BOOTHBAY HARBOR SEWER DISTRICT

WASTEWATER COLLECTION SYSTEM SPECIFICATIONS

2004 Edition

Approved by BBHSD Board of Trustees June 1, 2004

PREFACE

This technical manual is provided by the Boothbay Harbor Sewer District for use by Developers and Contractors for design and construction of sanitary sewers and appurtenances within the District's service area. These standards must be followed in design development and construction. Use of this document for any other purpose other than preparation of plans for submittal to the Boothbay Harbor Sewer District or for construction of sanitary sewers in the District's service area is forbidden.

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SECTION 1

GENERAL INSTRUCTIONS

1.0 DEFINITIONS: Wherever in these Specifications the following words, terms and expressions, or pronouns in place of them are used, the intent and meaning shall be interpreted as follows:

A. BBHSD: Boothbay Harbor Sewer District including any agent, officer or employee duly authorized to act for the said party in the execution of the work required by the Contract.

B. Completion Certificate: The certificate of the Engineer or BBHSD Inspector indicating the completion and acceptance of all work specified and performed under the Contract.

C. Contract: The written agreement executed by and between the Developer and the Contractor, or the BBHSD and the Contractor, covering the performance of the work and the furnishing of labor, materials and service in the construction of sewer extensions or sewer replacement to the Boothbay Harbor Sewer District Wastewater Collection System.

D. Contractor: The corporation, partnership, or individual utilized to construct sanitary sewer system or party hired by the Developer to construct sanitary sewer system, acting directly or through his authorized lawful agents, legal representatives, superintendents, or employees, appointed to act for said party in the performance of the work under contract.

E. Developer: For new Subdivisions, the corporation, partnership, or individual intending to develop for residential or other purposes a certain tract of land situated within the sewer franchise area of the BBHSD, acting directly or through any authorized lawful agents, legal representatives or employees appointed to act for said party in the execution of the work of the Contract.

F. Drawings or Plans: Collectively, all of the drawings or plans (or reproductions of them) pertaining to the construction of the project and attached to the Contract or otherwise made a part thereof; and also such supplementary drawings as may be issued from time to time in order to elucidate or clarify said Contract Drawings, or for showing details which are not shown thereon.

G. Engineer: The person or organization duly employed by the BBHSD as consultant and authorized to inspect the results of the performance of the work under Contract by the Contractor, acting directly or through properly authorized agents, engineers, assistants, inspectors, or other representatives acting severally within

the scope of the particular duties entrusted to them. The word "Engineer" shall include the officers, agents and employees of the Engineer. In cases where the BBHSD does not employ a consultant, the word "BBHSD" is substituted for "Engineer" throughout these Specifications.

H. Inspection: The examination of the work performed by the Contractor to ascertain its conformity with the Specifications. May also be referred to as Construction Observation.

I. Project: All the necessary performance, services and materials required for the satisfactory completion of the work under Contract as described in the Specifications and indicated on the Drawings.

J. Specifications: Collectively, all of the definitions, descriptions, directions, provisions, requirements, terms and stipulations contained in these Standard Specifications; and all written supplements thereto, made or to be made, pertaining to the Contract, and the materials and workmanship to be furnished under the Contract.

J. Subcontractor: A person, firm or corporation having a direct contact with the Contractor to perform part of the latter's contract; such as one who installs or furnishes and installs equipment forming a permanent part of the Contract work, or who furnishes labor for work required by the Contract in accordance with the Plans and Specifications. This term does not include individual workmen furnishing labor only, nor one who merely furnished material not worked to a special design.

K. Warranty Period: An 12 month time period beginning with the BBHSD's issuance of certificate of final acceptance.

L. AASHTO: American Association of State Highway and Transportation Officials.

M. ACI: American Concrete Institute.

N. AISC: American Institute of Steel Construction.

O. ANSI: American National Standards Institute.

P. ASTM: American Society of Testing Materials.

Q. Fed. Spec: Federal Specifications, United States Government.

R. "Approved", etc. The words "approved", acceptable", "satisfactory", or words of like import, shall mean approved by, or acceptable, or satisfactory, to the Engineer, unless another meaning is plainly intended or otherwise specifically stated.

1.2 DRAWINGS AND SPECIFICATIONS

A. The Drawings and Specifications are complimentary, and the requirements of any one shall be considered as the requirements of all.

B. The Specifications in this document are written as if they were included in the Contract Documents executed by and between the Developer and the Contractor and/or BBHSD and Contractor. Whether they are so used is at the discretion of the Developer; however, the Authority will not accept the sanitary sewer extensions provided by the Developer or Contractor unless and until they conform to the requirements of these Standard Specifications.

C. All drawings or plans pertaining to the Project (the Contract Drawings) are to be submitted by the Developer to the BBHSD for review. After review of these Contract Drawings by the BBHSD, the Developer shall make any corrections required, and submit corrected copies thereof to the BBHSD. The BBHSD's approval of the Contract Drawings shall not relieve the Developer from responsibility for errors or discrepancies in such drawings. All Contract Drawings shall be prepared and submitted in conformance with the requirements set forth in Section 01300.

Deviations from the Drawings or Specifications required by the exigencies of construction will be determined by the Engineer only, and authorized in writing.

D. At all times the Contractor shall keep on the Project, available to the Engineer and his representatives, one (1) copy of the Drawings, and Specifications.

1.3 PRELIMINARY INSPECTION

A. Unless the requirement is waived by the Engineer prior to the start of actual construction operations, the Contractor, or his authorized representative, shall go over the Project accompanied by the Engineer, or his designated representative, and shall observe for himself/herself, with the approved Drawings before him/her, all pertinent conditions relative to the Contract, including the status of rights-of-way and structures, obstructions, or other objects to be removed, altered and changed.

1.4 WORKING CONDITIONS

A. No work shall be done without the Engineer's presence, unless previous written arrangements have been made with the Authority.

B. Any request for inspectors other than normal working hours must be put in writing 48 hours prior to time needed; The availability of an Inspector is not guaranteed!

1. Normal working hours are considered to be between 7am and 4 pm.

1.5 MATERIALS

A. The Contractor shall furnish the Engineer, promptly after the award or execution of the Contract, with a complete statement of the origin, composition, and manufacture of all materials to be used in the construction of the Project. Only materials conforming to the requirements of these Specifications and approved by the Engineer shall be used in the work.

B. Representative preliminary samples of the materials, of the character and quality prescribed in the Contract shall be submitted when indicated or directed, for advance examination or test. Written approval of the quality of such samples shall be received by the Contractor prior to obtaining materials from the respective sources of supply.

C. Samples of all materials requiring laboratory tests shall be taken under the direction or supervision of, or in the manner prescribed by the Engineer. Such materials shall not be used until accepted as the result of such tests. Materials will be used only so long as the quality of the material remains equal to that of the accepted sample. The acceptance at any time of any material shall not be a bar to its future rejection, if it is subsequently found to be defective or inferior in quality to the material specified.

D. Required laboratory tests of materials shall be made by a testing laboratory or agency selected or approved by the Engineer and in accordance with the methods indicated herein. When standard Specifications and serial numbers of technical societies and associations are stipulated, the reference shall be construed to be the latest of such Specifications and serial numbers.

E. Contractor shall furnish all labor, materials, and equipment necessary for collecting, packaging and identifying, representative samples of materials, and the shipping of such samples to the testing laboratory.

F. For tests or inspections conducted by, and at the options of, the Engineer, at sites other than the testing laboratory and not under the jurisdiction thereof, the Contractor shall furnish or arrange with the producer to furnish all material, labor, tools, and equipment, and every facility for the verification of the accuracy of all scales, measures and testing equipment, necessary for such tests or inspections.

G. The Contractor shall permit or arrange with the producer to permit the Engineer or any agent of the testing laboratory to inspect or test any and all material being used or to be used, at any time before, during or after its preparation, or while being used during the progress of the work or after its preparation, or while being

used during the progress of the work or after the work has been completed.

H. Materials shall be stored so as to insure preservation of their specified quality and fitness for the work. When considered necessary they shall be placed on wooden platforms or other hard and clean surfaces, and not on the ground, and shall be placed under cover when directed. Stored materials shall be located so as to facilitate prompt inspection. Private property shall not be used for storage purposes without permission of the owner or lessee of the property, unless written permission is received from Owner and a copy provided BBHSD.

I. If any material intended for use in the construction of the Project has been inspected and rejected after such material has been delivered to the Site, the Contractor shall immediately remove all such rejected material from the property.

1.6 ADVERTISING

A. No advertising will be permitted on any part of buildings, scaffolding, fences, materials, obstructions, barricades or work.

1.7 PERMITS AND LICENSES

A. With the exception of the MeDOT Highway Occupancy Permit, if applicable, the Contractor or Developer shall, unless otherwise specified, procure all necessary permits and licenses, pay all charges and fees, and shall give all notices necessary and incident to the proper and lawful prosecution of the work. The Developer or Contractor shall pay any fees and charges associated with the Highway Occupancy Permit.

B. The MeDOT Highway Occupancy Permit applications shall be prepared by the Developer in the name of the BBHSD and submitted to the BBHSD along with the application fees. After review of the applications by the BBHSD, the Developer shall make any corrections, if required, and submit corrected copies to the BBHSD. The BBHSD will forward the applications and fees to the Maine Department of Transportation.

C. Payment for personnel from State Agencies, as required to be on hand during the construction of work on Highways under their jurisdiction, shall be borne by the Contractor or Developer.

D. Where work is to be done by the Contractor, in placing any pipe or other construction under railroad tracks, within the right-of-way of any railroad company, the Contractor shall be governed by the requirements of the railroad company involved, and shall consult with the officials thereof relative to the installation. If the railroad company requires any of their personnel to be on hand during the construction of the work, payment for such personnel shall be borne by

the Contractor or Developer.

1.8 CARE OF PUBLIC AND PRIVATE PROPERTY.

A. The Contractor shall take all necessary precaution to prevent damage to all overhead and underground structures and to protect and preserve property within or adjacent to the Project and shall be responsible for damage thereto. Special care must be used by the Contractor in the prosecution of the work in order to avoid interference or damage to any operating utilities or plants; however, where there is any possibility of such interference or damage, the Contractor shall make satisfactory arrangements with responsible officers or with the owners of the utilities or plants, covering the necessary precautions to be used as safeguards during the performance of the work by the Contractor. Such arrangement shall be made before the work is started and shall be subject to the approval of the Engineer, which approval will not be considered as releasing the Contractor from any responsibility for the acts of himself or his employees or representatives. The Contractor shall protect all land monuments and property markers that will be affected by the construction until they have been correctly referenced. Contractor when directed shall, satisfactorily reset monuments and markers that are disturbed by the Contractor during the construction of the Project or otherwise.

B. If the sewer lines cross telephone, telegraph, electric, television cables, gas, oil or water lines, no excavation or pipe laying shall be done at those crossings without the presence of an authorized representative from the office of the authority having jurisdiction.

1.9 SAFETY REQUIREMENTS

A. The Contractor is responsible for all site safety.

B. If, and when the use of explosives is necessary for the prosecution of the work, the Contractor shall store and use in strict conformity to all State and local laws and regulations.

C. Observance of, and compliance with, said regulations shall be solely and without qualification, the responsibility of the Contractor, without any responsibility whatsoever on the part of the BBHSD or Engineer. The duty of enforcing such laws and regulations lies with the said Department, not with the BBHSD or Engineer.

1.10 REGULATIONS AND REQUIREMENTS OF THE DEPARTMENT OF ENVIRONMENTAL PROTECTION

A. The Contractor and the Developer are advised that they will be required to design and conduct their work in compliance with the rules, regulations and requirements of the Maine Department of Environmental Protection.

1.11 OBSERVANCE OF LAWS AND REGULATIONS

A. The Contractor at all times shall observe and comply with all Federal and State laws and regulations, and local bylaws, ordinances and regulations in any manner affecting the conduct of the work or applying to employees on the Project, as well as all safety precautions and orders or decrees which have been promulgated or enacted, or which may be promulgated or enacted, by any legal bodies or tribunals having authority or jurisdiction over the work, materials, equipment, employees or the Contract; such observance and compliance shall be solely and without reliance on superintendence or direction by the BBHSD or Engineer.

1.12 ENGINEER'S DUTIES, EXAMINATION AND INSPECTION

A. The work shall at all times be subject to the examination and inspection of the Engineer, BBHSD or its authorized employees, who shall have free access to the work, and be furnished by the Contractor with every reasonable facility for examination of the work, to the extent of uncovering, testing or removing finished portions thereof. The Contractor shall provide all labor and equipment necessary for such examinations. The Engineer may require the Contractor to uncover for examination, or to remove any work done or placed in violation or disregard of instructions issued to the Contractor by the Engineer or his representative.

B. The Engineer and its assistants are the representatives of the BBHSD during the construction of the work. When so authorized by the BBHSD, it shall be the duty of the Engineer to see that all materials and work are properly inspected and that all such materials and work conform fully to the requirements of the Specifications. The Engineer shall perform such other duties as may be defined assigned him from time to time and shall have such additional authority as may be defined elsewhere in these General Instructions. The Engineer shall in no case act as foreman or perform other duties for the Contractor nor interfere with the management of the work by the Contractor.

C. All inspections and tests shall be performed without unnecessarily delaying the work. All material and workmanship, if not otherwise designated by the Specifications shall be subject to inspection, examination and test by the Engineer or his duly authorized representatives. The Engineer shall have the right to reject defective material or workmanship, or require its correction. Rejected workmanship shall be satisfactorily replaced with proper material and the Contractor shall promptly segregate and remove rejected material from the premises. If the Specifications, the Engineer's instructions, laws, ordinances, or any public authority require the work to be specially tested or approved, the Contractor shall give the Engineer three working days notice of its readiness for inspection.

D. The Engineer shall, within a reasonable time after presentation to it, determine all

questions in relation to the construction of the Project, and in all cases decide every question that may arise relative to the performance of the work covered by the Contract.

E. The Engineer shall have full authority to decide all questions that may arise under the Contract relative to the quality and acceptability of materials furnished and the manner, rate of progress, quality and acceptability of work performed, and the interpretation of any or all Plans and Specifications.

F. Any verbal opinion or suggestion that the Engineer may give the Contractor shall in no way be construed as binding the BBHSD in any way.

G. In case of any dispute relative to the quality of materials or work, the Engineer shall have authority to reject materials and to suspend the work. He shall not be authorized to revoke, alter, enlarge, relax or release any requirements of the Specifications, nor to approve or accept any portion of the work, or issue instructions contrary to the Specifications.

1.13 DEFECTIVE WORK

A. When any material not conforming to the requirements of the Specifications and Drawings, has been delivered upon the Site of the Project, or incorporated in the work, or when any work performed is of inferior quality, such material or work shall be considered as defective and shall be immediately removed and renewed or made satisfactory as directed by the Engineer. Failure or neglect on the part of the Engineer to condemn or reject any bad or inferior work or materials, shall not be construed as to imply an acceptance of such work or materials, if such bad or inferior material or work becomes evident at any time prior to the delivery of the Completion Certificate by the BBHSD to the Developer.

B. The Contractor shall remove any work or material condemned, and shall rebuild and replace the same.

C. The Contractor shall promptly move from the premises all materials condemned by the Engineer as failing to conform to the Specifications, whether incorporated in the structure or not, and the Contractor shall promptly replace its own work in accordance with the Contract.

1.14 NOTICE

A. The service of any notice, by the BBHSD or Engineer to the Developer or Contractor, shall be considered accomplished upon completion or any one of the following procedures.

1. When delivered, in writing, to the person in charge of the office used by the addressee to conduct business;

2. When delivered, in writing, to the addressee or any of its authorized agents in person;

   When delivered, in writing, to the addressee or any of its agents at the office used by the addressee to conduct the business of the Contractor at or near the Site of the work;

3. When deposited in the United States Mail, postpaid, and addressed to the party intended for such service at its office used for conducting the business of the Contract at the Site of the work, or its last known place of business.

1.15 ENGINEERING STAKES

A. The Contractor shall furnish, set and maintain suitable stakes, grade boards, temporary structures, templates, and other materials for establishing and maintaining points, marks, and lines. The Contractor shall be held responsible for the preservation of all stakes and marks.

