the actual location and elevation of the sewer is not as shown on the drawings, the Owner's representative shall be notified by letter prior to beginning any sewer work.
- C. Sewer work shall be corrected at the expense of the Contractor in compliance with instructions by the Owner's engineer when the installed work is in error due to deviations between the drawings and as-built sewer line and grade, and the Contractor has not complied with the above procedure.

3.02 HANDLING

- A. Pipe shall be distributed at the job site by the Contractor or supplier in a manner so as not to

damage the pipe.

B. Pipe shall be inspected prior to use, and any pipe which is damaged shall be rejected from use in the work and shall be immediately removed from the site by the Contractor.

3.03 EXCAVATION

A. Pipe trench: Excavation shall be in accordance with Section 02210, "Earthwork for Utilities". Trench excavation shall be of sufficient depth and width to provide adequate room for construction and installation of the work, except that the width of a trench from the pipe invert to a point 12 inches above the top of the sewer pipe shall not be greater than:

<u>Pipe Size</u>	<u>Trench Width</u>
12 inches or smaller	O.D. + 9 inches
15 inches to 30 inches	O.D. + 12 inches
36 inches to 60 inches	O.D. + 18 inches

If the widths referenced above are exceeded, the Contractor shall install, at his expense, Class A concrete bedding as required by the Engineer to support the load of the backfill.

B. Structures: Excavation for structures such as manholes, catch basins and inlets shall be made to the depth required for pouring or placing the base slab. Whenever possible, the base shall rest on undisturbed soil with a minimum amount of compacted sand-cement mixture to be used for leveling. In no case will more than 3 inches of sand-cement mixture be permitted under a base slab. If ground conditions or excess excavation causes need for more than 3 inches of fill or leveling course, an approved aggregate fill, compacted in place, will be required.

C. Excavations shall at all times be finished to the required grade for an adequate distance in advance of the completed sewer line, but not more than 100 feet of trench shall be open at one time ahead of the pipe laying operation.

3.04 PIPE INSTALLATION

A. Bedding Requirements: Shall be in accordance with Section 02210, Earthwork for Utilities.

B. Pipe Alignment

1. Construction shall begin at the outlet end and proceed upgrade with the spigot ends pointing in the direction of flow. All pipe shall be laid to the line and grade specified on the drawings.

2. The Contractor shall use laser aligning equipment for the laying of sewers to the specified lines and grades. The Contractor shall furnish all necessary equipment and personnel required to operate the laser equipment.

3. The laser beam projector shall be rigidly mounted to its support platforms in a manner

that will minimize effects from all ground equipment vibrations, and that will permit the laser beam to be projected coaxially through the center of the pipe. All units shall be furnished with equipment to control atmospheric conditions in the pipe which could affect the acceptable standard of construction.

4. The laser alignment method selected must be shown to have performed satisfactorily on at least three previous projects of a similar nature. The equipment shall be operated by competent, trained operators.

C. Laying Pipe

1. Each pipe shall be inspected for defects prior to being lowered into the trench, and the inside of the pipe and the outside spigot shall be clean of dirt or any foreign matter. Lowering of the pipe into the trench shall be accomplished in a manner which will avoid injury to the workmen and damage to the pipe.

2. Concrete Pipe: Joints shall be prepared and seated in the manner recommended by the manufacturer and approved by the Owner's representative. When pipe is laid in wet trenches, the Contractor shall provide suitable mechanical means of seating the joint and holding it in position. Mechanical means shall be used for seating all rubber gasket joints when manual means will not result in pushing and holding the pipe home. Any remaining annular space in the joints of pipes 30 inches in diameter or larger shall be completely filled on the insides with mortar.

3. Polyethylene Pipe: Shall be installed in accordance with Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers.

4. Corrugated Steel Pipe: Shall be jointed with hugger type connections with O-ring gaskets, installed in accordance with manufacture's recommendation

5. Whenever the pipe is found to be off line or grade by sighting through the completed portion, this pipe shall be properly relaid by the Contractor at no extra cost to the Owner.

3.05 BACKFILL OPERATIONS

A. Backfill shall be in accordance with Section 02210, Earthwork for Utilities, as modified below.

B. No backfilling shall be done prior to inspection of the pipe, and after this inspection, the granular backfill required to a point one foot above the pipe shall be placed. The entire backfilling operation shall proceed along with the laying of the pipe.

C. Any settlement of trench backfill during the warranty period shall be filled and reshaped by the Contractor.

D. Backfilling Around Structures: After the structure and/or mortar coating has set sufficiently to avoid damage, backfilling shall be done in a manner that will not cause unequal pressure on the

structure. Backfill material other than sand shall not be placed within 3 feet of the structure.

E. Catch Basin Connections: Any catch basin lead which has less than 2 feet clearance between the pavement slab and the top of pipe shall be completely backfilled with an approved dry sand-cement mixture compacted in place.

3.06 DRAINAGE STRUCTURE INSTALLATION

A. Drainage structures shall be constructed at the locations shown and in compliance with the details. All necessary metal steps, frames and covers shall be furnished and installed.

B. Covers shall be set at the required final elevation, 1/4" to 3/8" below flush with pavement or flush with lawn elevations so subsequent adjustment shall not be necessary.

C. Brick or Block Structures: Brick shall be laid radial in courses in full bed of mortar with interior joints not more than 1/4 inch in width. Whole bricks only shall be used except to effect closures and to fill in the outside of radial joints. Each seventh course shall be laid as "stretchers", the intervening courses being composed of "headers". Wall thicknesses shall be as shown. The upper section of the manhole shall be tapered, drawing in the cone to such a diameter as will fit the iron casting. All bricks shall be moist prior to laying. Brick and block structures shall be completely mortared to a thickness of at least 1/2 inch on the exterior surface.

3.07 STUBS, CONNECTIONS, BULKHEADS AND MISCELLANEOUS ITEMS

A. Stubs, connections, bulkheads and miscellaneous items of work specified shall be provided, installed or constructed by the Contractor.

B. Stubs shall consist of one complete length of sewer pipe of the size and type indicated.

C. Existing sewers shall be connected to the sewer under construction as indicated. All connections shall be made in a workmanlike manner and in strict compliance with all requirements of the specifications or the requirements of any other agency involved.

3.08 FINAL ACCEPTANCE

A. Prior to final acceptance of the project, the Contractor shall make all necessary corrections and adjustments, and finish all clean-up operations.

END OF SECTION 02720

SECTION 02730 - SANITARY SEWERSPART ONE - GENERAL**1.01 REFERENCES**

A. All work is to be installed per the Ten State's standards and specifications. In case of a discrepancy between the Ten State's standards and the technical specifications outlined in this section, the Ten State's standards shall prevail. All discrepancies shall be brought to the attention of the Engineer.

B. Performance and material requirements shall meet specific reference standards as referred to herein as:

ANSI - American National Standards Institute
ASTM - American Society of Testing and Materials
AWWA - American Water Works Association

C. Installation of sanitary sewer pipe shall be in conformance with ASTM D2321.

1.02 SUBMITTALS

A. Certification of Pipe: All pipe delivered to the job site shall be accompanied by certification papers showing that the pipe has been tested in accordance with applicable specifications and that the pipe meets the specifications for this project.

B. Joint Details: Furnish proposed details of the pipe joints for consideration and approval before ordering any pipe.

PART TWO - MATERIALS**2.01 SEWER MAINS**

A. Polyvinyl Chloride Pipe (PVC) Gravity Sewer pipe and fittings shall be bell and spigot **ASTM D3034, SDR 35/26** with flexible elastomeric gaskets conforming to **ASTM D3212**.

B. Polyvinyl Chloride Pipe (PVC) Pressure Sewer Pipe and fittings for pipe 4" diameter and larger shall be **AWWA C900 DR18**, and for pipe smaller than 4" diameter shall be **ASTM D2241, SDR 21**. Each joint shall consist of a spigot and a formed bell complete with a factory-installed flexible elastomeric gasket meeting the requirements of ASTM D 3139 and D 3212.

C. Joints in all tee branches, wyes, fittings, riser pipes, and service laterals shall conform to joints furnished for the polyvinyl chloride sewer pipe. When necessary to field cut a standard length of pipe, the new spigot end shall be prepared as recommended by the manufacturer.

D. For sewer pipe penetrations of existing and new manholes, flexible and watertight connections shall be provided, such as link seals or elastomeric boot type connections.

2.02 SEWER LEADS

A. Gravity Sewer pipe and fittings shall be: **Polyvinyl Chloride Pipe (PVC) - ASTM D3034, SDR 35/26** with either elastomeric gasket or solvent welded joints.

B. Pressure Sewer pipe and fittings shall be either: **Polyvinyl Chloride Pipe (PVC) Pressure Sewer Pipe and Fittings - ASTM D2241, SDR 21** or **Polyethylene (PE) Plastic Tubing - ASTM D2737, SDR 11**.

2.03 VALVES

A. Gate Valves

1. Gate valves shall be resilient wedge, open left, designed for 150 psi working pressure and meet the requirements of **AWWA C509**. Gate valves shall have a clear waterway opening equivalent when fully opened to that of the connecting pipe.

2. Gate valves which are not in valve vaults shall be furnished with cast iron valve boxes. Valve boxes shall be three piece adjustable type with cast iron covers with the word "Sewer" cast in raised letters.

3. Two Complete sets of accessories shall be furnished including operation wrench of suitable length for the 6 foot 6 inch minimum cover depth.

B. Check Valves

1. Check valves shall be the swing type conforming to **AWWA C508** with iron or steel body, 150 psi pressure rating. Valves shall have a clear waterway opening equivalent when fully opened to that of the connecting pipe.

2.03 STRUCTURES

A. Manholes and other sanitary structures shall be of precast reinforced concrete to the dimensions and profiles shown on the drawings. Provide metal frames, covers or gratings as shown. No steps are allowed in sanitary manholes.

B. Precast concrete structures shall comply with ASTM Specification for "Precast Reinforced Concrete Manhole Risers and Tops", C478. All precast manhole tops shall be the eccentric cone type. Precast manhole joints shall be plain tongue and groove with O-ring seals or premium rubber joints. All precast manhole joints shall also be pointed inside and outside. Lifting holes shall be plugged and mortared to a smooth surface finish.

C. Base slab for structures shall be precast reinforced concrete. All concrete to be used for fill and shaping flow channels shall be MDOT Grade S3.

D. Grade Adjustment Rings: Grade rings shall be Underground Technologies or approved equivalent. Brick or concrete blocks shall not be allowed for use to adjust manhole covers.

E. Concrete: Any concrete used in the construction of sanitary structures, cradles, and encasement shall be MDOT Grade S3.

F. Manhole frames and covers: Cast iron manhole frames and covers shall conform to the requirements of ASTM A48, Class No. 30B. They shall be heavy duty solid covers with "Sanitary" cast on the cover and be of the type noted on the drawings.

2.04 LOCATION MARKERS

A. Buried tracer wire shall be placed along all non-ferrous force mains and shall be brought to the surface inside valve boxes as shown on the plans.

PART THREE - EXECUTION

3.01 GENERAL

A. Installation of PVC sewer pipe shall conform with ASTM D2321, and with the provisions of Section 02210, Earthwork for Utilities.

3.02 EXCAVATION

A. All excavations for pipes and structures to be completed as outlined in Section 02210, Earthwork for Utilities.

3.03 LAYING PIPE

A. All pipe shall be laid to the line and grade called for on the drawings. Each pipe, as laid, shall be checked by the Contractor with line and grade pole to ensure that this result is obtained. The finished work shall be straight and shall be sighted through between manholes.

B. Each pipe shall be inspected for defects prior to being lowered into the trench. The inside of pipe and outside of the tongue shall be cleaned of any dirt or foreign matter. Joint materials shall be placed as recommended by the manufacturer.

C. The pipe shall be centered in the grooves and pushed tight together to form a smooth and continuous invert. Mechanical means shall be used for pulling the pipe home, consisting of a cable placed inside of the pipe with a suitable winch, jack, or come-along for pulling the pipe home and holding the pipe in position.

3.04 PIPE BEDDING AND BACKFILLING

A. All pipe bedding and backfilling to be completed as authorized in Section 02210, Earthwork for Utilities.

3.05 PAVEMENT CUTS

A. When the trench must be cut through pavement, driveway, or sidewalk, particular care shall be taken not to unnecessarily damage the adjoining areas of the pavement, driveway, or sidewalks. All cuts through existing surfaces shall be made with a concrete saw, sawing deep enough to allow a straight cut parallel with longitudinal and transverse construction or contraction joints.

3.06 LASER ALIGNMENT

A. Construction shall begin at the outlet end and proceed upgrade with the spigot ends pointing in the direction of flow. All pipe shall be laid to the line and grade specified on the drawings.

B. The Contractor shall use laser aligning equipment for the laying of sewers to the specified lines and grades. The Contractor shall furnish all necessary equipment and personnel required to operate the laser equipment.

C. The laser beam projector is to be rigidly mounted to its support platforms in a manner to be approved by the Owner's representative. This will ensure that all ground equipment vibrations will be kept to a minimum and will permit the laser beam to be projected coaxially through the center of the pipe. All units shall be furnished with equipment to control atmospheric conditions in the pipe which could affect the acceptable standard of construction.

D. The laser alignment method selected must be shown to have performed satisfactorily on at least three previous projects of a similar nature. The equipment shall be operated by competent, trained operators.

3.07 ALLOWABLE TOLERANCES IN SEWER GRADE

A. Sewers shall be constructed per the alignment and grade indicated on the drawings. A variation of $>1/4$ inch from this will be deemed sufficient reason for the work to be rejected and relaid.

3.08 CONCRETE CRADLE FOR PIPE

A. Where required on the drawings, pipe shall be installed with a concrete cradle. Each pipe shall rest on a 6 inch minimum thickness bed of concrete, shaped to fit the bottom of the pipe. After setting the pipe, the space between the outside of the pipe and the undisturbed trench bank shall be filled to a level equal to a point one-third of the diameter of the pipe invert with concrete, having a 2 inch slump and mechanically vibrated to ensure complete filling of the annular space between the excavated face of the original ground and the outside face of the pipe.

3.09 CONCRETE ENCASEMENT

A. Where required on the drawings, pipe shall be installed with a concrete encasement. The concrete encasement shall be a minimum of 12 inches thick around the entire pipe and fitting. It shall be cast against undisturbed earth and contain at least one wrap of 6 x 6 #10 mesh. The encasement shall extend 18 inches beyond each end of the fitting joint with the existing sewer pipe. Particular care shall be taken to bed the pipe in concrete so that a complete support of the pipe shall be made. Encasement at the side and top shall be placed in a manner so that the pipe will not be disturbed or floated from its bedding.

3.10 STUBS, BULKHEADS, AND MISCELLANEOUS WORK

A. The Contractor shall furnish all material and labor required to construct stubs, bulkheads, and miscellaneous work shown on the drawings or detailed in the specifications. The cost of this work shall be incidental prices for manholes, structures, and/or sewers.

3.11 SANITARY STRUCTURE INSTALLATION

A. Structures shall be constructed of the type and in compliance with the details and at the locations shown. All necessary metal frames and covers shall be furnished and installed. Covers shall be set at the required final elevation or flush with pavement or lawn elevations so subsequent adjustment shall not be necessary.

B. Grade Adjustment Rings: Grade rings shall be Underground Technologies or approved equivalent. Brick or concrete block shall not be allowed for use to adjust manhole covers.

C. Backfilling Around Structures: After the structure has set sufficiently to avoid damage, backfilling shall be done in a manner that will not cause unequal pressure on the structure. Backfill material other than sand shall not be placed within 3 feet of the structure.

D. By-Pass Pumping: By-pass pumping shall be incidental to the work of sanitary sewers as described in this section. Continuous and uninterrupted by-pass pumping shall be provided during construction wherever it is required to prevent sewage spill and contamination, and to maintain sewage flow past the construction area. All equipment, materials and labor required to provide by-pass pumping shall be provided by the contractor, including but not limited to a submersible sewage pump with back-up, hoses of sufficient length to reach the next downstream manhole and sewer invert, sewer plugs, power for operation independent of City power, continuous monitoring and supervision of the by-pass pumping operation, and all other means necessary for the successful diversion of the sewage.

3.12 TESTING

A. Gravity sewers: A final visual inspection will be performed with the Owner's representative to note any defects, dips, or other problems. All gravity sanitary sewers shall be air pressure tested in accordance with **ASTM F1417** prior to final acceptance. A deflection test will be performed on all gravity sanitary sewers. The deflection test will be performed by passing a go-nogo ball through the pipe 30 days after construction. A maximum deflection of 5% will be permitted.

B. Pressure sewers: All pressure sewers shall be water pressure tested in accordance with AWWA Publication *No. M23; PVC Pipe - Design and Installation* and the requirements for water mains. The test will be conducted at 100 psi.

C. All corrective work shall be completed and additional testing performed until all work passes the testing requirements. This testing and inspection work is considered incidental to the cost of construction.

SANITARY SEWER PRESSURE TEST

Time required for loss of pressure from 3.5 psig to 2.5 psig for size and length of pipe indicated for Q = 0.003 (cft/min/sft of internal surface area).

<u>Pipe Dia.</u>	<u>Min. time (min:sec)</u>	<u>Length for min. time</u>	<u>Time for longer length (sec)</u>
4	1:53	597	0.190L
6	2:50	398	0.427L
8	3:47	298	0.760L
10	4:43	239	1.187L
12	5:40	199	1.709L
15	7:05	159	2.671L
18	8:30	133	3.846L
21	9:55	114	5.235L
24	11:20	99	6.837L
27	12:45	88	8.653L
30	14:10	80	10.683L
33	15:35	72	12.926L
36	17:00	66	15.384L

Example: 400 feet of 10 inch

$$\begin{aligned}
 \text{Time} &= 1.187 \times L \\
 &= 1.187 \times 400 \\
 &= 475 \text{ sec (7 min 55 sec)}
 \end{aligned}$$

When (2) sizes of pipe are involved, the time shall be computed by the ratio of the lengths involved:

Example: 400 feet of 10 inch and 200 feet of 6 inch

$$\begin{aligned}
 \text{Time} &= (\text{Length1} \times \text{Time1}) + (\text{Length2} \times \text{Time2}) \div (\text{Length1} + \text{Length2}) \\
 &= (400 \times 475 \text{ sec}) + (200 \times 170 \text{ sec}) \div (400 + 200) \\
 &= (190,000 + 34,000) \div 600 \\
 &= 373 \text{ sec (6 min 13 sec)}
 \end{aligned}$$

END OF SECTION 02730

SECTION 03100 - STANDARD WATER SPECIFICATIONS

1. Contractor's Responsibility for Material

- A. The Contractor shall inspect all material delivered to the site, and any defective material shall be removed from the site immediately by the Contractor. The Contractor shall be responsible for the safe storage of all material until it has been incorporated in the completed project and accepted by the Owner. Any material lost, stolen, or damaged at the site shall be replaced by the Contractor at his expense.
- B. Proposed water main pipe shall be **AWWA standard for polyvinyl chloride (PVC) pressure pipe C900-07, DR18, NSF Standard 14.**
- C. The Contractor shall furnish the Owner with an affidavit of compliance from the Manufacturer, certifying that the pipe complies with the **AWWA Standard for Polyvinyl Chloride (PVC) Pressure Pipe C900-07 DR 18.** All PVC-plastic pipe must be stamped NSF-pw on the exterior pipe wall.
- D. Proposed water main pipe larger than 12 inches diameter shall be **AWWA standard for polyvinyl chloride (PVC) pressure pipe C905, DR18, NSF Standard 14** and be stamped NSF-pw on the exterior pipe wall. Contractor shall furnish affidavit as noted above.

2. Handling of Pipe and Accessories

- A. Pipe and accessories, unless specific instructions are received from the Owner, shall be unloaded at the point of delivery and distributed to the site of the project by the Contractor. Pipe and accessories shall be handled with care at all times to avoid damage. Whether moved by hand, skidways or hoists, material shall not be dropped or bumped. The ends of all pipe shall be kept free from dirt and foreign matter at all times. In distributing the material to the site of the work, each piece shall be unloaded near the place it is to be laid in the trench.
- B. Pipe shall be handled in such manner as to avoid damage to the ends. Pipe damaged at such points that cannot be repaired to the Engineer's satisfaction shall be replaced at the Contractor's expense. Valves and hydrants shall be kept well drained and stored before installation in a manner protecting them from damage due to freezing of trapped water.
- C. Construction of PVC watermain shall be in accordance with **AWWA Standard C605 for Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.**

3. Alignment and Grade

- A. The Contractor shall be responsible for locating the pipelines and accessories at the specified line and grade. The line shall be as shown on the plans and directed by the engineer, the grade to be such that will provide a minimum cover over the pipe of 6 1/2 feet to existing grade of roads, as presently graded, or to the proposed grade of roads as designed, and any deviation shall be permitted only on the specific instruction of the Engineer. Pipelines in crosslot locations shall have a minimum of 6 1/2 feet of cover, except

as ordered by the Engineer.

- B. Fittings, valves and hydrants shall be installed at the required locations with joints centered, spigots home, and all hydrant valve stems plumb.

4. Excavation and Preparation of Trench

- A. General: The trench shall be dug to the required alignment and depth shown on the contract drawings or as directed by the Engineer and only so far in advance of pipe laying as the Engineer shall permit. The trench shall be braced and drained when necessary so that workmen may work therein safely and efficiently.
- B. Width: The trench width at the ground surface may vary with, and depend upon, its depth and the nature of the ground encountered. The minimum clear width of un-sheeted or sheeted trench measured at the horizontal diameter of the pipe shall at 18 inches, or 1 foot greater than the outside diameter of the barrel of the pipe, whichever is greater. The maximum clear width of trench at the top of the pipe shall not be more than the outside diameter of the barrel of the pipe plus 2 feet. Greater width of trench at the top of the pipe shall be permitted only on approval by the Engineer.
- C. Foundation: The pipe shall be laid on stable soil. Any part of the trench excavated below grade shall be backfilled to grade with thoroughly compacted material approved by the Engineer. When an unstable subgrade condition is encountered and, in the opinion of the Engineer, it cannot support the pipe, an additional depth shall be excavated and refilled to pipe foundation grade with crushed stone or other suitable material as required by the Engineer to achieve a satisfactory trench bottom as specified in Section 5 below.
- D. Crushed stone used as pipe embedment shall meet the gradation requirements of **AWWA C605**. Stone shall be rounded with a maximum particle size of 1 inch. The stone shall be presented to the Engineer for pre-approval prior to use as bedding material.
- E. Rock excavation: Ledge rock, boulders, and large stones, shall be removed to provide 6 in. of clearance on each side and below all pipe and accessories. Excavations below subgrade in rock or in boulders shall be refilled to subgrade with material approved by the Engineer, and thoroughly compacted. Blasting for excavation will be permitted only after the approval of the Engineer has been secured and only when proper precautions have been taken for the protection of persons and property. The hours of blasting shall be fixed by the Engineer. Any damage caused by the blasting shall be repaired by the Contractor at his expense. The Contractor's procedures and methods of blasting shall conform to state and local laws and to municipal ordinances.
- F. Excavation methods: The use of trench-digging machinery will be permitted except where its operations will cause damage to trees, buildings, or existing structures above or below ground. At such locations, hand methods shall be employed to avoid such damage. Wherever it is necessary to prevent caving, trench excavations in soils such as gravel and sandy soils shall be adequately sheeted and braced. Where sheeting and bracing are used, the trench width shall not be less than that specified in Section IV-B. As backfill sand is placed and if sheeting is to be withdrawn, it shall be withdrawn in increments of not more than 1 foot, and the void left by the withdrawn sheeting shall be filled and compacted. All excavated material shall be piled in a manner that will not endanger the work.

- G. Provision for public safety: To protect persons from injury and to avoid property damage, adequate barricades, construction signs, torches, warning lights, and guards shall be placed and maintained during the progress of the construction work until the site is safe for traffic use. Whenever appropriate, watchmen shall be provided to prevent accidents. Rules and regulations of the state and local authorities regarding safety provisions shall be observed. The Contractor is responsible for prevention of the occurrence or development of unsafe conditions, and for the timely correction of such unsafe conditions.

5. Preparation of Trench Bottom

- A. The trench bottom should be smooth and free from stones greater than 1/2" diameter, large dirt clods, and any frozen material. Pipe bedding material shall be placed as shown in the trench detail on the plans, and shall be placed so that the pipe is fully supported at pipe joints and along the sides of the pipe.

6. Lowering the Pipe and Accessories into Trench:

- A. Implements, tools, and facilities satisfactory to the Engineer shall be provided and used by the Contractor for the safe and efficient execution of the work. All pipe, fittings, valves, hydrants, and accessories shall be carefully lowered into the trench with suitable equipment in a manner that will prevent damage to the materials. Under no circumstances shall pipe or accessories be dropped or dumped into the trench. Prior to being lowered into the trench, pipe and accessories shall be inspected for defects. Any defective, damaged, or unsound material shall be repaired or replaced as directed by Engineer. All foreign matter or dirt shall be removed from the ends of pipe and accessories before it is lowered into position in the trench. Pipe openings shall be kept free from dirt & debris by the contractor during and after laying.

7. Pipe Joints

- A. Bell and Spigot: Make certain that the ring groove in the bell is clean, with no dirt or foreign material that could interfere with proper sealing of the ring. Lubricate the spigot end of the pipe with manufacturer's lubricant. Do not lubricate ring. Insert the bevel end into the bell so that it is in contact with the ring.

8. Joint of Pipe to Fittings

- A. Each cast iron valve or hydrant connected to the pipe shall be equipped with a bell that has an inside profile that presents a seal to be made between the pipe end and the bell of the fitting with a rubber transition gasket provided by the pipe manufacturer.
- B. Before valves or hydrants are laid, all lumps, blistering, and excess coating shall be removed from the bell. The inside of the bell shall then be wire-brushed and both the inside of the bell and the spigot end of the pipe wiped clean and dry.

9. Bends, Tees, and Reducers

- A. Bends, tees, and reducers shall be lowered into the trench, inspected, cleaned as specified above, and joined to the pipe, as specified by the manufacturer.