1.16 ITEMS REQUIRED PRIOR TO BEGINNING CONSTRUCTION

A. Wastewater Contract
B. Approved Erosion Control Plan.
C. Security Capacity Agreement.
D. MeDOT Highway Occupancy Permit if needed.
E. 10 day notice letter indicating Contractor intends to start work.
F. Pre-Construction meeting
G. Sewer Connection Permit(s) issued prior to building permit, applicable to the Project.
H. Evidence of approved Preliminary Plans or recorded Final Plans if applicable.
I. Financial security as specified by the BBHSD to assure completion of the sewer extension.
J. Receipt of a letter from the Developer stating the name of the Contractor who will be installing the sanitary sewer extension, when applicable.
K. A list of suppliers for the materials to be used in the sanitary sewer construction.
L. Shop drawings of manhole bases, manhole risers, manhole frames and covers, pipe and other necessary construction materials approved by the BBHSD.
M. Certification from the pipe manufacturer that the pipe meets or exceeds the requirements of the BBHSD to proceed with construction.

1.17 PROTECTION OF WATER SUPPLIES

A. Water Supply Interconnection: There shall be no physical connections between a public or private potable water supply system and a wastewater system, or appurtenance thereto which would permit the passage of any wastewater or polluted water into the potable supply. No water pipe shall pass through or come in contact with any part of a gravity wastewater line or manhole.

B. Relation to Waterworks Structures: While no general statement can be made to cover all conditions, it is generally recognized that wastewater shall meet the requirements of the appropriate reviewing agency with respect to minimum distances from public water supply wells or other water supply sources and structures.

C. Relation to Water Mains:

Horizontal Separation: Wastewater lines shall be laid at least ten (10') feet horizontally from any existing or proposed water main. The distance shall be measured edge to edge. In cases where it is not practical to maintain a ten foot separation, the appropriate reviewing agency may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the wastewater line closer to a water main, provided that the water main is in a separate trench or on an undisturbed earth shelf located on one side of the wastewater line and at an elevation so the bottom of the water main is at least eighteen (18") inches above the top of the wastewater line and at least five (5’) feet horizontally from the wastewater line. The above requirements apply to either gravity wastewater or force mains.

Crossing: Wastewater lines crossing water mains shall be laid to provide a minimum vertical distance of eighteen (18") inches between the outside of the water main and the outside of the wastewater line. This shall be the case where the water main is either above or below the wastewater line. The above requirements apply to all gravity wastewater mains or service laterals and force mains.

The crossing shall be arranged so that the wastewater line joints shall be equidistant and as far as possible from the water main joints. Where a water main crosses under a wastewater line, adequate structural support shall be provided for the wastewater line to prevent damage to the water main.

Special Conditions: When it is impossible to obtain proper horizontal and vertical separation as stipulated above, the wastewater line shall be designed and constructed as follows:

1. Maximize the distances between the wastewater lines and the potable water mains and the joints of each;

2. The pipe materials shall be equal to water pipe and shall be pressure tested to assure water tightness prior to backfilling;
3. Allow enough distance to make repairs to one of the lines without damaging the other.

1.18 SERVICE LATERALS AND WYES

A. Service Laterals:

Service laterals shall be installed where required to provide a connection from the gravity wastewater line to all lots. Wastewater service laterals shall terminate at the property line, unless otherwise directed. Service lines to houses shall be four (4") inch schedule 35 minimums. If less than eighteen (18") inches of cover is provided underneath driveways or storm drains, or if less than thirty-six (36") inches of cover is provided underneath drainage ditches or swales, service lines shall be ductile iron pipe (DIP) and insulated. Transition from PVC to DIP shall be made with gasketed, PVC slip-on transition or MJ couplings. Fernco Couplings are not approved.

Service laterals from the main to the property line shall consist of 6" diameter DIP or SDR 35 PVC and conform to the requirements of these specifications. A service wye shall be installed at the end of each service lateral and plugged in a manner to allow for air testing. The depth of a service shall be a minimum of thirty-six (36") inches below finished grade, and a maximum of sixty (60") inches. Service laterals must be provided with cleanouts spaced not more than eighty (80') feet apart. Vertical stacks shall be provided for service connections and shall be terminated with a cleanout, installed at finish grade level.

Service laterals shall not be connected at manholes whenever possible. Where services must enter manholes, they must be at a height of two (2') feet or more above the main line, an inside drop shall be brought down to the bench.

1.19 WYES:

A. Wye branches shall be installed in gravity wastewater lines as required. If such branches are not used immediately they shall be capped as specified by the manufacturer.
B. If the work consists of the construction of a wastewater line that is to replace an existing wastewater line, all of the existing service lines shall be connected to the new line by a method approved by BBHSD prior to construction.
C. Wyes shall be installed in gravity wastewater line so as to properly serve each existing house and each vacant lot facing or abutting the street or alley in which the wastewater line is being laid, and at such other locations as may be designated by BBHSD. The Engineer, before backfilling, shall determine the exact location of each connection.
D. Wyes shall be of the same material and strength as the main line on which they are installed.

E. Marking and Protecting Wyes and Service Laterals:

1. Location of wyes and ends of service laterals shall be shown on As-Built Drawings and on individual service location forms.

2. The location of the ends of all wyes and service laterals shall be marked and protected. All service lateral stacks shall be protected from damage by the installing the service cleanout stack immediately below grade. Service wyes shall have plugs and stacks secured so as to withstand low-pressure air test (max. 9.0 psig).

END OF SECTION

SECTION SC-1

GENERAL

A. DIVISIONS AND SECTIONS

For the convenience and reference, the Specifications are separated into the titled Divisions and Sections. Such separations shall not, however, operate to make the Owner or the Engineer an arbiter to establish limits to the contracts between the Contractor and Sub-contractor.

B. COPIES OF THE CONTRACT

In addition to Contract Documents furnished tot he Contractor by the Owner for the Contractor's use during construction, there shall be at least three (3) executed copies of the Contract Documents to be distributed by the Owner as follows:

1. One (1) copy each to the Owner, Engineer, and Contractor.
2. Additional copies as required dependent upon other Federal, State, or Local agencies contributing to or participating in project costs.

C. DEFAULT AND ANNULMENT OF CONTRACT

In addition to the provisions contained in the General Conditions of the Construction Contract, the Owner may give notice in writing to the Contractor and his Surety and may suspend Work upon the occurrence of any one or more of the following events:

1. If the Contractor is adjudged bankrupt or insolvent,
2. If the Contractor makes a general assignment for the benefit of creditors,
3. If a trustee or receiver is appointed for the Contractor or for any of the Contractor's Property.
4. If the Contractor files a petition to take advantage of any debtor's act, or to recognize under the bankruptcy or similar laws,
5. If the Contractor repeatedly fails to supply sufficient skilled workmen or suitable materials or equipment,
6. If the Contractor repeatedly fails to make prompt payments to Sub-contractors or for labor, materials, or equipment,
7. If the Contractor disregards laws, ordinances, rules, regulations or orders of any public body having jurisdiction,
8. If the Contractor disregards the authority of the Engineer,
9. If the Contractor otherwise violates in any substantial way any provisions of the Contract Documents,
10. If the Contractor fails to begin the Work within the time limit stated in the Notice TO Commence Work and completion of phases of the Work in accordance with schedules approved by the Owner,
11. If the Contractor discontinues the Work or fails to resume the Work when directed by the Owner, or,
12. If the Contractor does not perform the Work in a manner acceptable to the Owner.

D. NON-RESIDENT CONTRACTORS

The successful Bidder, if a corporation established under the laws other than the State in which the proposed construction is located, shall file, at the time of execution of the contract, with the owner, notice of the name of its resident attorney, appointed as required by the laws of the State in which the proposed construction is located. The successful Bidder, if a resident of another State other than that in which the proposed construction is located and not a corporation, shall file, at the time of execution of the contract, with the Owner, a written appointment of a resident of the State in which the construction is located, having an office or place of business therein, to be his true and lawful attorney upon whom all lawful processes in any actions or proceedings against him may be served; and in such writing, which shall set forth said attorney's place of residence, shall agree that any lawful process against him which is served on said attorney shall be of the same legal force and validity as if served on him, and that the authority shall continue in force so long as any liability remains outstanding against him in said State. The power of attorney shall be filed in the office of the Secretary of State if required, and copies certified by the Secretary shall be sufficient evidence thereof. Such appointment shall continue in force until revoked by an instrument in writing, designating in a like manner some other person upon whom such processes may be served, which instrument shall be filed in the manner provided herein for original appointment.

A Non-resident Contractor shall be deemed to be:

1. A person who is not a resident in the State where the proposed construction is to be located.
2. Any partnership that has no member thereof resident in the State where the proposed construction is to be located.
3. Any corporation established under the laws other than those of the State where the proposed construction is located.

E. DUTIES, RESPONSIBILITIES, AND LIMITATIONS OF THE AUTHORITY OF RESIDENT PROJECT REPRESENTATIVE:

1. General:

   Resident Project Representative is Engineer's Agent and shall act as directed by and under the supervision of the Engineer. He shall confer with Engineer regarding his actions. His dealings in matters pertaining to the on-site Work will in general be only with Engineer and Contractor. His dealings with subcontractors will only be through or with full knowledge of Contractor or his superintendent. He shall generally communicate with Owner only through or as directed by Engineer.

2. Duties and Responsibilities of the Resident Project Representative shall be:

   a. Schedules:

      Review the progress schedule, schedule of Shop Drawing submissions, schedule of values and other schedules prepared by Contractor and consult with Engineer concerning their acceptability.

b. Conferences:

Attend preconstruction conferences. Arrange as schedule of progress meetings and other job conferences as required in consultation with Engineer and notify in advance those expected to attend. Attend meetings, and maintain a circulate copies of minutes thereof.

c. Liaison:

Serve as Engineer's liaison with Contractor, working principally through Contractor's superintendent and assist him in understanding the intent of the Contract Documents. Assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's on-site operations. As requested by Engineer, assist in obtaining from Owner additional details or information, when required at the job site for proper execution of the Work.

In the interest of preserving the proper channels of communication, advise Engineer of any direct communication between Owner and Contractor.

d. Shop Drawings and Samples:

Receive and record date of receipt of Shop Drawings and samples which have been reviewed by Engineer.

Receive samples which are furnished at the site by Contractor for Engineer's approval, and notify Engineer of their availability for examination.

Advise Engineer and Contractor or his superintendent immediately of the commencement of any work requiring Shop Drawings or sample submission if the submission has not been received by Engineer.

e. Review of Work, Rejection of Defective Work, Observations, and Tests:

Conduct on-site observations of the Work in progress to assist Engineer in determining that the Project is proceeding in accordance with Contract Documents and that completed Work will conform to the Contract Documents.

Report to Engineer whenever he believes that any Work is faulty, or defective or does not conform to the Contract Documents, or has been damaged, or does not meet the requirements of any observations, tests or reviews required to be made; and advise Engineer when he believes Work should be corrected or rejected or should be uncovered for observation, or required special testing.

Verify that tests, equipment and systems, start-ups and operating and maintenance instructions are conducted as required by the Contract Documents and in presence of the required personnel, and that Contractor

maintains adequate records thereof; observe, record and report to Engineer appropriate details relative to the test procedures and start-ups.

Accompany Owner and visiting representatives of public or other agencies having jurisdiction over the Project, record the outcome of these reviews and report to Engineer.

f. Interpretation of Contract Documents:

Transmit to Contractor clarification and interpretation of the Contract Documents as issued by Engineer.

g. Modifications:

Consider and evaluate Contractor's suggestions for modifications in Drawings and/or Specifications and report them with recommendations to Engineer.

h. Records:

Maintain at the job site orderly files for correspondence, reports of job conferences, Shop Drawings and sample submissions, reproductions of original Contract Documents including all addenda, change orders, field orders, additional Drawings issued subsequent to the execution of the Contract, Engineer's clarifications and interpretations of the Contract Documents, progress reports and other Project related documents.

END OF SECTION

SECTION SC-2

INSURANCE

PART 1 – GENERAL

1.1 DESCRIPTION

The Contractor shall purchase and maintain, throughout the work period, insurance of the limits and types stated in the General Conditions of the Construction Contract and as stated below, from an insurance company approved by the Owner and the Town of Boothbay Harbor, Maine. The Town, Boothbay Region Water District, and Boothbay Harbor Sewer District shall be included as an "additional-named insured".

1.2 EVIDENCE OF INSURANCE

As evidence of insurance coverage, the Owner and the Town may, in lieu of actual policies, accept official written statements from the insurance companies certifying that all the insurance policies specified below are in force for the specified period. The Contractor shall submit evidence of insurance to the Owner and the Town at the time of executing the Agreement.

1.3 FORM OF INSURANCE

Insurance shall be in such forms as will protect the Contractor, the Owner, the Boothbay Region Water District, the Boothbay Harbor Sewer District, and the Town from all claims and liabilities for damages for bodily injury, including accidental death, and for property damage, which may arise from operations under this contract, whether such operations be by himself or by anyone directly or indirectly employed by him.

1.4 AMOUNT OF INSURANCE

Except when otherwise stated, the amount of insurance for each policy shall be not less than:

A. Liability for bodily injury, accidental death and property damage:
   1. $1,000,000 for any one person.
   2. $1,000,000 for each accident.

B. Liability for property damage:
   1. $500,000 for any accident.
   2. $500,000 for all accidents.

1.5 TYPES OF INSURANCE

Purchase and maintain the following types of insurance:

A. Full Worker's Compensation insurance coverage for all persons employed by the Contractor to perform work on this project. This insurance shall be in strict accordance with the requirements of the most current laws of the State of Maine.

B. Comprehensive General Liability to cover Bodily Injury and Property Damage, including Contractual Liability including XCU coverage (for blasting explosion, and injury to, or destruction of, wires, pipes, conduits and similar property, appurtenant apparatus, whether public or private and collapse of, or structural injury to, any building or structure, except those on which work under this Contract is being performed) including Broad Form Property Damage and including Owner's, Town's, Boothbay Region Water District's, Boothbay Harbor Sewer District's and Contractor's Protective Liability.

C. Automobile Insurance to cover Bodily Injury and Property Damage resulting from the operation of all motor vehicles and equipment, whether or not owned by the Contractor, being operated in connection with the work under this Contract.

D. Fire and Flood Insurance shall be included with all Property Damage Insurance, either by clause or accompanying letter, in an amount equal to the total bid price of all structures subject to fire damage.

1.6 PROPERTY INSURANCE

Delete paragraph 5.6 of the General Conditions in its entirety and insert the following:

5.6 Contractor shall purchase and maintain until final payment property insurance upon the Work at the site to the full insurable value thereof (subject to such deductible amounts as may be provided in these Supplementary Conditions or required by Laws and Regulations). This insurance shall include the interests of the Owner, the Town, the Boothbay Region Water District, the Boothbay Harbor Sewer District, Contractor, Subcontractors, Engineer and Engineer's consultants in the Work (all of whom shall be listed as insured or additional insured parties), shall insure against the perils if fire and extended coverage, shall include "all-risk" insurance for physical loss and damage including theft, vandalism and malicious mischief, collapse and water damage, and other such perils as may be provided in these Supplementary Conditions, and shall include damages, losses and expenses arising out of or resulting from any insured loss or incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers, architects, attorneys and other professionals). If not covered under the "all-risk" insurance or otherwise provided in these Supplementary Conditions, Contractor shall purchase and maintain similar property insurance on portions of the Work started on and off the site or in transit when such portions of the Work are to be included in an Application for Payment. The policies of insurance required to be purchased and maintained by Contractor in accordance with this paragraph 5.6 shall comply with the requirements of GC-5.8.

END OF SECTION

SECTION 01010

SUMMARY OF WORK

PART 1-GENERAL

A. Location: Work under this contract includes, but is not limited to, locations within the right-of-ways on the following streets and easements in the Town of Boothbay Harbor, Maine.

1. Sunset Road
2. Pines Motel Development

B. Work Included:

The work to be performed under this Contract includes but is not limited to furnishing and installing gravity sewer, manholes, excavation, backfill, removal and replacement of pavement, and appurtenant work.

C. Schedule Limitations

The work under this contract must be substantially completed by November 15, 2005 for Sunset Road.

The Contractor is advised to forward all material submittal for review as early as possible. Delays in receipt of and materials will not be considered sufficient cause for obtaining a time extension.