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- B. Reaction or thrust backing shall be used at all bends, tees, and reducers or fittings where changes in pipe diameter occur. The design of concrete thrust backing shall be as shown on the attached detail or as specified by the pipe manufacturer. The material of reaction or thrust backing shall be concrete composed of concrete aggregates in accordance with ASTM Designation C33 and portland cement in accordance with ASTM Designation C150 for portland cement or C175 for air-entrained portland cement. The mix shall not be leaner than 1 part of cement 2 1/2 parts sand, and 5 parts stone and shall have compressive strength of no less than 2,000 psi in 36 hours for high-early-strength cement (Types 111 or 111A) and 7 days for standard cement (1 or 1A). Backing shall be placed between solid, undisturbed ground and the fitting to be anchored. The area of bearing on fitting and ground shall in each instance be that required by the Engineer. Unless otherwise directed by the Engineer, the backing shall be placed so that the pipe and fitting joints will be accessible for repair. Metal harness tie rods and pipe clamps shall be used to prevent movement, as shown on the contract drawings or directed by the Engineer. Steel rods and clamps shall be galvanized or otherwise rustproofed or painted.
 - C. Reaction or thrust backing will be considered incidental to the project, and separate payment will not be made.
 - D. Mechanical joint restraint, such as megalug or approved equal may be used. Such restraint systems shall be designed and installed in accordance with manufacturer's recommendations.

10. Plugging of Dead Ends

- A. Standard plugs shall be inserted into the bells of all dead-end fittings. Spigot end of fittings and plain ends of pipe shall be capped. A concrete reaction or thrust backing shall be provided at all dead ends of pipe that are capped and plugged. Capped or plugged outlets to fittings shall be tied to the fittings with clamps and tie rods. The number and size of rods shall be as specified.

11. Connections

- A. Where shown on the drawings, connection of existing mains to the new mains will be done only after the new mains are shown to be sterile by the results of the bacteriological analysis. All connections to the existing mains will be completed under the direction and supervision of the engineer. Street cuts, excavation and backfill, and testing will be done by the Contractor.
- B. The Engineer will supervise all new taps and connections to the existing water mains. The contractor shall be responsible for coordinating all new connections and taps with the Engineer.

12. Backfilling, Cleaning, and Maintenance of Surfaces

- A. Backfilling procedure before pipe testing: Backfill material approved by the Engineer, unfrozen and free from rock, lumps of clay, large stones, boulders or other unsuitable substances, shall be deposited in the trench uniformly at both sides of the pipeline for the full width of the trench up to the horizontal diameter of the pipeline. This backfill material shall be tamped in 4 inch thick layers and shall be sufficiently damp to permit thorough

compaction under and on each side of the pipe to provide support and fill voids. Refer to Earthwork for Utilities 02210-2.01.B for bedding and backfilling materials.

- a.1 If visual inspection during testing is not required, the pipe and joints shall be backfilled as specified above and a cushion of approved material hand placed over the pipeline and joints to an average depth of 12 inches of all sizes of pipe.
- a.2 If joints are to be exposed during testing, additional approved backfill material shall be hand placed between the joints in order to hold the line securely during testing. The average depth of material shall be 12 inches over the top of 8 inch diameter and smaller pipe and 24 inches over larger pipe.
- B. Backfill procedure after pipe testing: Upon completion of pressure leakage tests, exposed couplings shall be covered with approved backfill hand placed to a depth of 12 inches above the top of the pipe and couplings. The balance of backfill shall contain no stones more than 6 inches in their largest dimension, and the backfill mixtures shall not contain more than 25 percent stones. The Contractor shall not permit the excavation to be used for disposal of refuse. Trenches in the right of way of a road shall be backfilled to a compacted density of 95 percent, trenches not in road right-of-way shall be backfilled to a density of 90% of maximum density as determined by modified proctor test **ASTM D 1557-7C**. Trench not in a right of way may be backfilled without tamping. Any deficiency in the quantity of material for backfilling the trenches or filling depressions caused by settlement shall be supplied by the Contractor at his expense.
- C. Restoration and Cleanup: The Contractor shall restore or replace all removed or damaged paving, curb, sidewalks, gutters, shrubbery, fences, sod, or other disturbed surfaces or structures in a condition equal to that before the work began and to the satisfaction of the Engineer and shall furnish all labor and material incidental thereto.
- D. Surplus pipeline, material, tools, and temporary structures shall be removed by the Contractor. All dirt and rubbish shall be hauled to a dump provided by the Contractor, and the construction site shall be left clean to the satisfaction of the Engineer and Owner.

14. Groundwater Control

- A. The Contractor shall provide and maintain adequate pumping and drainage facilities for removal and disposal of water from trenches or other excavations. Where work is in ground containing free water, the Contractor shall provide, install and maintain suitable drainage facilities such as well points connected to manifolds and reliable pumping equipment and shall so operate them to insure proper working conditions. In impervious materials, the Contractor shall construct suitable drains, underdrains, sumps and provide adequate pumping facilities to maintain the trench in a dry condition. Contractor shall take measures to protect pipe or structures from hydrostatic uplift. Discharge shall be to surface disposal, and shall be done without damage to adjacent ground and without depositing soils in natural water courses or on adjacent properties.
- B. Any necessary permits for dewatering shall be the responsibility of the Contractor.

15. Protection of Environment

- A. Protection of the environment is of the essence in the project, including but not limited to existing ground cover, groundwater and streams. It is the responsibility of the Contractor that all work be planned and executed to preserve the environmental integrity of the project site and adjacent areas.

16. Hydrant Assembly

- A. General: Hydrants shall meet the requirements of **AWWA C502**. Hydrants shall be lowered into the trench, inspected, and joined to pipe as specified above, and reaction or thrust backing provided. Hydrants shall be thoroughly cleaned in the manner specified above before they are set. Hydrants shall be East Jordan Iron Works Model 5-BR with one(1) 5" integral STORZ connection. Hydrants shall have a 36 inch long, 3/8 inch diameter flange mounted fiberglass marker.
- B. Location: Hydrants shall be located to provide complete accessibility and to minimize the possibility of damage from vehicles or injury to pedestrians. The following provisions shall govern, unless other instructions are issued by the Engineer; the bowl of any hydrant placed behind the curb shall be set so that no portion of the hydrant or hose nozzle caps on the street side shall be less than 6 or more than 12 inches from the face of the curb; all hydrants shall stand plumb; pumper nozzles shall be at right angles to and facing the curb; hose nozzles shall parallel the curb, except those hydrants with two hose nozzles 90 degrees apart shall be set so that the nozzles face the curb at an angle of 45 degrees; and nozzles shall be at least 13 inches above the ground and as directed by the Engineer.
- C. Connection to main: Each hydrant shall be connected to the main with 6 inch diameter pipe and shall be controlled by an independent 6 inch gate valve. Hydrant valves shall be a minimum of three feet from the valve. Hydrants with valves attached are not acceptable.
- D. Drainage: Hydrants drains shall meet all requirements of *Recommended Standards for Water Works*, latest edition. Hydrant drains should be plugged. Hydrant drains, where allowed, must be above the seasonal high groundwater table. Where not plugged, hydrant drains shall be provided with a gravel pocket or drywell or be in naturally well drained soils per *Recommended Standards for Water Works*, latest edition.
- E. Reaction or thrust backing: Thrust backing shall be provided at the bowl of each hydrant and shall be so placed as not to obstruct the drainage outlet of the hydrant. The size and shape of concrete thrust backing or the number and size of the tie rods shall be as shown on the contract drawings or as directed by the Engineer. Reaction or thrust backing is considered incidental to the project, and separate payment will not be made.
- F. **Hydrant assembly** shall be as specified. The hydrant assembly **shall include** the **hydrant** constructed for 6 1/2 foot bury, **thrust backing**, one 6" **tee** & one 6" **gatevalve**. Pipe between the hydrant and the main is NOT included and will be paid for as part of the water main pipe item. Hydrant shall comply with **AWWA Standard C502**.

17. Gatevalves & Valve boxes

- A. All water gatevalves shall be East Jordan Iron Works or approved equivalent. Gate valves

shall be **Resilient Wedge**, Mechanical joint Gate Valves, test pressure 400 lbs., WWP 200 psi, open left, or approved equivalent. Resilient wedge gatevalves shall comply with **AWWA Standard C509**.

- B. All gatevalves shall be provided with a new three piece cast iron valve box, w/ cover. The valve box shall be **EJIW 8550 series combined with a EJIW 3612 Type E Outer Cover** to prevent settlement, or approved equivalent, placed in conformance with the manufacturer's recommendations, completely supported independent of the valve, centered and plumb over the wrench nut, and not touching the valve at any point, extending to and flush with the proposed finished grade, and allowing ready accessibility to the valve wrench nut. Lids or covers shall be cast with the word "water".

18. Service Lines

- A. HDPE CST SDR 9 Pipe and Tubing for 3/4 inch to 2 inches:
1. Materials used for the manufacture of polyethylene pipe and fittings shall be made from a PE 3408 high density polyethylene resin compound meeting cell classification 345434C per ASTM D3350; and meeting Type III, Class C, Category 5, Grade P34 per ASTM D1238.
 2. High Density Polyethylene (HDPE) pipes shall comply with AWWA Specifications C901.
 3. If rework compounds are required, only those generated in the Manufacturer's own plant from resin compounds of the same class and type from the same raw material supplier shall be used.
 4. Dimensions and workmanship shall be as specified by ASTM D3035. HDPE fittings and transitions shall meet ASTM D3261. HDPE pipe shall have a minimum density of 0.955 grams per cubic centimeter. All HDPE pipe and fittings shall have a Hydrostatic Design Basis (HDB) of 1,600 psi
 5. HDPE pipe and accessories 2" and less in diameter, shall be 160 psi at 73.4° meeting the requirements of Standard Dimension Ration (SDR) 9 as MINIMUM STRENGTH.
 6. The pipe Manufacturer must certify compliance with the above requirements. The pipe shall be indent printed with the manufacturer's name, the nominal pipe size, the dimension ration, and shall be color identified blue to indicate potable water usage.
 7. The contractor is responsible for compatibility between pipe materials, fittings, and appurtenances.
 8. Tracing wire shall be installed on all HDPE service lines longer than 50'.
 9. All molded fittings and fabricated fittings shall be fully pressure rated to match the pipe SDR pressure rating to which they are made. All fittings shall be molded or fabricated by the manufacturer. No Contractor fabricated fittings shall be used unless approved by the Engineer.

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10. The manufacturer of the HDPE pipe shall supply all HDPE fittings and accessories as well as any adapters and/or specials required to perform the work as shown on the Drawings and specified herein.
- B. Corporation stops shall be:
- | |
|--|
| Ford 3/4" flared fittings # F-1000 |
| Ford 1" flared fitting # F-1000 |
| Mueller 3/4" flared fittings # H-15000 |
| Mueller 1" flared fitting # H-15000 |
- C. Goosenecks shall be Type K copper tubing. Joint ends for goosenecks shall be appropriate for connecting to corporation stop and service line. Length of goosenecks shall be in accordance with standard practice.
- D. Curb or service stops shall be:
- | | |
|--------------|-------------|
| Ford 3/4" | # B22-333 |
| Ford 1" | # B22-444 |
| Mueller 3/4" | # B-25204-3 |
| Mueller 1" | # B-25204-3 |
- E. Service Saddles shall be:
- | | |
|----------|---------|
| Ford | # FC202 |
| McDonald | # 4856A |
- F. Curb boxes shall be **Tyler/Union, 6500 series, # 95E**, or approved equivalent.
- G. Size of service lines and curb stops shall be as designated on the plans.

19. Fittings

- A. All tees, bends, reducers and other fittings shall be new ductile iron conforming to **ANSI/AWWA C153**, with rubber gasket joints conforming to **ANSI/AWWA C111**. Linings shall be in accordance with **AWWA C104** for cement-mortar linings for ductile iron pipe for water.

20. Single Service Building Connections - See Detail.

- A. Water service pipe shall be **HDPE CST SDR 9 ASTM D3350**, 1 inch minimum size, or as specified on the plans.

21. Blowoffs:

- A. Blowoffs shall be constructed where designated in conformance with the detail drawings. The valve boxes shall be firmly supported, and centered and plumb over the blowoff valve, with sufficient clearance within the shaft of the valve box to permit easy access to the blowoff valve with a valve wrench.

22. Manufacturer's Recommendations

- A. In all situations, unless specifically designated otherwise in these documents or in writing by the Engineer, the Contractor shall follow precisely the recommendations of the manufacturer or supplier for the handling and placement of the pipe, fittings and all other materials used.

23. Substitutions

- A. Substitutions may be allowed for such materials as are designated on the plans or specifications by the term "or equivalent" only if authorized in writing by the Engineer. The contractor shall supply such data as the Engineer may request, describing and/or warranting the substitution.

24. Incidental Work and Materials

- A. Work and materials needed to complete the project in accordance with the plans and specifications which are not listed as separate bid items on the bid sheet, shall be considered incidental to the project and separate payment will not be made for these items.

25. Separation from Sanitary and Storm Sewer

- A. Horizontal Separation: Watermains shall be laid at least 10 feet horizontally measured from edge to edge from any existing or proposed storm sewer, sanitary sewer or force mains. Any deviation under the ten foot minimum shall be done in such a way as to minimize the risk of contamination and only with the approval of the Engineer and the Department of Environmental Quality.
- B. Vertical Separation: Watermains crossing sewers shall be constructed to provide a minimum vertical separation of 18 inches above or below the sewer main. A crossing above the sewer main is preferred if possible. At crossings, one full length of watermain shall be located so both joints will be as far from the sewer as possible. Special additional structural support for the pipes may be required.
- C. Separation from Sanitary Manholes: No watermain shall pass through, under, or come in contact with any part of a sanitary manhole.

26. Watermain Location

- A. Tracer wire, no. 12 AWG shall be placed alongside all watermain. The wire shall be brought to the surface at every hydrant inside of a 1 1/2" diameter PVC conduit extending 24 inches into the ground and 12 inches above finished grade. The conduit shall be placed alongside and behind the hydrant, and shall have a screwed cap. The wire shall be brought inside to the top of the conduit, looped with an excess of +/- 24 inches of wire, and then returned back down the conduit to continue along the main. The cost of the tracer wire shall be considered incidental to the placement of the watermain.

27. Disinfection

- A. After completion of the entire system and prior to connection to the existing main, and when designated by the Engineer, the Contractor shall disinfect the system under the direction of the Engineer and in accordance with the requirements of **AWWA Standard C651 for Disinfecting Water Mains**. The water shall be chlorinated so that after a 24 hour holding period the chlorine residual is not less than 10 mg/l. After disinfection but before sampling, the watermains shall be flushed using potable water acquired from a suitable source. This shall be considered incidental to the project, and separate payment will not be made.

- B. The Contractor shall be responsible for collecting samples for bacteriological testing in accordance with **AWWA Standard C651 for Disinfecting Water Mains**. Samples (at least 2) shall be collected at a minimum of 24 hours apart from each section of main. If the sample results show a positive coliform, repeat disinfection process until acceptable results are obtained.
- C. Acceptable tests are negative for bacteria and as otherwise defined by **AWWA C651** and MDEQ regulations. Bacteriological analysis shall be made by a State certified laboratory.

28. Pressure and Leakage Test

- A. After the pipeline has been laid and all service taps are made and with the corporation stops open, it shall be filled with water and subjected to a hydrostatic pressure test. Unless otherwise specified, the test pressure shall be 150 psi. A test shall be made only after a part or all backfilling has been completed and at least 36 hours after the last concrete thrust backing has been cast with high-early strength cement, or at least 7 days after the last concrete thrust backing has been cast with standard cement. The duration of the test shall be 2 hours unless otherwise directed by the Engineer.
- B. Procedure: Each section of pipeline shall be slowly filled with water, and the specified test pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer. The pump, pipe connection, and all necessary apparatus and labor shall be furnished by the Contractor. The pressure test must be in accordance with **AWWA C605**, and must be preceded by flushing of the water main in accordance with **AWWA C605**.
- C. Overall Leakage: No pipe installation will be accepted until or unless the leakage for the section of line tested is no greater than shown in **Table 1**. If the test leakage in any section is greater than that permitted, the Contractor shall locate and repair the defective joints at his own expense until the leakage is within the permitted allowance.

**TABLE 1
MAXIMUM ALLOWABLE LEAKAGE FOR WATERMAIN**

AVG. TEST PRESSURE (psi)	NOMINAL DIAMETER					
	4"	6"	8"	10"	12"	16"
100	0.27	0.41	0.54	0.68	0.81	1.08
125	0.30	0.45	0.60	0.76	0.91	1.21
150	0.33	0.50	0.66	0.83	0.99	1.32
175	0.36	0.54	0.72	0.89	1.07	1.43
200	0.38	0.57	0.76	0.96	1.15	1.53
225	0.41	0.61	0.81	1.01	1.22	1.62
250	0.43	0.64	0.85	1.07	1.28	1.71

GALLONS PER HOUR per 1000 feet

END STANDARD WATER SPECIFICATIONS

SECTION 06100 - SOIL EROSION CONTROLPART ONE - GENERAL

1.01 REFERENCES

A. All work shall comply with requirements of the 1996 Michigan Department of Transportation "Standard Specifications for Construction", section 208 Soil Erosion and Sedimentation Control.

B. Where referenced, work shall conform to American Society of Testing Materials series of Standard Specifications, referred to as ASTM.

1.02 SUBMITTALS

A. Certified Test Reports: Prior to construction, submit certified test reports for all Contractor-supplied materials such as silt fence, erosion control netting/blankets, etc.

PART TWO - TEMPORARY EROSION CONTROL MEASURES

2.01 SILT FENCE

2.02 SEDIMENT BASINS

2.03 TOPSOIL, SEED, MULCH

2.04 EROSION CONTROL NETTING/BLANKETS

PART THREE - EXECUTION

3.01 SILT FENCE: Provide silt fence as required to prevent sedimentation of on-site soils off-site and into sediment basins. Silt fence shall be placed as shown on the Soil Erosion Control Plan, and additional silt fence shall be placed as deemed necessary by the Engineer or the soil erosion control officer at no additional cost to the Owner. The Contractor shall be responsible for the maintenance and/or replacement of all silt fence as directed by the Engineer or erosion control Officer.

3.02 SEDIMENT BASINS: Sediment basins shall be constructed as necessary to collect sediment on-site. Proposed permanent retention basins may be used as sediment basins during site construction. Refer to the Soil Erosion Control Plan for required sediment basins.

3.03 TOPSOIL, SEED, MULCH: Place topsoil, seed & mulch on any disturbed area of one acre or more immediately after grading operations are completed. The Engineer shall have the authority to halt all operations until the contractor completes this item.

3.04 EROSION CONTROL NETTING/BLANKETS: Provide erosion control netting/blankets as

required to prevent erosion of areas in excess of 12% slope. The blankets shall be secured as recommended by the manufacturer. Erosion control netting/blankets shall be placed as shown on the Soil Erosion Control Plan, and additional netting/blankets shall be placed as deemed necessary by the Engineer or the soil erosion control officer at no additional cost to the Owner. The Contractor shall be responsible for the maintenance and/or replacement of all erosion control netting/blankets as directed by the Engineer or erosion control Officer.

3.05 MAINTENANCE:

A. The contractor shall inspect the erosion control measures weekly and after all rainfalls of 1 inch in a 24 hour period.

B. Maintenance of erosion control measures shall be scheduled immediately when maintenance is required. The Engineer may require that work cease on other areas of the site in order to correct erosion control deficiencies.

C. Sediment shall be removed from behind silt fence when the depth reaches 1/3 of the height of the silt fence. The fence shall be restored to an upright position and re-anchored if necessary.

D. Sediment basins shall be cleaned out upon having filled halfway, or upon the Engineer's direction.

E. Erosion control netting/blankets shall be replaced and/or re-anchored if they become dislodged or torn away during a rainfall event.

F. The Engineer shall have the authority to require additional erosion control measures at his discretion to prevent possible erosion or sedimentation. Any additional measures required shall be at no additional cost to the Owner.

3.06 FINISH OPERATIONS

A. Temporary erosion control measures shall not be removed until the site has been stabilized in the opinion of the Engineer.

B. The grading & utility contractor shall be released from his obligation of soil erosion control & maintenance when the areas disturbed by construction for this contract have been stabilized in the opinion of the Engineer, at which time, the obligation will transfer to the Owner for any continued maintenance or additional measures required on-site.

END OF SECTION 06100

SECTION 07100 - STANDARD SPECIFICATIONS FOR SIDEWALKS**MATERIALS**CONCRETE

The concrete for sidewalks shall be in accordance with the 2003 MDOT Standard Specifications for Construction, Section 803 "Concrete Sidewalk, Sidewalk Ramps, and Steps". Dolomite aggregate shall be used. The subgrade shall be thoroughly compacted.

The concrete for sidewalks shall be placed in accordance with the 2003 MDOT Standard Specifications for Construction Section 601. Concrete shall be Grade P1, 6.0 sack cement, with a 28 day minimum compressive strength of 3500 psi. The air content of the concrete at time of placement shall be 6.5% +/- 1.5%. The slump shall not exceed 4". If water reducers are added the slump may not exceed 5". The amount and type of water reducer shall be clearly shown on the delivery ticket. No water shall be added on site without the permission of the engineer / inspector. Water added on site shall be recorded on the delivery ticket.

Special emphasis shall be placed on Table 601-1 "Time between Charging the Mixer and Placing Concrete". Redi-Mix trucks will have a maximum of 120 minutes to be totally unloaded when the concrete temperature is less than 60°F. This maximum time is reduced to 90 minutes when the concrete temperature between 60°-85°F and further reduced to 70 minutes when the concrete temperature exceeds 85°F. Failure to meet these delivery times is basis for rejecting the load. Concrete Temperature must be between 45°F and 90°F at the time of placement. All other provisions of Section 601 shall apply.

JOINT FILLERS

Joint filler shall be PROFLEX Vinyl Expansion Joints manufactured by Oscoda Plastics Inc., or approved equivalent.

FORMSMATERIALS

Forms shall be of wood or metal, and if constructed of wood shall be free from warp or twist and of sufficient strength to resist springing out of alignment when concrete is placed within.

SETTING

The forms shall be well staked or otherwise held to the established lines and grades, and their upper edges shall conform to the established grade of the sidewalk.

TREATMENT

All wood forms in use shall be thoroughly wetted and metal forms oiled before depositing concrete against them. All mortar and dirt shall be removed from any forms that have been previously used.

CONSTRUCTIONCONTRACTION JOINTS

The sidewalk shall be divided into unit areas of not more than 6 feet by contraction joints ½ inch in depth.

JOINTS

A full depth ½ inch joint shall be provided at least once every 50 lineal feet of sidewalk. It shall be

filled with a suitable joint filler. A similar joint shall be provided at each intersection of sidewalk and street curb, sidewalk and existing sidewalk, and sidewalk with concrete driveway. Sidewalks constructed in a business district shall be separated from any abutting building by a full depth 1/2 inch joint properly filled.

THICKNESS OF SIDEWALK

Residential	4" thick	MDOT P1, 6.0 sack mix
Business	5" thick	MDOT P1 or 35S, 6.0 sack mix
Driveway crossings	7" thick	MDOT HE, 8.4 sack mix

PROTECTION OF EDGES

The upper edge of the concrete slabs shall be rounded to a radius of 1/2 inch. The edge of all slabs abutting a business street where the edge of the sidewalk acts as curbing shall be rounded to a radius of 1 1/2 inches.

WIDTH OF SIDEWALKS

Sidewalks in residential districts shall be 6 feet wide unless otherwise permitted by resolution of the City Council. All sidewalks in business districts where streets are paved and curbed shall extend from the face of the building to the back of the curb line.

RAMPED CURBS

All sidewalk areas being constructed or replaced that have a curb crossing into a roadway shall be ramped in accordance with MDOT standard specifications.

TREATMENT AND CURING

As soon as the finished sidewalk has hardened sufficiently to prevent it from being damaged, the surface shall be covered with plastic film or other suitable material for a period of at least 3 days. This is to prevent too rapid drying. White membrane curing compound meeting MDOT Specification 8.24.06 (a) may be used as an alternate curing method.

BARRIERS AND BARRICADES

Barricades shall be erected, maintained, and properly lighted by the contractor from sundown to sunrise to protect the walk from pedestrian or vehicular traffic.

FINISHING

After the concrete has been brought to the established grade by means of screed or straight edge, it shall be worked with a float to produce an even, gritty surface.

MDOT STANDARDS

MDOT Standards shall apply to all areas not specifically defined in these minimum standards. Refer to the MDOT 2003 Standard Specifications for Construction.

END SIDEWALK SPECIFICATIONS

SECTION 08800 – TRACER WIRE SPECIFICATIONS**MATERIALS****General**

All trace wire and trace wire products shall be domestically manufactured in the U.S.A.

All trace wire shall have HDPE insulation intended for direct bury, color coated per APWA standard for the specific utility being marked.

Trace Wire

- **Open Trench** - Trace wire shall be #12 AWG Copper Clad Steel, High Strength with minimum 450 lb. break load, with minimum 30 mil HDPE insulation thickness.
- **Directional Drilling/Boring** - Trace wire shall be #12 AWG Copper Clad Steel, Extra High Strength with minimum 1,150 lb. break load, with minimum 30 mil HDPE insulation thickness.
- **Trace wire – Pipe Bursting/Slip Lining** - Trace wire shall be 7 x 7 Stranded Copper Clad Steel, Extreme Strength with 4,700 lb. break load, with minimum 50 ml HDPE insulation thickness.

Connectors

- All mainline trace wires must be interconnected in intersections, at mainline tees and mainline crosses. At tees, the three wires shall be joined using a single 3-way lockable connector. At Crosses, the four wires shall be joined using a 4-way connector. Use of two 3-way connectors with a short jumper wire between them is an acceptable alternative.
- **Direct bury wire connectors** – shall include 3-way lockable connectors and mainline to lateral lug connectors specifically manufactured for use in underground trace wire installation. Connectors shall be dielectric silicon filled to seal out moisture and corrosion, and shall be installed in a manner so as to prevent any uninsulated wire exposure.
- Non locking friction fit, twist on or taped connectors are prohibited.

TERMINATION/ACCESS

- All trace wire termination points must utilize an approved trace wire access box (above ground access box or grade level/in-ground access box as applicable), specifically manufactured for this purpose.
- All grade level/in-ground access boxes shall be appropriately identified with “sewer” or “water” cast into the cap and be color coded.
- A minimum of 2 ft. of excess/slack wire is required in all trace wire access boxes after meeting final elevation.
- All trace wire access boxes must include a manually interruptible conductive/connective link between the terminal(s) for the trace wire connection and the terminal for the grounding anode wire connection.
- Grounding anode wire shall be connected to the identified (or bottom) terminal on all access boxes.
- **Service Laterals on public property** - Trace wire must terminate at an approved grade level/in-ground trace wire access box, located at the edge of the road right-of-way, and out of the roadway.
- **Service Laterals on private property** - Trace wire must terminate at an approved above-ground trace wire access box, affixed to the building exterior directly above where the utility enters the building, at an elevation not greater than 5 vertical feet above finished grade, or terminate at an approved grade level/in-ground trace wire access box, located within 2 linear feet of the building being served by the utility.
- **Hydrants** – Trace wire must terminate at an approved above-ground trace wire access box, properly affixed to the hydrant grade flange. (affixing with tape or plastic ties shall not be acceptable)
- **Long-runs, in excess of 500 linear feet without service laterals or hydrants** - Trace wire access must be provided utilizing an approved grade level/in-ground trace wire access box, located at the edge of the road right-of-way, and out of the roadway. The grade level/in-ground trace wire access box shall be

delineated using a minimum 48" polyethylene marker post, color coded per APWA standard for the specific utility being marked.

GROUNDING

- Trace wire must be properly grounded at all dead ends/stubs
- Grounding of trace wire shall be achieved by use of a drive-in magnesium grounding anode rod with a minimum of 20ft of #14 red HDPE insulated copper clad steel wire connected to anode (minimum 0.5 lb.) specifically manufactured for this purpose, and buried at the same elevation as the utility.
- When grounding the trace wire at dead ends/stubs, the grounding anode shall be installed in a direction 180 degrees opposite of the trace wire, at the maximum possible distance.
- When grounding the trace wire in areas where the trace wire is continuous and neither the mainline trace wire or the grounding anode wire will be terminated at/above grade, install grounding anode directly beneath and in-line with the trace wire. Do not coil excess wire from grounding anode. In this installation method, the grounding anode wire shall be trimmed to an appropriate length before connecting to trace wire with a mainline to lateral lug connector.
- Where the anode wire will be connected to a trace wire access box, a minimum of 2 ft. of excess/slack wire is required after meeting final elevation.

INSTALLATION

General

- Trace wire installation shall be performed in such a manner that allows proper access for connection of line tracing equipment, proper locating of wire without loss or deterioration of low frequency (512Hz) signal for distances in excess of 1,000 linear feet, and without distortion of signal caused by multiple wires being installed in close proximity to one another.
- Trace wire systems must be installed as a single continuous wire, except where using approved connectors. No looping or coiling of wire is allowed.
- Any damage occurring during installation of the trace wire must be immediately repaired by removing the damaged wire, and installing a new section of wire with approved connectors. Taping and/or spray coating shall not be allowed.
- Trace wire shall be installed at the bottom half of the pipe and secured (taped/tied) at 5' intervals.
- Trace wire must be properly grounded as specified.
- Trace wire on all service laterals/stubs must terminate at an approved trace wire access box located directly above the utility, at the edge of the road right-of-way, but out of the roadway. (See Trace wire Termination/Access)
- At all mainline dead-ends, trace wire shall go to ground using an approved connection to a drive-in magnesium grounding anode rod, buried at the same depth as the trace wire. (See Grounding)
- Mainline trace wire shall not be connected to existing conductive pipes. Treat as a mainline dead-end, ground using an approved waterproof connection to a grounding anode buried at the same depth as the trace wire.
- All service lateral trace wires shall be a single wire, connected to the mainline trace wire using a mainline to lateral lug connector, installed without cutting/splicing the mainline trace wire.
- In occurrences where an existing trace wire is encountered on an existing utility that is being extended or tied into, the new trace wire and existing trace wire shall be connected using approved splice connectors, and shall be properly grounded at the splice location as specified.

Sanitary Sewer System

- A mainline trace wire must be installed, with all service lateral trace wires properly connected to the mainline trace wire, to ensure full tracing/locating capabilities from a single connection point.

- Lay mainline trace wire continuously, by-passing around the outside of manholes/structures on the North or East side.
- Trace wire on all sanitary service laterals must terminate at an approved trace wire access box color coded green and located directly above the service lateral at the edge of road right of way.

Water System

- A mainline trace wire must be installed, with all service lateral trace wires properly connected to the mainline trace wire, to ensure full tracing/locating capabilities from a single connection point.
- Lay mainline trace wire continuously, by-passing around the outside of valves and fittings on the North or East side.
- Trace wire on all water service laterals must terminate at an approved trace wire access box color coded blue and located directly above the service lateral at the edge of road right of way.
- Above-ground tracer wire access boxes will be installed on all fire hydrants.
- All conductive and non-conductive service lines shall include tracer wire.

Storm Sewer System

This section shall be included at the discretion of the facility owner.

- If the storm sewer system includes service laterals for connection of private drains and tile lines, it shall be specified the same as a sanitary sewer application.
- Lay mainline trace wire continuously, by-passing around the outside of manholes/structure on the North or East side.

PROHIBITED PRODUCTS and METHODS

The following products and methods shall not be allowed or acceptable

- Uninsulated trace wire
- Trace wire insulations other than HDPE
- Trace wires not domestically manufactured
- Non locking, friction fit, twist on or taped connectors
- Brass or copper ground rods
- Wire connections utilizing taping or spray-on waterproofing
- Looped wire or continuous wire installations, that has multiple wires laid side-by-side or in close proximity to one another
- Trace wire wrapped around the corresponding utility
- Brass fittings with trace wire connection lugs
- Wire terminations within the roadway, i.e. in valve boxes, cleanouts, manholes, etc.
- Connecting trace wire to existing conductive utilities

TESTING

All new trace wire installations shall be located using typical low frequency (512Hz) line tracing equipment, witnessed by the contractor, engineer and facility owner as applicable, prior to acceptance of ownership. This verification shall be performed upon completion of rough grading and again prior to final acceptance of the project. Continuity testing in lieu of actual line tracing shall not be accepted.

END OF SECTION 08800

SECTION 09000 - SPECIAL PROVISIONS**SUMMARY OF WORK:**

A. The Work to be done under this Contract and in accordance with these Contract Documents consists of performing all work, supplying all labor, and furnishing and installing all materials and incidentals necessary or convenient for completion of the construction of the site and carrying out all duties and obligations imposed upon the Contractor by the Contract Documents.

B. The main features of Work include, but are not limited to: _____, restoration, and are further defined below.

C. Also included are the following support activities:

1. Agency Coordination
2. Coordination of and cooperation with utility contractors, including misc. clean-up.
3. Layout Survey and Staking (Refer to General Requirements, Section 01050)
4. Protection of Existing Site Conditions
5. Security of the Site

D. Unless otherwise noted in the Contract Documents, the Contractor shall precisely follow the recommendations of the manufacturer or supplier for handling and placement of materials and equipment into the project work.

E. Work and materials needed to complete the project which are not listed shall be considered as incidental to the project.

F. This contract anticipates first-class workmanship throughout the construction of the project. All labor shall be done by personnel qualified and competent to produce a quality product.

G. The Drawings and Specifications contemplate a finished piece of Work of such character and quality as is described in and is reasonably inferable from them. Inadvertent discrepancies or the failure to show repeated details on any drawing of the figures or notes given on another shall not be the cause for additional charges or claims.

H. The Contractor shall consult the Engineer regarding any item which may, through oversight, be omitted from the Drawings or Specifications, or for which no symbol or other designation is given for identification. In the absence of any definite instructions from the Engineer, however, such items shall be furnished to correspond with similar items for which information is given.

I. All work shall be done in conformance with the 2012 Standard Specifications for Construction published by the Michigan Department of Transportation and the attached specifications and supplemental specifications.

MDOT 107 Sediment & Dust Control

MDOT 208 Soil Erosion and Sedimentation Control

MDOT 803 Concrete Sidewalk, Sidewalk Ramps
 MDOT 816 Turf Establishment

J. The locations of existing underground utilities as listed below and shown on these plans are shown in an approximate way only. The Contractor shall determine the exact location of all existing utilities before commencing work. He agrees to be fully responsible for any and all damages which might be occasioned by his failure to exactly locate and preserve any and all underground utilities.

<u>Name of Owner</u>	<u>Kind of Utilities</u>
?	Electric (---)
ATT	Telephone (Jeff Collard, 231-348-8010, cell 586-764-8260)
DTE Energy	Gas (Matt Logan, 231-258-3785, cell 231-492-7479)
Charter Communications	Cable TV (Gerald Steinberg, 231-932-8260, cell 231-463-1920)

K. The Contractor shall be responsible for the location of and the preservation of all survey corners in the construction site area. The Contractor shall not attempt to witness, re-adjust, or reset any survey corner, unless the work is performed by a licensed surveyor, as required in Act 26 of Michigan Public acts of 1988. Any survey corners reported to the Owner as being disturbed or destroyed in the project area shall be replaced by the Owner, and the total cost shall be paid by the Contractor, and shall be deducted from payments made by the owner to the Contractor.

L. The Contractor shall comply with all requirements of the EGLE, including but not limited to deflection testing, pressure testing & disinfection, if applicable.

STREET & SIDEWALK:

A. The roadway shall be constructed in accordance with the cross-sections shown on the plans and in accordance with applicable MDOT specifications.

B. The base course for pavement shall be MDOT 22A gravel compacted in place to 98% of its maximum weight as determined by a One-Point Michigan Cone Test. The base course shall be placed in accordance with the 2012 Standard Specifications for Construction, Section 302 Aggregate Base Courses. The allowable minimum tolerance of thickness for aggregate base is zero.

C. After placement of the gravel, the Engineer shall be notified a minimum of 24 hours in advance of paving to inspect the gravel base before placement of Hot Asphalt Mix.

If requested by the Owner, the Contractor shall perform core sampling at 50 foot intervals with the Engineer present. Areas not meeting minimum thickness requirements shall have enough gravel applied to meet the specified thickness before placement of bituminous mix. If areas are paved before the gravel has been inspected and approved by the Engineer, a penalty shall be imposed:

$$Penalty = 0.50 \times (Area\ Unapproved \div Total\ Area) \times Gravel\ Cost$$

The penalty shall be deducted from the contract amount. Core samples shall be replaced with proper compaction by the Contractor before placement of bituminous mix. No additional payment shall be made for the core sampling and repair. The Engineer will require a minimum 24 hour advance notice before providing inspection.

D. All bituminous paving shall be performed in accordance with MDOT specification for Hot Mix Asphalt Pavements and Surface Treatments, section 501. Pavement sections shall be per the details as shown on the plans. The HMA design mix shall have an Asphalt Performance Grade 58-34, and shall have an asphalt cement content to meet 3% target air voids, by regression method. The contractor shall submit a Job Mix Formula to the Engineer for review a minimum of 7 days prior to HMA placement.

E. Sawcutting of the existing pavement and concrete where new pavement matches shall be required and is incidental as part of the associated roadway & concrete bid items.

CONCRETE SIDEWALK, PAVEMENT & CURB CONSTRUCTION:

A. The work for ***Detectable Warning Plate*** shall include all labor, materials and equipment required for the placement of the warning plates in the locations shown on the plans. The plates shall be EJIW warning plates or approved equivalent, black asphalt dip finish. Note that some locations require radial warning plates as noted on the plans. All sidewalk ramps shall be constructed in compliance with A.D.A. requirements.

B. The bid items for sidewalks and approaches shall be in accordance with the 2012 MDOT Standard Specifications for Construction, Section 801 "Concrete Driveways" and Section 803 "Concrete Sidewalk, Sidewalk Ramps, and Steps". Dolomite aggregate shall be used. The subgrade shall be thoroughly compacted. The concrete for sidewalks shall be placed in accordance with the 2012 MDOT Standard Specifications for Construction Section 601. Concrete shall be 6.0 sack cement, with a minimum 28 day compressive strength of 4000 psi. The air content of the concrete at time of placement shall be 6.5% +/- 1.5%. The slump shall not exceed 4". If water reducers are added the slump may not exceed 5". The amount and type of water reducer shall be clearly shown on the delivery ticket. No water shall be added on site without the permission of the engineer / inspector. Water added on site shall be recorded on the delivery ticket.

C. Forms shall be of wood or metal, and if constructed of wood shall be free from warp or twist and of sufficient strength to resist springing out of alignment when concrete is placed within. The forms shall be well staked or otherwise held to the established lines and grades, and their upper edges shall conform to the established grade of the curb & gutter or sidewalk. All wood forms in use shall be thoroughly wetted and metal forms oiled before depositing concrete against them. All mortar and dirt shall be removed from any forms that have been previously used.

D. A full depth ½ inch joint shall be provided at least once every 100 lineal feet of sidewalk. Joint filler shall be PROFLEX Vinyl Expansion Joints manufactured by Oscoda Plastics Inc., or approved equivalent. A similar joint shall be provided at each intersection of sidewalk and street curb, sidewalk and existing sidewalk, and sidewalk with concrete driveway. Sidewalks abutting a building shall be separated by a full depth ½ inch joint properly filled.

E. After the concrete has been brought to the established grade by means of screed or straight edge, it shall be worked with a float to produce an even, gritty surface.

F. The sidewalk shall be divided into unit areas of not more than 6 feet by contraction joints ½ inch in depth.

G. The upper edge of the concrete slabs shall be rounded to a radius of ½ inch. The edge of all

slabs where the edge of the sidewalk acts as curbing shall be rounded to a radius of 1 ½ inches

H. All sidewalk areas being constructed or replaced that have a curb crossing into a roadway shall be ramped in accordance with MDOT standard specifications.

I. As soon as the finished sidewalk has hardened sufficiently to prevent it from being damaged, the surface shall be covered with plastic film or other suitable material for a period of at least 3 days. This is to prevent too rapid drying. Clear membrane curing compound meeting MDOT Specification 8.24.06(a) may be used as an alternate curing method.

J. Barricades shall be erected, maintained, and properly lighted by the contractor from sundown to sunrise to protect the walk from pedestrian or vehicular traffic.

K. Special emphasis shall be placed on Table 601-1 "Time between Charging the Mixer and Placing Concrete". Redi-Mix trucks will have a maximum of 120 minutes to be totally unloaded when the concrete temperature is less than 60°F. This maximum time is reduced to 90 minutes when the concrete temperature between 60°-85°F and further reduced to 70 minutes when the concrete temperature exceeds 85°F. Failure to meet these delivery times is basis for rejecting the load. Concrete Temperature must be between 45°F and 90°F at the time of placement. All other provisions of Section 601 shall apply.

L. The concrete for curb and gutters shall be placed in accordance with the 2012 MDOT Standard Specifications for Construction Sections 601 & 802. Concrete shall be 6.0 sack cement, with a 28 day minimum compressive strength of 4000 psi. The air content of the concrete at time of placement shall be 6.5% +/- 1.5%. The slump shall not exceed 3". If water reducers are added the slump may not exceed 4". The amount and type of water reducer shall be clearly shown on the delivery ticket. No water shall be added on site without the permission of the engineer / inspector. Water added on site shall be recorded on the delivery ticket.

M. For exposed edges of concrete such as retaining walls and seat walls a concrete vibrator shall be used to minimize voids.

N. MDOT Standards shall apply to all areas not specifically defined in these minimum standards. Refer to the MDOT 2012 Standard Specifications

MISCELLANEOUS:

A. ***Sediment & Dust Control*** shall comply with MDOT section 107.15, Compliance with Laws, Environmental Protection. In addition, the contractor shall be responsible for obtaining a soil & sedimentation permit (if required) from the City. The contractor shall comply with all requirements and conditions of the permit.

CHANGE ORDERS:

Change Orders requiring additional payment or time extension of Work shall be verbally approved by Engineer before proceeding with work and shall be submitted in writing for Engineer's approval within 5 days.

END OF SECTION 09000

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. This Division includes all labor, materials, equipment, tools, supervision, start-up services, Owner's Instructions, including all incidental and related items necessary to complete installation and successfully test and start up and operate in a practical and efficient manner the Mechanical Systems indicated on Drawings and described in each Section of Division 15 Specifications and conforming with all Contract Documents.
- B. Bidding: the Contractor shall bid the project in strict accordance with the plans and Specifications. Alternative methods or materials, beyond those indicated as "Base Bid", proposed by the Contractor shall be in the form of a voluntary alternate, with all details indicated, and a separate add or deduct price for these changes submitted with the Contractor's bid. (Reference General Requirements - Product Substitutions)

C. Mechanical systems complete and in place, shall include the following:

SECTION 15.000	MECHANICAL GENERAL PROVISIONS
SECTION 15.050	BASIC MECHANICAL MATERIALS AND METHODS
SECTION 15.100	VALVES
SECTION 15.140	SUPPORTS AND ANCHORS
SECTION 15.190	MECHANICAL IDENTIFICATION
SECTION 15.260	THERMAL INSULATION
SECTION 15.410	PLUMBING PIPING
SECTION 15.430	PLUMBING SPECIALTIES
SECTION 15.890	DUCTING

- D. The General Provisions of this Contract, including General and Supplementary Conditions and other General requirements Sections, apply to the Work specified in this Section.
- E. This Section is not intended to supersede, but to clarify the definitions in Division 1, General Requirements and Supplementary Conditions.

F. Drawings and Specifications:

- 1. Drawings and Specifications are intended to complement each other, and all work specified and not shown or work shown and not specified shall be provided as though mentioned in both specifications and drawings.
- 2. 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 or Subcontractor for such system, whether or not they are specifically called for by the specifications or drawings.
- 3. Drawings are diagrammatic and indicate general arrangement of systems and work included in the Contract, and shall serve only as design drawings, to represent design intent for general layout of various equipment and systems and not intended to be scaled for rough-in measurements or to service as measured shop drawings.
- 4. If directed by the Engineer, the Contractor shall, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work. (Refer to General Requirements for co-ordination between trades).

1.02 RELATED WORK

- A. Section 16000 - Electrical General Provisions
- B. All building construction documents.

1.03 COORDINATION OF WORK

A. Responsibility:

1. The Mechanical Contractor shall be responsible for his Sub-Contractors and Suppliers, and include in his bid all materials, labor, and equipment involved, and install in accordance with all local customs, codes, rules, regulations, jurisdictional awards, and decisions; and secure compliance of all parts of the Specifications and Drawings regardless of Sectional inclusion in these Specifications.
2. The Mechanical Contractor and Sub-Contractor shall be responsible for all tasks applicable to their trades as directed by the General Contractor, in accordance with the Specifications, Drawings, and code requirements, and shall be responsible for coordinating locations and arrangements of their work to give best results with all other relevant Mechanical, Architectural, Structural and Electrical Contractors' Specifications, Drawings and shop drawings. Coordinate work so that sprinkler heads, lights, diffusers, etc. are coordinated into Project and are installed per the architectural reflected ceiling plan.

B. Site and Project Document Examination:

1. Submission of a proposal is considered evidence that the Contractor has visited site and acquainted themselves with all existing conditions, made all necessary measurements, examined the Drawings and Specifications of all trades, including Mechanical, Architectural, Structural, and Electrical, and has fully informed himself with all Project and site conditions, and is proficient, experienced and knowledgeable of all standards, codes, ordinances, permits and regulations which affect the installation of his respective trade, and that all costs are included in his proposal.
2. No allowance shall subsequently be made in his behalf for extra expense incurred due to failure or neglect on his part to make this visit and examination.
3. The Mechanical Contractor and/or Sub-Contractor shall obtain all required permits and assessments have been obtained prior to starting work. Contractor shall verify requirement to include privilege fees and permits as part of his formal bid, as described in General and Supplementary Conditions.
4. It is the responsibility of the Contractor to notify the Engineer, prior to submitting his bid, of any potential problems that he has identified during his site visit or from examination of the Contract documents.

C. General Supports:

1. Provide all necessary angle and channel brackets or supplementary steel as required for adequate support for all piping, specialties, and equipment which is hung or mounted above floor. No trade shall hang equipment from work of another trade (such as sprinkler lines hanging from heating lines or electrical conduit). Secure approval from Architect, in writing, before welding or bolting to steel framing or anchoring to concrete structure.
2. Where piping or equipment is suspended from concrete construction, set approved concrete inserts in formwork to receive hanger rods, such as Unistrut or Powerstrut, and where installed in metal deck, use Ramset or Welds as required.

D. Access Panels:

1. No valve, trap, control, fire damper, duct access opening, etc., shall be installed in inaccessible locations without access panels. Any subcontractor having items requiring access shall also include access panels for same unless Drawings indicate otherwise. Contractor shall be responsible for quantities of panels and receive approval for locations of panels from Architect/Engineer before installation.
2. Any wall, ceiling, or floor access panels required shall be equal to Milcor with hinged door and latch. Those in walls or floor shall be type to accept finished surface material. Those in ceiling shall be exposed metal.
3. Removable ceilings or sections of ceilings are acceptable as access panels. Panels in rated construction shall have U.L. label and proper rating and construction to match partition, ceiling, or roof assemblies in which they occur.

4. Purchase proper access panel, coordinate location, have General Contractor install access panel, and reimburse for installation. This trade is to coordinate the access panel manufacturer with the architectural access panels.

E. Field Changes:

1. This Contractor shall not make any field changes which affect timing, costs, or performance without written approval from the Architect/Engineer in the form of a Change Order, Field Change Order, or a Supplemental Instruction. In special circumstances, verbal approvals pending paperwork may be acceptable. The Contractor assumes liability for any additional costs for changes made without such instruction or approval. Should any unauthorized change be determined by the Architect/Engineer as lessening the value of the project, a credit will be determined and issued as a change to the contract in accordance with the General Requirements.

1.04 STANDARDS, CODE AND PERMITS

- A. Refer to General Requirements and Supplementary Conditions.
- B. All work installed under Mechanical Sections shall comply with latest edition of applicable standards and codes of following:

ADAG	Americans with Disability Act Guidelines, Title III
ASA	American Standards Association
ASME	American Society of Mechanical Engineers
SMACNA	Sheet Metal & Air Conditioning Contractor Association
NSF	National Sanitation Foundation
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASTM	American Society of Testing Materials
ANSI	American National Standards Institute
AGA	American Gas Association
AWWA	American Water Works Association
NFPA	National Fire Protection Association
IBR	Institute of Boiler and Radiator Manufacturers
AWS	American Welding Society
UL	Underwriter's Laboratories
NEMA	National Electric Manufactures Association
NESC	National Electric Safety Code (H13)
ARI	American Refrigeration Association
OSHA	Occupational Safety and Health Act
ABMA	American Boiler Manufacturers Association
BOCA	Mechanical and Plumbing Code as Amended by State of Michigan
CAGI	Compressed Air and Gas Institute

- C. All work shall be provided and tested in accordance with all applicable local, county, and state laws, ordinances, codes, rules, and regulations.
- D. Contractor shall give all notices, file all drawings, obtain necessary approvals, obtain all permits, pay all fees, deposits, and expenses required for installation of all work under this Contract.
- E. No work shall be covered or enclosed until work is tested in accordance with applicable codes and regulations, and successful tests witnessed and approved by authorized inspection authority. Written approvals shall be secured by Contractor and kept on file for inspection by the Engineer.
- F. In general, all material, where applicable, shall be labeled or listed by Underwriters' Laboratories, Inc.
- G. In the event that plans and specifications conflict with any rules, regulations, or codes applying, said rules,

regulations, and codes shall govern the Contractor.

1.05 SUBMITTALS

A. Shop Drawings:

1. After a schedule of Sub-Contractors is approved by the Engineer, submit six (6) neatly bound copies of shop drawings (or number as directed by General Requirements) with one device or fixture of each type clearly identified (high-lighted, bolded, underlined, etc.) in each set on equipment and materials indicated on drawings or in the specifications.
2. Submit complete manufacturer's shop drawings of all equipment, plumbing fixtures, accessories, and controls, including dimensions, weights, capacities, construction details, installation, control methods, wiring diagrams, motor data, etc.
3. Engineer's approval of shop drawings is for general application only, and is a service that is not considered as a guarantee of total compliance with, or that relieves the Contractor of basic responsibilities under all Contract Documents, and does not approve changes in time or cost.
4. After approval, each Contractor is responsible for expeditiously providing information to all other trades involved in, or affected by, installation of his equipment and work.

B. Operating and Maintenance Instructions and Manuals:

1. Each Contractor shall provide for all major items of equipment two (2) copies, in 3-ring notebooks, of indexed sets of operating and maintenance instructions to Engineer for approval. After approval, manuals will be given to Owner by Engineer.
2. Manuals shall include a complete set of shop drawings submitted, repair parts lists, manufacturer's standard equipment manuals, valve tag schedule, and automatic control diagrams, all indexed with tabs for each section.
 - a. Operating Instructions:
Typewritten instructions regarding the starting and operating of all equipment and accessories. Operating instructions shall be encased in plastic and mounted in mechanical room. Provide additional copies of above materials in 3-ring notebooks. Operating instructions within notebooks shall also include locations of temperature control devices, switches, and equipment (including air handlers, pumps, etc.). Also, include steps of trouble-shooting and describe areas served by equipment.
 - b. Maintenance Instructions:
Provide a list of all mechanical contractors and subcontractors, including contact person and day/night telephone numbers. Upon completion of work, provide for periods not less than four (4) hours, competent person to instruct Owner in operation and maintenance of mechanical systems, equipment, controls, etc.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Standards:

1. All products shall be provided by established manufacturers regularly engaged in making the type of materials to be provided and shall be complete with all parts, accessories, trim, finish, safety guards and other devices and details needed for a complete installation and for the intended use and effect.