END OF SECTION

SECTION 01045

CUTTING AND PATCHING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Work Included – This section establishes general requirements pertaining to cutting (including excavation), fitting, and patching of the Work required to:
   1. Make the several parts fit properly.
   2. Uncover work to provide for installation, inspection, or both, of ill-timed work.
   3. Remove and replace work not conforming to the requirements of these specifications.
   4. Remove and replace defective work.
   5. Make alterations to existing structures.

B. Related Work Specified Elsewhere:
   1. In addition to the other requirements specified, upon the Engineer's request, uncover work to provide for inspection by the Engineer of covered work, and remove samples of installed materials for testing.
   2. Do not cut or alter work performed under separate contract without the Engineer's written permission.

C. Quality Assurance:
   1. Perform all cutting and patching in strict accordance with pertinent requirements of these Specifications, and in the event no such requirements are determined, in conformance with the Engineer's written direction.

D. Submittals:
   1. Request for Engineer's Consent:
      a. Prior to cutting which affects structural safety, submit written request to the Engineer for permission to proceed with cutting.
      b. Should conditions of the work, or schedule, indicate a required change of materials or methods for cutting and patching, so notify the Engineer and secure his written permission prior to proceeding.
   2. Notices to the Engineer
      a. Prior to cutting and patching performed pursuant to the Engineer's instructions, submit cost estimate to the Engineer. Secure the Engineer's approval of cost estimates and type of cost reimbursement before proceeding with cutting and patching.
      b. Submit written notice to the Engineer designating the time the work will be uncovered to provide for the Engineer's observation.

PART 2 – PRODUCTS

2.1 MATERIALS

A. For replacement of work removed, use materials which comply with the pertinent sections of these Specifications.

2.2 PAYMENT FOR COSTS

A. The Owner will reimburse the Contractor for cutting and patching performed pursuant to the Engineer's written request after claim for such reimbursement is submitted by the Contractor. Perform all other cutting and patching needed to comply with the Specifications at no additional cost to the Owner.

PART 3 – EXECUTION

3.1 CONDITIONS

A. Inspection
   1. Inspect existing conditions, including elements subject to movement or damage during cutting, excavating, backfilling, and patching.
   2. After uncovering the work, inspect conditions affecting installation of new work.

B. Discrepancies
   1. If uncovered conditions are not as anticipated, immediately notify the Engineer and secure needed directions.
   2. Do not proceed in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 PREPARATION PRIOR TO CUTTING

A. Provide all protection including, but not necessarily limited to, shoring, bracing and support to maintain structural integrity of the work.

3.3 PERFORMANCE

A. Perform all required excavating and backfilling as required under pertinent sections of these Specifications. Perform cutting and demolition by methods which will prevent damage to other portions of the work and will provide proper surfaces to receive installation of repair and/or new work. Perform fitting and adjustment of products to provide finished installation complying with the specified tolerances and finishes.

END OF SECTION

SECTION 01050

COORDINATION

PART 1 - GENERAL

1.1 DESCRIPTTON

A. Contractor is required to work in close proximity to Owner's existing facilities. The Contractor, under this Contract, will be responsible for coordinating construction activities with Owner to ensure that services, facilities, and safe working conditions are maintained.

B. Other Construction Contractors may be interfacing with this Contract and working within the work area and in the vicinity of this Contract. The Contractor, under this contract, shall act as Construction Coordinator and shall coordinate construction activities with other Contractors working for Owner.

C. Any damage to existing structures, equipment and property, accepted equipment or structures, and property or work in progress by others; as a result of the Contractor's or his subcontractor's operations shall be made good by the Contractor at no additional cost to the Owner.

1.2 COORDINATION WITH OTHERS:

A. Town of Boothbay Harbor:

1. Contractor shall coordinate access, egress, detours and traffic control, if required, at each site with the Boothbay Harbor Police Department. The Contractor shall notify Boothbay Harbor Police, Fire Department and Rescue Squad at least 24 hours in advance of any street closings or detours.
2. The Contractor shall be responsible for coordinating and maintaining public services to all public and private properties.

B. Central Maine Power Company (CMP):

1 . The Contractor shall be responsible for coordinating and providing power to construction sites both temporary and permanent services. The Contractor shall be responsible for coordinating all work in and around CMP facilities, with CMP, and bear all costs of CMP inspection requirements, temporary facilities relocation and all other requirements.

C. Boothbay Harbor Water District (BBHWD)

The Contractor shall be responsible for coordinating work in the vicinity of water lines with the BBHWD. Contractor shall bear all costs for BBHWD's inspection requirements, temporary facilities, water main adjustment and other requirements.

D. Town of Boothbay Harbor Department of Public Works (DPW)

The Contractor shall be responsible for obtaining all Opening and Utility Location Permits. The Contractor shall be responsible for coordinating access, egress, detours and traffic control on all Town roadways with the Town's DPW.

E. New England Telephone (NYNEX)

The Contractor shall be responsible for coordinating and providing telephone service to all construction sites, both temporary and permanent. The Contractor shall also be responsible for coordinating all work around NYNEX facilities with NYNEX and shall bear all costs of inspection requirements, temporary facilities relocation and all other requirements.

F. Other Public Services

The Contractor shall be responsible for coordinating and maintaining public services to all properties.

G. Easements

The Contractor shall coordinate work in all easement areas with the Owner. The Owner reserves the right to review and approve construction methods and equipment used in the easements in the interest of protecting private property.

H. Hours of Work

The Contractor shall obtain the approval of the Town Manager prior to performing any work before 7:00 AM or after 6:00 PM or on weekends.

END OF SECTION

SECTION 01070

ABBREVIATIONS & SYMBOLS

PART 1 - GENERAL,

1.1 DESCRIPTION

A. Where any of the following abbreviations are used in these Specifications, they shall have the meaning set forth opposite each.

AASHTO	American Association of State Highway and Transportation Officials
AC	Alternating Current
ACI	American Concrete Institute
ACP	Asbestos Cement Pipe
AGA	American Gas Association
AIC	Ampere Interrupting Capacity
AGMA	American Gear Manufacturers Association
AIEE(IEEE)	American Institute of Electrical Engineers (Institute of Electrical and Electronics Engineers, Inc.)
AISC	American Institute of Steel Construction
amp	Ampere
Amer. Std.	American Standard for Cast Iron Pipe Flanges and Flanged Fittings, Class 125 (ASA B16 11960)
ANSI	American National Standards Institute
API	American Petroleum Institute
ASA	American Standards Association
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWG	American or Brown and Sharpe Wire Gage
AWWA	American Water Works Association
BOD	Biochemical Oxygen Demand
c.f.	Cubic Foot
c.f.m.	Cubic Foot Per Minute
c.f.s.	Cubic Foot Per Second
ci	Cast Iron
CIPRA	Cast Iron Pipe Research Association
csi	Construction Specifications Institute

c.y.	Cubic Yards
DC	Direct Current
DEP	Department of Environmental Protection
DI	Ductile Iron
DOT	Department of Transportation
EDR	Equivalent Directional Radiation
EPA	U.S. Environmental Protection Agency
FmHA	Farmers Home Administration (now the Rural Economic Community Development)
fps	Feet Per Second
ft.	Feet
gal.	Gallons
gpd	Gallons Per Day
gpm	Gallons Per Minute
Hp	Horsepower
IBR	Institute of Boiler and Radiator Manufacturers
in.	Inches
inter.	Interlock
ISA	Instrument Society of America
kva	Kilovolt-ampere
kw	Kilowatt
lb.	Pound
max.	Maximum
MCB	Master Car Builders
MGD	Million Gallons Per Day
Min.	Minimum
NBS	National Bureau of Standards
NEC	National Electrical Code, Latest Edition
NEMA	National Electrical Manufacturers Association
NEWWA	New England Water Works Association
NPT	National Pipe Thread
OS&Y	Outside Screw and Yoke
PCA	Portland Cement Association
PPM	Parts Per Million
%	Percent
psi	Pounds Per Square Inch
psig	Pounds Per Square Inch Gage
PVC	Polyvinyl Chloride
rpm	Revolutions Per Minute
s.f.	Square Foot
STL.W.G.	U.S. Steel Wire, Washburn and Moen, American Steel and Wire Cos., or Roebling Gage

s.y.	Square yard
TDH	Total Dynamic Head
USAS	Standards of the United States of America Standards Institute (formerly American Standards Association)
USS GAGE	United States Standard Gage
vc	Vitrified Clay
WSP	Working Steam Pressure
Fed. Spec.	Federal Specifications issued by the Federal Supply Service of the General Service Administration, Washington, D.C.

END OF SECTION

SECTION 01200

PROJECT MEETINGS

PART 1 - GENERAL,

1.1 DESCRIPTION

A. Work Included: To enable orderly review during progress of the work, and to provide for systematic discussion of problems, the Engineer will conduct project meetings throughout the construction period.

B. Related work described elsewhere: The Contractor's relations with his subcontractors and materials suppliers, and discussions relative thereto, are the Contractor's responsibility and are not part of project meetings content.

1.2 QUALITY ASSURANCE

A. Persons designated by the Contractor to attend and participate in the project meetings shall have all required authority to commit the Contractor to solutions agreed upon in the project meetings.

1.3 SUBMITTALS

A. Agenda items: To the maximum extent practicable, advise the Engineer at least 24 hours in advance of project meetings regarding all items to be added to the agenda.

B. Minutes: The Engineer will compile minutes of each project meeting and will furnish a copy to the Contractor. The Contractor may make and distribute such other copies as he wishes.

PART 2 - PRODUCTS

(No products are required in this Section.)

PART 3 - EXECUTION

3.1 MEETING SCHEDULE

A. Except as noted below for Preconstruction Meeting, project meetings will be held monthly. Coordinate as necessary to establish mutually acceptable schedule for meetings.

3.2 MEETING LOCATION

A. To the maximum extent practicable, meetings will be held at the job site in the Engineer's field office.

3.3 PRECONSTRUCTION MEETING

A. Preconstruction meeting will be scheduled within twenty days after the Effective Date of the Agreement, but before the Contractor starts work at the site. Provide attendance by authorized representatives of the Contractor and all major subcontractors. The Engineer will advise other interested parties and request their attendance.

B. Minimum agenda: Distribute data on, and discuss:

1. Identification of key project personnel for Owner, Engineer, Contractor, funding/regulatory Agencies.
2. Responsibilities of Owner, Engineer, Resident Project Representative, Contractor.
3. Channels and procedures for communications.
4. Construction schedule, including sequence of critical work.
5. Easements, permits.
6. Contract Documents, including distribution of required copies of original documents and revisions.
7. Processing of Shop Drawings and other data submitted to the Engineer for review.
8. Processing of field decisions and Change Orders.
9. Rules and regulations governing performance of the Work, including funding/regulatory Agency requirements.
10. Procedures for safety and first aid, security, quality control, housekeeping, and other related matters.

3.4 PROJECT MEETINGS

A. Attendance: To the maximum extent practicable, assign the same person or persons to represent the Contractor at project meetings throughout progress of the Work. The Superintendent shall attend. Subcontractors, materials suppliers, and others may be invited to attend those project meetings in which their aspects of the Work are involved.

B. Minimum agenda:

1. Review, revise as necessary, and approved minutes of previous meeting.
2. Review progress of the Work since last meeting, including status of submittals for approval.
3. Review schedule of work to be accomplished prior to next meeting.
4. Discuss monthly partial payment request.
5. Review status of change order requests and Work Directive Changes.
6. Identify problems which impede planned progress.
7. Develop corrective measures and procedures to regain planned schedule.
8. Complete other current business.

END OF SECTION

SECTION 01310

CONSTRUCTION SCHEDULES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Within ten (10) days after the effective date of the Agreement between Owner and Contractor submit to the Engineer an estimated progress schedule as specified herein.

B. Form of Schedules:
   1. Narrative: Completely describe the construction methods to be employed.
   2. Network Analysis System:
      a. Provide a separate horizontal schedule line for each trade or operation and show concurrent and preceding activities.
      b. Present in chronological order the beginning of each trade or operation showing duration and float time.
      c. Scale: Identify key dates and allow space for updating and revision.
   3. Mathematical Analysis:
      a. A mathematical analysis shall accompany the network diagram. A computer printout will be acceptable.
      b. Information shall be included on activity numbers, duration, early start, late start, etc. and float times.

C. Content of Schedules:
   1. Provide complete sequence of construction by activity:
      a. Shop Drawings, Project Data and Samples:
         (1) Submittal dates.
         (2) Dates reviewed copies will be required.
      b. Decision dates for:
         (1) Products specified by allowances.
         (2) Selection of finishes.
      c. Estimated product procurement and delivery dates.
      d. Dates for beginning and completion of each element of construction.
   2. Identify work of separate phases and logically grouped activities.
   3. Show the projected percentage of completion for each item of work as of the first day of each month.
   4. Provide separate sub-schedules, if requested by the Engineer, showing submittals, review times, procurement schedules, and delivery dates.

D. Updating:
   1. Show all changes occurring since previous submission.
   2. Indicate progress of each activity, show completion dates.
   3. Include:

a. Major changes in scope.
b. Activities modified since previous updating.
c. Revised projections due to changes.
d. Other identifiable changes.

4. Provide narrative report, including:
   a. Discussion of problem areas, including current and anticipated delay factors.
   b. Corrective action taken, or proposed.
   c. Description of revisions that may affect schedules.

1.2 SUBMITTALS

A. Submit updated schedules with each progress payment request.
B. Submit 4 copies of initial and updated schedules to the Engineer.

END OF SECTION

SECTION 01340

SUBMITTALS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Submit to the Engineer, Shop Drawings, Operation and Maintenance Manuals, Manufacturers' Certificates, Project Data, and Samples required by the Specification Sections.

B. Related Work Specified Elsewhere:

1. Construction Schedules: Section 01310
2. Project Record Documents: Section 01720
3. General Conditions: Section 00702.

1.2 SHOP DRAWINGS

A. Shop Drawings are required for each and every element of the work. Each shop drawing shall be assigned a sequential number for purposes of easy identification, and shall retain its assigned number, with appropriate subscript, on required resubmissions.

B. Shop Drawings are generally defined as all fabrication and erection drawings, diagrams, brochures, schedules, bills of material, manufacturers data, spare parts lists, and other data prepared by the Contractor, his subcontractors, suppliers, or manufacturers which illustrate the manufacturer, fabrication, construction, and installation of the work, or a portion thereof.

C. The Contractor shall submit to the Engineer a minimum of six (6) copies of Shop Drawings and approved data. The Engineer will retain three (3) copies (for Owner's, Engineer's and Field Representative's files) and return three (3) copies to the Contractor for distribution to subcontractors, suppliers and manufacturers. If the Contractor requires more than three (3) then the number of copies submitted shall be adjusted accordingly. The only exception to the above is that all shim drawings which incorporate blue line drawings shall be submitted with only one good quality reproducible, The Engineer will return the one marked reproducible to the Contractor,

D. The Contractor shall provide a copy of a completed submittal certification form which shall be attached to every copy of each shop drawing. Shop Drawings shall show the principal dimensions, weight, structural and operating features, space required, clearances, type and/or brand of finish or shop coat, grease fittings, etc., depending on the subject of the drawing. When it is customary to do so, when the dimensions are of particular importance, or when so specified, the drawings shall be certified by the manufacturer or fabricator as correct for the work.

E. The Contractor shall be responsible for the prompt and timely submittal of all shop and working drawings so that there shall be no delay to the work due to the absence of such drawings.

F. No material or equipment shall be purchased or fabricated especially for the Contract until the required shop and working drawings have been submitted as hereinabove provided and reviewed for conformance to the Contract requirements. All such materials and equipment and the work involved in their installation or incorporation into the Work shall then be as shown in and represented by said drawings.

G. Until the necessary review has been made, the Contractor shall not proceed with any portion of the work (such as the construction of foundations), the design or details of which are dependent upon the design or details of work, materials, equipment or other features for which review is required.

H. All shop and working drawings shall be submitted to the Engineer by and/or through the Contractor, who shall be responsible for obtaining shop and working drawings from his subcontractors and returning reviewed drawings to them. Shop drawings shall be of standardized sizes to enable the Owner to maintain a permanent record of the submissions. Approved standard sizes shall be: (a) 24 inches by 36 inches; (b) 11 inches by 17 inches, and (c) 11 inches by 8-1/2 inches. Provision shall be made in preparing the shop drawings to provide a binding margin on the left hand side of the sheet. Shop drawings submitted other than as specified herein may be returned for resubmittal without being reviewed.