B. Substitution and Changes:

1. Contractor and/or Equipment Supplier may propose alternate equipment or materials of equal quality,

function, durability, and appearance as described and permitted in Specification Section 15000, 1.01.B. The substitution will take the form of an "Add-Deduct" at the time of bid submittal. It is the submitter's responsibility to provide sufficient material for review as may be required by the Engineer's office. Acceptance and approval is the responsibility of the Engineer.

2. No substitutions will be accepted, except as authorized in a Project Addendum.
3. Contractor and/or Equipment Supplier is liable for any added costs to himself or others, and is responsible for verifying dimensions, clearance, and roughing-in requirements, when product not specifically named or described as the basis of design is used. The Contractor is responsible for advising other Contractors of variations and, if requested, submitting revised drawing layout for approval of the Engineer.

C. Explanation of Scheduled Manufacturers:

1. **Base Bid.** This term designates that this equipment will be the product which the contractor generates his bid from. It is usually a component that is critical to maintaining the design intent. No other equipment suppliers will be allowed to bid as an equal.
2. **Based On.** This term designates that the equipment is designed around a certain product. Products of equal status are listed and may be bid as if they were the basis of design. The **based on** equipment shall serve as the standard to which equals will be judged.

2.02 ELECTRICAL REQUIREMENTS

A. Motor Starters and Controls:

1. Electrical Contractor shall provide all manual or magnetic motor starters as required for motors as indicated on the Electrical Drawings and specified in Division 16.
2. Mechanical Contractor shall provide factory installed motor starters and/or safety switches, integral with packaged equipment, containing thermal over current protection in ungrounded conductors with heater coils selected for specific motor usage for motors.
3. "Package equipment" shall be defined as Mechanical, Architectural, Civil, or other Trade's equipment, and which is specified in other divisions of this specification, and which shall be furnished and installed complete with all associated electrical components by those trades.

Other Trades providing package equipment shall also provide both integral and remotely located devices if necessary for a complete system, ready for operation except for a single incoming power source. These devices may include main disconnect switches, heavy duty disconnect switches, starters, control transformers, interlocks, relays, fuses, terminal blocks, capacitors, wire, wire and device identification, conduit, and other necessary components.

Any special work to be provided under this division of the specifications outside the definition of package equipment shall be as noted on the drawings accompanying these specifications, or as specially noted after the package equipment list entry hereinafter.

B. Electrical Wiring and Controls:

1. Mechanical Contractor shall provide all motors, drives, and controllers integral to packaged equipment and factory mounted controls for all mechanical equipment. When pre-wired equipment is used, control circuit shall be separately fused at control transformer, and shall always revert to a fail-safe condition.
2. Mechanical Contractor shall provide electrical devices requiring mechanical/electrical connections, such as pressure switches, limit switches, float switches, solenoid valves, motor operated valves, etc.
3. Electrical Contractor shall install power wiring and conduit to motors and/or factory mounted control panels

as indicated on Drawings or in specifications.

4. All electrical wiring work by Mechanical Contractor shall be in accordance with Division 16 requirements.

PART 3 - EXECUTION

3.01 CONNECTIONS AND SERVICES

A. Connections to Existing Lines Within Building:

1. Where existing lines are indicated on Drawings, connection shall be on an "as found" basis. Include all necessary costs to make proper connection.
2. Locate, identify, maintain, and protect existing mechanical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.

B. Connecting Into Existing Facility and Street Lines:

1. Connection into existing service and street lines shall be on an "as found" basis. All service interruption shall be coordinated with Owner and public utility. No interruption of utilities shall be made without prior arrangement with Owner.
 2. Locate existing underground utilities in excavation areas. If utilities are indicated to remain, support and protect services during excavation operations.

C. Continuity of Services:

Continuity of all existing utility services in building shall be maintained throughout construction period. Where new services are to be tied into existing services, it shall be done when and as directed by Owner, General Contractor, or Engineer.

3.02 CLOSEOUT

A. Final Acceptance:

Final acceptance and payment will only be made after the final check list completion and receipt at Engineer's office of:

- All Guarantees/Warranties
- Test Reports
- Operating and Maintenance Instruction Manuals (2)
- Record Drawings (As-Built)
- Certificates of Inspection
- Lubrication and Valve Charts
- Maintenance Contracts, if required
- Spare Parts (i.e. filters, etc.)
- Test and Balance Reports - Air and Hydronic
- Boiler Start-up Report

B. Certificates of Inspection and Test Reports:

The Contractor is to provide the Engineer with evidence that the installation has been inspected and approved by municipal or state inspector having jurisdiction over that phase of work involved, i.e., plumbing, heating, boiler, fire protection, refrigeration, etc.

C. Guarantees and Warranties:

1. During the one year guarantee period (except if General Requirements specify a longer warranty period), make two complete inspections (at approximately 3 months and 10 months)

of all systems, fixtures, equipment, safety devices, and controls to ensure that the equipment is operating properly, and report to the Engineer in writing. The visits are to be coordinated with the owner.

D. Record Drawings:

1. Maintain a white-print set of Mechanical Contract Drawings in clean, undamaged condition for mark-up of actual installation on Contract Drawings, which vary substantially (i.e. location of piping, ductwork, size changes, etc.) from the work as shown.

E. Operating and Maintenance Instructions:

1. Provide instruction of Owner's personnel in operation and maintenance procedures for all systems equipment such as boilers, HVAC equipment, temperature controls, etc.
2. Provide the Owner with instructions on the location of hand valves, and other concealed items, etc.

F. Placing Systems into Operation:

1. Mechanical Contractor shall be responsible for all start-up procedures, system checks and balancing, and coordinating work of other Contractors and Sub-Contractors to assure cooperation.
2. All equipment shall be installed, tested and operated in accordance with the manufacturer's recommendations at normal operating conditions.
3. Permanent equipment may be operated during construction only with adequate protection from damage and dirt by filtering of air using minimum 30% efficient filters or straining of fluids, and replacing as often as necessary to keep mechanical systems reasonably clean and dust free and replacement at turnover to owner.
4. Place all systems into operation, when weather or other considerations require their use. Perform repair, adjustment and balancing operations as often as required to assure satisfactory operation before final acceptance.
5. Check, test and adjust pressure reducing and relief valves, thermometers, gauges, meters, safety controls and devices, and other instruments and controls to assure proper operation.
6. Tests:
 - a. Make necessary tests to provide leak-proof and code-tested system under operation. Make tests before work is concealed or covered and perform all necessary repairs as required or as otherwise indicated by test results.
 - b. See subsequent trade sections for additional requirements.
 - c. Soil, waste, and vent piping shall be closed and tested with water at head equal to highest fixture.
 - d. Domestic hot and cold water piping and all heating lines shall be tested at 125 PSI. Gas piping shall be tested at 125 PSI with soap bubbles.

G. Adjustments and Balancing:

1. Subsequent to the installation of the heating, piping, and air distribution systems and upon the beginning of operation, the Contractor shall make all necessary adjustments to equipment,

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control dampers, fans, and any other equipment installed by him under this Contract so as to ensure proper operation of the same. The Contractor shall be responsible for balancing the air system to deliver the air quantities shown on the Plans. This shall include changing fan speeds, belts, drive, sheaves, and drive guards as required to properly balance these systems. The Contractor shall be responsible for balancing the hydronic system to deliver the flow required to service each device as shown on the plans. This shall include changing impellers, pumps, auto flow control valves and circuit setters, as required to properly balance these systems. The Contractor shall have an independent AABC or NEBB subcontractor submit (2) copies of his balancing work sheets indicating preliminary and final results. All balancing shall be performed as specified in the SMACNA Manual and ADC Standards. **Balancing must be completed and report submitted before Engineer completes final check list.**

3.03 GUARANTEES AND WARRANTIES

- A. All labor, materials and equipment shall be guaranteed by Contractor and/or warranted by the Manufacturer for one year after acceptance date and/or one normal continuous complete season's operation applicable to equipment or system except where specified longer for special equipment. Contractor shall secure such warranty from all Suppliers or the Contractor will assume the warranty and issue an Insurance Policy to the owner.
- B. Acceptance date of substantial completion shall be Owner occupancy as determined by Architect/Engineer.
- C. Contractor shall make all necessary alterations, repairs, adjustments, and replacements during guarantee periods as directed by Architect/Engineer to comply with Drawings and Specifications at no cost to Owner. The Contractor shall repeat as often as necessary to give satisfactory system in opinion of Engineer.
- D. Repair or replacements made under guarantee shall bear further one year guarantee from date of acceptance of repair or replacement.

3.04 COMMISSIONING SERVICES

- A. All services and requirements of the commissioning agent (CA) shall be completed in a timely manor.
- B. All reports, training, and TAB services shall be completed as required in construction documents.

END OF SECTION

NOTE: THESE SPECIFICATIONS ARE THE PROPERTY OF THE ENGINEER AND ARE NOT TO BE REUSED OR REPRODUCED WITHOUT WRITTEN PERMISSION. THIS SPECIFICATION IS COPYWRITTEN.

PART 1 - GENERAL

This Specification is intended to describe general mechanical systems' methods and materials.

1.01 RELATED WORK

- A. Section 15000 - Mechanical General Provisions
- B. Section 16000 - Electrical General Provisions

1.02 WORKMANSHIP

- A. Install work in accordance with best practice of trade.
 - 1. Install new piping and ductwork straight and true with no unnecessary offsets and parallel with walls, beams, floors, or ceilings.
 - 2. Install new piping so as to be completely drainable. Provide drain cocks and capped hose adapters at all low points in piping system.
 - 3. Provide for expansion and contraction of piping at bends or risers. Install piping so as to be free from pockets due to sagging.
 - 4. Where no elevation is indicated, piping and ducts suspended above and/or below ceilings shall be hung as high as possible.
 - 5. No piping shall be installed in a manner which will interfere with necessary passage or head room, with operation of any doors or windows, with ductwork, lay-in ceiling panels, lighting outlets or fixtures, or Owner's equipment.
 - 6. No piping over electrical equipment, elevator machine rooms, electrical rooms, and telephone rooms without prior approval from Architect/Engineer.

1.03 PIPES AND PIPE FITTINGS

A. General:

- 1. Coordinate with work of other trades. Piping shall not be supported from ductwork or piping of other trades.
- 2. Support piping from structure using approved hangers; pipe straps shall not be permitted.
- 3. Allow for adequate expansion and contraction while maintaining alignment. Provide expansion joints or loops as required.
- 4. Use reducing fittings when changing pipe sizes. Bushings and "Orange Peeling" shall not be permitted.
- 5. Terminate piping to fixtures and equipment furnished by others including stop valves.
- 6. Install strainers on the supply side of each control valve, pressure reducing or regulating valve, solenoid valve, and elsewhere as indicated.
- 7. Install unions adjacent to each valve, and at the final connection to each piece of equipment and plumbing fixture having 2" and smaller connections, and elsewhere as indicated.
- 8. Dielectric Unions: Provide dielectric unions with appropriate end connections for the pipe materials in which installed (screwed, soldered, or flanged) which effectively isolate dissimilar

metals, to prevent galvanic action, and stop corrosion.

9. Install flanges in piping 2-1/2" and larger, adjacent to each valve, at the final connection to each piece of equipment, and elsewhere as indicated.
10. Install sectionalizing valves at main branch lines where branch connects into mains.
11. Fit all openings in piping with temporary plugs and caps during construction.
12. Insulating couplings shall be installed at all locations where copper piping connects to other metals and in gas piping at meter connections.
13. If leak occurs, pipe or fitting shall be replaced with new length or fitting. Ream out all pipe ends. Clean out debris and excess oil before installing. Use approved lubricant for all threaded joints. Do not stop leaks by adding caulking to joints.
14. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade of floors, unless indicated otherwise.
15. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.
16. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, or floors, the fire rated integrity shall be maintained. Refer to Architectural Drawings or Plans indicating walls, floors, or ceilings requiring ratings and the amount of rating.
17. Drip Pans: Provide drip pans fabricated from corrosion-resistant sheet metal with watertight joints, and with edges turned up 2-1/2" with reinforced top. Provide hole, gasket, and flange at low point for watertight joint and 1" drain line connection.
18. Drip Pan Installation: Locate drip pans under piping, passing over or within 3" horizontally of electrical equipment, under roof relief vents, and elsewhere as indicated. Hang from structure with rods and building attachments, attach rods to sides of drip pan. Brace to prevent sagging or swaying. Connect 1" drain line to drain connection, and run to nearest plumbing drain or elsewhere as indicated.

B. Sleeves and Escutcheons:

1. Piping passing through concrete and masonry walls and floors shall be sleeved; wall sleeves shall be cut back 3/8" from face of wall.
2. Sleeves shall be fabricated from sections of steel pipe, 1/2" to 1" larger than pipe or insulation.
3. Sleeves passing through floors shall extend 3/8" above floor. Void between sleeve and pipe shall be caulked water tight. Use fire-rated sealants at rated floors and walls.
4. Sleeves shall be permanently mortared in.
5. Where pipes pass through exterior walls, seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6" shall be steel; pipe sleeves 6" and larger shall be sheet metal. Pipe to be sealed with 100% Silicone caulking to create an air tight seal.
6. Wherever pipes are exposed and pass through walls, floors, partitions, or ceilings, they shall be fitted with chromium plated escutcheons, held in place by internal spring tension.

Escutcheons shall be large enough to fit over insulation on insulated pipes.

7. Plumbing vent stacks passing through roofs shall have a vent collar/seal installed.

C. Pipe Joints:

1. Steel Pipe Joints:

- a. Pipe 2" and Smaller: Thread pipe with tapered pipe threads in accordance with ANSI B2.1. Apply pipe joint lubricant or sealant suitable for the service for which the pipe is to be used.
- b. Pipe Larger than 2": Weld pipe joints for steel pipe (except for exterior water service pipe) in accordance with ASME Code for Pressure Piping, B31.

2. Brazed and Solder Joints: For copper tube and fitting, braze joints in accordance with ANSI B31.1.0 - Standard Code for:

- a. Pressure Piping, Power Piping; ANSI B9.1 - *Standard Code for Mechanical Refrigeration*.
- b. Solder: Type of solder shall conform to following schedule:
 - Hot and cold water and recirculating lines - lead free solder.
 - Heating piping – lead free solder.
 - Drain piping – lead free material if possible.
 - Condensate drain piping – lead free solder
 - Refrigerant hot gas and liquid lines - silver braze.
 - Refrigerant suction lines - silver braze.
 - Refrigerant line connections to equipment – lead free solder.

3. Welding:

- a. Qualifications: Welders shall be qualified according to provisions of *ASME Standard Qualifications for Welding Procedures, Welders and Welding Operators, or ASME Boiler and Pressure Vessel Code* for class of piping being welded. Submit welding qualifications for all welders on project when requested by Engineer.
- b. Welding Procedure: Preparation of base metals and welding procedures shall conform to ASME American Standard Code for Pressure Piping.
- c. Filler Material: Conform to ASTM Specifications compatible with base metal being welded.
- d. Field Fabricated Fittings: Mitered or segmental elbows, swages, orange-peel, bull plugs, or similar construction will not be permitted.
- e. Branch Connections: Welding of branch connections directly to run will be permitted in lieu of tees, laterals, or crosses when branch sizes are less than 1/2 of main size unless detailed otherwise. Branch pipe shall not project beyond inside of main. Failure to comply with accepted standards of workmanship in making weld-in branch lines shall require that these connections be removed and replaced with ASA B 16.9 fittings.

4. Caulked Joints:

- a. Provide thick ring of oakum tightly into hub of pipe, pour hub full of non-lead material and caulk. Connections between steel and cast iron pipe shall be caulked with oakum and non-lead material.

- b. Tyler "XH" extra heavy TY-Seal Gaskets may be used in lieu of caulked joints for buried cast iron pipe.

- 5. **Mechanical Joints or Shove-On Joints:** Follow manufacturer's recommendations for joint assembly. Provide socket clamps with tie rods at all dead ends, run outs, direction changes, and similar locations where other means of anchoring are not provided.

D. Pipe:

1. Steel Pipe:

- a. Highest quality, mild steel.
- b. Manufacturer's name shall be stamped or rolled into each length of pipe.

2. Black Steel Pipe:

- a. Pipe: Schedule 40, ASTM-A-120.
Use: Above ground gas piping.
 - b. Screwed Fittings:
Use: 2" and under accessible locations.
 - i. Type: 150# malleable iron-banded.
 - ii. Unions: Ground bronze to iron seat with extra heavy body and nuts.
 - iii. Nipples: Same as pipe, except use Schedule 80 for short and close nipples.
 - c. Welded Fittings:
Use: Over 2" and non-accessible locations.
 - i. Type: 150# W.P. - conforming to ASTM A234 Grade WAPB, and U.S.A.S. B 16.9 butt weld.
 - ii. Elbows: Long radius, butt weld.
 - iii. Unions: Companion flanges, 150# raised face, slip-on conforming to U.S.A.S. and ASTM specifications; use welding neck flanges at pump connections. Flanges shall have American Standard Template drilling.
- 3. Galvanized Pipe:** Schedule 40, ASTM A-120. Screwed fittings for waste, drain, and vent piping.

E. Sanitary Pipe and Storm Water Pipe and Fittings:

1. ABS Pipe:

- a. Sanitary Sewer and Storm Water Piping, Buried Beyond 5 Feet of Building: ABS pipe: Schedule 40 ASTM F 628 or ASTM D 2282 – 99(2005). Fittings: ABS.
- b. Sanitary Sewer and Storm Water Piping Above Grade (In Exposed Areas): ABS pipe: If used in exposed areas, piping must be covered with minimum 1" fiberglass insulation with approved fire resistance rating. **NOTE:** Exposed is defined as a pipe that is exposed to view or installed above an accessible ceiling inside a building. Not approved for vertical runs in interior walls.

2. PVC Pipe:

- a. Sanitary Sewer and Storm Water Piping, Buried Beyond 5 Feet of Building: PVC pipe: ASTM D3033 or D3034, SDR 35. Fittings: PVC. Joints: ASTM F477, elastomeric gaskets.
- b. Sanitary Sewer and Storm Water Piping, Buried and Above Grade, but Concealed Within Building: PVC pipe: ASTM D2665, D3034. Fittings: PVC. Joints: ASTM D2855, solvent weld. **NOTE:** Concealed is defined as a pipe that is contained within a wall or in a fire rated chase.
- c. Sanitary Sewer and Storm Water Piping Above Grade (In Exposed Areas): PVC pipe: ASTM D2665, D3034. Fittings: PVC. Joints: ASTM D2855, solvent weld. If used in exposed areas, piping must be covered with minimum 1" fiberglass insulation with approved fire resistance rating. **NOTE:** Exposed is defined as a pipe that is exposed to view or installed above an accessible ceiling inside a building.
- d. Not approved for vertical runs in interior walls.

3. Cast Iron Pipe:

- a. Sanitary Sewer and Storm Water Piping Above Grade (In Exposed Areas): Cast iron ASTM A74; C1SP1 301. Fittings: ASME B16.4; ASME B16.12. **NOTE:** Exposed is defined as a pipe that is exposed to view or installed above an accessible ceiling.
- b. **All vertical runs of Sanitary Sewer and Storm Water are to be run in Cast Iron.**

- 4. Chrome Plated Drain Lines:** Use chrome plated drain lines for all exposed piping under sinks, etc.

F. Copper Pipe and Fitting (Domestic Water - Above Ground/Underslab & Heating):

- 1. Pipe:** Conform to ASTM Specifications. Pipe shall be color coded or marked at factory for identification. Tubing shall conform to following:

- a. Above Ground: Type L hard drawn, ASTM B-88.
- b. Buried: Type K, annealed temper, ASTM B-88.
- c. Refrigeration: Type ACT, hard drawn, ASTM B-280.
- d. Drainage: Type DWV, ASTM B-306.
- e. Exposed: Use chrome plated piping for all exposed domestic water piping for sinks, toilets, urinals, etc.

2. Fittings:

- a. General Service: Sweat type, wrought copper (cast fittings permitted only where wrought copper is not manufactured). Long radius elbows.
- b. Drainage: Sweat type, wrought copper, drainage pattern. Specialty items such as closet elbows may be cast brass.

G. Plastic Pipe and Fittings (Domestic Water - Underslab):

- a. Pipe: Schedule 80 ABS - conform to ASTM D2282-99(2005) and MIL-STD-129, 160 psi

working pressure.

b. Fittings: ABS

H. **Grooved Piping:**

1. **Pipe:** Schedule 10 ASTM A-120 with factory supplied roll grooves that meet grooved coupling manufacturer=s latest specification. All field roll grooves must be measured with a pi-tape and meet specification prior to coupling assembly. **Note:** This assembly method is important and joints will be randomly field checked by the engineer.
2. **Gaskets:** Gaskets must be Grade E with a Flushseal center leg design as provided by Victaulic Company of America or engineer approved equal. All product submittals must be approved prior to bidding. All gaskets must be lubricated with a non-petroleum based lubricant compatible with the grooved coupling manufacturer=s gasket. Approved grooved coupling manufacturers: **Victaulic only.**
3. **Fittings:** All grooved fittings must be domestic and of one manufacturer. All grooved fittings must be manufactured of ASTM A-536 Ductile Iron. Approved grooved fittings manufacturers are **Victaulic Company of America.**
4. **Couplings:** All grooved couplings must be domestic and of one manufacturer. All couplings shall be Zero-Flex Arigid® design. All couplings must be installed as per the manufacturer=s latest recommendations. Provide all necessary anchors, supports and restraints per the manufacturer=s recommendations for all grooved pipe systems. Three (3) flexible grooved Style 77 or 75 couplings may be used at all pumps in lieu of flex connectors.
5. **Grooved Valves:**
 - a. All grooved butterfly and check valves must be of one domestic manufacturer and shall be rated to 300 PSI. All grooved valves shall have an internal and external PPS coating and the disc liner must be consistent with that of the grooved coupling gasket and be compatible for the service. All grooved butterfly valves must have a blowout proof stem. The disc and stem must be of a one piece ductile iron construction.
 - b. Butterfly Valves 2" - 6" must have a 10 position lever lock handle and valves above 6" must have a gear operator.
 - c. Tour & Anderson circuit balancing valves series 787 threaded, series 786 solder end & 789 grooved end arc are approved for heating services.
6. **Straining Devices:** Victaulic S/730 Tee strainer & 731 Suction Diffuser are approved for heating services.

1.04 **VALVES**

- A. All valves shall be of same manufacturer.
- B. Where grooved piping system is specified, groove end butterfly valves equal to **Victaulic.**
- C. Valves are rated for 125 PSI service. Provide higher rated (250) PSI valves per system requirements.
- D. Valves shall be submitted with shop drawings for various uses.
- E. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

- F. Install globe valves for throttling, bypass, or manual flow control services.
- G. Provide spring loaded check valves on discharge of water pumps.

1.05 PIPING SPECIALTIES

- A. **General:** All piping systems shall be complete with all specialties and appurtenances required for complete operating system.
- B. **Expansion Loop Guides:** Two installed on each side of loops, securely anchored to building structure.
- C. **Expansion Joints:** Iron body, internal guides, stainless steel bellows. Piping shall be properly guided at all expansion joints and at intermediate locations as recommended by manufacturer.
- D. **Mechanical Type Couplings: Victaulic.**
- E. **Insulating Couplings:** Install at all locations where copper tubing connects to galvanized iron pipe and gas piping at meter connections.
- F. **Strainers and Filters:**
 - 1. **Strainers:** Strainers shall be Y pattern, 125# W.P. iron body for general use and 250 p.s.i. WSP for high pressure process and hydraulic use.
 - a. Screwed: For piping 2" and smaller.
 - b. Flanged or Grooved: For piping 2-1/2" and larger.
 - c. Screens: Monel, cylindrical, reinforced ends. 20 mesh for water; 40 mesh for air, gas.

G. Vacuum Breakers and Backflow Preventers

- 1. **General:** Vacuum breakers and backflow preventers shall be installed in accordance with all applicable codes and as specified.
- 2. **Vacuum Breakers:**
 - a. Domestic Service: Vacuum breakers shall be provided on all flush valves, hose faucets, laboratory sinks, chemical vats, laundries, swimming pools, process equipment, fittings, and fixtures covered by codes. Vacuum breakers shall be chrome plated where located exposed in finished portions of building.
 - b. Installation: Vacuum breakers shall be installed above highest fixture they are protecting in such manner that it will preclude back pressure. Vacuum breakers shall be installed where they will be accessible for periodic testing and where spillage will not be objectionable.
- 3. **Backflow Preventers:**
 - a. General: Backflow preventers shall be installed in all systems where domestic water is subject to contamination due to reduced pressures causing backflow such as heating and cooling system make-up water, lawn sprinklers, and all areas designated by local codes as health hazard. Backflow preventers may serve more than one piece of equipment or system as long as cross contamination between systems is not objectionable. Backflow preventers shall be of reduced pressure, dual, spring loaded, check; intermediate vacuum breaker.

- b. Installation: Backflow preventers shall be installed in horizontal position in open accessible for maintenance and periodic inspections and testing. Backflow preventers shall be piped with drain line to nearest floor drain. Drain shall terminate at floor drain with minimum of 12" air gap and in area not subject to flooding or freezing.
- c. Drain Pan: Install galvanized drain pan under all backflow preventers installed above ceilings, pipe 3/4" copper line from drain pan to nearest floor drain or mop sink. Pan shall be 3" wider and longer than backflow preventer size. Depth of drain pan shall be 1-1/2".

1.06 GAUGES AND THERMOMETERS

- A. **Gauges:** Provide 4-1/2" face glass, aluminum body pressure gauges with adjustable pointer, gauge cocks, and shock reducing snubber. Each gauge shall be labeled to indicate units in "PSI" or "FT-HD" on gauge face. Gauge pressure shall be selected to give approximately two (2) times pressure that gauge will encounter constantly. (Example: 15 PSI steam gauge range 0 to 30 PSI.) Install at following locations or as indicated on prints.
 - 1. All heating pumps' inlets and outlets.
 - 2. All domestic hot water pumps' inlets and outlets.
 - 3. Cold water supply at meter outlet or connecting point where cold water supply for new addition connects to old line (if in exposed location).
 - 4. Water meter inlet and outlet.
- B. **Thermometers:** Thermometers shall be installed on water side and set so that they do not restrict or obstruct fluid flow. Install at following locations or as indicated on prints.
 - 1. At each heating return line balancing valve that occurs in return main where two or more heat users return water to it.
 - 2. At all three ports of 3-way valves.
 - 3. At domestic hot water tank supply and return pipes, near pump.
 - 4. At inlet and outlet of hot water heating coils.
 - 5. At boiler inlet and outlet.

1.07 DUCTWORK

- A. **General:**
 - 1. Before proceeding with fabrication and installation of ductwork, inspect the contract documents, site conditions and truss shop drawings and determine that the location of work does not interfere with other work. In case of interference, notify the Engineer.
 - 2. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
 - 3. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

4. Connect diffusers or troffer boots to low pressure ducts with 5 feet maximum length of flexible duct only in accessible areas where a ceiling is installed. Hold in place with strap or clamp.
5. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
6. Where ductwork, structure, etc. can be seen behind grilles, registers, diffusers, etc. apply flat black paint to all visual surfaces.

B. Ductwork:

1. General: Non-combustible or conforming to requirements for Class 1 air duct materials, or UL 181.
2. Steel Rectangular Ducts: ASTM A525 or ASTM A527 galvanized steel sheet, lock-forming quality, having zinc coating of 1.25 oz per square feet for each side in conformance with ASTM A90.
3. Insulated Flexible Ducts: Flexible duct wrapped with flexible glass fiber insulation, enclosed by seamless aluminum pigmented plastic vapor barrier jacket; maximum 0.23 K value at 75 degrees F.
4. Round Spiral Ducts: ASTM A-527-71, galvanized steel, spiral locking seam equal to United McGill Uni-Seal. For underslab ductwork, use United McGill Uni-Coat.
5. Internal Insulated Round Spiral Ducts: ASTM A-527-71, galvanized steel, spiral locking seam equal to United McGill Uni-Rib k-27.
6. Stainless Steel Ducts: ASTM A167, type 304.

1.08 SUPPORTS AND ANCHORS

- A. **General:** Furnish and install all necessary pipe hangers, rollers, and duct hangers required for all systems. Hanger rod shall be all-thread carbon steel type. Rod shall conform to ASA B1/1960 Class 2A fit.
- B. **Ductwork:** Supports and hangers for ductwork and appurtenances shall conform to *Manual of Sheet Metal and Air Conditioning Contractors Association, Inc. and latest edition of American Society of Heating, Refrigeration, and Air Conditioning Engineers Handbook* Ducts 36" x 12", or equivalent, and larger, shall be supported by trapeze type hangers.
- C. **Pipe Hangers:** First two piping supports away from new mechanical equipment supporting 1" diameter pipe or larger shall be isolated from structure by means of vibration and noise isolators. This piping shall be isolated with Type "H" Hangers. Floor mounted piping shall be isolated with Type "S" Spring Mounts for first two supports. Flexible members shall be incorporated in piping adjacent to all reciprocating equipment. Where steel supports contact copper lines, isolate copper from support with PVC sleeve to prevent galvanic corrosion.

1. Vertical Piping:

- a. Wall mounted support spacing shall be on not more than 12' centers. Wall support shall be electro-galvanized pipe clamp with at least 12" of electro-galvanized 1-5/8" x 1-5/8" 12 gauge steel channel anchored to wall with at least two 1/4" Ramset plated threaded fasteners with 1" or more wall penetration.

- b. Vertical pipes through floors shall be supported at each floor. Support shall consist of riser clamp. In addition to clamp, attach 1/2" dia. by 1/2" long stud to pipe just above clamp to prevent slipping of pipe. Stud shall be of same material as supported pipe.
2. **Horizontal Piping:** Clevis hangers blacksteel or approved equal with threaded rods and jamb nuts. Maximum pipe hanger spacing for Schedule 40 steel pipe shall be as follows:
- a. 3/4" to 2" pipe on 8' centers with 3/8" rod.
 - b. 2-1/2" to 3" pipe on 10' centers with 1/2" rod.
 - c. 4" on 14' centers with 5/8" rod.
 - d. 6" to 8" pipe on maximum of 17' centers with 3/4" rod. (Use maximum 10' centers on precast plank.)
 - e. 8" pipe - 19' span with 7/8" rod.
3. **Attachment to Structure:**
- a. Steel Joist Attachment: Grinnell #87 malleable iron "C" clamp (2" pipe and smaller) with lock nut and retaining clips. Grinnell #229 and #292 (2-1/2" pipe and larger) attach to upper or lower web of joists as conditions require and only at panel joints, with two "C" clamps, and two rods, and two clevis hangers so that joist is symmetrically loaded. Line sizes 1-1/2" and smaller may be hung with only one hanger.
 - b. Steel Beam Attachment: Grinnell #87 malleable iron "C" clamp (2" pipe and smaller) with lock nut and retainage clips. Grinnell #229 and #292 (2-1/2" pipe and larger) attach to either upper or lower flange as field conditions require with one hanger.
 - c. Wood Beams and Purlins (for piping under 4" only): Grinnell #142 1/2" diameter lag screws with bolt thread head of black steel. Length shall penetrate not less than two-thirds of member depth. Use welded eye rods such as Grinnell #287 black steel of rod diameter specified above. Use 3/8" diameter lag screws for piping 1-1/2" and smaller.
 - d. Wood Trusses: Suspend piping from the building structure using one of the following methods:
 - i. Piping Under 2" Only: Install Grinnell #142 1/2" diameter lag screws with bolt thread head of black steel. Length shall penetrate not less than two-thirds of member depth. Use welded eye rods such as Grinnell #287 black steel of rod diameter specified above. Use 3/8" diameter lag screws for piping 1-1/2" and smaller.
 - ii. Piping 2" and Larger: Install uni-strut (trapeze) anchored to the top side of the roof truss bottom chord and then suspend down to a trapeze bar and/or a clevis hanger.
 - e. Concrete and Masonry Surfaces: Attachment to horizontal poured concrete surfaces shall be by concrete inserts or expansion sleeves. Attachment to vertical poured concrete surfaces or masonry surfaces shall be by concrete inserts, expansion sleeves, and Ramset or Hilte fasteners. Attachment to precast concrete construction shall be by use of rod passing through plank on joints and with plate not less than six times diameter of rod by 1/4" thick plus nut on top surface of plank.
 - f. Rooftop: Use prefabricated curb pipe support. Unit shall be built of not less than 18 gauge galvanized steel and constructed for use on the specific roof type for this project.

- g. Roof-Top Equipment Supports:
 - i. Unless indicated otherwise on Drawings, roof-mounted equipment shall set on prefabricated equipment support rails. Support rails shall be of monolithic construction, 18 gauge galvanized steel, continuous mitred and welded corner seams, integral base plate, factory installed 2 x 4 wood nailer, and 18 gauge galvanized steel counter-flashing.
 - ii. Support height shall be selected so that support rails bear on metal or concrete roof deck and project minimum of 8" above top surface of roof, or as specified on drawings, and at least one foot beyond edge of equipment which it supports. See Drawings for possible additional requirements.
- h. Anchors and Guides:
 - i. Anchor all pipes as required and/or where indicated in Contract Documents. Anchors shall properly distribute expansion and shall be securely attached to supporting construction to satisfaction of Architect's Field Representative.
 - ii. Provide semi-steel spider and guiding cylinder pipe alignment guides on all piping in all areas. Pipe alignment guides shall be spaced as required according to manufacturer's design criteria and recommendations (minimum of two guides on each side of expansion joints and loops). Pipe alignment guides shall serve to guide expanding pipe to move freely from anchor points to expansion joints, loops, or bends. Guides shall be of same manufacturer as expansion joints.

1.09 PUMPS

- A. **General:** Pumps shall be sized and selected to provide specified flow rate at specified pressure difference. If pumps installed cannot provide both design conditions of flow rate and pressure difference, make any or all changes to pumps to achieve design conditions at no additional cost to Owner. This change may include, but is not necessarily limited to the following; change impeller size, change motor size, or change entire pump. If motor size is increased, resulting in electrical changes, Mechanical Contractor shall compensate Electrical Contractor for cost of change.
- B. Piping connections to pumps shall be same size as pump connection or larger with reducing fittings installed as close as possible to pump connection.
- C. Shut-off and check valves shall be same size as line size.
- D. Elbows shall occur at least 7 pipe diameters from pump suction. (When used instead of suction diffuser.)
- E. Piping shall be supported by other means than pump connections. Piping shall be properly supported before connections are made.
- F. Avoid air pockets in suction piping; horizontal piping shall pitch up to pump.
- G. Suction and discharge piping shall be provided with pressure gauges and needle valves.
- H. **Hot Water Circulating, and Miscellaneous Pumps:**
 - 1. Furnish and install pumps of size, type and capacity as indicated.
 - 2. Pumps shall be complete with motors, pump base, couplers, seals, tapped gauge openings, etc. for complete assembly. In-line pumps may be installed without flex conditions.

3. Pumps shall be installed, aligned, and started in accordance with manufacturer's recommendations. Pump suction sizes shall not be less than those indicated in Schedule. Pumps shall be selected for and designed for quiet operation.

1.10 **MOTORS**

- A. **Ratings:** Motors shall meet NEMA Standards and shall be capable of operating at rated load with voltage variation of plus or minus 10%, rated frequency variation of plus or minus 5%, or combined variation of 10% without damage to motor.
- B. **Selection:** Motors shall be selected for type of service involved and shall be selected at minimum of 15% above required rating of equipment served. Provide "quiet rated" motors where required.

1.11 **BELT AND SHAFT GUARDS**

- A. **Requirements:** All open drives on fans, pumps, compressors, and other similar drives shall be provided with guards in accordance with MIOSHA and all safety and construction codes.
- B. **Belt Drives:** Compressors, fans, and equipment with sheave and pulley drives shall be provided with guards in accordance with MIOSHA and all safety and construction codes.
- C. **Coupling Drives:** Direct motor coupling drives shall be provided with guards. Guards shall be extended to include shafts.
- D. **Extended Shafts:** Equipment with extended shafts for dual bearings shall be provided with guards to cover entire shaft.
- E. **Walk-In Equipment:** Equipment designed for walk-in service shall be provided with guards.
- F. **Guards:** Guards shall be constructed of extra heavy gauge metal, formed to fit over protected items and securely fastened to equipment or floor. Provisions shall be made for access at test openings and allowance for motor adjustments. Guards shall allow for ample clearance of pulley, drives, and couplings. Guards shall be prime coated and finished in enamel to match their respective equipment.

1.12 **ACCESS DOORS:** Steel access doors and frames, factory-fabricated and assembled, complete with attachment devices and fasteners for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.

- A. **Frames:** 16-gage steel, with a 1-inch wide exposed perimeter flange.
 1. For installation in masonry, ceramic tile, or wood paneling: 1-inch wide exposed perimeter flange and adjustable metal masonry anchors.
 2. For gypsum wallboard or plaster; perforated flanges with wallboard bead.
 3. For full-bed plaster applications; galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.
- B. **Flush Panel Doors:** 14-gage sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.
 1. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.
 2. Locking Devices: Flush, screwdriver-operated cam locks.

1.13 MECHANICAL IDENTIFICATION (also refer to Spec. 15.190)

- A. General:** All system components shall be identified to allow proper operation and maintenance.
- B. Valve Identification:** Label valves with brass tags on chain (1/2" letters). Prepare typewritten valve tag schedule indicating label, size, type, and function of each valve for inclusion in operation and maintenance manual. Also, mount plastic-encased copy of same in mechanical room.
- C. Pipe Identification:**
 - 1. Label all pipes with stencil labeler (1-1/2" characters), this includes flow arrows.
 - 2. Label all pipes where they are exposed, at change of piping direction, and every 50 feet at long straight runs.
- D. Pipe and Duct Identification:** All pipe covering, insulation work, and piping installed, except concealed or metal and aluminum foil jacketed work, shall be painted to match room/structure finish.

1.14 MECHANICAL SOUND, VIBRATION, AND SEISMIC CONTROL

- A. General:** Entire mechanical system shall be installed to provide quiet and vibration free environment in occupied spaces. Contractor shall replace or repair equipment and/or provide additional sound and vibration control equipment if Architect/Engineer deems system or its components do not meet design criteria for sound and vibration.
- B. Vibration Isolation Supports and Hangers:**
 - 1. All mechanical equipment over 1 horsepower, unless otherwise noted, shall be isolated from structure by means of resilient vibration and noise isolators supplied by single manufacturer. Where isolator type and required deflection are not shown or tabulated, equipment shall be isolated in accordance with latest version of ASHRAE Systems Handbook. Isolator manufacturer's submittal shall include complete design for supplementary bases, tabulation of design data on isolators, including outside diameter, free, operating, and solid heights of springs, free and operating heights of neoprene, or fiberglass isolators.
- C. Pipe Hangers:** Refer to Section 1.07.
- D. Vibration Isolation and Expansion Compensation:** Furnish and install all vibration isolators, flexible connections, expansion joints, and expansion loops required to reduce noise transmissions and stress on equipment and piping.
 - 1. **Vibration Isolation:**
 - a. Locations:** Floating slabs, fans, compressors, and all motor driven equipment subject to noise transmission.
 - b. Deflection:** Selection to be made in conjunction with equipment manufacturers to assure workable system.
 - 2. **Expansion Joints:**
 - a. General:** Install piping for adequate movement without stress or damage. Provide sufficient expansion loops, changes in direction and within stress limits of ASME code. Where deflection cannot be employed to absorb expansion and contraction expansion

joints should be employed.

- b. **Installation:** Joints shall be properly anchored and guided in compliance with recommendations of manufacturer of expansion joint. Refer to Paragraph 1.06.C.4.g for anchors and guides.

3. Flexible Connections:

- a. **General:** All equipment subject to vibration and noise transmission shall be provided with flexible connections.
- b. **Compressors:** Braided steel or bronze.
- c. **Pumps:** Braided steel or bronze. When using the Victaulic pipeline system, three Victaulic Style 75 or 77 flexible couplings may be used in lieu of a flex connector. See Victaulic TS-5000 for details.
- d. **Duct Connections to Air Moving Equipment:** Neoprene coated flame-proof fabric minimum 2" side.

- E. **Spin Balance:** All new rotating equipment shall be factory balanced, both statically and dynamically. If any equipment is determined by Architect/Engineer to be unbalanced after installation, equipment shall be electronically in-place spin balanced according to balancing criteria as set forth in latest *Systems Edition of ASHRAE Handbook*. Before and after readings shall be submitted in writing for Architect/Engineer's review.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.01 FIELD QUALITY CONTROL - PIPING

A. Installation:

1. Establish elevations of buried piping outside the building to ensure not less than minimum cover by code.
2. Establish invert elevations, slopes for drainage to 1/8" per foot, one percent minimum. Maintain gradients.
3. Install valves with stems upright or horizontal, not inverted.
4. Install unions downstream of valves and at equipment or apparatus connections.
5. Install brass male adaptors each side of valves in copper piped system. Sweat solder adaptors to pipe.
6. Install nail stoppers at all pipe/wall stud intersections (both sides). Nail stoppers to be equal to Simpson "Strong-Tie" Model "NS".

- B. **Testing:** Refer to individual piping system specification sections for testing specifications. If testing specifications are not given in individual section, test piping system as follows:

1. Provide temporary equipment for testing, including pump and gages. Test piping system before insulation is installed wherever feasible, and remove control devices before testing. Test each 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.
 - a. Required test period is 2 hours.
 - b. Test each piping system at 150% of operating pressure indicated, but not less than 25 psi test pressure.
 - c. 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.
 - d. Record date of each test and results in a log which shall be turned over to Architect/Engineer at completion of Project.
2. 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-lead compounds, mastics, or other temporary repair methods.

C. Disinfection of Domestic Water Piping System:

1. Prior to starting work, verify system is complete, flushed, and clean.
2. Ensure pH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
3. Inject disinfectant - free chlorine in liquid, powder, tablet, or gas form - throughout system to obtain 50 to 80 mg/L residual.
4. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
5. Maintain disinfectant in system for 24 hours.
6. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
7. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
8. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C601.

3.02 FIELD QUALITY CONTROL - DUCTWORK

A. Installation:

1. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Use splitter dampers only where indicated.
2. Provide fire dampers or combination fire and smoke dampers at locations where ducts and outlets pass through fire rated components. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings, and hinges.
3. Demonstrate re-setting of fire dampers to authorities having jurisdiction and Owner's

representative.

4. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
5. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment.
6. Provide support for all diffusers/grilles in any ceiling structure with a non-exposed-to-view support system. System is to support diffuser/grille and associated ductwork without adding weight to ceiling tile.

B. Duct Sealants:

1. Duct systems, including all seams, joints, fastener penetrations and connections, shall be effectively sealed in accordance with SMACNA Seal Class A requirements, and leak tested with total allowable leakage from high and medium pressure (4" W.C. or greater) ducts not to exceed one (1) percent of the total system design airflow rate. Joint sealants shall have fire and smoke hazard rating as tested by ASTM D-2202. Exterior mastic sealant shall be certified to pass 500 hours QUV. Sealants shall also comply with ASTM freeze/thaw standard C731 and D2202.
2. Manufacturer, upon request shall be able to properly document an established record of experience and success in the specialized formulation of duct sealants, elastomeric tapes, and adhesives.
3. All duct work shall be suitably cleaned and prepared, and sealant applied in strict accordance with manufacturer's recommendations for cure time shall be followed before pressure testing is begun. Any additional paint or coatings must conform to manufacturer's specifications.
4. Sealant Manufacturer: **AMF Safecoat Dynoflex, United Duct Sealer (Water based Uni-Mastic 181)**

3.03 SELECTIVE DEMOLITION

- A. Demolish, remove, demount, and disconnect abandoned mechanical materials and equipment indicated to be removed and not indicated to be salvaged or saved. Where noted or indicated to be removed, that portion of the existing mechanical systems are to be disconnected, taken down, removed from Owner's property and properly disposed of by the Contractor.
- B. **Materials and Equipment to be Salvaged:** Remove, demount, and disconnect existing mechanical materials and equipment indicated to be removed and salvaged, and deliver materials and equipment to the location designated for storage.
 1. Where noted or indicated to be removed and turned over to the Owner, that portion of the existing mechanical systems are to be disconnected, taken down and moved to a location where the Owner wants it stored.
 2. Where noted or indicated to be removed and reused, that portion of the existing mechanical systems are to be disconnected, taken down, stored in a clean, dry location by the Contractor until such time as the Contractor shall reinstall. The portions of the reused mechanical system which can be cleaned of rust, sludge, etc. shall be cleaned before reinstalling. If existing surfaces are painted, such surfaces shall be touch-up painted or repainted after reinstallation.
- C. **Job Conditions:**
 1. While the drawings indicate certain existing mechanical systems or other materials are to be reused or removed, Contractor shall not consider these notations as showing all items in the area. The notations are general in nature and are to establish the intent and nature of work

and apply to all mechanical items in the area.

2. Certain mechanical materials that must be removed are concealed in walls or ceilings are not shown but shall be removed when walls are removed at no cost to the Owner.
3. If the existing occupied facility is to stay in operation throughout the entire remodeling period, mechanical services for the occupied facility shall be completely operable and shall function continuously while remodeling work is completed.
4. **Mechanical Materials and Equipment:** Demolish, remove, demount, and disconnect the following items:
 - a. Inactive and obsolete HVAC equipment, piping, fittings and specialties, equipment, ductwork, controls, fixtures, and insulation.
 - b. Piping and ducts imbedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations. Remove materials above accessible ceilings. Drain and cap piping and ducts allowed to remain.
 - c. Installation and Removal: Where walls are to be removed and existing piping or ductwork is uncovered which must be reused to serve a section of the building other than this remodeling area, it shall be this Contractor's responsibility to reroute and provide permanent piping to replace that which is removed. Unused piping and ductwork shall be removed to 2" below disturbed surfaces and capped.

END OF SECTION

NOTE: THESE SPECIFICATIONS ARE THE PROPERTY OF THE ENGINEER AND ARE NOT TO BE REUSED OR REPRODUCED WITHOUT WRITTEN PERMISSION. THIS SPECIFICATION IS COPYWRITTEN.

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Gate valves.
- B. Globe or angle valves.
- C. Ball valves.
- D. Check valves.
- E. Butterfly valves.
- F. Drain valves.
- G. Hose bibs.
- H. Auto Flow Valves

1.02 RELATED WORK

- A. Section 15050 - Materials and Methods
- B. Section 15430 - Plumbing Specialties.

1.03 SUBMITTALS

- A. Submit product data under provisions of Section 15000.
- B. Submit detailed shop drawings under provisions of Section 15000. Clearly indicate make, model, location, type, size pressure rating, end connection details, seating materials, trim material, and arrangement.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Provide valves of same manufacturer throughout where possible.
- B. Provide valves with manufacturer's name and pressure rating clearly marked on outside of body.
- C. See Specification Section 15000.

2.02 VALVE CONNECTIONS

- A. Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use pipe size valves.
- B. Thread pipe sizes 2 inches and smaller.
- C. Flange pipe sizes 2-1/2 inches and larger.

- D. Solder or screw to solder adapters for copper tubing.
- E. Use grooved body valves with mechanical grooved jointed piping.
- F. Provide butterfly valve with tapped lug body when used for isolating service.

2.03 GATE VALVES

- A. Gate Valves, 2-Inches and Smaller:

MSS SP-80; Class 125, body and bonnet of ASTM B 62 cast bronze; with threaded or solder ends, solid disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, and malleable iron handwheel. Provide Class 150 valves meeting the above where system pressure requires. Use for domestic hot and cold water only.

- B. Gate Valves, 2-Inches and Smaller:

MSS SP-80; Class 150, body and union bonnet of ASTM B 62 cast bronze; with threaded or solder ends, solid disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, and malleable iron handwheel. Use for hot water.

- C. Gate Valves, 2-1/2 Inches and Larger:

MSS SP-70; Class 125 iron body, and bonnet conforming to ASTM A 126 Class B; with flanged ends, "Teflon" impregnated packing, and two-piece backing gland assembly.

2.04 GLOBE VALVES

- A. Globe Valves, 2-Inches and Smaller:

MSS SP-80; Class 125; body and screwed bonnet of ASTM B 62 cast bronze; with threaded or solder ends, brass or replaceable composition disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, and malleable iron handwheel. Provide Class 150 valves meeting the above where system pressure requires.

- B. Globe Valves, 2-1/2 Inches and Larger:

MSS SP-85; Class 125 iron body and bolted bonnet conforming to ASTM A 126, Class B; with outside screw and yoke, bronze mounted, flanged ends, and "Teflon" impregnated packing, and two-piece backing gland assembly.

2.05 BALL VALVES

- A. Ball Valves, 1 Inch and Smaller:

Rated for 150 psi saturated steam pressure, 400 psi WOG pressure; two-piece construction; with bronze body conforming to ASTM B 62, standard (or regular) port, chrome-plated brass ball and stem, replaceable "Teflon" or "TFE" seats and seals, blowout-proof stem design, and vinyl-covered steel handle.

- B. Ball Valves, 1-1/4 Inch to 2 Inches:

Rated for 150 psi saturated steam pressure, 400 psi WOG pressure, 3-piece construction; with

bronze body conforming to ASTM B 62, conventional port, chrome-plated brass ball and stem, replaceable "Teflon" or "TFE" seats and seals, blowout proof stem design, and vinyl-covered steel handle.

2.06 CHECK VALVES

A. Swing Check Valves, 2-1/2 Inches and Larger:

MSS SP-71; Class 125 (Class 175 FM approved for fire protection piping systems), cast iron body and bolted cap conforming to ASTM A 126, Class B; horizontal swing, and bronze disc or cast-iron disc with bronze disc ring; and flanged ends. Provide valves capable of being refitted while the valve remains in the line.

B. Wafer Check Valves:

Class 250, cast-iron body; with replaceable bronze seat, and non-slam design lapped and balanced twin bronze flappers and stainless steel trim and torsion spring. Provide valves designed to open and close at approximately one foot differential pressure.

C. Lift Check Valves, 2-Inches and Smaller:

Class 125; cast-bronze body and cap conforming to ASTM B-62; horizontal or angle pattern, lift-type valve, with stainless steel spring, bronze disc holder and renewable "Teflon" disc, and threaded ends. Provide valves capable of being refitted and ground while the valve remains in the line.

D. Swing Check Valves, 2-Inches and Smaller:

MSS SP-80; Class 125, cast-bronze body and cap conforming to ASTM B 62; with horizontal swing, Y-pattern, and bronze disc; and having threaded or solder ends. Provide valves capable of being reground while the valve remains in the line. Provide Class 150 valves meeting the above specifications, with threaded end connections, where system pressure requires or where Class 125 valves are not available.

2.07 BUTTERFLY VALVES

A. Butterfly Valves, 2-1/2 Inch and Larger:

MSS SP-67; rated at 200 psi; cast-iron body conforming to ASTM A 126, Class B. Provide valves with field replaceable EPDM sleeve, nickel-plated ductile iron disc, stainless steel stem, and EPDM O-ring stem seals. Provide lever operators with locks for sizes 2 through 6 inches and gear operators with position indicator for sizes 8 through 24 inches. Provide lug or wafer type as indicated. Drill and tap valves on dead-end service or requiring additional body strength.

2.08 DRAIN VALVES

A. Threaded Ends 2 Inch and Smaller: Class 125, bronze body, screwed bonnet, rising stem, composition disc, 3/4" hose outlet connection.

B. Soldered Ends 2 Inch and Smaller:

Class 125, bronze body, screwed bonnet, rising stem, composition disc, 3/4" hose outlet connection.