I. Only drawings which have been checked and corrected by the fabricator should be submitted to the Contractor by his subcontractors and vendors. Prior to submitting drawings to the Engineer, the Contractor shall check thoroughly all such drawings to satisfy himself that the subject matter thereof conforms to the Drawings and Specifications in all respects. All drawings which are correct shall be marked with the date, checker's name, and indication of the Contractor's approval, and then shall be submitted to the Engineer.

J. If a shop drawing shows any deviation from the Contract requirements, the Contractor shall make specific mention of the deviations in his letter of transmittal.

K. Should the Contractor submit equipment that requires modifications to the structures, piping, electrical conduit, wires and appurtenances, layout, etc., detailed on the Drawings, he shall also submit details of the proposed modifications. If such equipment and modifications are accepted, the Contractor, at no additional cost to the Owner, shall do all work necessary to make such modifications.

L. A maximum of two submissions of each Shop Drawing will be reviewed, checked, and commented upon without charge to the Contractor- Any additional submissions which are ordered by the Engineer to fulfill the stipulations of the Drawings and Specifications, and which are required by virtue of the Contractor's neglect or failure to comply with the requirements of the Drawings and Specifications, or to make those modifications and/or corrections ordered by the Engineer in the review of the first two submissions of each Shop Drawing, will be

reviewed and checked as deemed necessary by the Engineer, and the cost of such review and checking, as determined by the Owner, and based upon Engineer's documentation of time and rates established for additional services in the Owner-Engineer Agreement for this Project, may be deducted from the Contractor to make all modifications and/or corrections as may be required by the Engineer in an accurate, complete, and timely fashion.

1.3 SAMPLES

A. The Contractor shall submit samples when requested by the Engineer to establish conformance with the specifications, and as necessary to define color selections available.

1.4 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall furnish the Engineer six (6) copies of a complete instruction manual for installation, operation, maintenance, and lubrication of each item specified. At least 3 months prior to the expected substantial completion date, the Contractor shall submit to the Engineer all manuals in accordance with the requirements specified herein.

B. Manuals shall include operating and maintenance information on all systems and items of equipment. The data shall consist of catalogs, brochures, bulletins, charts, schedules, equipment numbers, shop drawings corrected to as-built conditions, wiring diagrams, and assembly drawings which shall describe location, operation, maintenance, lubrication, operating weight, lubrication charts showing manufacturer recommended lubricants for each rotating or reciprocating unit, and other necessary information for the Engineer to establish a complete maintenance program.

C. The submittal shall also include details of all replacement parts; "Nameplate" data for all equipment; detailed instructions for start-up, normal operation, shutdown procedures, and control techniques; and a guide to troubleshooting the system.

1.5 MANUFACTURER'S CERTIFICATION

A. Prior to accepting the installation, the Contractor shall submit manufacturer's certificates for each item specified.

B. Such manufacturer's certificates shall state that the equipment has been installed under either the continuous or periodic supervision of the manufacturer's authorized representative, that it has been adjusted and initially operated in the presence of the manufacturer's authorized representative, and that it is operating in accordance with the specified requirements, to the manufacturer's satisfaction. All costs for meeting this requirement shall be included in the Contractor's bid price.

1.6 SUBMISSION REQUIREMENTS

A. Accompany submittals with transmittal letter, containing:

1. Date.

2. Project title and number.
3. Contractor's name and address.
4. The number of each Shop Drawing, Project Data and Sample submitted.
5. Notification of deviations from Contract Documents.
6. Other pertinent data.

B. Submittals shall include:
1. Date and revision dates.
2. Project title and number.
3. The names of-
   a. Engineer.
   b. Contractor.
   c. Subcontractor.
   d. Supplier.
   e. Manufacturer.
   f. Separate detailer when pertinent.
4. Identification of product or material.
5. Relation to adjacent structure or materials.
6. Field dimensions, clearly identified as such.
7. Specification section number.
8. Applicable standards, such as ASTM number or Federal Specification.
9. A blank space, 4" x 4", for the Engineer’s stamp.
10. Identification of deviations from Contract Documents.
11. Contractor's stamp, initialed or signed, certifying to review of submittal, verification of field measurements and compliance with Contract Documents.
12. Where specified or when requested by the Engineer, manufacturer's certification that equipment, accessories and shop painting meet or exceed the Specification requirements.
13. Where specified, manufacturer's guarantee.

1.7 RESUBMISSION REQUIREMENTS

A. Revise initial drawings as required and resubmit as specified for initial submittal.
B. Indicate on drawings any changes which have been made other than those required by Engineer.

1.8 ENGINEER'S REVIEW

A. The review of shop and working drawings hereunder will be general only, and nothing contained in this specification shall relieve, diminish or alter in any respect the responsibilities of the Contractor under the Contract Documents and in particular, the specific responsibility of the Contractor for details of design and dimensions necessary for proper fitting and construction of the work as required by the Contract and for achieving the result and performance specified thereunder.

SUBMITTAL CERTIFICATION FORM

PROJECT: _____ CONTRACTOR's PROJ. NO: _____

CONTRACTOR: _____ ENGINEER'S PROJ. NO: _____

ENGINEER: _____

TRANSMITTAL NUMBER: _____ SHOP DRAWING NUMBER: ____

SPECIFICATION SECTION OR DRAWING NO: _____

DESCRIPTION: _____

MANUFACTURER: _____

The above referenced submittal has been reviewed by the undersigned and I/we certify that the material and/or equipment meets or exceeds the project specification requirements with

____ NO DEVIATIONS

or

____ A COMPLETE LIST OF DEVIATIONS AS FOLLOWS [A]:

_____
_____
_____
_____
_____

By: _____ By: _____
Contractor [B] Manufacturer [c]

Date: _____ Date: _____

[a] Any deviations not brought to the attention of the Engineer for review and concurrence shall be the responsibility of the Contractor to correct, if so directed.
b Required on all submittals
C When required by specifications

END OF SECTION

SECTION 01380

PRE-CONSTRUCTION VIDEO REPORTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

Contractor shall provide a continuous video recording to obtain a visual record of the entire project area, a copy of same shall be given to Engineer.

1.2 QUALITY

A. Quality shall be such that the condition of existing pavement, curbing, driveway entrances, sidewalks, etc. can be readily determined.

1.3 SUBMITTAL OF PRINTS

A. Submit all video tapes to the Engineer prior to any construction work.

B. The quality of the video tapes are subject to approval by the Engineer prior to the start of construction work in the areas shown by the photos.

END OF SECTION

SECTION 01400

QUALITY CONTROL

PART I - GENERAL

1.1 REQUIREMENTS INCLUDED

A. General Quality Control.
B. Workmanship.
C. Manufacturer's Instructions.
D. Manufacturer's Certificates.
E. Manufacturer's Field Services.
F. Testing Laboratory Services.

1.2 RELATED REQUIREMENTS

A. Section 00700 - General Conditions: Inspection and testing required by governing authorities.
B. Section 01340 - Submittals: Submittal of Manufacturer's Instructions.
C. Section 02200 - Earthwork.
D. Section 02250 - Trench Backfilling, Compaction Control and Testing.
E. Section 03300 - Cast-in-Place Concrete.
F. Section 03305 - Concrete Testing.
G. Section 02480 - Landscaping.

1.3 QUALITY CONTROL

A. Maintain quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.

1.4 WORKMANSHIP

A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
B. Perform work by persons qualified to produce workmanship of specified quality.
C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking.

1.5 MANUFACTURERS' INSTRUCTIONS

A. Comply with instructions in full detail, including each step in sequence. Should instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

1.6 MANUFACTURERS' CERTIFICATES

A. When required by individual Specifications Section, submit manufacturer's certificate that products meet or exceed specified requirements.

1.7 MANUFACTURERS' FIELD SERVICES

A. When specified in respective Specification Sections, require supplier and/or manufacturer to provide qualified personnel to observe field conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment as applicable, and to make appropriate recommendations.

B. Representative shall submit written report to Engineer listing observations and recommendations.

1.8 TESTING LABORATORY SERVICES

A. Owner will employ and pay for services of an Independent Testing Laboratory to perform inspections, tests, and other services wherever an Independent Testing Laboratory is required by individual specification sections listed in paragraph 1.2 above, unless otherwise indicated.

B. Services will be performed in accordance with requirements of governing authorities and with specified standards.

C. Reports will present observations and test results and indicate compliance or noncompliance with specified standards and with Contract Documents. Independent Testing Laboratory will submit one copy of each report directly to each of the following:Engineer, Resident Project Representative, Contractor. Reports will be mailed within 5 days of obtaining test results. If test results indicate deficiencies, Independent Testing Laboratory shall telephone or FAX results to Engineer, Resident Project Representative and Contractor within 24 hours.

D. Contractor shall cooperate with Independent Testing Laboratory personnel; furnish tools, samples of materials, design mix, equipment, storage and assistance as requested.

E. Contractor shall coordinate all testing work and shall notify Engineer and Independent Testing Laboratory at least 24 hours prior to performing work requiring testing services. If scheduled tests or sampling cannot be performed because the work is not ready as scheduled, testing costs associated with the delay will be determined by Engineer and invoiced by Owner to Contractor. If unpaid after 60 days, the invoice amount will be deducted from the Contract Price. If adequate notice is not provided, Contractor shall suspend work on that portion of the Project until testing can be performed. Such suspension will not be grounds for a claim against the Owner for delay, nor will it be an acceptable basis for an extension of time.

F. Payment for Independent Testing Laboratory services shall be as follows:

1. General: Where testing is the Owner's responsibility, payment will be made as stated below unless other requirements are given in Specification Sections.

Testing which is the responsibility of the Contractor will be considered an incidental item unless otherwise indicated in Section 01150, Measurement and Payment.

2. Initial Testing: Owner will pay for initial tests.
3. Retesting: Costs of retesting due to non-compliance will be paid by Owner. The cost of retesting will be determined by Engineer and Owner will invoice Contractor for this cost. If unpaid after 60 days, the invoice amount will be deducted from the Contract Price.
4. Contractor's Convenience Testing,: Inspections and tests performed for Contractor's convenience will be paid for by Contractor.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01510

TEMPORARY UTILITIES

PART I - GENERAL

1.1 DESCRIPTION

A. Work Included:

I Provide and pay for all temporary applicable utilities required to properly perform the Work at no additional cost to the Owner including the placement and removal of the utilities.

2. Completely remove all temporary equipment and materials upon completion of the Work and repair all damage caused by the installation of temporary utilities.

3. Make all necessary applications and arrangements for electric power, light, water and other utilities with the local utility companies. Notify the local electric power company if unusually heavy loads, such as welders, will be connected.

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:

I . Obtain permits as required by local governmental authorities.

2. Obtain easements, when required, across private property other than that of the Owner for temporary power service.

3. Comply with the latest National Electrical Code.

4. Comply with all local, State and Federal codes, laws, and regulations.

B. All temporary utilities are subject to the approval of the Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Electrical:

I . Provide all required facilities, including but not limited to, transformers, conductors, poles, conduits, raceways, fuses, switches, fixtures, and lamps.

2. Use new or used materials adequate in capacity for the purposes intended.

3. Materials must not create unsafe conditions or violate the requirements of applicable codes.

4. Conductors:

a. Wire, cable or busses of appropriate type, sized in accordance with the latest National Electrical Code for the applied loads.

b. Use only UL approved wire.

5. Conduit:

a. Rigid steel, galvanized: ANSI C80. 1.

b. Electrical metallic tubing: ANSI C80.3.
c. Other material approved by NEC.

6. Equipment: Provide appropriate enclosures for the environment in which used in compliance with NEMA Standards.

B. Heating:

1. When heat is required for the protection of the work, provide and install a non-hazardous type of heating apparatus, and provide adequate and proper fuel.
2. Heating equipment and materials in proper condition.

C. Water:

Provide drinking water equipment and material that will prevent contamination and health hazards.

D. Sanitary Accommodations:

1. Shall comply with all local, State and Federal codes, laws and regulations.

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Electrical:

1. Provide electrical energy to:
   a. All necessary points on the construction site so that power can be obtained at any desired point with extension cords no longer than 100 feet.
   b. Construction site offices.
   c. Lighting as required for safe working conditions at any location on the construction site.
   d. Night security light.
   e. When applicable, Owner's present facilities during the change-over of electrical equipment.
2. Maintain electrical energy throughout the entire construction period.
3. Capacity:
   a. Provide and maintain adequate electrical service for construction use by all trades during the construction period at the locations necessary.
4. Installation:
   a. Install all work with a neat and orderly appearance.
   b. Have all installations performed by a qualified electrician.
   c. Modify service as job progress requires.
   d. Locate all installations to avoid interference with cranes and materials handling equipment, storage areas, traffic areas and other work.

B. Heating:

1 . Maintain a heated environment for the work at the temperature and for the length of time specified or as directed by the Engineer.

2. Precaution:
   a. Operate temporary heating apparatus in such a manner that finished work will not be damaged.

   b. Repair all damage, caused by temporary heating operations, to the complete satisfaction of the Engineer.

C. Water:
1. Provide and maintain water for drinking and construction purposes as required for the proper execution of the Work.

D. Sanitary Accommodations:
1 . Provide and maintain sanitary accommodations for the use of the employees of the Contractor, subcontractors, and Engineer.
2. Sanitary accommodations shall meet the requirements of all local, State and Federal health codes, laws and regulations.

END OF SECTION

SECTION 01546

USE OF EXPLOSIVES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

Provide all materials and perform all work necessary to insure safe use and storage of explosives.

2. Contractor shall be responsible for any and all damage resulting from use of explosives.

1.2 QUALITY ASSURANCE

A. Requirements of regulatory agencies: Conduct all blasting in accordance with all applicable local and stable laws, ordinances and code requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Explosive charges and detonation devices shall be of a type suitable for the intended use.

B. Store all explosives in a secure manner, in compliance with all State and local laws and ordinances, and legibly mark all such storage places. Storage shall be limited to such quantity as may be needed for the work underway.

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Designate as a BLASTING AREA all sites where electric blasting caps are located and where explosive charges are being placed.

B. Mark all blasting areas with signs as required by law.

C. Place signs, as required by law, at each end of the blasting area and leave in place while the above conditions prevail. Immediately remove signs after blasting operations or the storage of caps is over.

D. Perform a pre-blast survey of structures in the proximity blasting area to determine pre-blast conditions.

E. Notify each property owner and public utility company having structures in proximity to the site of the work sufficiently in advance to enable the companies to take such steps as they may deem necessary to protect their property. Such notice shall not relieve the Contractor of any of his responsibility for damage resulting from his blasting operation.

F. Warn all persons within the danger zone of blasting operations and do not perform blasting work until the area is cleared. Provide sufficient flagmen outside the danger zone to stop all approaching traffic and pedestrians.
G. Provide watchmen during the loading period and until charges have been exploded.
H. Provide adequate protective covering over all charges before being exploded.

END OF SECTION

SECTION 01562

DUST CONTROL

PART 1 - GENERAL

1.1 DESCRIPTIONS

A. Work Included:

Furnish and apply water or calcium chloride on the road surfaces within the construction site, when required to control dust.

2. When dust control is not included as a separate item in the Contract, the work shall be considered incidental to the appropriate items of the Contract.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Water for Sprinkling:

1. Clean, free of salt, oil, and other injurious matter.

B. Calcium Chloride:

1. Meet the requirements of AASHTO M144.

PART 3 - EXECUTION

3.1 APPLICATION

A. Water:

1. Apply water by methods approved by the Engineer.
2. Use approved equipment including a tank with gauge equipped pump and spray bar.

B. Calcium Chloride:

1. Apply at a rate sufficient to maintain a damp surface but low enough to assure non-contamination of water courses.
2. Apply water prior to calcium chloride addition.

END OF SECTION

SECTION 01570

TRAFFIC REGULATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Provide all materials and perform all work necessary to completely regulate traffic in the area of Work.
2. Perform all work in such a manner as to provide safe passage at all times for the public and with a minimum of obstruction to traffic.
3. Do not close roads or streets to passage of the public without the permission of the proper authorities.

B. The local police department and/or the Maine Department of Transportation will decide if safe passage is being maintained and shall have the authority to require the Contractor to take any additional steps necessary to maintain safe passage. If MDOT furnishes an inspector on the job as a result of poor traffic control by the Contractor, the Contractor shall be responsible for all costs assessed by MDOT. (State Highways)

1.2 SCHEDULING WORK

A. Schedule all work so that two adjacent parallel streets are not closed to passage by the public at any one time, if at all possible.

B. Revise the plan of work if it will create a traffic hazard or an unreasonably long detour.

C. Do not start work in any new location without the permission of the Engineer.

D. Notify all police and fire departments of all scheduled detours and when streets are reopened.

PART 2 - PRODUCTS

2.1 WARNING SIGNS AND BARRICADES

A. Provide adequate warning signs, barricades, signal lights, watchmen and take other necessary precautions for the safety of the public.

B. Provide and illuminate suitable warning signs to show where construction, barricades or detours exist.

C. Provide barricades of substantial construction and painted with a finish that increases visibility at night.

D. Keep signal lights illuminated at all barricades and obstructions from sunset to sunrise.

E. Maintain all necessary signs, barricades, lights, watchmen and other safety precautions during authorized suspension of the Work, weekends, holidays or other times when the Work is not in progress.

F. Traffic control signs for construction work shall be located and of the size and type as outlined in Manual on Uniform Traffic Control Devices for Streets and Highways as published by U. S. Department of Transportation.

2.2 UNIFORMED POLICE OFFICER

A. A uniformed police officer is a police officer (local, county or state) on regular or special duty dressed in uniform with the necessary high visibility vest and apparel needed for traffic control.

B. Arrange the police detail with the local Chief of Police, County Sheriff, or State Police Captain depending on jurisdiction.

2.3 FLAG PERSON

A. A flag person is an individual assigned specifically to the task of directing traffic and is outfitted in the necessary high visibility vest and apparel needed for traffic control.

B. Flag persons shall be provided by the Contractor.

PART 3 - EXECUTION

3.1 DETOURS

A. Provide, identify and maintain suitable detours when the project, or any part thereof, is closed to public travel.

B. When the closed part of the project is reopened, restore the detour area and any other disturbed areas to the original condition.

3.2 INCONVENIENCE TO RESIDENTS OF VICINITY

A. Whenever a traveled way is closed, perform the Work in such a manner that local travel and residents in the vicinity of the Work will be inconvenienced as little as possible.

B. Allow access to residents and abutting land owners along the project to driveways and other normal outlets from their property.

3.3 TRAFFIC CONTROL OFFICERS

A. Where required by the local, county or state police departments and/or when specified, traffic control officer shall be Uniformed Police Officers.

B. Where the local, county or state police departments do not wish to or are unable to furnish traffic control officers and/or when specified, the traffic control officers shall be flag person.

END OF SECTION

SECTION 01630

SUBSTITUTIONS & PRODUCT OPTIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The below listed requirements are in addition to the requirements contained in the "Equivalent Materials and Equipment" part of the Standard General Conditions of the Construction Contract".

1.2 SUBMITTAL

A. Submit a written application for approval completely describing the proposed substitution.

B. Submit, when requested by the Engineer:

1. Manufacturer's catalog data.
2. Illustrations.
3. Specifications.
4. Samples.
5. Other material that may be required to determine equality.

1.3 CRITERIA

A. The following criteria will be used by the Engineer in determining the equality of proposed substitutions:

1. Adaptability to the design.
2. Functional performance.
3. Quality of materials.
4. Strength of materials.
5. Complexity, frequency and cost of maintenance.

1.4 RESULTING CHANGES

A. If proposed substitutions are judged as being acceptable, make all changes to structures, buildings, piping, electrical, and other items necessary to accommodate the substitutions, at no additional cost to the Owner.

B. Whenever it may be written that an equipment manufacturer must have a specified period of experience with his product, equipment which does not meet the specified experience period can be considered if the equipment supplier or manufacturer is willing to provide a bond or cash deposit for the duration of the specified time period which will guarantee replacement of that equipment in the event of failure.

END OF SECTION

SECTION 01710

PROJECT CLEANING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Maintain premises and public properties free from accumulations of waste, debris, and rubbish, caused by operations.
2. At completion of work, remove waste materials, tools, equipment, machinery and surplus materials, and clean all sight-exposed surfaces. Leave project clean and ready for use.

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Conduct cleaning and disposal operations in accordance with all applicable local and state laws, ordinances, and code requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Use only cleaning materials recommended by manufacturer of surfaces to be cleaned.

B. Use cleaning materials only on surfaces recommended by cleaning material manufacturers.

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Cleaning During Construction:

I. Execute cleaning operations to ensure that buildings, grounds, and public properties are maintained free from accumulations of waste materials and rubbish.

2. Entirely remove and dispose of material or debris during the progress of the work that has washed into or has been placed in watercourses, ditches, gutters, drains, catch basins, or elsewhere as a result of the Contractor's operations.
3. Wet down dry materials and rubbish to lay dust and prevent blowing dust.
4. At reasonable intervals during the progress of work, clean the site and dispose of waste materials, debris, and rubbish.
5. Clean interiors of buildings, when applicable, prior to finish painting, and continue to clean on an as-needed basis until buildings are ready for occupancy.

6. Handle materials in a controlled manner with as few handlings as possible. Do not drop or throw material from heights.
7. When applicable, schedule cleaning operations so that dust and other contaminants resulting from the cleaning process will not fall on wet, newly painted surfaces.

B. Control of Hazards:
1. Store volatile wastes in covered metal containers, and remove from premises daily.
2. Prevent accumulation of wastes which may create hazardous conditions.
3. Provide adequate ventilation during use of volatile or noxious substances.

C. Disposal:
1. Do not burn or bury rubbish and waste materials on project site.
2. Do not dispose of volatile wastes, such as mineral spirits, oil, or paint thinner, in storm or sanitary drains.
3. Do not dispose of wastes into streams or waterways.

D. Final Cleaning:
I . Employ experienced workmen, or professional cleaners, for final cleaning.
2. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials, from all sight-exposed interior and exterior finished surfaces.
3. Repair, patch and touch up marred surfaces to specified finishes.
4. Broom clean paved surfaces.
5. Rake clean non-paved surfaces of the project site.
6. Restore to their original condition those portions of the site not designated for alterations by the Contract Documents.

END OF SECTION

SECTION 01720

PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

Keep accurate record documents for all additions, substitutions of material, variations in work, and any other additions or revisions to the Contract.

B. Related Work Specified Elsewhere:

1. Shop Drawings, Project Data, and Samples are specified in "General Conditions, and Section 01340, Submittals.

1.2 MAINTENANCE OF DOCUMENTS

A. Maintain at job site, one copy of:

1. Contract Drawings
2. Specifications
3. Addenda
4. Reviewed Shop Drawings
5. Change Orders
6. Any other modifications to the Contract
7. Field Test Reports

B. Store documents in files and racks specifically identified for this use, that are apart from documents used for construction.

C. File documents in a logical manner indexed for easy reference.

D. Maintain documents in clean, dry, legible condition.

E. Do not use record documents for construction purposes.

F. Make documents available at all times for inspection by the Engineer and Owner, and by the end of the project, transmit these documents to the Engineer.

1.3 RECORDING

A. Label each document "PROJECT RECORD" in large high printed letters.

B. Keep record documents current and do not permanently conceal any work until required information has been recorded.

C. General Field Recording Issues:

1. All ties should be taken from existing, permanent features such as utility poles, comers of houses and hydrants. Porches, sheds or other house additions should be avoided for they could be tom down. A minimum of two ties should be taken.
2. Stations should be recorded to the nearest foot.
3. Inverts should be recorded to the nearest hundredth of a foot.
4. Elevations should be recorded to the nearest hundredth of a foot.

5. Building dimensions should be recorded to the nearest 1/4".

D. Project Record Drawings - Legibly mark Contract Drawings to record existing utilities and actual construction of all work, including but not limited to the following (where applicable):

1. Existing Utilities

   Water mains and services, water main gate valves, sewer mains and services, storm drains, culverts, steam lines, gas lines, tanks and other existing utilities encountered during construction must be accurately located and shown on the Drawings. In congested areas supplemental drawings or enlargements may be required.

   a. Show any existing utilities encountered in plan and profile and properly labeled showing size, material and type of utility' Ties should be shown on plan. Utility should be drawn to scale in section (horizontally and vertically) and an elevation should be called out to the nearest hundredth of a foot.
   b. When existing utility lines are broken and repaired, ties should be taken to these locations.
   c. If existing water lines are replaced or relocated, document the area involved and pipe materials, size, etc. in a note, and with ties.

2. Manholes, Catch Basins, Valve Pits and other structures.
   a. Renumber structure stationing to reflect changes.
   b. Show ties to center of structure covers or hatches.
   c. In general, show inverts at center of structures. However, for manholes with drop structures, or steep channels (greater than 0.2' change on slope), show inverts at face of manhole.
   d. Show inverts for other structures at the face of the structure.
   e. Draw any new structures that are added on plan and profile.
   f. Show any field or office redesigns.
   g. Redraw plan if the structure's location is moved more than 5 feet in any direction. [Note: It is important to show existing utilities, as outlined in Paragraph I above, especially if they were one reason for relocating the sewer, manholes and other structures.]
   h. Redraw profile if inverts changed by more than 6 inches.

3. Gravity Sewer Line
   a. Change sewer line slopes indicated on Drawings if inverts are changed.
   b. Draw any new gravity lines that are added on plan and profile.
   c. Show any field or office redesigns.
   d. Redraw the sewer line profile if manhole inverts are redrawn.
   e. Redraw the sewer line on plan corresponding to relocated manholes.

4. Water Mains and Force Mains
   a. Show ties to the location of all valves, bends (horizontal and vertical), tees and other fittings. The use of thrust blocks should be recorded.

b. Revise elevations indicated on the Drawings to reflect actual construction.

5. House Services
   a. Draw all house services (even to empty lots) on plan, and show ties.
   b. Show ties or distances to wyes from manhole.
   c. Show chimneys heights in the profile.
   d. The "Sanitary Sewer Service Location" forms shall be used to record sewer service information. A copy of these forms should be provided to the Owner, along with the Record Drawing Set.
6. Septic Tanks
   a. Show ties to center of tank covers.
   b. Label size of septic tanks that are other than standard 1000 gallon capacity.
   c. The "Sanitary Sewer Service Location" forms shall be used to record septic tank information. A copy of these forms should be provided to the Owner, along with the Record Drawing Set.
7. Ledge
   a. Ledge profiles should be shown. Note whether the plotted ledge profile reflects undisturbed or expanded conditions.
8. Yard Piping and Buried Electrical Conduit
   a. Site piping should be drawn to reflect the installed locations, with ties and elevation of all bends (horizontal and vertical).
   b. Show routing for electrical conduits and pull boxes, especially in close proximity to buildings and when the conduits change direction or cross process piping.
9. Roads
   a. Show centerline road profile and level spot elevations.
   b. Show pavement widths.
   c. On road cross sections, show the pavement cross slope.
   d. Show any deviations from the design plans.
10. Buildings
   a. In general, small changes to structures should not be redrawn. If any dimensional changes were made in the field, the numerical change should be made on the Drawing and be properly labeled. Update dimensions and elevations on Drawings.
   b. Show finished concrete elevations (top of slab, top of wall, top of footing, etc.). Redraw any foundation, frost wall, etc. that was modified, deepened, or altered during construction.
   c. Adjust finished concrete horizontal dimensions that are shown on the Drawings.
   d. Adjust structural steel elevations and horizontal dimensions that are shown on the Drawings.

e. Show location of anchors, construction and control joints, and waterstops, when they are different from those shown on Drawings.
f. Any additions or major changes should be shown in both plan and elevation (i.e. relocated doors, opposite door swings, change in wall location, relocation of floor drains).
g. Show approximate location and routing of electrical conduits in walls, slabs and ceilings. Most conduits are run in groups, therefore, use range of measurements to define location for entire section of conduits.
h. Special circuits for computers, alarms and instrumentation should be shown.
i. Show any changes in location and elevation of ductwork and devices, fuel piping and equipment, and heat piping and equipment.
j. Location of gravity sewer system below slabs in buildings should be shown, if changes are made in the configuration.
k. If wall mounted electrical switches, control boxes, thermostats, etc. have been relocated significantly, (other side of door, or to a wall other than indicated diagrammatically on electrical plans) make the revision accordingly.

E. Specifications and Addenda - Legibly mark up each section to record:
1. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
2. Changes made by Change Order, Field Order, or other method.

1.4 SUBMITTALS

A. At the completion of the project, deliver record documents to the Engineer.
B. Accompany submittal with transmittal letter, in duplicate, containing:
1. Date, project title and number.
2. Contractor's name and address.
3. Title and number of each record document with certification that each document is completed and accurate.
4. Signature of Contractor, or his authorized representative.
C. Failure to supply all information on the Project Record Drawings as specified in Part 1.3 may result in additional retainage from monthly partial payment requests, and in non-approval of final payments of the Contract and/or if contract time (as specified in accordance with the Standard General Conditions of the Construction Contract) has elapsed, this shall be grounds for the enactment of the liquidated damages as specified.

END OF SECTION

SECTION 02050A

DEMOLITION

PART 1 – GENERAL

1.1 DESCRIPTION

A. Work Included:

1. The Contractor shall furnish all labor, materials, tools, equipment and apparatus necessary and shall do all work required to complete the demolition, removal, and alterations of existing facilities as indicated on the Drawings, as herein specified, and/or as directed by the Engineer.
2. Demolition and alteration work within occupied areas shall be accomplished with minimum interference to the occupants and to the plant which shall be in continuous operation during construction.
3. All equipment, piping, and other materials that are not to be relocated or to be returned to the Owner shall become the property of the Contractor and shall be disposed of him by, away from the site of the work and at his own expense.
4. All demolition or removal of existing structures, utilities, equipment, and appurtenances shall be accomplished without damaging the integrity of existing structures, equipment, and appurtenances to remain, to be salvaged for relocation or stored for future use.
5. Such items that are damaged shall either be repaired or replaced at the Contractor's expense to a condition at least equal to that which existed prior to the start of the work.

B. Related Work Specified Elsewhere: (When Applicable)

1. Earthwork is specified in Section 02200.
2. Use of explosives is specified in Section 01546.
3. See Summary of Work Section 01010.

1.2 JOB CONDITIONS

A. Condition of Structures:

1. The Owner assumes no responsibility for the actual condition of structures to be demolished.
2. Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner as far as practicable. However, variations within the structures may occur due to the Owner's removal and salvage operations prior to the start of demolition work (where applicable).

1.3 UTILITIES

A. Utility Location:

1. Utility locations shown on the plans are approximate only, based on information supplied by the utility companies.

B. Coordination with Utilities:
   1. The Contractor shall make all necessary arrangements and perform any necessary work to the satisfaction of affected utility companies and governmental divisions involved with the discontinuance or interruption of affected public utilities and services.

1.4 SUBMITTALS
A. Schedule – Demolition
   1. Submit two (2) copies of proposed methods and operations of demolition to the Engineer for review prior to the start of work. Include in the schedule the coordination for shut-off, capping and continuation of utility services as required.
   2. Provide a detailed sequence of demolition and removal work to ensure the uninterrupted progress of the Owner's operations.

1.5 PROTECTIONS
A. Ensure safe passage of persons around the area of demolition. Conduct operations to prevent injury to adjacent buildings, structures, other facilities and persons. Erect temporary, covered passageways as required by authorities having jurisdiction.
B. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement or collapse of structures to be demolished and adjacent facilities to remain.

1.6 DAMAGES
A. The Contractor shall promptly repair damages caused by demolition operations to adjacent facilities at no cost to the Owner.

PART 2 – PRODUCTS

Not applicable

PART 3 – EXECUTION

3.1 PERFORMANCE
A. Remove and dispose of non-salvageable material in accordance with all applicable local and state laws, ordinances and code requirements.
B. Dispose of material daily as it accumulates.
C. Carefully remove, store and protect from damage all materials to be salvaged.
D. Buildings and Adjacent Property:
   1. Protect all buildings and property adjacent to equipment to be removed from damage by erecting suitable barriers or by other suitable means.
   2. Leave such buildings in a permanently safe and satisfactory condition.

E. Maintaining Traffic:
   1. Ensure minimum interference with roads, streets driveways, sidewalks and adjacent facilities.
   2. Do not close or obstruct streets, sidewalks, alleys or passageways without permission from authorities having jurisdiction.
   3. One lane shall be maintained and passable for local traffic and emergency vehicles at all times.