2.09 REDUCED PRESSURE PRINCIPLE VALVES

- A. The backflow preventer shall be a Reduced Pressure Principle and shall include a tightly closing resilient-seated shut-off valve on each end of the body. The assembly shall be fitted with four (4) properly located resilient-seated test cocks.

The assembly shall have two (2) independent and internally loaded check valves and a pressure differential relief valve located between the check valves.

The backflow preventer shall be suitable for supply pressure up to 175 psi and water temperatures from 33 to 180EF.

The backflow preventer shall meet the requirements of the following standards: USC's FCCC & HR Manual, Sec. 10 ASSE 1013, AWWA C-511, IAPMO, CSA B64.4, and UL.

- B. Provide piping to drain as required.

2.10 HOSE BIBS

- A. Bronze or red brass, replaceable hexagonal disc, hose thread spout, chrome plated where exposed.
- B. Non-freeze type with chrome plated wall plate hose thread spot, removable key.

2.11 SELECT VALVES (with the following ends or types of pipe/tube connections):

- A. Copper Tube Size, 2-Inches and Smaller:

Solder ends, except provide threaded ends to match existing conditions.

- B. Steel Pipe Sizes, 2-Inches and Smaller:
Threaded or end.

- C. Steel Pipe Sizes 2-1/2 Inches and Larger:

Flanged ends.

2.12 AUTO FLOW VALVES

- A. Automatic flow control valve cartridges shall automatically control flow rates with $\pm 5\%$ accuracy over an operating pressure differential range of at least 14 times the minimum required for control. Four operating pressure ranges shall be available with the minimum range requiring less than 3 PSID to actuate the mechanism.
- B. Valve internal control mechanism shall consist of a stainless steel one-piece cartridge with segmented port design and full travel linear coil spring.
- C. Manufacturer shall be able to provide certified independent laboratory tests verifying accuracy of performance. (Consult the factory for details).
- D. All flow control valve cartridges shall be warranted by the manufacturer for five years from date of sale.
- E. Body Styles
Isolator™ Series Valve (IY, IR)

1. Isolator series valves, sizes 1/2" through 1-1/2", shall have a ASTM brass alloy body, rated at no less than 400PSI/250°F. Isolator series valves, sizes 1-1/2" Large through 3", shall have a CAST brass alloy body, rated at no less than 275PSI/250°F. These sizes shall be constructed in a one-piece body to include a handle ball valve, a flow control cartridge assembly, dual pressure or pressure/temperature test valves for verifying accuracy of flow performance for all sizes combined with a manual air vent, and a union end which will accept various end pieces. The IY shall include a removable 20 mesh stainless steel strainer. Available flow rates shall be from 0.25 GPM to 160.0 GPM.
2. The body design shall allow inspection or removal of cartridge or strainer without disturbing piping connections.
3. The body design shall allow inspection or repair of handle operated stem without disturbing piping connections. The repairable stem shall include two Teflon seals and one EPDM o-ring for protection against chemicals and modulating temperature.
4. The valve shall come fully assembled and be permanently marked to show direction of flow; shall have a body tag to indicate flow rate and model number.

PART 3 - EXECUTION

3.01 INSTALLATIONS

A. General Application:

Use gate or ball valves for shut-off duty, use globe valve where indicated. Ball valves may be substituted for gate valves limited by requirements of this section. Refer to piping system specification sections for specific valve applications and arrangements. Install valves where indicated and where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping serving two or more terminal units or fixtures. Locate valves so as to be accessible.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves and unions for each fixture and item of equipment arranged to allow equipment removal without system shutdown. Unions are not required on flanged devices.

D. Install valves in horizontal piping with stem at or above the center of the pipe. Install valve drains with hose-end adapter for each valve that must be installed with stem below horizontal plane.

E. Insulation:

Where insulation is indicated on cold water systems install extended-stem valves or handles arranged in proper manner to receive insulation.

F. Install valves in a position to allow full stem movement.

G. Install drain valves at low points of all systems.

END OF SECTION

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PART 1 GENERAL

1.01 WORK INCLUDED

- A. Pipe, duct, and equipment hangers, supports, and associated anchors.
- B. Sleeves and seals.
- C. Flashing and sealing equipment and pipe stacks.

1.02 RELATED WORK

- A. Section 15121 - Expansion Compensation
- B. Section 15260 - Thermal Insulation

1.03 REFERENCES

- A. Conformance with ANSI/ASME B31.1 - Power Piping.
- B. Conformance with NFPA 13 - Standard for the Installation of Sprinkler Systems.
- C. Conformance with Manufacturer's Standardization Society MSS SP-90.

1.04 SUBMITTALS

- A. Submit product data under provisions of Section 15000.
- B. Indicate hanger and support framing and attachment methods.

PART 2 - PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS

- A. Hangers for Pipe Sizes 1/2 to 2 Inch: Malleable iron carbon steel, adjustable swivel, split ring.
- B. Hangers for Pipe Sizes 2-1/2 to 4 Inches and Cold Pipe Sizes 6 Inches and Over: Carbon steel, adjustable, clevis.
- C. Hangers for Hot Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron roll, double hanger.
- D. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods; cast iron roll and stand for hot pipe sizes 6 inches and over.
- E. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
- F. Wall Support for Pipe Sizes to 4 Inches and Over: Welded steel bracket and wrought steel clamp; adjustable steel yoke and cast iron roll for hot pipe sizes 6 inches and over.
- G. Vertical Support: Steel riser clamp.
- H. Floor Support for Pipe Sizes to 4 Inches and all Cold Pipe Sizes: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.
- I. Floor Support for Hot Pipe Sizes 6 Inches and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
- J. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

- K. Shield for Insulated Piping 2 Inches and Smaller: 18 gauge galvanized steel shield over insulation in 180 degree segments, minimum 12 inches long at pipe support.
- L. Shield for Insulated Piping 2-1/2 Inches and Larger (Except Cold Water Piping): Pipe covering protective saddles.
- M. Shields for Insulated Cold Water Piping 2-1/2 Inches and Larger: Hard block non-conducting saddles in 90° segments, 12 " minimum length, block thickness same as insulation thickness.

2.02 HANGER RODS

- A. Steel Hanger Rods: Threaded both ends, threaded one end, or continuous threaded.

2.03 INSERTS

- A. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.04 FLASHING

- A. Metal Flashing: 26 gauge galvanized steel.
- B. Flexible Flashing: 47 mil thick sheet compatible with roofing.
- C. Caps: Steel, 22 gauge minimum; 16 gauge at fire resistant elements.

2.05 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Floors: Form with steel pipe or 18 gauge galvanized steel.
- B. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fireproofing: Prefabricated fire rated sleeves including seals, UL listed.
- C. Sleeves for Round Ductwork: Form with galvanized steel.
- D. Sleeves for Rectangular Ductwork: Form with galvanized steel or wood.
- E. Fire Stopping Insulation: Glass fiber, type, foam or cement type to be equal or greater than rating of structure being penetrated.
- F. Caulk: Acrylic sealant.

2.06 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.

2.07 FINISH

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

PART 3 EXECUTION

3.01 INSERTS

- A. Provide inserts for placement in concrete formwork.
- B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
- D. Where concrete slabs form finished ceiling, provide inserts to be flush with slab surface.
- E. 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.

3.02 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as follows:

<u>PIPE SIZE</u>	<u>MAX. HANGER SPACING</u>	<u>HANGER DIAMETER</u>
1/2 thru 1-1/4 inch	6'-6"	3/8"
1-1/2 thru 2 inch	10'-0"	3/8"
2-1/2 thru 3 inch	10'-0"	1/2"
4 thru 6 inch	10'-0"	5/8"
8 thru 12 inch	14'-0"	7/8"
PVC (All Sizes)	6'-0"	3/8"
C.I. Bell and Spigot (or No-Hub)	5'-0" and at Joints	1/2"

- B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- C. Place a hanger within 12 inches of each horizontal elbow.
- D. Use hangers with 1-1/2 inch 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.

3.03 EQUIPMENT BASES AND SUPPORTS

- A. Provide equipment bases of concrete type specified by architect or on drawings.
- B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct support of steel members. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.04 FLASHING

- A. Provide flexible flashing and metal counter flashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Flash vent and soil pipes projecting 3 inches minimum above finished roof surface with lead worked one inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipe through outside walls, turn flanges back into wall and caulk, metal counter flash and seal.
- C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.
- D. Seal floor, shower, and mop sink drains watertight to adjacent materials.
- E. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacture's instructions for sound control.
- F. Provide curbs for mechanical roof installations 14 inches minimum high above roofing surface (or as indicated on drawings). Flexible sheet flash and counter flash with sheet metal; seal watertight.

3.05 SLEEVES

- A. Set sleeves in position in formwork. Provide reinforcing around sleeves.
- B. Extend sleeves through floors one inch above finished floor level. Caulk sleeves full depth and provide floor plate.
- C. 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 air tight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- D. Install chrome plated steel escutcheons at finished surfaces.

END OF SECTION

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PART 1 GENERAL

1.01 WORK INCLUDED

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

1.02 REFERENCES

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

1.03 SUBMITTALS

- A. Submit product data under provisions of Section 15000.
- B. Submit list of wording, symbols, letter size, and color coding for mechanical identification.

PART 2 PRODUCTS

2.01 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. Metal tags: Brass with stamped letters.
- D. Stencils: With clean cut symbols and letters of the following size:

<u>OUTSIDE DIAMETER OF INSULATION OR PIPE</u>	<u>LENGTH OF COLOR FIELD</u>	<u>SIZE OF LETTERS</u>
3/4" - 1-1/4"	8"	1/2"
1-1/2" - 2"	8"	3/4"
2-1/2" - 6"	12"	1-1/4"
Equipment	---	2-1/2"

- E. Stencil Paint: Semigloss enamel.
- F. 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.
- G. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- H. Underground Plastic Markers: Bright colored continuously printed plastic ribbon tape of not less than 6" wide by 4 mil. thick, manufactured for direct burial service.

PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

- A. Plastic or Metal Nameplates: Install with corrosive-resistant mechanical fasteners, adhesive or corrosive-resistant chain.
- B. Plastic Tape or Plastic Pipe Markers: Install complete around pipe in accordance with manufacturer's instructions.
- C. Equipment: Identify air handling units, pumps, tanks, heat transfer equipment, condensing units, and air compressors with plastic nameplates. Small devices, such as in-line pumps, may be identified with plastic or metal tags.
- D. Controls: Identify control panels and major control components outside panels with plastic nameplates.
- E. Piping: Identify piping, concealed or exposed, with plastic tape pipe markers or stenciled painting. Tags may be used on small diameter piping. 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.
- F. Underground Plastic Pipe Markers: Install 6 to 8 inches below finished grade, directly above buried pipe.

3.03 MECHANICAL IDENTIFICATION SCHEDULE

- A. Domestic hot and cold water piping, natural gas piping, heating hot water supply and return piping, chilled water supply and return piping, tanks, air handling units, condensing units, condensers, exhaust fans, return fans, pumps and heat transfer equipment.
- B. Provide valve chart and schedule in frame with glass or clear plastic cover. Install in Mechanical Room.

END OF SECTION

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PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Piping insulation, jackets and accessories.
- B. Ductwork insulation, jackets and lining.
- C. Equipment insulation and covering.

1.02 RELATED WORK

- A. Section 15050 - BASIC MECHANICAL MATERIALS AND METHODS.
- B. Section 15510 - HYDRONIC PIPING
- C. Section 15520 - STEAM AND STEAM CONDENSATE PIPING

1.03 QUALITY ASSURANCE

- A. Applicator: Company specializing in piping insulation application with three years minimum experience.
- B. Insulation materials shall be 100% asbestos free.

1.04 SUBMITTALS

- A. Submit product data under provisions of Section 15000.
- B. Include product description, list of materials and thickness for each service or equipment scheduled, and locations. Provide manufacturer's installation instructions.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Owens Corning, Manville, Armstrong, Certain Teed, Knauf or substitutions under provisions of Section 15000.

2.02 MATERIALS

- A. Type A: Fiberglass pipe insulation equal to Owens Corning Fiberglass ASJ/SSL-II Pipe Insulation with a "k" value of 0.25 @ 75 F, ASTM C547, Class 1, including vapor barrier.

Vapor Retarder Jacket: White kraft paper reinforced with glass fiber yarn and bonded to aluminum foil, secure with self sealing longitudinal laps and butt strips or jacket with outward clinch expanding staples coated with vapor barrier mastic as needed.

- B. Type B: Closed-Cell, Elastomeric foam rubber insulation equal to Armstrong AP Armaflex . (Pipe and/or sheet insulation in accordance with ASTM C-534; with a ΔK_{90} value not to exceed .27 @ 75 F), max flame spread 25, max smoke developed 50.
- C. Type C: Rigid board duct, class 1, insulation equal to Owens Corning type 703 with a maximum thermal conductivity of .22 @ 75 F, and FRK vapor barrier facing, ASTM C612, Class 1.
- D. Type D: Flexible duct insulation equal to Owens Corning all service duct wrap type 100 with a

maximum thermal conductivity of .27 @ 75 F, and FRK vapor barrier facing ASTM C553, Type 1, Class B-4.

- E. Type E: Acoustical duct liner equal to Owens Corning Aeroflex duct liner type 150 with a maximum thermal conductivity of .28 @ 75 F. Ductwork dimensions indicated are inside dimensions required for air flow. For applications involving indoor air quality concerns, use Armstrong=s self-adhering, non-fibrous, Armaflex duct liner (3/4" thick).
- F. Type F: Rigid foam glass with Pit wrap.
 - 1-1/2" thickness up to 2" pipe dia.
 - 2" thickness above 2" pipe dia.
- G.. Type G: Semi-rigid fiberglass board insulation, factory jacketed with a laminated Kraft aluminum foil All Service Jacket (ASJ) vapor barrier. Maximum thermal conductivity of 0.27 @ 75° F. Insulation shall be equal to Owens Corning pipe and tank insulation.
- H. Field Applied Jackets
 - 1. PVC Plastic: One piece molded type fitting covers and jacketing material, gloss white.
 - a. Connections: Tacks, pressure sensitive color matching vinyl tape.
 - 2. Canvas Jacket: UL Listed fabric, 6 oz./sq. yd., plain weave cotton treated with dilute fire retardant lagging adhesive.
 - 3. Aluminum Jacket: 0.016 inch thick sheet finish, with longitudinal slip joints and 2 inch laps, die shaped fitting covers with factory applied moisture barrier.
 - 4. Stainless Steel Jacket: Type 304 stainless steel, 0.010 inch.
- I. Hydrous Calcium Silicate meeting ASTM C 533, Type I; rigid molded pipe; asbestos-free color coded throughout material thickness.
 - 1. >K= Value: 0.42 at 300 ° F Mean Temperature as tested in accordance with ASTM C 335.
 - 2. Maximum Service Temperature: 1200 ° F.
 - 3. Non-combustible as determined by test following ASTM E 136.
 - 4. Tie Wire: 16 gage stainless steel with twisted ends on maximum 12 inch centers.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Install materials after piping or ductwork has been tested and approved. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics and insulation cements.

3.02 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions, building codes and industry standards.
- B. Continue insulation with vapor barrier through penetrations.
- C. Exterior insulated piping shall be jacketed with .016" aluminum jacket, banded on 18" centers and sealed watertight with mastic. Sealing not required if Type B insulation (elastomeric foam) is

installed per manufacturer=s instructions (entire insulation system is air/water tight, vapor barrier).

- D. All fittings and valves shall be insulated with corresponding pipe insulation. Domestic hot water line valves, mechanized fittings and joints (i.e., unions, etc.) may be uninsulated if they are concealed in walls or above ceilings.
- E. Unions and flanges on insulated cold water piping shall be insulated, but on other systems shall not be insulated. Terminate insulation neatly at each side of union and/or flange with insulating cement, so unions and flanges may be taken apart without disturbing insulation.
- F. Rigid board insulation shall be impaled over Mechanical fasteners, (SMACNA fastener standard), on 12 in. x 18 in. centers. Use a minimum of two rows of fasteners per side.
- G. Flexible insulation shall be firmly adhered to ducts with full coverage of fire retardant adhesive. For flexible insulation on ducts 24 inches or more in width, use both adhesive and mechanical fasteners on the bottom of the duct to prevent possible sagging. Mechanical fasteners and spacing shall be as specified for rigid board insulation.
- H. Acoustical duct liner shall be adhered to the sheet metal with 100% coverage of adhesive, and all exposed leading edges and all transverse joints coated with adhesive. Duct liner shall also be secured using mechanical fasteners which shall compress the liner sufficiently to hold it firmly in place.
- I. Cover exterior insulated rectangular ducts with .016" thick aluminum jacket secured watertight with mechanical fasteners, bands or screws.
- J. Cover exterior insulated round ducts with .016" thick aluminum jacket with moisture barrier.

3.03 INSULATION SCHEDULE

<u>SERVICE</u>	<u>SIZE</u>	<u>INSULATION TYPE & THICKNESS</u>
HEATING HOT WATER	UP THRU 1-1/2"	TYPE A, 1" or TYPE B, 3/4"
HEATING HOT WATER	OVER 1-1/2"	TYPE A, 1-1/2" or TYPE B, 1"
DOMESTIC COLD WATER	ALL SIZES	TYPE A, 1" or TYPE B, 1/2"
DOMESTIC HOT WATER	UP THRU 1-1/2"	TYPE A, 1" or TYPE B, 1/2"
DOMESTIC HOT WATER	OVER 1-1/2"	TYPE A, 1-1/2" or TYPE B, 3/4"
DOMESTIC COLD WATER	ALL SIZES	TYPE A, 1" or TYPE B, 1/2"
STORM	ALL SIZES	TYPE A, 1" or TYPE B, 1/2"
ROOF DRAINS	ALL SIZES	TYPE A, 1" or TYPE B, 1/2"
ALL ROUND OUTSIDE AIR (MAKE-UP & COMBUSTION) & RELIEF AIR DUCTS	ALL SIZES	TYPE D, 2" or TYPE B, 3/4"

<u>SERVICE</u>	<u>SIZE</u>	<u>INSULATION TYPE & THICKNESS</u>
ALL RECTANGULAR OUTSIDE AIR (MAKE-UP & COMBUSTION) & RELIEF AIR DUCTS	ALL SIZES	TYPE C, 1-1/2" or TYPE B, 3/4"
ALL DUCTWORK EXPOSED TO OUTDOOR AIR TEMPERATURES (i.e. ATTIC OR SOFFIT INSTALLATIONS)	ALL SIZES	TYPE D, 2" or Type B, 1 1/2"
ALL DUCTWORK EXPOSED TO OUTDOOR AIR TEMPERATURES (i.e. ROOF MOUNTED INSTALLATIONS) for covering	ALL SIZES	TYPE B, 1 1/2", Reference 3.02.1

END OF SECTION

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PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Pipe and pipe fittings.
- B. Valves.
- C. Sanitary sewer piping system.
- D. Domestic water piping system.
- E. Natural gas piping system.

1.02 RELATED WORK

- A. Architectural - Earth Work.
- B. Section 15260 - Piping Insulation.
- C. Section 15430 - Plumbing Specialties.

1.03 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.
- C. Welders Certification: In accordance with [ANSI/ASME Sec 9.] [ANSI/AWS D1.1.]

1.04 SUBMITTALS

- A. Submit product data under provisions of Section 15000.

PART 2 - PRODUCTS

2.01 SANITARY SEWER AND STORM WATER PIPING, BURIED BEYOND 5 FEET OF BUILDING

- A. PVC Pipe: ASTM D3033 or D3034, SDR 35. Fittings: PVC. Joints: ASTM F477, elastomeric gaskets.

2.02 SANITARY SEWER AND STORM WATER PIPING, BURIED AND ABOVE GRADE, BUT CONCEALED WITHIN BUILDING

- A. PVC Pipe: ASTM D2665, D3034. Fittings: PVC. Joints: ASTM D2855, solvent weld.
NOTE: Concealed is defined as a pipe that is contained within a wall or in a fire rated chase.

2.03 SANITARY SEWER AND STORM WATER PIPING, ABOVE GRADE (In Exposed Areas)

- A. PVC Pipe: ASTM D2665, D3034. Fittings: PVC. Joints: ASTM D2855, solvent weld. If used in exposed areas, piping must be covered with minimum 1" fiberglass insulation with approved fire resistance rating.
NOTE: Exposed is defined as a pipe that is exposed to view or installed above an accessible ceiling.
- B. Cast iron pipes (**in exposed areas & on vertical installations**): ASTM A74; C1SP1 301.
NOTE: Exposed is defined as a pipe that is exposed to view or installed above an accessible ceiling.

2.04 WATER PIPING, BURIED

- A. Copper Tubing: ASTM B75 or B88 or B251, Type K, annealed temper. Fittings: ANSI/ASME B16.23, cast brass, or ANSI/ASME B16.29, wrought copper. Joints: 95.5% tin, 4% copper, .5% silver "lead free" solder.

2.05 WATER PIPING, ABOVE GRADE

- A. Copper Tubing: ASTM B75 or B88 or B251, Type L, hard drawn. Fittings: ANSI/ASME B16.23, cast brass, or ANSI/ASME B16.29, wrought copper. Joints: 95.5% tin, 4% copper, .5% silver "lead free" solder.

2.06 NATURAL GAS PIPING ,BURIED BEYOND 5 FEET OF BUILDING

- A. Gas Company to install and furnish material to bring gas service to building.

2.07 NATURAL GAS PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53 or A120, Schedule 40 black. Fittings: ANSI/ASME B16.3, malleable iron, or ASTM A234, forged steel welding type. Joints: Screwed for pipe two inches and under; ANSI/AWS D1.1, welded, for pipe over two inches, welded in concealed locations for all sizes.
- B. Test Criteria: Gas piping shall be tested with air or an inert gas. System to be tested to a pressure of 1-1/2 times the system working pressure, but not less than 3 psi. Piping system shall maintain the full-test pressure for a period of 10 minutes.
- C. Piping in concealed locations shall not have unions, fittings, or threads.

2.08 FLANGES, UNIONS, AND COUPLINGS

- A. Pipe Size 2 Inches and Under: 150 psig malleable iron unions for threaded ferrous piping; bronze unions for copper pipe, soldered joints.
- B. Pipe Size Over 2 Inches: 150 psig forged steel slip-on flanges for ferrous piping; bronze flanges for copper piping; neoprene gaskets for gas service; 1/16 inch thick preformed neoprene bonded to asbestos.
- C. Grooved and Shouldered Pipe End Couplings: Malleable iron housing clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; "C" shape composition sealing gasket; steel bolts, nuts, and washers; galvanized couplings for galvanized pipe.
- D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.09 GATE VALVES

- A. Up to 2 Inches: Bronze body, rising stem and handwheel, inside screw, double wedge or disc, solder.
- B. Over 2 Inches: Iron body, bronze trim, rising stem and handwheel, OS&Y, double wedge, flanged ends.

2.10 GLOBE VALVES

- A. Up to 2 Inches: Bronze body, rising stem and handwheel, inside screw, renewable composition disc, solder screwed ends, with backseating capacity.
- B. Over 2 Inches: Iron body, bronze trim, rising stem and handwheel, OS&Y, plug-type disc, flanged ends.

2.11 BALL VALVES

- A. Up to 2 Inches: Bronze body, stainless steel ball, Teflon seats and stuffing box ring, lever handle and

balancing stops, threaded ends with union.

- B. Over 2 Inches: Cast steel body, chrome plated steel ball, Teflon seat and stuffing box seals, lever handle.

2.12 GAS COCKS

- A. Up to 2 Inches: Bronze body, bronze tapered plug non-lubricated, Teflon packing, threaded ends.
- B. Over 2 Inches: Cast iron body and plug, non-lubricated, Teflon packing, flanged ends.

2.13 SWING CHECK VALVES

- A. Up to 2 Inches: Bronze 45 degree swing disc, screwed ends.
- B. Over 2 Inches: Iron body, bronze trim, 45 degree swing disc, renewable disc and seat, flanged ends.

2.14 SPRING LOADED CHECK VALVES

- A. Iron body, bronze trim, spring loaded, renewable composition disc, screwed, wafer, or flanged ends.
- B. Over 2 Inches: Cast iron body, bronze fitted, elastomer diaphragm and seat disc, flanged.

2.15 ACCEPTABLE MANUFACTURERS

- A. Nibbco, Red and White, Grinnell, and Substitutions: Under provisions of Section 15000.

2.16 ACCEPTABLE MANUFACTURERS - RELIEF VALVES

- A. Watts.
- B. Substitutions: Under provisions of Section 15000.

2.17 RELIEF VALVES

- A. Bronze body, Teflon seat, steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside.
- C. Prepare piping connections to equipment with unions.

3.02 INSTALLATION

- A. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- B. Provide access where valves and fittings are not exposed. {Coordinate size and location of access doors with Section 15000}.
- C. Slope water piping and arrange to drain at low points.
- D. Establish elevations of buried piping outside the building to ensure not less than minimum cover by

code.

- E. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- F. Prepare pipe, fittings, supports, and accessories not finished, ready for finish painting. Refer to Section 15000.
- G. Establish invert elevations, slopes for drainage to 1/8 inch per foot one percent minimum. Maintain gradients.
- H. Install bell and spigot pipe with bell end upstream.
- I. Install valves with stems upright or horizontal, not inverted.

3.03 APPLICATION

- A. Use grooved mechanical couplings and fasteners only in accessible locations.
- B. Install unions downstream of valves and at equipment or apparatus connections.
- C. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.
- D. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- E. Install globe valves for throttling, bypass, or manual flow control services.
- F. Provide spring loaded check valves on discharge of water pumps.

3.04 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Prior to starting work, verify system is complete, flushed and clean.
- B. Ensure PH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
- D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- E. Maintain disinfectant in system for 24 hours.
- F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- H. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C601.

END OF SECTION

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PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Floor Drains.
- B. Cleanouts.
- C. Backflow Preventers.
- D. Water Hammer Arresters.
- E. Thermostatic Mixing Valves.
- F. Hose Bibs Hydrants.

1.02 RELATED WORK

- A. Section 15050 - Materials and Methods.
- B. Section 15410 - Plumbing Piping.