END OF SECTION

SECTION 02110

CLEARING AND GRUBBING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Clearing includes, but is not limited to, removal of trees, brush, stumps, wooded growth, grass, shrubs, poles, posts, signs, fences, culverts and other vegetation and minor structures; the protection of designated wooded growth; the storage and protection of minor structures and materials which are to be replaced; and the disposal of nonsalvageable structures and materials, and necessary preliminary grading.

B. Limits of Work:

1. Perform clearing and grubbing work within the areas required for construction, or as shown on the Drawings, to a depth of 12 inches below the existing grade.
2. Perform additional clearing and grubbing work within areas and to depths which, in the opinion of the Engineer, interfere with excavation and/or construction, or are otherwise objectionable.

C. Work Not Included:

1. Clearing and grubbing work performed for the convenience of the Contractor will not be considered for payment.

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:

1. Dispose of combustible material by burning only when permitted by and in accordance with all applicable local and state laws, ordinances and code requirements.

B. Remove and dispose of nonsalvageable structures and material in accordance with all applicable local and state laws, ordinances and code requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide all materials required to complete the work.

B. All timber and wood shall become the property of the Contractor unless other agreements are made between the Owner and the Contractor.

C. Repair any damage to structures to the complete satisfaction of the Owner and Engineer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Carefully preserve and protect from injury all trees and/or shrubs not to be removed.

B. Right-Of-Way:

1. Where excavation is required on public or private rights-of-way containing trees, shrubs, other growth, or any structure or construction, obtain the Engineer's direction concerning the extent to which such obstacles can be cleared or stripped prior to performing the Work.
2. In all rights-of-way, remove only those particular growths or structures which are, in the opinion of the Engineer, essential for construction operations.
3. All other removals or damage shall be replaced or restored at the Contractor's expense.

3.2 PERFORMANCE

A. Clearing:

1. Remove and dispose of all trees, brush, slash, stubs, bushes, shrubs, plants, debris and obstructions within the area to be cleared, except any areas that may be designated as "Selective Clearing", and except as otherwise shown on the Drawings or as directed by the Engineer.
2. Remove all stumps unless otherwise directed by the Engineer.
3. Dispose of material to be removed daily as it accumulates.
4. Take special care to completely dispose of all elm trees and branches immediately after cutting either by burial in approved locations or, when permitted, by burning in areas well removed from standing elm growth.

B. Protection of Wooded Growth:

1. Fell trees toward the center of the area being cleared to protect trees and shrubs to be left standing.
2. Cut up, remove and dispose of trees unavoidably falling outside the area to be cleared.
3. Employ skilled workmen or tree surgeons to trim and repair all trees that are damaged but are to be left standing and paint all cut surfaces with an approved bituminous paint.

C. Selective Clearing:

1. When shown on the Drawings and when directed by the Engineer, perform selective clearing work to preserve natural tree cover.
2. Perform selective clearing work only under the direction and supervision of the Engineer.
3. Remove all dead and uprooted trees, brush, roots and other material which, in the opinion of the Engineer, are objectionable.
4. Cut flush with the ground and remove only those trees indicated by the Engineer.

5. Employ skilled workmen or tree surgeons to carefully trim all branches requiring cutting on trees to be left standing and to paint all cut surfaces with an approved bituminous paint.
6. Paint tree roots which are cut and are to be left exposed to the weather with an approved bituminous paint.

D. Grubbing:
1. Perform grubbing work beneath new roads, driveways, walks, seeded areas and other areas and as directed by the Engineer.
2. Grub out all sod, vegetation and other objectionable material to a minimum depth of 12 inches below the existing grade.
3. Completely remove all stumps, including major root systems.

E. Disposal:
1. Remove from the site and dispose of material not being burned.
2. Provide an approved disposal area unless otherwise specified.

F. Burning:
1. Dispose of combustible materials by burning only if approved by local and state officials.
2. Employ competent workmen to perform burning work in such a manner and at such locations that adjacent properties, trees and growth to remain, overhead cables, wires and utilities will not be jeopardized.
3. Do not leave fires unguarded.
4. Do not bum poison oak, poison ivy or other plants of similar nature.
5. Do not use tires or other combustible waste material to augment burning.
6. Bum combustible materials daily as the work progresses.
7. The Contractor shall be responsible for all damage caused by burning and shall be responsible for obtaining all necessary permits for burning.

3.3 REPLACEMENT OF MATERIALS

A. Paving, Curbing and Miscellaneous Material:
1. Remove all paving, subpaving, curbing, gutters, brick, paving block, granite curbing, flagging and minor structures that are over the area to be filled or excavated.
2. Remove and replace bituminous asphaltic and Portland cement concrete in accordance with the appropriate sections of these Specifications.
3. Properly store and preserve all material to be replaced in a location approved by the Engineer.

B. Shrubs and Bushes:
1. Remove, store, and replace ornamental shrubs and bushes to be preserved in accordance with accepted horticultural practices.

C. Topsoil:
1. When applicable, carefully remove, store, and protect topsoil in accordance with the appropriate section of this division.

D. Responsibility:

Replace, at no additional cost to the Owner, materials lost or damaged because of careless removal or neglectful or wasteful storage, disposal or use of these materials.

END OF SECTION

SECTION 02156

SHEETING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish, install and maintain sheeting and bracing as required to comply with all applicable State and Federal regulations including the Occupational Safety and Health Act.

B. Related Work Specified Elsewhere (When Applicable): structure excavation, trench excavation, backfilling, and dewatering are specified in the appropriate Sections in this Division.

C. Design: The sheeting shall be properly designed and installed to sustain all existing and expected loads, to prevent all movement to earth which could in any way cause injury to workmen, delay the work or endanger adjacent structures.

PART 2-PRODUCTS

2.1 MATERIAL

A. All materials shall conform to all applicable State and Federal regulations including the Occupational Safety and Health Act.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install sheeting in accordance with all applicable State and Federal regulations including the Occupational Safety and Health Act.

3.2 REMOVAL OF SHEETING

A. Remove all sheeting and bracing unless the removal may cause injury to adjacent structures and/or property.

B. Proceed with backfilling as specified in these Specifications. When the level of compacted backfill reaches the location of bracing and walls, remove these items from the trench or other excavation. When the level of the backfill reaches a point three feet below the existing ground grade, remove the sheeting by approved methods and equipment.

C. After removing the sheeting, complete backfilling in the usual manner.

END OF SECTION

SECTION 02200

EARTHWORK

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Work described by this Section consists of all earthwork encountered and necessary for construction of the project as indicated in the Contract Documents, and includes but is not limited to the following:
   1. Excavation
   2. Backfilling and Filling
   3. Compaction
   4. Embankment Construction
   5. Grading
   6. Providing soil material as necessary
   7. Disposal of excess suitable material and unsuitable materials

B. Related Work Specified Elsewhere: (When Applicable)
   1. The use of explosives is specified in the Supplementary Conditions section of this Contract, and in Division 1.
   2. Traffic Regulation is specified in Division 1.
   3. Clearing and Grubbing, Dewatering, Filter Fabric, Temporary Erosion Control, Stripping and Stockpiling of Topsoil, Sheeting, Landscaping, and Paving are specified in the appropriate sections of this Division.
   4. Section 01400 - Quality Control.
   5. Pipe, fittings and valves are specified in Division 15 or 2.

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:
   1. All work shall be performed and completed in accordance with all local, state and federal regulations.
   2. The General Contractor shall secure all other necessary permits unless otherwise indicated from, and furnish proof of acceptance by, the municipal and state departments having jurisdiction and shall pay for all such permits, except as specifically stated elsewhere in the Contract Documents.

B. Line and Grade:
   1. The Contractor shall establish the lines and grades in conformity with the Drawings and maintain same to properly perform the work.

C. Testing Methods:
   1. Gradation Analysis: Where a gradation is specified the testing shall be in accordance with ASTM C-117-90 and ASTM C-136-93 (or latest revision).
   2. Compaction Control:
      a) Unless otherwise indicated, wherever a percentage of compaction for backfill is indicated or specified, it shall be the in-place density divided

by the maximum density and multiplied by 100. The maximum density shall be the density at optimum moisture as determined by ASTM Standard Methods of Test for Moisture-Density Relations of Soil Using 10-lb. Hammer and 18-in. Drop, Designation D-1557-91 (Modified Proctor), or latest revision, unless otherwise indicated.

b) The in-place density shall be determined in accordance with ASTM Standard Method of Test for Density of Soil in Place by the Sand Cone method, Designation D 1556-90, (or latest revision) or Nuclear method Designation D2922.

c) Wherever specifically indicated, maximum density at optimum moisture may be determined by ASTM Standard Methods of Test for Moisture Density Relations of Soils, ASTM D-698-91 (Standard Proctor).

d) An Independent Testing Laboratory will be retained by the Owner to conduct all laboratory and field soil sampling and testing, and to observe earth work and foundation construction activities. Laboratory testing will consist of sieve analyses, natural water content determinations, and compaction tests. Field testing will consist of field unit weight tests and determination of water contents.

1.3 SUBMITTALS

A. Collection of samples and testing of all materials for submittals shall be performed by the Independent Testing Laboratory and paid for by the Contractor until the materials are approved by the Owner or Engineer.

B. Submit test results in accordance with the procedure specified in the General and Supplementary Conditions.

C. Submit test results (including gradation analysis) and source location for all borrow material to be used at least 10 working days prior to its use on the site. Contractor shall identify and provide access to borrow sites.

D. Submit moisture density curve for each type of soil (on site or borrow material) to be used for embankment construction or fill beneath structures or pavement.

1.4 TESTS

The Independent Testing Laboratory shall conform to the following procedures and standards:

A. Submit test results in accordance with the procedure specified in the General and Supplementary Conditions.

B. All testing shall be performed by a qualified Independent Testing Laboratory acceptable to the Engineer and Contractor at the Owner's expense unless otherwise indicated (see Section 01400 - Quality Control).

C. Field density tests on embankment materials shall be as follows:

1. Tests shall be taken on every 1,000 cubic yards of embankment material. In order to determine optimum water content, maximum allowable lift, and number of equipment passes required, one test section shall be constructed, and thoroughly tested. The section shall be a minimum of 1,000 cubic yards in volume. To avoid conflicts the Contractor shall allow a minimum of one working day for testing to be conducted on the test section. The test section may be part of the embankment.

D. Paved Areas and Building Slab Subgrade: Make at least one field density test of subgrade for every 2,000 sq. ft. of paved area or building slab, but in no case less than 3 tests. In each compacted fill layer, make one field density test for every 2,000 sq. ft. of overlaying building slab or paved area, but in no case less than 3 tests.

E. Trenches: Field density test in trenches shall be taken at 75 linear foot intervals on every third lift.

F. Foundation Wall Backfill: Take at least one (1) field density tests per lift per wall at locations and elevations as designated by the Engineer.

G. In addition to the above tests the Independent Testing Laboratory will perform additional density tests at locations and times requested by the Engineer.

H. Additional density testing will be required by the Engineer if the Engineer is not satisfied with the apparent results of the Contractor's compaction operation.

1. If the test results fail to meet the requirements of these specifications, the Contractor shall undertake whatever action is necessary, at no additional cost to the Owner, to obtain the required compaction. The cost of retesting will be paid by Owner. The cost of retesting will be determined by Engineer and Owner will invoice Contractor for this cost. If unpaid after 60 days, the invoice amount for retesting will be deducted from the Contract Price. No allowance will be considered for delays in the performance of the work.
2. If the test results pass and meet the requirements of these Specifications, the cost of the testing service will be borne by the Owner, but no allowance will be considered for delays in the performance of the work.

1.5 JOB CONDITIONS

A. Site Information:

1. Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that Owner and Engineer will not be responsible for interpretations or conclusions drawn therefrom by the Contractor. Data are made available for the convenience of Contractor.
2. Additional test borings and other exploratory operations may be made by Contractor at no additional cost to Owner.

B. Existing Utilities and Structures:
   1. The locations of utilities and structures shown on the Drawings are approximate as determined from physical evidence on or above the surface of the ground and from information supplied by the utilities. The Engineer in no way warranties that these locations are correct. It shall be the responsibility of the Contractor to determine the actual locations of any utilities or structures within the project area.

PART 2 - PRODUCTS

2.1 SOIL MATERIAL

A. Aggregate Base: Shall be screened or crushed gravel of hard durable particles free from vegetable matter, lumps or balls of clay and other deleterious substances. Type B Aggregate for base shall not contain particles of rock that will not pass the 4 inch square mesh sieve. The gradation of the part that passes a 3-inch sieve shall meet the following grading requirements:

Sieve Designation	Percent by Weight Passing Square Mesh Sieves Type B Aggregate
1/2 inch	35-75
1/4 inch	25-60
No. 40	0-25
No. 200	0-5

B. Aggregate Leveling Course and Untreated Surface Course: Shall be screened or crushed gravel consisting of hard durable particles which are free from vegetable matter, lumps or balls of clay and other deleterious substances. The gradation of the material shall meet the grading requirements of the following table:

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves
1 inch	95-100
3/4 inch	90-100
No. 4	40-65
No. 10	10-45
No. 200	0-7

C. Blanket Drain Material: Shall be gravel of hard durable particles free from vegetable matter, lumps or balls of clay and other deleterious substances. Blanket drain material shall not contain particles of rock which will not pass the 2-inch

square mesh. The gradation of the part that passes a 2-inch sieve shall meet the following grading requirements:

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves
2-inch	100
1/4 inch	25-70
No. 40	0-30
No. 200	0-5

The blanket drain material shall have a permeability of 5-3 cm/sec. or faster. Permeability supersedes gradation requirements.

D. Common Borrow: Shall consist of approved material required for the construction of the work where designated. Common borrow shall be free from frozen material, perishable rubbish, peat, organic, and other unsuitable material.

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves
6-inch	100
No. 200	0-5

Common borrow may be used for embankments unless otherwise indicated and provided that the material is at a moisture content suitable for compaction to the specified density. No rocks shall exceed 3/4 of the depth of the specified lift thickness.

E. Crushed Stone: Shall be a uniform material consisting of clean, hard, and durable particles or fragments, free from vegetable or other objectionable matter, containing angular pieces, as are those which come from a mechanical crusher. Gradation requirements shall be as follows:

Sieve Designation	Percent by Weight Passing Square Mesh Sieve
1-1/2 inch	100
1 inch	95-100
1/2 inch	25-60
No. 4	0-10

F. Screened Stone: Shall be a well graded stone consisting of clean, hard, and durable particles or fragments, free from vegetable or other objectionable matter, meeting the following gradation requirements:

Sieve Designation	Percent by Weight Passing Square Mesh Sieve
1 inch	100
3/4 inch	90-100
3/8 inch	20-55
No. 4	0-10
No. 8	0-5

G. Select Fill: Shall consist of well graded granular material free of organic material, loam, wood, trash, snow, ice, frozen soil and other objectionable material and having no rocks with a maximum dimension of over 4 inches and meeting the following gradation requirements, except where it is used for pipe bedding in which case the maximum size shall be 2 inches.

Sieve Designation	Percent by Weight Passing Square Mesh Sieve
4 inch	100
3 inch	90-100
1/2 inch	25-90
No. 40	0-30
No. 200	0-5

H. Sand: Shall be well graded durable material free of organic matter and conform to the following gradation requirements:

Sieve Designation	Percent by Weight Passing Square Mesh Sieve
3/8 inch	100
No. 4	95-100
No. 16	50-85
No. 50	10-30
No.100	2-10
No.200	0-5

Sand conforming to the requirement for fine aggregate in ASTM Standard Specifications for Concrete Aggregate, Designation C-33, will meet the above requirement.

I. Impervious Dam Material: The impervious dam material shall be uniform natural or selected cohesive soil with minimum of 30 percent of the material passing a No. 200 sieve. It shall not contain vegetation masses of roots, individual roots larger than 12 inches long or ½ inch in diameter or other porous or organic matter.

2.2 CONCRETE

A. If concrete is required for excess excavation, provide 3,000 psi concrete complying with requirements of Section 03300.

2.3 FILTER FABRIC

A. If filter fabric is required, refer to Section 02260.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions under which excavating, backfilling, filling, compaction and grading are to be performed and notify the Engineer in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 EXCAVATION

A. General:

1. Excavation consists of removal and disposal of all material encountered when establishing line and grade elevations required for execution of the work.
2. The Contractor shall make excavations in such manner and to such widths as will give suitable room for building the structures or laying and jointing the piping; shall furnish and place all sheeting, bracing, and supports; shall do all coffer damming, pumping, and draining; and shall render the bottom of the excavations firm, dry and acceptable in all respects.
3. All excavation shall be classified as either earth or ledge.
   a) Earth Excavation shall consist of the removal, hauling and disposal of all earth materials encountered during excavation including but not limited to native soil or fill, pavement (bituminous or concrete), existing sewers and manholes, ashes, loam, clay, swamp muck, debris, soft or disintegrated rock or hard pan which can be removed with a backhoe, or a combination of such materials, and boulders measuring less than one cubic yard.
   b) Ledge Excavation: Shall consist of the removal, hauling, and disposal of all ledge or rock encountered during excavation. "Ledge" and "rock" shall be defined as any natural compound, natural mixture that in the opinion of the

Engineer can be removed from its existing position and state only by drilling and blasting, wedging, sledging, boring or breaking up with power operated tools. No boulder, ledge, slab, or other single piece of excavated material less than one cubic yard in total volume shall be considered to be rock unless, in the opinion of the Engineer it must be removed from its existing position by one of the methods mentioned above.

4. The Contractor shall not have any right of property in any materials taken from any excavation. Do not remove any such materials from the construction site without the approval of the Engineer. This provision shall in no way relieve the Contractor of his obligations to remove and dispose of any material determined by the Engineer to be unsuitable for backfilling. The Contractor shall dispose of unsuitable and excess material in accordance with the applicable sections of the Contract Documents.

B. Additional Excavation: When excavation has reached required subgrade elevations, notify the Engineer and Resident Project Representative who will observe the conditions.

1 . If material unsuitable for the structure or paved area or pipeline (in the opinion of the Engineer) is found at or below the grade to which excavation would normally be carried in accordance with the Drawings and/or Specifications, the Contractor shall remove such material to the required width and depth and replace it with thoroughly compacted select fill, screened stone, crashed stone, or concrete as directed by the Engineer.

2. All excavated materials designated by the Engineer as unsuitable shall become the property of the Contractor and disposed of at locations in accordance with all State and local laws and the provisions of the Contract Documents.

C. Unauthorized Excavation: Shall consist of removal of materials beyond indicated subgrade elevations or dimensions without specific authorization of Engineer. Unauthorized excavation, as well as remedial work required buy the Engineer shall be at the Contractor's expense. Remedial work required is as follows:

1. Under footings, foundation bases, or retaining walls, fill unauthorized excavation with select fill or crushed stone compacted to 95%. Provide 12" minimum select fill or crushed stone directly under footings. Concrete fill may be used to bring elevations to proper position, when acceptable to Engineer.
2. If the bottom of a trench is excavated beyond the limits indicated, backfill the resulting void with thoroughly compacted screened stone, unless otherwise indicated.
3. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Engineer.

D. Structural Excavation:

1. Shall consist of the removal, hauling, disposal, of all material encountered in the excavation to permit proper installation of structures.

2. Excavations for structures shall be carried to the lines and subgrades shown on the Drawings.
3. Excavate areas large enough to provide suitable room for building the structures.
4. The extent of open excavation shall be controlled by prevailing conditions subject to any limits designated by the Engineers
5. Provide, install, and maintain sheeting and bracing as necessary to support the sides of the excavation and to prevent any movement of earth which could diminish the width of the excavation;,)n or otherwise injure the work, adjacent structures, or persons and proper, y, in accordance with all state and OSHA safety standards.
6. Erect suitable fences around structure excavation and other dangerous locations created by the work, a no additional cost to the Owner.
7. Exposed subgrade surfaces shall remain undisturbed, protected, and maintained as uniform, plane areas, proof rolled and shaped to receive the foundation components of the structure.
   a. Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10', and .,extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
   b. In excavating for footings and foundations, take care not to disturb bottom of excavation. Excavate by hand to final grade and trim bottoms to required lines and grades to leave solid base to receive the structure.
   c. If a structure is to be constructed within the embankment, the fill shall first be brought to a minimum of 3 feet above the base of the footing. A suitable excavation shall then be made as though the fill were undisturbed earth.

E. Trench Excavation: Shall consist of removal, hauling and disposal of all material encountered in the excavation to the widths and depths shown on the Drawings to permit proper installation of underground utilities.

1 . Excavate trenches to the uniform width shown on the Drawings sufficiently wide to provide sufficient space for installation, backfilling, and compaction. Every effort should be made to keep the sides of the trenches firm and undisturbed until backfilling has been completed and consolidated.
2. Trenches shall be excavated with approximately vertical sides between the elevation of the center of the pipe and an elevation one foot above the top of the pipe.
3. Grade bottoms of trenches as indicated for pipe and bedding to establish the indicated slopes and invert elevations, notching under pipe joints to provide solid bearing for the entire body of the pipe, where applicable.

4. If pipe is to be laid in embankments or other recently filled material, the material shall first be placed to the top of the fill or to a height of at least two feet above the top of the pipe, whichever is the lesser. Particular care shall be taken to ensure maximum consolidation of material under the pipe location. The pipe trench shall be excavated as though in undisturbed material.
5. Unless otherwise specifically directed or permitted by the Engineer, begin excavation at the low end of sewer and stone lines and proceed upgrade.
6. Perform excavation for force mains and water mains in a logical sequence.
7. The extent of open excavation shall be controlled by prevailing conditions subject to any limits prescribed by the Engineer.
8. As the excavation progresses, install such shoring and bracing necessary to prevent caving and sliding and to meet the requirements of the state and OSHA safety standards, as outlined in the appropriate section of this Specification.

F. Protection of Persons, Property and Utilities:

1. Barricade open excavations occurring as part of this work and post with warning lights in compliance with local and State regulations.
2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations. Exercise extreme caution and utilize sheeting, bracing, and whatever other precautionary measures that may be required.
3. Rules and regulations governing the respective utilities shall be observed in execution all work. Active utilities and structures shall be adequately protected from damage, and removed or relocated only as indicated or specified. Inactive and abandoned utilities encountered in excavation and grading operations shall be removed, plugged or capped only with written authorization of the utility owner. Report in writing to the Engineer, the locations of such abandoned utilities. Extreme care shall be taken when performing, work in the vicinity of existing utility lines, utilizing hand excavation in such areas, as far as practicable,
4. Repair, or have repaired, all damage to existing utilities, structures, lawns, other public and private property which results from construction operations, at no additional expense to the Owner, to the complete satisfaction of the Engineer, the utility, the property owner, and the Owner.

G. Use of Explosives:

1. Do not bring explosives onto site or use in work without prior written permission from authorities having jurisdiction. Contractor is solely responsible for handling, storage, and use of explosive materials when their use is permitted.

2. All blasting shall be performed in accordance with all pertinent provisions of the "Manual of Accident Prevention in Construction" of the Associated General Contractors of America, Inc.

H. Stability of Excavations:

1. Slope sides of excavations to comply with all codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.
2. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.

I. Shoring and Bracing:

1 . Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition.
2. Provide trench shoring and bracing to comply with local codes and authorities having jurisdiction. Refer to Specification Section 02156.
3. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Install shoring and bracing as excavation progresses.

J. Material Storage:

1. Stockpile excavated materials which are satisfactory for use on the work until required for backfill or fill. Place, grade and shape stockpiles for proper drainage and protect with temporary seeding or other acceptable methods to control erosion.
2. Locate and retain soil materials away from edge of excavations.
3. Dispose of excess soil material and waste materials as herein specified.

K. Dewatering:

1. To ensure proper conditions at all times during construction, the Contractor shall provide and maintain ample means and devices (including spare units kept ready for immediate use in case of breakdowns) with which to intercept and/or remove promptly and dispose properly of all water entering trenches and other excavations (including surface and subsurface waters).
2. Excavations shall be kept dry until the structures, pipes, and appurtenances to be built therein have been completed to such extent that they will not be floated or otherwise damaged. Refer to Specification Section 02401.

L. Cold Weather Protection:

1. Protect excavation bottoms against freezing when atmospheric temperature is less than 35'F.
2. No frozen material shall be used as backfill or fill and no backfill shall be placed on frozen material.

M. Separation of Surface Material:
1. The Contractor shall remove only as much of any existing pavement as is necessary for the prosecution of the work.
2. Prior to excavation, existing pavement shall be cut where in the opinion of the Engineer it is necessary to prevent damage to the remaining road surface.
3. Where pavement is removed in large pieces, it shall be disposed of before proceeding with the excavation.
4. From areas within which excavations are to be made, loam and topsoil shall be carefully removed and separately stored to be used again as direct; or, if the Contractor prefers not to separate surface materials, he shall furnish, as directed, loam and topsoil at least equal in quantity and quality to that excavated.

N. Dust Control:
1. During the progress of the work, the Contractor shall conduct his operations and maintain the area of his activities, including sweeping and sprinkling of streets as necessary, so as to minimize the creation and dispersion of dust. Refer to Specification Section 01562.
2. If the Engineer decides that it is necessary to use calcium chloride for more effective dust control, the contractor shall furnish and spread the material, as directed.

3.3 BACKFILL AND FILL

A. General:
1. Backfilling shall consist of replacing material removed to permit installation of structures or utilities, as indicated in the Contract Documents.
2. Filling shall consist of placing material in areas to bring them up to grades indicated on the Drawings.
3. The Contractor shall provide and place all necessary backfill and fill material, in layers to the required grade elevations.
4. Backfill excavations as promptly as work permits, but not until completion of the following:
   a. Acceptance by Engineer of construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
   b. Inspection, approval, and recording locations of underground utilities.
   c. Removal of concrete formwork.
   d. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Temporary sheet piling driven below bottom of structures shall be removed in manner to prevent settlement of the structure or utilities, or cut off and left in place if required.
   e. Removal of trash and debris.
   f. Permanent or temporary horizontal bracing is in place on horizontally supported walls.

g. Density testing having results meeting requirements specified herein.

5. In general, and unless otherwise indicated, material used for backfill of trenches and excavations around structures shall be suitable excavated material which was removed in the course of making the construction excavation. Unless otherwise specified or allowed by the Engineer the backfill and fill shall be placed in layers not to exceed 8 inches in thickness.
6. All fill and backfill under structures and pavement, and adjacent to structures, shall be compacted crushed stone or select fill as specified or as indicated on the Drawings. The fill and backfill materials shall be placed in layers not exceeding 8 inches in thickness.
7. All structures (including manholes) shall be placed on a 6-inch mat of screened stone unless otherwise indicated.
8. Suitable excavated material shall meet the following requirements:
   a. Free from large clods, silt lumps or balls of clay.
   b. Free from stones and rock fragments with larger than 12 inch max. dimension.
   c. Free from organics, peat, etc.
   d. Free from frozen material.
9. If sufficient suitable excavated material is not available from the excavations, and where indicated on the Drawings, the backfill material shall be select fill or common borrow, unless otherwise indicated, as required and as directed by the Engineer.
10. Do not backfill with, or on, frozen materials.
11. Remove, or otherwise treat as necessary, previously placed material that has frozen prior to placing backfill.
12. Do not mechanically or hand compact material that is, in the opinion of the Engineer, too wet.
13. Do not continue backfilling until the previously placed and new materials have dried sufficiently to permit proper compaction.
14. The nature of the backfill materials will govern the methods best suited for their placement and compaction. Compaction methods and required percent compaction is covered in Compaction section.
15. Before compaction, moisten or aerate each layer as necessary to provide a water content necessary to meet the required percentage of maximum dry density for each area classification specified.
16. Do not allow large masses of backfill material to be dropped into the excavation in such a manner that may damage pipes and structures.
17. Place material in a manner that will prevent stones and lumps from becoming nested.
18. Completely fill all voids between stones with fine material.
19. Do not place backfill on or against new concrete until it has attained sufficient strength to support loads without distortion, cracking, and other damage.

20. Deposit backfill and fill material evenly on all sides of structures to avoid unequal soil pressures.
21. Keep stones or rock fragments with a dimension greater than two inches at least one foot away from the pipe or structure during backfilling.
22. Leave sheeting in place when damage is likely to result from its withdrawal.
23. Completely fill voids left by the removal of sheeting with screened stone which is compacted thoroughly.

B. Pipe Bedding, Initial Backfill and Trench Backfill

1. Place bedding and backfill in layers of uniform thickness specified herein, and as shown on the Drawings.
2. Thoroughly compact each layer by means of a suitable vibrator or mechanical tamper.
3. Install pipe bedding and initial backfill in layers of uniform thickness not greater than eight (8) inches.
4. Deposit the remainder of the backfill in uniform layers not greater than eight inches.
5. Provide underground sewer marking tape for the full length of sewer trenches as shown on the Drawings. Marking tape shall be SETON #210 SEW or equivalent.
6. Where soft silt and clay soils are encountered the trench shall be excavated six inches below the normal bedding and backfilled with 6-inches of compacted sand.
7. Backfill trenches with concrete where trench excavations pass within 18 inches of column or wall footings and which are carried below the bottom of such footings, or which pass under wall footings. Place concrete to the level of the bottom of adjacent footings.
8. The following schedule gives the bedding requirements for various types of pipe. Distances refer to vertical thickness below the pipe.

BEDDING REQUIREMENTS

DI, Concrete, and Culvert pipe	6 inches min. screened stone or select fill
PVC, ABS, and PE Pipe	6 inches min. screened stone.
Culverts and Storm Drain Pipe	6 inches min. select fill.

9. The following schedule gives the initial backfill requirements for various types of pipes.

INITIAL BACKFILL REQUIREMENTS

DI, Concrete, and culvert Pipe	Screened stone or select fill 6 inches min. over top of pipe.
PVC, ABS, and PE Pipe	6 inches min. screened stone over the top of the pipe.
Culverts and Storm Drain Pipe	Select fill 6 inches min.

10. Special bedding and backfill requirements shown on the Drawings supersede requirements of this section.
11. Where pipes or structures pass through or under the impervious core of the lagoon embankments, bedding and backfill material shall consist of the impervious embankment material. Extra care should be given to properly and thoroughly compact the bedding material around the pipe.

C. Improper Backfill:
1. When excavation and trenches have been improperly backfilled, and when settlement occurs, reopen the excavation to the depth required, as directed by the Engineer.
2. Refill and compact the excavation or trench with suitable material and restore the surface to the required grade and condition.
3. Excavation, backfilling, and compacting work performed to correct improper backfilling shall be performed at no additional cost to the Owner.

D. Ground Surface Preparation:
1. Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow, strip, scarify or break-up sloped surface steeper than I vertical to 4 horizontal.
2. When existing ground surface has a density less than that specified under "compaction" for the particular area classification, break up the ground surface, pulverize, moisture-condition to the optimum moisture content, and compact to required depth and percentage of maximum density.

3.4 COMPACTION

A. General:
1. Control soil compaction during construction to provide not less than the minimum percentage of density specified for each area classification.

B. Percentage of Maximum Density Requirements:

1. Compact soil to not less than the following percentages of maximum dry density determined in accordance with ASTM D 1557 as indicated.

a. Structures: Compact each layer of backfill or fill material below or adjacent to structures to at least 95% of maximum dry density (ASTM D1557).

b. Off Traveled Way Areas: Compact each layer of backfill or fill material to at least 90% of maximum dry density (ASTM D 1557).

c. Walkways: Compact each layer of backfill or fill material to at least 93% of maximum dry density (ASTM DI 557).

d. Roadways, Drives and Paved Areas: Compact each layer of fill, subbase material, and base material to at least 95% of maximum dry density (ASTM D 1557).

e. Pipes: Compact bedding material and each layer of backfill to at least 90% maximum dry density (ASTM D1557). Where backfilling with excavated material, compact to native field density.

f. Embankments: Compact each layer of embankment material to at least 95% of maximum dry density (ASTM D1557).

C. Moisture Control:

1. Where subgrade or a layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material, in quantities controlled to prevent free water appearing on surface during or subsequent to compaction operations.

2. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.

3. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory level.

D. Embankment Compaction:

1. After each embankment layer has been spread to the required maximum 8 inch thickness and its moisture content has been adjusted as necessary, it shall be rolled with a sufficient number of passes to obtain the required compaction. One pass is defined as the required number of successive trips which by means of sufficient overlap will insure complete coverage and uniform compaction of an entire lift. Additional passes shall not be made until the previous pass has been completed.