1.03 QUALITY ASSURANCE

- A. ANSI/ASSE 1012 - Backflow Preventers with immediate Atmospheric Vent.
- B. ANSI/ASSE 1011 - Hose Connection Vacuum Breakers.
- C. ANSI/ASSE 1013 - Backflow Preventers, Reduced Pressure Principle.
- D. ANSI/ASSE 1019 - Wall Hydrants, Frost Proof Automatic Draining Anti-Backflow Types.
- E. ANSI A112.21.1 - Floor Drains.
- F. ANSI A112.26.1 - Water Hammer Arresters.
- G. PDI WH-201 Water Hammer Arresters.

1.04 QUALITY ASSURANCE

- A. Manufacturer: For each product specified, provide components by same manufacturer throughout.

1.05 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 15000.
- B. Include component sizes, rough-in requirements, service sizes, and finishes.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS - FLOOR DRAINS

- A. Wade, Zurn, Jay R. Smith.
- B. Substitutions: Under provisions of Section 15000.

2.02 FLOOR DRAINS

- A. ANSI A112.21-1: Cast iron two piece body with double flange, weep holes, reversible clamping collar, and adjustable strainer; Model Z-415 manufactured by Zurn.

2.03 ACCEPTABLE MANUFACTURERS - CLEANOUTS

- A. Wade, Zurn, Jay R. Smith.
- B. Substitutions: Under provisions of Section 15000.

2.04 CLEANOUTS

- A. Interior Finished Floor Areas: Cast iron, two piece body with double drainage flange, weep holes, reversible clamping collar, and adjustable nickel-bronze strainer, round with scoriated cover in service areas. Model Z-1400 manufactured by Zurn.

2.05 ACCEPTABLE MANUFACTURERS - BACKFLOW PREVENTERS

- A. Chicago, Watts, Wilkins (Zurn).
- B. Substitutions: Under provisions of Section 15000.

2.06 BACKFLOW PREVENTERS

- A. Reduced Pressure Backflow Preventers: ANSI/ASSE 1013; bronze body with bronze and plastic internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve which opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks; Series 909 manufactured by Watts.
- B. Double Check Valve Assemblies: ANSI/ASSE 1012; Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent; Series 709 manufactured by Watts.

2.07 WATER HAMMER ARRESTERS

- A. ANSI A112.26.1; sized in accordance with PDI WH-201, precharged suitable for operation in temperature range -100 degrees F to +300 degrees F and maximum 250 psig working pressure.

2.08 ACCEPTABLE MANUFACTURERS - THERMOSTATIC MIXING VALVES

- A. Lawler, Leonard, Powersza.
- B. Substitutions: Under provisions of Section 15000.

2.09 THERMOSTATIC MIXING VALVES

- A. Provide thermostatic mixing valve, with check valve, volume control shut-off valve on outlet, stem type thermometer on outlet, strainer stop check on inlet.

2.10 ACCEPTABLE MANUFACTURERS - HOSE BIBS/HYDRANTS

- A. Woodford, Wade, Zurn.
- B. Substitutions: Under provisions of Section 15000.

2.11 HOSE BIBS/HYDRANTS

- A. Bronze or brass, replaceable hexagonal disc, hose thread spout, with vacuum breaker in conformance with ANSI/ASSE 1011. Woodford Model 65.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Coordinate forming of floor construction to receive drains to required invert elevations.

3.02 INSTALLATION AND APPLICATION

- A. Install specialties in accordance with manufacturer's instructions to permit intended performance.
- B. Extend cleanouts to finished floor surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- C. Install water hammer arresters complete with accessible isolation valve.

END OF SECTION

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PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Low pressure ducts.
- B. Duct cleaning.

1.02 RELATED WORK

- A. Section 15140 - Supports and Anchors: Sleeves.
- B. Section 15260 - Thermal Insulation.
- C. Section 15990 - Testing, Adjusting and Balancing.

1.03 REFERENCES

- A. ASHRAE - Handbook 1989 Fundamentals; Duct Design.
- B. ASHRAE - Handbook 1988 Equipment; Duct Construction.
- C. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- D. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.
- E. SMACNA - Low Pressure Duct Construction Standards.
- F. SMACNA - High Pressure Duct Construction Standards.
- G. UL 181 - Factory-Made Air Ducts and Connectors.

1.04 DEFINITIONS

- A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.
- B. Low Pressure: Three pressure classifications: 1/2 inch WG positive or negative static pressure and velocities less than 2,000 fpm; 1 inch WG positive or negative static pressure and velocities less than 2,500 fpm and 2 inch WG positive or negative static pressure and velocities less than 2,500 fpm.

1.05 REGULATORY REQUIREMENTS

- A. Construct ductwork to NFPA 90A, NFPA 90B and NFPA 96 (if applicable) standards.

1.06 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 15000.
- B. Indicate duct fittings, particulars such as gauges, sizes, welds, and configuration prior to start of work for low and medium pressure and kitchen hood exhaust systems.
- C. Submit manufacturer's installation instructions for glass fiber ducts under provisions of Section 15000.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General: Non-combustible or conforming to requirements for Class 1 air duct materials, or UL 181.
- B. Steel Rectangular Ducts: ASTM A525 or ASTM A527 galvanized steel sheet, lock-forming quality, having zinc coating of 1.25 oz per square feet for each side in conformance with ASTM A90.
- C. Insulated Flexible Ducts: Flexible duct wrapped with flexible glass fiber insulation, enclosed by seamless aluminum pigmented plastic vapor barrier jacket; maximum 0.23 K value at 75 degrees F.
- D. Round Spiral Ducts: ASTM A-527-71, galvanized steel, spiral locking seam equal to United McGill Uni-Seal.
- E. Internal Insulated Round Spiral Ducts: ASTM A-527-71, galvanized steel, spiral locking seam equal to United McGill Uni-Rib k-27.
- F. Fibrous Glass Ducts: UL 181; 1-1/2 inch thick rigid glass fiber with aluminum foil, glass scrim and kraft or plastic jacket vapor barrier; maximum 0.23 K value at 75 degrees F.
- G. Stainless Steel Ducts: ASTM A167, type 304.

2.02 LOW PRESSURE DUCTWORK

- A. Fabricate and support in accordance with SMACNA Low Pressure Duct Construction Standards and ASHRAE handbooks, except as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
- B. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by written permission.
- C. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.
- D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.
- E. Provide easements where low pressure ductwork conflicts with piping and structure. Where easements exceed 10 percent duct area, split into two ducts maintaining original duct area.
- F. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.
- G. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.
- H. Use double nuts and lock washers on threaded rod supports.

PART 3 - EXECUTION

3.01 PREPARATION/INSTALLATION

- A. Before proceeding with fabrication and installation of ductwork, inspect the contract documents and determine that the location of work does not interfere with other work. In case of interference,

notify the Engineer.

- B. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
- C. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- D. Connect diffusers or troffer boots to low pressure ducts with 5 feet maximum length of flexible duct in areas where a ceiling is installed. Hold in place with strap or clamp.
- E. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- F. Provide residue traps in kitchen hood exhaust ducts at base of vertical risers with provisions for clean out. Use stainless steel for all ductwork. Ductwork installation is to meet Michigan Health Department Regulations.

3.02 DUCTWORK APPLICATION SCHEDULE

AIR SYSTEM

MATERIAL

Low Pressure Supply	Rectangular or spiral round as indicated on drawings.
Return and Relief	Rectangular or spiral round as indicated on drawings.
Outside Air Intake	Galvanized Steel
Combustion Air	Galvanized Steel

3.03 ADJUSTING AND CLEANING (Only required if contractor fails to keep clean.)

- A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.
- B. Clean duct systems with high power vacuum machines. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes.

END OF SECTION

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PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Labor, materials, equipment, tools supervision & start-up services.
- B. Electrical building system closeout.

1.02 SECTION INCLUDES

SECTION 16.000	ELECTRICAL GENERAL PROVISIONS
SECTION 16.050	BASIC ELECTRICAL MATERIALS AND METHODS
SECTION 16.400	SERVICE AND DISTRIBUTION
SECTION 16.450	GROUNDING
SECTION 16.470	PANEL BOARDS
SECTION 16.720	TESTING

1.02 COORDINATION OF ELECTRICAL WORK

- A. Responsibility:
 - 1. The Electrical Contractor shall be responsible for his Sub-Contractors and Suppliers, and include in his bid materials, labor, and equipment involved, and install in accordance with local customs, codes, rules, regulations, jurisdictional awards, and decisions; and secure compliance of parts of the Specifications and Drawings regardless of Sectional inclusion in these Specifications.
 - 2. The Electrical Contractor and Sub-Contractor(s) shall be responsible for tasks applicable to his trade, as directed by the General Contractor, in accordance with the Specifications, Drawings, code requirements and shall be responsible for coordinating locations and arrangements of his work with all other relevant Mechanical, Architectural, Structural and Electrical Contractor's Specifications, Drawings and shop drawings. Coordinate work so that sprinkler heads, lights, diffusers, etc. are coordinated into Project and are installed per the architectural reflected ceiling plan.
- B. Site and Project Document Examination:
 - 1. Submission of a proposal is considered evidence that the Contractor has visited site and acquainted themselves with all existing conditions, made all necessary measurements, examined the Drawings and Specifications of all trades, including Mechanical, Architectural, Structural, and Electrical, and has fully informed himself with all Project and site conditions, and is proficient, experienced and knowledgeable of all standards, codes, ordinances, permits and regulations which affect the installation of his respective trade, and that all costs are included in his proposal.
 - 2. The Electrical Contractor and/or Sub-Contractor(s) shall obtain all required permits and assessments prior to starting work. Contractor shall verify requirement to include permits as part of his formal bid, as described in the General and Supplementary Requirements.
 - 3. No allowance shall subsequently be made in the Contractor's behalf for extra expense incurred due to failure or neglect on his part to make this site visit and examination.
 - 4. It is the responsibility of the Contractor to notify the Engineer, prior to submitting his bid, of any potential problems that he has identified during his site visit or from examination of the Contract documents.

C. General Supports:

1. Provide all necessary angle, channel, brackets or supplementary steel as required for adequate support for all conduit, specialties and equipment which is hung or mounted above floor. Secure approval from Architect, in writing, before welding or bolting to steel framing or anchoring to concrete structure.
2. Where conduit or equipment is suspended from concrete construction, set approved concrete inserts in formwork to receive hanger rods, such as structural steel channel, and where installed in metal deck use Ramset or welds as required.

D. Equipment Clearance:

1. Electrical Contractor to coordinate with the Architectural and Mechanical trades for equipment locations and to ensure adequate clearance is maintained, as required by the National Electrical Code and applicable state and local codes, as well as accessibility for future maintenance and operation.
2. Electrical work shall be arranged with building construction to provide minimum 6'-8" overhead clearance where possible.

E. Wall, Floor and Ceiling Openings:

1. Locate openings and advise the General Contractor/Construction Manager of details and templates of all openings necessary for inspection of electrical work.
2. In general, openings and required lintels shall be provided through the General Contractor/Construction Manager. Size and location is the responsibility of this Contractor. Cracks and rough edges left following installation of equipment shall be caulked or covered by Electrical Contractor.
3. Openings through drywall or concrete surfaces for supporting electrical equipment, including conduit penetrations, shall be drilled in a neat and work-like manner.
4. Electrical penetration holes through fire rated materials and systems shall be sealed in a manner to maintain the fire rating of that material and system.
5. Foam type sealer shall be used in accordance with the manufacturer's instructions for storage, hole preparation, mixing, and application. Two part foam type fire sealer shall be Dow Corning Silicone RTV, or approved equal.
6. Mechanical type fire stops shall be fitted to the opening and cable sizes, assembled, and installed per the manufacturer's instructions. Stops shall be Crouse-Hinds "TW Series, Thru-Wall-Barrier", Nelson Electric "Multi-Cable Transits", or approved equal.

F. Access Panels:

1. Items of equipment which require accessibility, adjustment, maintenance or observation such as junction boxes, controls, etc., shall be located and arranged for ready access either directly or through the use of access doors.
2. Notify the Engineer and all affected trades where and of what size and/or configuration access doors will be installed. Secure the approval of the Architect/Engineer for these locations and configurations.
3. Such access doors/panels shall meet or exceed the fire barrier rating of the floor, wall or partition into which they are inserted.

4. Access doors or panels, where required, shall be provided by the Contractor or Subcontractor whose equipment requires the access unless otherwise noted. This trade is to coordinate the access panel manufacturers with the architectural access panels.

G. Excavating and Backfilling:

1. Excavation and backfilling shall be performed in accordance with Division 2, Earthwork, and this Section.
2. Respective trades shall provide all trenching, excavating and backfilling as required for the installation of their work, including bracing, shoring and dumping as may be required. Provisions shall be made to ensure the safety of persons and property while work is proceeding as well as when the area is unattended.
3. Excavations shall conform to the required burial depth of equipment designated on the drawings, as required by field conditions, code requirements and as directed by the Engineer.
4. Enclose, support, barricade and mark all excavations as required and as directed by the Architect/Engineer, or Owner's representative.
5. Exercise caution in excavation and personally check with all utilities (Call "Miss Dig") and the Owner for all required information on existing underground work in the area of the excavation. Repair all damage to existing underground work if damage is inflicted in the course of the excavation.
6. Obtain Architect/Engineer's permission, in writing, before any tunneling.
7. Provide separate trenches for each utility unless otherwise noted or directed.
8. Where electrical work is to be installed in filled or disturbed earth, raceways shall be supported by brick piers or other approved supports placed under the raceways and carried down to a firm bearing. All lines shall be laid straight and true alignment with the grade in the location established on the drawings or as directed by the Engineer.
9. Backfill under buildings, sidewalks, drives or parking lots shall be with 100 percent clean, non-cohesive sand. Compaction shall be in accordance with Division 2, Earthwork.

H. General Cleaning:

1. It shall be the responsibility of this Contractor to keep the premises free of accumulations of surplus material or rubbish caused by his operations and/or the operations of his Subcontractors. Combustible rubbish and debris shall be removed immediately. The trades shall remove their rubbish and debris from the project site promptly upon its accumulation.
2. Upon completion of the installation, the Contractor shall thoroughly clean all fixtures, equipment, boxes, raceways, controls, enclosures and other applicable equipment and accessories free of all foreign material.
3. All patching, repairing and painting required of surfaces damaged or allowed to deteriorate in the performance of this work made by this Contractor, where directed by the Architect/Engineer, shall be at this Contractor's expense.
4. If a Contractor does not remove rubbish or clean the systems as specified above, the Owner's representative reserves the right to have the work performed by others, with the cost back-charged to the Contractor who made the removal or cleaning necessary.

I. Field Changes:

1. The Contractor shall not make any field changes that affect timing, costs or performance without written approval from the Architect/Engineer in the form of a Change Order, Field Change Order or a Supplemental Instruction. The Contractor assumes liability for any additional costs for changes made without such instruction or approval. Should any unauthorized change be determined by the Architect/Engineer as lessening the value of the project, a credit will be determined and issued as a change to the contract.

1.03 STANDARDS, CODES AND PERMITS

- A. Refer to Division 1, General Requirements and Supplementary Conditions.
- B. All work installed under Electrical Sections shall comply with latest edition of applicable standards and codes of the following, including local codes and variances:
 - ADAG Americans with Disabilities Act Guidelines
 - AEIC Association of Edison Illuminating Companies
 - ANSI C2, American National Standards Institute
 - ANSI C73, Dimensions of Attachment Plugs and Receptacles
 - ASA American Standards Association
 - ASTM American Society of Testing Materials
 - ICEA Insulated Power Cable Engineers Association
 - IEEE Institute of Electrical and Electronics Engineers
 - OSHA Occupational Safety and Health Act
 - NEC Latest edition of (NFPA 70) as approved by the local authority having jurisdiction
 - NECA Standards for Installation
 - NEMA National Electric Manufacturers Association
 - NESC National Electric Safety Code (H13)
 - NETA National Electrical Testing Association, Inc.
 - NFPA National Fire Protection Association
 - UL Underwriter's Laboratories
 - Regulations of the local power utility company.
- C. Work shall be provided and tested in accordance with all applicable local, county, state laws, governmental ordinances, codes, rules and regulations.
- D. Contractor shall give all notices, file all drawings, obtain necessary approvals, obtain all permits, pay all fees, deposit and expenses required for installation of all work under this Contract.
- E. No work shall be covered or enclosed until work is tested in accordance with applicable codes and regulations, and successful tests witnessed and approved by authorized inspection authority.
- F. In general, material where applicable shall be labeled or listed by Underwriters' Laboratories, Inc. Assembled electrical equipment supplied to the job site shall be listed or labeled and/or approved by the authority having jurisdiction.
- G. In the event plans and specifications conflict with any rules, regulations or codes applying, said rules, regulations and codes shall govern the Contractor.

1.04 SUBMITTALS

- A. Shop Drawings:
 1. After a schedule of Sub-Contractors is approved by the Engineer, submit eight (8) neatly bound copies of shop drawings (or number as directed by General Requirements) with one device or fixture of each type clearly identified (high-lighted, bolded, underlined, etc.) in each set on

equipment and materials indicated on drawings or in the specifications.

2. Submit complete manufacturer's shop drawings of equipment, accessories and controls, including dimensions, weights, capacities, construction details, installation, control methods, wiring diagrams, and motor data, etc.
3. Engineer's approval of shop drawings is for general application only and is a service only and not considered as a guarantee of total compliance with or as relieving Contractor of basic responsibilities under Contract Documents, and does not approve changes in time or cost.
4. After approval, each Contractor is responsible to provide information to other trades involved in, or affected by, installation of his equipment and work.

B. Operating and Maintenance Instructions and Manuals:

1. Electrical Contractor shall provide for all major items of equipment two (2) bound and indexed sets of operating/installation and maintenance instructions to Engineer for approval. After approval, manuals will be given to Owner by Engineer.
2. Manuals shall include a complete set of shop drawings submitted, indexed with tabs for each section.

1.05 ELECTRICAL SERVICE REQUIREMENTS

- A. Electrical Contractor shall verify with the Utility Company the electrical system amperage, voltage and phase and report any variation from what is indicated on the drawings to the Engineer. Electrical Contractor shall obtain written verification of the available symmetrical and asymmetrical RMS fault current from the Utility Company and submit to the Engineer.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Standards:

1. Products shall be of established manufacturers regularly engaged in making type of materials to be provided and complete with all parts, accessories, trim, finish, safety guards and other devices and details needed for a complete installation and for the intended use and effect.

B. Substitution and Changes:

1. Contractor and/or Equipment Supplier may propose alternate equipment or materials of equal quality, function, durability and appearance as described and permitted in Specification Section 16000, 1.01.B. The substitution will take the form of an "Add-Deduct" to the bid proposal. It is the submitter's responsibility to provide sufficient material for review as required by Engineer's office. Acceptance and approval is the responsibility of the Engineer.
2. No substitutions will be accepted, except as authorized in a Project Addendum.
3. Contractor and/or Equipment Supplier is liable for any added costs to himself or others and is responsible for verifying dimensions, clearance and roughing-in requirements, when product not named as the basis of design is used and the Contractor is responsible for advising other Contractors of variations and, if requested, submit revised drawing layout for approval by the Engineer.

C. Explanation of Scheduled Manufacturers:

1. "Base Bid". This term designates that this equipment will be the product which the contractor generates his bid from. It is usually a component that is critical to maintaining the design intent. No other equipment suppliers will be allowed to bid as an "equal".
2. "Based On". This term designates that the equipment is designed around a certain product. Products of equal status are listed and may be bid as if they were the basis of design. The "based on" equipment shall serve as the standard to which equals will be judged.

2.02 EQUIPMENT REQUIREMENTS AND CONNECTIONS

A. Motor Starters and Controls:

1. Electrical Contractor shall provide manual or magnetic motor starters as required for motors not provided by Mechanical Trades and as indicated on Electrical Drawings and as specified within this Specification.
2. Mechanical Contractor shall provide factory installed motor starters integral with packaged equipment containing thermal overcurrent protection in ungrounded conductors with heater coils selected for specific motor usage for motors, unless otherwise shown on electrical drawings.

B. Electrical Wiring and Controls:

1. Mechanical Contractor shall provide motors, drives, controllers and safety switches integral to packaged equipment and factory mounted controls for mechanical equipment as indicated. When pre-wired equipment is used, control circuit shall be separately fused at control transformer and shall always revert to a fail-safe condition.
2. Mechanical Contractor or Temperature Control Contractor shall provide electrical devices requiring mechanical connections, and/or electrical connections, such as pressure switches, limit switches, float switches, solenoid valves, motor operated valves, motor operated dampers, fire stats, freeze stats, thermostats, override timers, E.P.'s, P.E.'s, temperature control cabinet, etc.
3. Mechanical Contractor or Temperature Control Contractor shall provide Class 2 and 3 wiring, conduit, boxes for their associated equipment unless otherwise noted.

Electrical subcontractor shall furnish and wire duct type smoke detectors. Duct type smoke detectors shall be installed by Mechanical Trades.

4. Electrical Contractor shall install power wiring and conduit to motors and/or factory mounted control panels as indicated on Drawings or as indicated in other sections of the Specifications.
5. Electrical wiring work by Mechanical Contractor and Temperature Control Contractor shall be in accordance with Division 16 requirements.

C. Owner Supplied Equipment:

1. Electrical Contractor is to provide power wiring, conduit, starters and safety switches on equipment as indicated on the drawings. Make final power connections to equipment. Any control wiring or remote power supplied by the equipment to remote units shall be provided by the Owner.

PART 3 - EXECUTION

3.01 CLOSEOUT

A. Final Acceptance:

Final acceptance and payment will only be made after final punch list completion and receipt at Engineer's office of:

- Certificates of Inspection
- Test Reports
- Guarantees/Warranties
- Record Drawings (As-Builts)
- Operating and Maintenance Instruction Manuals (2)

B. Certificates of Inspection and Test Reports:

The Contractor shall submit to the Engineer's Office evidence that installation has been inspected and approved by municipal or state electrical inspector and/or the authority having jurisdiction.

C. Guarantees and Warranties:

1. During the one year period of continuous operation (except if General Requirements specify a longer warranty period), make two complete inspections (one at 3 months and one at 6 months) of all systems, fixtures, equipment, safety devices and controls to ensure equipment operating properly, and report to Engineer in writing. Contact the Owner's Operation/Maintenance Supervisor to schedule site inspection.

D. Record Drawings:

1. Maintain a white-print set of Electrical Contract Drawings in clean, undamaged condition for mark-up of actual installation on Electrical Contract Drawings which vary substantially from the work as shown. These drawings are to be available for inspection by the Engineer on a weekly basis.
2. Submit as-built record drawings consisting of separate plans and riser diagrams for following systems:
 - Power
 - Lighting and Controls
 - Fire Alarm/Life Safety System

Each system drawing shall show location, size and conductor fill for conduits, junction boxes and outlets. Specification changes shall also be submitted.

E. Operating and Maintenance Instructions:

1. Provide instruction of Owner's personnel in operation and maintenance procedures for all systems equipment.

F. Placing Systems into Operation:

1. Electrical Contractor shall be responsible for all start-up procedures, system checks and balancing associated with his equipment.
2. Equipment shall be installed, tested and operated in accordance with manufacturer's recommendations at normal operating conditions.
3. Permanent electrical equipment operated during construction periods shall be cleaned, and

damaged equipment replaced.

G. Adjustments and Balancing:

1. Subsequent to beginning operation of the electrical power and distribution systems, the Contractor shall make all necessary adjustments to equipment installed or connected by him under this contract so as to ensure proper operation of the same. The Contractor shall measure, phase balance and make necessary adjustments to any portion of the electrical system that is substantially out of balance.

3.02 GUARANTEES AND WARRANTIES

- A. Labor, materials and equipment shall be guaranteed by Contractor and/or warranted by manufacturer for one year after acceptance date and/or one normal continuous complete season's operation applicable to equipment or system except where specified longer for special equipment. Contractor shall secure such warranty from Suppliers (not one year from shipment date), or Contractor to assume warranty.
- B. Acceptance date of substantial completion shall be Owner occupancy as determined by Architect/Engineer.
- C. Contractor shall make necessary alterations, repairs, adjustments, replacements during guarantee periods as directed by Architect/Engineer to comply with Drawings and Specifications at no cost to Owner.
- D. Repair or replacements made under guarantee bear further one year guarantee from date of acceptance of repair or replacement.

END OF SECTION

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PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Shop drawing submittals
- B. Raceways, wire & cables, outlet boxes, wiring devices, motor starters & panels.
- C. Installation methods

1.02 IDENTIFICATION

- A. Service switches, motor disconnects, controllers, etc., whether or not furnished under this Division shall be marked to identify the equipment served and the origin of the power source. Branch panelboards, distribution panels, transformers, and switchboards shall be identified as to designation and voltage characteristics. **All identification shall be done with engraved plastic plates, black with white letters.**

1.03 DIRECTORIES

- A. **Provide each panel with a typewritten index.** Insert index into a transparent plastic holder secured to the inside of the panel door.

1.04 SUBMITTALS

- A. Shop Drawings
 - 1. Submit shop drawings for the following:
 - a. Wiring Devices and Switches.
 - b. Specialty Wiring Devices.
 - c. Starters.
 - d. Panel boards.
 - e. Safety Switches.
 - f. Transient Voltage Surge Suppression.
 - g. Lighting fixtures and controls.

PART 2 - PRODUCTS

2.01 RACEWAYS

- A. Wiring shall be installed in approved raceways where required by code and be a minimum size of 3/4" for homeruns unless otherwise noted. 1/2" conduit will be permitted for switch and receptacle runs in walls. Conduit or tubing shall be installed in a manner which complies with all applicable provisions of the National Electrical Code.
- B. Ends of conduit or tubing shall terminate in a bushing or fitting having factory installed insulating liners. Provide plastic bushings on conduit or tubing with wire larger than #4 AWG. Exposed runs shall be supported by hangers, clamps, or straps secured by toggle bolts in hollow construction or expansion bolts or inserts in poured or brick walls.
- C. Every precaution shall be taken to protect the conduit from damage and from water, dirt, concrete, etc., getting into the system during construction. Capped bushings shall be used on conduit terminations until wire is installed. If, in the opinion of the Engineer, conduit or tubing has become damaged or contains unremovable foreign matter, it shall be replaced at the Contractor's expense. Aluminum conduit is not acceptable in this contract.

- D. Intermediate metallic conduit (IMC) shall be hot dipped galvanized steel, and shall be used on all runs above 2-1/2" unless otherwise noted. Intermediate metallic conduit may be used in all poured construction, fill, outside masonry walls, areas exposed to weather, under drives and walks, and in areas where tubing may become damaged.
- E. Cast and threaded fittings for IMC shall be used on exposed conduit installed on walls below 8'-0" and on conduit exposed to weather.
- F. Plastic conduit shall be high strength smooth inner with polyvinyl chloride, heavywall type equal to Carlon Schedule 40 for use as direct burial without concrete encasement, except as required by code. Couplings shall be the solvent welded type. Circuits run in PVC conduit require a separate grounding conductor.
- G. Electric-metallic-tubing (thinwall conduit) shall be standard weight with manufacturer's name and Underwriters' Label on each length. Maximum permissible size tubing shall be 2-1/2".
- H. Tubing may be used for feeders and branch circuits above suspended accessible ceilings; for switch and receptacle legs which terminate above suspended accessible ceilings and for exposed feeders and branch circuits.
- I. Metal conduit and EMT fittings should be galvanized malleable iron, steel, aluminum, or zinc die-cast. Connectors and couplings shall be threaded, set-screw, or compression type, and concrete-tight and/or rain-tight where required. Conduit bodies shall be malleable iron or aluminum cover gaskets exposed to weather.
 - 1. Expansion Fittings: cast or malleable iron bodies, with threaded end caps for receiving fixed and moveable conduits, metallic pressure packing, and copper bonding jumper assembly. Fittings shall provide for minimum 2" of movement of conduit in either direction. Fittings shall be Appleton type "XJ" or similar fittings by another approved manufacturer.
 - 2. Expansion-Deflection Fittings: neoprene sleeve secured to silicon bronze threaded couplings by means of stainless steel bands. Fitting shall be designed to provide for movement of not less than 3/4" from normal in all directions and shall be complete with tinned flexible copper braid bonding jumper protected by neoprene sleeve and securely bolted to couplings for grounding continuity through joint. Fittings shall be O.Z./Gedney Electric Company, type "DX" or similar fittings by another approved manufacturer.
 - 3. Locknuts: malleable iron or steel. Bushings shall be malleable iron or steel, or plastic. Malleable iron or steel bushings shall be zinc or cadmium plated and shall have insulating insert of thermosetting plastic molded and locked into bushing ring. Plastic bushings shall be thermosetting phenolic insulating type conforming to Federal Specification W-F-406 and Amendment 6. Use of non-rigid plastic bushings is prohibited.
- J. Flexible metal conduit shall be used for connections to the following equipment: Motors and mechanical equipment. Maximum length of flexible metallic conduit shall be 6'-0". Minimum size shall be 1/2". Flexible metal conduit used for lighting fixture connections shall be "Greenfield" type. Fittings shall be insulated throat, flex-steel connectors. Flexible metal conduit used for equipment other than lighting fixtures shall be similar to "Greenfield" except jacketed with a plastic outer cover and terminated with appropriate factory-installed fittings, UL Labeled.
- K. Flexible metallic conduit shall have separate grounding conductor.
- L. Space around conduits at wall penetrations shall be filled with mortar, or other approved filler, maintaining the rating of wall/ceiling construction as required.

2.02 WIRES AND CABLES

- A. Wiring:

1. Shall be THHN stranded copper, single conductor, and shall be installed in conduit or tubing unless specified otherwise (areas required: garage, mechanical & electrical rooms and exterior).
 2. May be aluminum SER cable, single conductor, and shall be installed in conduit or tubing unless specified otherwise (areas required: garage, mechanical & electrical rooms and exterior). Primary feeders and sub-panel feeders only.
- B. Romex shall be acceptable in wood frame construction as directed by NEC.
- C. M.C. Cable shall be acceptable in steel stud construction as directed by NEC.
- D. Conductors shall be continuous between outlets or junction boxes with splice made only within such boxes.
- E. No wire smaller than #12 may be used unless specified under descriptions of special systems. Control wiring may be #14 AWG or smaller as indicated, and shall be stranded.
- E. Cables for smoke detection systems or for use in plenums without conduit shall be UL listed, UL Style 1330, meeting ASTM D-2116 and ICEA color codes.
- F. Wire for general interior, exterior, and control use, sizes #14 AWG through 500 MCM, shall be single conductor, insulated for a minimum of 75 degrees C, THHN, THWN, or XHHW, elsewhere, and be rated 600 volts. Where required ampacities can only be satisfied by conductor sizes larger than 500 MCM, parallel conductors shall be used.
- G. Wire for final connection at HID and incandescent lighting fixture sockets shall be NEC type SF-2 fixture wire rated 200 degrees C, 600 volts.
- H. Wire for use in fluorescent fixture wiring channels shall conform to NEC Types THHN or XHHW, rated 90 degrees C, 600 volts.
- I. Ground wire for interior use shall be green insulated, stranded copper. and shall meet requirements of wire for general interior use.
- J. Branch circuit wiring shall be color coded, red, black, blue for phase wiring, and white neutral. Bonding conductors shall be green or bare. Phase color coding shall be consistent throughout the entire branch circuit system.
- K. All neutral runs including feeders shall be white full length of conductor.

2.03 WIRE CONNECTORS AND JOINTS

- A. Conductors #6 AWG and smaller shall be joined with electrical spring connectors with vinyl insulating cap. Conductors larger than #6 shall be joined by compression type connectors.

2.04 OUTLET BOXES

- A. A standard galvanized or plastic outlet box shall be installed for each and every outlet shown.
- B. Set boxes squarely with faces flush to finished surfaces. The exact location of all outlets shall be approved by the Architect/Engineer before same are placed and Contractor shall consult Architect/Engineer at all times relative to the location of outlets. No outlets shall be placed behind plumbing or heating pipes or where they will interfere with ducts, pipes, equipment, or other work. Outlets not located in accordance with these instructions shall be relocated when so directed by the Architect or General Contractor by this Contractor at his expense including cost of any cutting and patching the work of other trades as may be required by such relocation.

- C. Each outlet shall be rigidly supported from the building construction (independent of the raceway system).
- D. Ceiling outlet boxes shall be 4" octagon, minimum 1-1/2" deep, with fixture hickey, and supported to withstand 80 pounds.
- E. Convenience outlet and switch boxes shall be a minimum of 2-1/8" deep. When installed in poured walls, 2-1/2" minimum deep box shall be used; when installed in masonry, 3-1/2" minimum deep box shall be used.

2.05 JUNCTION BOXES AND PULL BOXES

- A. When used, pull boxes and junction boxes shall be galvanized and have flat steel covers fastened with screws and set flush with the finished surface and located in an accessible area. When installed in damp locations, gaskets and seals shall be provided. Junction boxes shall be sized to meet N.E.C. Standards based on conduit and conductors. Provide identifying labels on each box.

2.06 WIRING DEVICES

A. Receptacles

- 1. Receptacles shall be mounted approximately 1'-4" above floor to bottom or at other heights indicated on Drawings.
- 2. Contractor shall be responsible for masking receptacles for protection from painting, plastering, etc.
- 3. Receptacles shall be commercial specification grade as manufactured by Hubbell, Leviton, or General Electric.
 - a. 20 Amp, 125 Volt, duplex, ground fault, (NEMA 5-20R), Hubbell GF-5352-W series, with #CWP26H outdoor weatherproof cover for exterior use.
 - b. 20 Amp, 125 Volt, duplex (NEMA 5-20R), Hubbell CBR20W series.
 - c. 20 Amp, 125 Volt, duplex with isolated ground (NEMA 5-20R), Hubbell IG5362 series.
 - d. 30 Amp, 125/250 Volt (NEMA 10-30R), Hubbell 9350 series.
 - e. 50 Amp, 125/250 Volt (NEMA 10-50R), Hubbell 7962 series.

NOTE: GFCI receptacles must meet UL 2003 Standards.

B. Wall Switches

- 1. Wall switches shall be mounted approximately 4'-0" above floor to top unless they interfere with wainscoting or trim. Switches shall be commercial specification grade, totally enclosed molded composition, silent type, spring action silver contacts, and rated at 120/277 volts A.C. Switches shall be binding screw type, side and back wired type.
- 2. Contractor shall be responsible for masking switches for protection from painting, plastering, etc.
- 3. Contractor shall confirm door swings with Building Trades Contractor before installing switches.
- 4. Switches shall be rated at 20 Amp, white in color, Hubbell CSB120 series, Leviton, or General Electric., or P & S switches of equivalent grade or as noted on construction drawings. Switches shall be single pole, double pole, three-way, keyed (master), or other type as indicated.

C. Wall Plates

1. Wall plates shall be installed plumb and level with all edges in contact with attaching surface. **Plates shall be brushed smooth stainless steel.** Provide blank cover plates for all data and telephone outlet boxes shown on plans. Plates used on exposed surface mounted outlets shall be the raised pressed metal type, stainless steel finish, to accommodate the device and cover the outlet box, without fillers of any kind. Mounting screws shall be metal with same finish as plate and with countersunk head. Plates shall be single, ganged, or combination, to accommodate arrangement indicated on drawings. Arrow-Hart, Leviton, General Electric, Hubbell, or P & S plates of equivalent grade will be acceptable.

2.07 SPECIALTY WIRING DEVICES

A. Thermostat/Sensors:

For each of the thermostats/sensors shown, a single gang box with a 1/2" conduit in new areas, or a single gang box with wiremold (to match existing) in existing areas, stubbed to the unit being controlled. Up to accessible ceiling or from controller to unit in non-accessible ceilings. Box mounted at 44" A.F.F.

B. Smoke Sensors for HVAC units 2000 cfm or more (Reference Mech. Plans):

It shall be required that the E.C. provide and install the necessary code required alarming/signaling equipment as related to the smoke sensors for HVAC units 2000 Cfm or more.

2.08 MAGNETIC STARTERS - COMBINATION TYPE; THREE-PHASE MOTORS

- A. In general, the magnetic starters shall be of the minimum NEMA 0, combination type consisting of a circuit protective device, switch and fuse type, and a NEMA size starter as required. Circuit protective device shall be a fused type "A" safety switch. The motor starter shall comprise of NEMA size contactors, overload relays, heaters, interlocks, etc. The hinged cover shall be so interlocked that it may not be opened when the switch is in the "ON" position, except that the interlock shall be tool-releasable by a qualified person. Starters shall have provisions for padlock. The motor starter shall include phase loss and phase unbalance protection, or auxiliary devices shall be installed to accommodate these types of protection.
- B. Each combination starter unit shall be furnished with HAND-OFF-AUTO selector switch, green running light, and with individual control transformers, with fused secondary, rated 120 volts. Starters shall be supplied with two N.O. contact.
- C. Starters shall be by Square D. General Electric or Cutler Hammer maybe bid as alternates.

2.10 SINGLE PHASE MOTOR STARTERS

- A. Manual starters for fractional horsepower single phase motors shall be single or double pole with pilot lights and thermal overload relay elements. Enclosure shall be NEMA 1, surface or flush mounted as indicated with provision for padlocking unless described otherwise on drawings. Thermal overload elements shall be sized on basis of motor rating and starter manufacturer's instructions. Units shall be General Electric "Type CR-101," Square D "Class 2510," or Cutler Hammer.

2.11 FUSESTATS

- A. Fusestats shall provide overload protection and may be used for permanently wired motors rated up to 1/2 HP, 125 Volt A.C. only.
- B. Fusestat base shall be constructed of pre-galvanized steel plate with a hood of galvanized steel and fit on a standard double gang 4" square box.

- C. Fusestat shall consist of a fused outlet and switch and be by Steel City, Catalog No. F8-S, or equal by other approved manufacturer.

2.12 PANELBOARDS

- A. Panelboards shall be of the circuit breaker type with main lugs or main breaker as indicated on Drawings. Use full size plug-in/bolt-on type branch circuit breakers (tandem type are not permitted). Branch circuit breakers shall be rated a minimum 10,000 amperes interrupting capacity symmetrical. The capacity shall be determined by the job conditions. It is the installing contractor's responsibility to guaranty that the requirements are met.
- B. Branch circuit panelboards shall be Square "D" type QO 'Load Center', NQOD, NF, I-line. General Electric or Cutler Hammer, may submit voluntary alternates of equal quality. All panels shall meet Federal Specifications W-P-115A.

2.13 FUSES

- A. Fuses 600 Amperes and Less: Dual element, current limiting, time delay, one-time fuse, 250 or 600 volt as required, UL Class J.
- B. Interrupting Rating: 200,000 rms amperes.

2.14 SAFETY SWITCHES

- A. Furnish and install required safety switches.
- B. Safety switches shall be NEMA heavy duty type "HD", fusible or non-fusible as indicated, and Underwriter's Laboratory approved. Switches shall be furnished in NEMA-1 enclosures unless otherwise shown on drawings. Weatherproof switches shall be NEMA-3R (raintight).
- C. Switches shall be Square D, or equal by General Electric or Cutler Hammer.

2.15 SUPPORTS AND HANGERS

- A. Provide and install necessary steel brackets, rods, clamps, etc., for support of work under this contract. Supports shall be plated or painted and shall be secured to structural members after Architect's approval.

2.16 SLEEVES AND INSERTS

- A. This Contractor shall be responsible for the proper location on all sleeves, chases, openings and inserts for the installation of his equipment.
- B. Holes through walls, floors, or structural members for electrical conduit and equipment shall be drilled in a work-like manner and be located only where permitted by the Architect or Engineer.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Conduits shall be cut, bent, joined, and installed per manufacturer's instructions, U.L. General Information, and the N.E.C.
- B. Outdoor and underground encased coupling and conduit threads shall be treated with mastic or similar compound to prevent entry of water.

3.02 INSTALLATION METHODS

- A. Conduit runs shall be placed neatly and orderly at parallel or perpendicular lines to building walls.
- B. Conduit runs parallel to or crossing uninsulated hot water or steam pipes shall be separated from same by 12" if parallel, or 7" if crossing. Where hot water or steam pipe lines are insulated, conduit shall clear insulation surface by 2". Conduits shall not be installed directly under cold water pipes.
- C. No more than two concealed conduits shall cross over at same point in a poured slab.
- D. Conduit and pull boxes shall be installed mechanically secure to permit pulling in or pulling out of cable proposed for same. Double locknuts and bushing shall be used for termination of conduit at boxes and equipment.
- E. Joints of conduits shall be tight, low resistance connections.
- F. **A #6 pullcord shall be provided for new empty conduits.** Pullcord shall be wax impregnated, nylon, or other synthetic material resistant to moisture and mildew to prevent deterioration.

3.03 FAULT CURRENT REQUIREMENTS

- A. Every effort shall be made by the installing contractor to guaranty that all distribution panels, panelboards and safety switches will be able to safely clear (interrupt) the amount of short circuit amps that could flow on a bolted phase to phase fault.
- B. All stated fault currents within the bid documents shall be verified to be correct by the installing contractor.
- C. If an error is found in the fault current stated, the contractor shall install the proper devices to maintain required levels.

END OF SECTION

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PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Applicable provisions of Bidding Requirements, Project Guidelines and General Requirements (Division 1) apply to the work specified in this Section.

1.02 DESCRIPTION

A. Work Included:

- 1. This Section includes all labor, materials, equipment, tools, supervision, start-up services and Owner's instructions, including all incidental and related items necessary to complete installation and successfully test, start-up and operate in a practical and efficient manner all services and distribution work indicated on the drawings.
- 2. In general, this shall include, but not be limited to:
 - a. Temporary Power
 - b. Service
 - c. Distribution

B. Related Work:

- 1. The applicable requirements from other Sections for related work shall form a part of the service and distribution work and this Contractor shall consult them in detail for general and specific requirements.

C. Quality Assurance:

- 1. Qualifications:
 - a. All service and distribution work shall be performed by licensed electricians.
- 2. Installation:
 - a. Installation methods shall conform to manufacturer's standards for each piece or item of equipment.

1.03 TEMPORARY POWER

A. General:

- 1. The Electrical Contractor is to provide temporary construction power facilities throughout the building(s) for his own use and for other use by the various trades. All enclosed rooms shall be equipped with temporary lighting so that work may proceed. Provide power outlets where requested by the various trades. (Note: This shall not be construed as indicating that the Electrical Contractor is to provide any and all voltages at any and all capacities to run heavy power tools, mixers, electric dryers, etc. Normal, 120/208 volt, single-phase power will be provided.) Comply with OSHA Lighting Standard Subpart D, Rule 1926.56(a) and (b). Provide maintenance service for power and lighting facilities, including lamp replacement, during normal working hours.

B. Extensions and/or Extension Cords:

- 1. If any Contractor requires an extension cord, it shall be provided by that Contractor. Should he require lighting or power in addition to that described in A above, he shall provide it in order to complete his own work. Such additional loads must be coordinated with the Electrical

Contractor so that cables and/or circuits are not overloaded.

C. Temporary Connections:

1. The Electrical Contractor shall provide temporary connections for the testing or operation of permanent or temporary motors, pumps, burners, unit heaters or similar units when temporary heat or ventilation is required during construction.

D. Use of Permanent Lighting System:

1. After the installation of the permanent lighting system, it may be used for construction lighting as required. Refer to Section 16500.

E. Codes:

1. Complete temporary power and lighting distribution system shall be in complete accordance with all applicable codes.

1.04 SERVICE

A. New Electrical Service (See Plans):

1. The building shall be fed by a completely new electrical service as herein described and as shown on the drawings.
2. The Electrical Contractor shall furnish and install a new underground secondary service from the transformer to the new main service distribution panel located the Storage Room #105. Refer to drawings for location and One Line Diagram for size and type.
3. The Electrical Contractor shall furnish and install a new 120/208 volt, three-phase, four-wire service entrance main switchboard. This switchboard shall be located in Storage Room #105. Refer to the One Line Diagram for type and size.

1.05 DISTRIBUTION

A. Distribution System:

1. This Contractor shall furnish and install a new distribution system for the building as shown on the drawings and the One Line Diagram.
2. All feeders shall be run continuously without splices, and be type THHN or THWN, unless otherwise noted.

END OF SECTION

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PART 1 - GENERAL

1.01 SCOPE

- A. The grounding system shall be in accordance with the drawings, specifications and with the National Electrical Code, NEMA, USASI and IEEE Standards, latest editions, where these standards apply. The ground bar of the main service disconnect enclosure shall be bonded to water mains, structural steel, and driven ground rods, by grounding electrode conductor, and as indicated on the drawings. Methods in accordance with good accepted practice for this type of work which cover conditions not indicated on the drawings or described in these specifications and which meet with the approval of the Engineer shall be used in order to secure a good substantial and permanent grounding system. Maximum ground resistance to be per N.E.C.
- B. All interconnections, risers, cables, etc. shall be provided and installed for grounding transformers, main switchboard, panelboards and other equipment. Bonding jumpers shall be copper, equal in cross section to the corresponding ground connectors and attached by solder less lugs, compression connections, or clamps. All ground connectors shall have brazed connections, unless otherwise indicated, such as Cadwell, Burndy, Thomas and Betts or equal as approved.
- C. Ground cables shall be protected by sleeves where the cable extends through a concrete surface. Ground inserts shall be used where ground cables extending through the surface would be exposed to mechanical damage during or after construction.
- D. Where ground cables are installed in rigid metal conduit, the cables shall be bonded to the conduit at both ends of the run.
- E. Welds on ground cables shall be cleaned and painted with an asphalt base paint where buried underground or imbedded in concrete.
- F. Miscellaneous and special systems shall be properly grounded in accordance with the requirements of each system.

1.02 BRANCH CIRCUIT GROUND WIRE (NEW CIRCUITS ONLY)

- A. Provide a #12AWG green grounding wire in each conduit in addition to the circuit wires (phase and neutral wires). The grounding wire shall be connected to grounding terminal bars (to be furnished with each distribution panel) in panelboards, and these bars shall be grounded to the system master ground at switchboard.
- B. All equipment, fixtures, receptacles, etc. shall be grounded by means of a separate green ground wire. These wires shall be connected to the respective distribution panel grounding bar, equipped with the required quantity of screw terminals.
- C. All isolated ground receptacles require a separate #12AWG ground wire from the receptacle to the isolated ground bus within the panel.
 - D. Circuits run in PVC conduit will require a separate grounding conductor, provided and installed at no additional cost.
 - E. All isolated ground circuits shall be connected to a separate ground bar. A separate ground conductor shall be installed for the additional ground bar and be grounded by a separate method from the panel grounding bar.

END OF SECTION

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PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. The other Contract Documents complement the requirements of this section. The General Requirements apply to the work of this section.

1.02 QUALITY ASSURANCE

- A. Panelboards shall be UL label and nameplate, and shall conform to latest NEMA and NEC standards.

PART 2 - PRODUCTS

2.01 PANELBOARDS

- A. Panelboards shall be factory assembled and conform to following:
 - 1. Flush or surface mounted galvanized steel cabinet as indicated.
 - 2. Hinged and lockable door with trims on circuit breaker panelboards.
 - 3. Individual hinged and lockable doors on fusible type power distribution panelboards.
 - 4. Locks keyed alike.
 - 5. Manufacturer's standard prime paint and factory finish.
 - 6. Heavy plastic covered typewritten directories.
 - 7. Voltage, phase and capacity as indicated on schedules.
 - 8. Internal assembly of circuit breakers or switch and fuse units as indicated.
 - 9. Circuit breakers and switch and fuse characteristics as specified.
 - 10. Ground fault circuit interrupter type circuit breakers where indicated on the panelboard schedules.
 - 11. Approved terminal grounding bar for general branch circuit equipment grounding conductors.
 - 12. Approved isolated grounding bar for isolated ground receptacle grounding conductors.
 - 13. Interrupting capacity of a minimum 10,000 A.I.C. (amperes rms symmetrical) for branch circuit breakers and a minimum 22,000 A.I.C. for main breakers in distribution or branch panelboards as indicated.
 - 14. Panelboards used for service entrance shall be so labeled and listed for such use and shall have separately barriered provisions for connection of emergency circuit loads. Non-linear load type panels shall be required for designated computer equipment panels.
 - 15. Panelboards shall be by Square D, type QO 'Load Center', NQO, I-Line.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Practice of drilling and tapping or drilling and using self-tapping fasteners in aluminum conductor bars for making electrical or mechanical support connections is prohibited in panelboard construction. Connections may be made by use of through-bolts with lock washers, Belleville washers, steel nuts or steel inserts. Steel helical inserts are not acceptable.

- B. Manufacturers who cannot or prefer not to use such methods, shall provide copper bus bars. Copper shall also be provided where required by local or state ordinances.

END OF SECTION

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PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. The other Contract Documents complement the requirements of this section. The General Requirements apply to the work of this section.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.01 FIELD QUALITY CONTROL

- A. Test all circuits as soon as conductors are installed and make final tests when all work is complete. If circuits are not properly controlled and insulated at time of such final tests, the necessary extra repairs and tests shall be made at the Contractor's expense.
- B. All 240 and 208 volt wiring systems, sizes No. 4 AWG and larger, shall be given an insulation resistance test between conductors and between a single conductor and ground. Resistance shall not be less than 40 megohms. Measurements shall be made with all panelboards, overcurrent devices, etc., in place, and with circuit breakers or disconnect switches in the open position.
- C. Lighting and control wiring shall be tested for shorts or opens and shall be given a complete operational test.
- D. After installation is complete and properly adjusted, the various equipments and systems shall be demonstrated to operate in accordance with the requirements of the drawings and specifications.
- E. Tests, inspections and work shall be performed in the presence of and approved by the Owner's Representative before energizing the system.
- F. Power circuit breaker shall be tested and calibrated with results entered in the forms specified.
- G. Circuit breakers, including those equipped with static trip units, shall be tested by the use of a "Multi-Amp" or similar piece of equipment. Long-time delays shall be tested by placing three times the rated current of the trip unit through the breaker. Instantaneous tripping shall be tested by placing the full value of current through the breaker. Lesser amounts of current with "artificial" tripping will not be permitted.

3.02 FIRE ALARM AND SMOKE DETECTION SYSTEM (For Smoke System as required for Sprinkler sys)

- A. Include services of a manufacturer's certified representative to provide final testing, adjusting, and commissioning and instructing the Owner's Representative in the operation and maintenance of the system as listed herein.
- B. Test heads by using manufacturer's recommended detector tester with halogenated type gas and sensitivity tester when adjustable detectors are used. The manufacturer's certified technician shall evaluate the installation and operation of the system.
- C. Submit eight copies of test and evaluation reports to the Architect/Engineer.
- D. Control wiring shall be tested for shorts or opens and system shall be given a complete operational test.
- E. After installation and adjusting the Smoke Detection System, the various equipment and systems shall be demonstrated to operate in accordance with the requirements of the drawings and

specifications.

- F. The whole system shall be tested and left in operating conditions. Testing shall be performed as directed by the Owner or Owner's Representative. Final test and inspection shall be performed with the Fire Marshall's Representative and Electrical Inspection Bureau Representative and done during Owner's normal working hours.
- G. The Contractor or its representative and the equipment manufacturer's representative shall be present at all inspections and be prepared to perform certain test functions and answer questions related to the equipment.
- H. Noise test shall be performed by the Contractor to ensure that the audible sound is heard everywhere and of a level acceptable to the Fire Marshall's Office. If the Fire Marshall's Office indicates that the sound level is too low from a device, the contractor shall replace the device at no cost to the owner.

END OF SECTION

NOTE: THESE SPECIFICATIONS ARE THE PROPERTY OF THE ENGINEER AND ARE NOT TO BE REUSED OR REPRODUCED WITHOUT WRITTEN PERMISSION. THIS SPECIFICATION IS COPYWRITTEN.