2. When any section of an embankment sinks or weaves excessively under the roller or under hauling units and other equipment, it will be evident that the required degree of compaction is not being obtained and that a reduction in the moisture content is required. If at any place or time such sinking and weaving produces surface cracks which, in the judgment of the Engineer are of such character, amount, or extent to indicate an

unfavorable condition, he will recommend operations on that part of the embankment to be suspended until such time as it shall have become sufficiently stabilized. The ideal condition of the embankment is that attained when the entire embankment below the surface being rolled is so firm and hard as to show only the slightest weaving and deflection as the roller passes.

3. If the moisture content is insufficient to obtain the required compaction, the rolling shall not proceed except with the written approval of the Engineer, and in that event, additional rolling shall be done to obtain the required compaction. If the moisture content is greater than the limit specified, the material of such water content may be removed and stockpiled for later use or the rolling shall be delayed until such time as the material has dried sufficiently so that the moisture content is within the specified limits. No adjustment in price will be made on account of any operation of the Contractor in removing and stockpiling, or in drying the materials or on account of delays occasioned thereby.
4. If because of insufficient overlap, too much or too little water, or other cause attributable to defective work, the compaction obtained over any area is less than that required, the condition shall be remedied, and if additional rollings are ordered, they will be done at no cost to the Owner. If the material itself is unsatisfactory or if additional rolling or other means fails to produce satisfactory results, the area in question shall be removed down to material of satisfactory density and the removal, replacement, and re-rolling shall be done by the Contractor, without additional compensation.
5. Material compaction by hand-operated equipment or power-driven tampers shall be spread in layers not more than 6 inches thick. The degree of compaction obtained by these tamping operations shall be equal in every respect to that secured by the rolling operation.

E. Compaction Methods: The Contractor may select any method of compaction that is suitable to compact the material to the required density.

1. General: Whatever method of compacting backfill is used, care shall be taken that stones and lumps shall not become nested and that all voids between stones shall be completely filled with fine material. All voids left by the removal of sheeting shall be completely backfilled with suitable materials and thoroughly compacted.
3. Tamping or Rolling: If the material is to be compacted by tamping or rolling the material shall be deposited and spread in uniform, parallel layers not exceeding the uncompacted thicknesses specified. Before the next layer is placed, each layer shall be tamped as required so as to obtain a thoroughly compacted mass. Care shall be taken that the material close to the excavation side slopes, as well as in all other portions of the fill

area, is thoroughly compacted. When the excavation width and the depth to which backfill has been placed are sufficient to make it feasible, and it can be done effectively and without damage to the pipe or structure, backfill may, on approval, be compacted by the use of suitable rollers, tractors, or similar powered equipment instead of by tamping. For compaction by tamping or rolling, the rate at which backfilling material is deposited shall not exceed that permitted by the facilities for its spreading, leveling, and compacting as furnished by the Contractor.

F. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape, and compact to required density prior to further construction.

3.5 GRADING:

A. General:

1. Grading shall consist of that work necessary to bring all areas to the final grades.
2. Uniformly grade areas within limits of work requiring grading, including adjacent transition areas.
3. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.

B. Grading Outside Building Lines:

1. Grade areas adjacent to building to drain away from structures and to prevent ponding.
2. Grade surfaces to be free from irregular surface changes, and as follows:
   a. Lawn or Unpaved Areas: Finish grade areas to receive topsoil to within not more than I " above or below the required subgrade elevations.
   b. Walks: Shape surface of areas under walks to line, grade and cross-section, with finish surface not more than 1/2" above or below the required subgrade elevation.
   c. Pavements: Shape surface of areas under pavement to line, grade and cross-section, with finish surface not more than 3/8" above or below the required subgrade elevation.

C. Grading Surface of Fill Under Building Slabs:

1. Grade surface to be smooth and even, free of voids, and compacted as specified, to the required elevation.
2. Provide final grades within a tolerance of 1/2" when tested with a 10' straight edge.

D. Compaction:

1. After grading, compact subgrade surfaces to the depth and percentage of maximum density for each area classification.

E. Protection of Graded Areas:
   1. Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
   2. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

3.6 BASE COURSE AND LEVELING COURSE

A. General:
   1. Base course consists of placing the specified materials in layers to support a leveling course or paved surface, as indicated in the Drawings.

B. Grade Control:
   1. During construction, maintain lines and grades including crown and crossslope of base course and leveling course.

C. Placing:
   1. Place base course on prepared subbase conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting base materials.
   2. Place leveling course on prepared base course, conforming to indicated cross-section and thickness. Maintain optimum moisture content for compaction.

D. Shaping and Compacting:
   1. All layers of aggregate base course and leveling course shall be compacted to the required density immediately after placing. As soon as the compaction of any layer has been completed, the next layer shall be placed.
   2. The Contractor shall bear full responsibility for and make all necessary repairs to the base leveling courses and the subgrade until the full depth of the base leveling courses is placed and compacted. Repairs shall be made at no additional cost to the Owner.
   3 . If the top of any layer of the aggregate base or leveling course becomes contaminated by degradation of the aggregate or addition of foreign materials, the contaminated material shall be removed and replaced with the specified material at the Contractor's expense.

END OF SECTION

SECTION 02224

TRENCH EXCAVATION - LEDGE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. A pre-blast survey is required before any drilling or blasting is to be started. This survey shall include all pertinent information of existing property within 500 feet of any area where blasting will occur, such as foundations, retaining walls, steps, etc. to be obtained through the use of photographs and written descriptions. This survey is to conducted at no additional cost to the Owner. A representative of the Engineer shall accompany the Contractor on the pre-blast survey. The Contractor shall notify the Engineer a minimum of five (5) days prior to the pre-blast survey.
2. Trench excavation work in ledge includes the removal of ledge and rock required for the installation of pipes and/or structures.
3. “Ledge” and “rock” include any natural compound, native mixture, and chemical element required to be excavated that, in the opinion of the Engineer, can be removed from its existing position and state only by blasting, drilling and blasting, wedging, drilling and wedging, wedging and breaking with power hand tools, or by extending the use of an approved excavating machine beyond the normal and design wear and tear. No boulder, ledge, slab, or other single piece of excavated material less than two cubic yards in total volume shall be considered to be rock unless, in the opinion of the Engineer, it must be removed from its existing position by one of the methods mentioned above.
4. All trench excavation shall be classed as earth or ledge.
5. Submittals to the Engineer: The Contractor shall submit documentation that shows that the blaster is qualified to undertake the planned work, including proof of insurance. The blaster shall submit a blasting work plan for approval by the Engineer prior to the start of the work. The plan shall include, but not be limited to:
    a. blasting materials and program
    b. monitoring program
    c. pre-blast survey
    d. safety
    e. traffic control

B. Related Work Specified Elsewhere:

1. The use of explosives is specified in Section 01546.
2. Traffic Regulation is specified in Division 1

3. Clearing, removal and replacement of paving, trench excavation (earth), trench backfilling, compaction, control and testing, dewatering, borrow and bedding material, manholes and basins, pipe and pipe fittings are specified in the appropriate sections of this Division.

1.2 JOB CONDITIONS

A. Utilities:

1. The locations of known buried water lines, sewer lines, telephone cables, storm drains, culverts, electric conduits and other utilities are shown on the Drawings. No guarantee is made as to the correctness of the locations shown and to the completeness of the information given.

B. Existing Structures:

1. Perform excavation in such a manner that will prevent any possibility of undermining and disturbing the foundations of any existing structures and any work previously completed under this Contract.
2. Where existing buildings and other structures are in proximity to the proposed construction, exercise extreme caution and utilize whatever precautionary measures that may be required.

C. Repairing Damage:

1. Repair, or have repaired, at no additional expense to the Owner, to the complete satisfaction of the Engineer, the utility company, property owner and the Owner, all damage to existing utilities, structures, lawns, and other public and private property which results from construction operations.

PART 2 - PRODUCTS

2.1 MATERIALS

A. The Contractor shall not have any right of property in any suitable materials taken from any excavation. Do not remove any such materials from the construction site without the approval of the BBHSD. This provision shall in no way relieve the Contractor of his obligation to remove and dispose of any material determined by the BBHSD to be unsuitable backfilling.

PART 3 - EXECUTION

3.1 PERFORMANCE

A. General:

1. Unless otherwise specifically directed or permitted by the Engineer, begin excavation at the low end of the sewer and storm lines and proceed upgrade.
2. Perform excavation for sewer mains and water mains in a logical sequence.

B. Amount of Excavation:
   1. Trench width: See Measurement and Payment section of the Contract.
   2. Trench depth: As shown on the Drawings.
   3. Open excavation:
      a. The extent of open excavation shall be controlled by prevailing conditions.
      b. Open excavation shall at all times be confined to the limits as directed by the Engineer.
   4. Unauthorized excavation:
      a. Backfill to the specified grade, any excavations beyond the limits stated above and as shown on the Drawings (unless specifically ordered by the Engineer) with thoroughly compacted crushed stone or screened gravel.
      b. Backfilling unauthorized excavation shall be at no additional cost to the Owner.

C. Blasting:
   1. The Contractor shall control blasting so that the peak particle velocity shall not exceed 2 inches per second at the nearest structure of significance and the maximum air overblast pressure shall not exceed 0.5 psi at the nearest structure of significance. The Contractor shall monitor all blasts for peak particle velocity and air overblast pressure.

      All monitoring results shall be provided to the Engineer within 48 hours of the blast.
   2. The Contractor shall take all steps required to limit flying rock damage.
   3. Blasting shall be done so that 90% of all rock has a maximum dimension of 2 feet or less.

END OF SECTION

SECTION 02260

FILTER FABRIC

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

Furnish all materials and install filter fabric of the types, dimensions and in the location(s) shown on the Drawings and specified herein.

B. Related Work Specified Elsewhere:

1. Temporary Erosion Control, Riprap and Stone Ditch Protection, and Gabions and Revet Mattresses are specified in the appropriate sections of this Division.

1.2 QUALITY ASSURANCE

A. A competent laboratory must be maintained by the manufacturer of the fabric at the point of manufacture to insure quality control.

B. During all periods of shipment and storage, the fabric shall be wrapped in a heavy duty protective covering to protect the fabric from direct sunlight, ultraviolet rays, temperatures greater than 1400F, mud, dirt, dust and debris.

1.3 SUBMITTALS

A. Manufacturer shall furnish certified test reports with each shipment of material attesting that the fabric meets the requirements of this Specification.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Filter fabric for use in stabilization, drainage, underdrains, erosion control, landscaping and beneath structures shall be formed in widths of not less than six (6) feet and shall meet the requirements of Table 1. Both woven and non-woven geotextiles are acceptable; however no "slit-tape" woven fabrics will be permitted for drainage, underdrain, and erosion control applications.

Table I

Geotextile Mechanical Property	Test Method	Minimum Permissible Value
Grab Tensile Strength (both directions)	ASTM D4595-86	120 pounds
Grab Elongation	ASTM D4632-86	50 percent
Mullen Burst Strength	ASTM D3786-87	210 psi
Puncture Strength	ASTM D3787	60 pounds
Trapezoid Tear Strength	ASTM D4533-85	50 pounds
Water Flow Rate	ASTM D4491-85	120 gal/min/sf
Equivalent Opening Size (EOS)	ASTM D4751	80
Coefficient of Permeability	ASTM D4491-85	0.2 cm/sec

The geotextile shall have property values expressed in "typical" values that meet or exceed the values stated above as determined by the most recent test methods specified above.

B. Filter fabric for use in reinforcement and under riprap shall meet the requirements of Table 2. Woven and non-woven geotextiles are acceptable.

Table 2

Geotextile Mechanical Property	Test Method	Minimum Permissible Value
Grab Tensile Strength (both directions)	ASTM 4595-86	195 pounds
Grab Elongation	ASTM D4632-86	20 percent
Mullen Burst Strength	ASTM D3786-87	340 psi

Puncture Strength	ASTM D3787	85 pounds
Trapezoid Tear Strength	ASTM D4533-85	85 pounds
Equivalent Opening Size (EOS)	ASTM D4751	U.S. Std. Sieve number(s) between #20 and #I 00

The geotextile shall meet or exceed the "typical" values stated above as determined by the most recent test methods specified above.

C. Filter Fabric for use in siltation fencing shall be the following:
   1. Environfence 100X (Mirafi)
   2. Supac 4NP (Phillip 66)
   3. Exxon 180 Siltfence
   4. Amoco 1380 Silt Stop
   5. Harris Siltfence
   6. Or equivalent

PART 3 - EXECUTION

3.1 Install filter fabric as shown on the drawings or as directed in appropriate specifications in this division or in accordance with manufacturer's instructions or as directed by the Engineer.

END OF SECTION

SECTION 02270

TEMPORARY EROSION CONTROL,

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. The work under this section shall include provision of all labor, equipment, materials and maintenance of temporary erosion control devices as specified herein, as shown on the Drawings and as directed by the Engineer.
2. Erosion control measures shall be provided as necessary to correct conditions that develop prior to the completion of permanent erosion control devices or as required to control erosion that occurs during normal construction operations.
3. Construction operations shall comply with all federal, state and local regulations pertaining to erosion control.
4. After awarded the Contract, prior to commencement of construction activities, meet with the Engineer to discuss erosion control requirements and develop a mutual understanding relative to details of erosion control.

B. Related Work Specified Elsewhere:

1. Site work is specified in appropriate sections of this Division.

C. Design Criteria:

1. Conduct all construction in a manner and sequence that causes the least practical disturbance of the physical environment.
2. Stabilize disturbed earth surfaces in the shortest time and employ such temporary erosion control devices as may be necessary until such time as adequate soil stabilization has been achieved.

1.2 SUBMITTALS

A. The Contractor shall furnish the Engineer, in writing, his work plan giving proposed locations for storage of topsoil and excavated material before beginning construction. A schedule of work shall accompany the work plan. Acceptance of this plan will not relieve the Contractor of the responsibility of completion of the work as specified.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Baled Hay:

1. At least 14" by 18" by 30" securely tied to form a firm bale, staked as necessary to hold the bale in place.

B. Sand Bags:

Heavy cloth bags of approximately one cubic foot capacity filled with sand or gravel.

C. Mulches:

1. Loose hay, straw, peat moss, wood chips, bark mulch, crushed stone, wood excelsior, or wood fiber cellulose.
2. Type and use shall be as specified by the "Maine Erosion and Sediment Control on Commercial, Industrial, Residential, Recreation and Government Construction Sites; Environmental Quality Handbook" prepared by the Maine Soil and Water Conservation Commission herein after referred to as the Environmental Quality Handbook.

D. Mats and Netting:

1. Twisted Craft paper, yam, jute, excelsior wood fiber mats, glass fiber and plastic film.
2. Type and use shall be as specified by the Environmental Quality Handbook.

E. Permanent Seed:

1. Conservation mix appropriate to the predominant soil conditions as specified in the Environmental Quality Handbook and subject to approval by the Engineer.

F. Temporary Seeding:

1. Use species appropriate for soil conditions and season as specified in the

G. Sod: Environmental Quality Handbook and subject to approval by the Engineer.

1. Grown from certified seed of adapted varieties to produce high quality sod free of any serious thatch, weeds, insects, diseases and other pest problems.
2. At least one year old and not older than three years. Cut with a 1/2 to I inch layer of soil.

H. Water:

1. The Contractor shall provide water and equipment to control dust, as directed by the Engineer.

I. Filter Fabrics:

1 . Filter fabric shall be of one of the commercially available brands such as Mirafi, Typar or equivalent. Fabric types for particular applications shall be approved by the Engineer prior to installation.

2.2 CONSTRUCTION REQUIREMENTS

A. Temporary Erosion Checks:

1 . Temporary erosion checks shall be constructed in ditches and other locations as necessary.
2. Baled hay, sand bags or siltation fence may be used in an arrangement to fit local conditions.

B. Temporary Berms:

1. Temporary barriers shall be constructed along the toe of embankments when necessary to prevent erosion and sedimentation.

C. Temporary Seeding:

Areas to remain exposed for a time exceeding 3 weeks shall receive temporary seeding as indicated below:

Season	Seed	Rate
Summer (5/15 - 8/15)	Sudangrass	40 lbs/acre
Late Summer/Early Fall	Oats	80 lbs/acre
(8/15 - 9/15)	Annual Ryegrass	40 lbs/acre
Fall (9/15 - 10/1)	Winter Rye	112 lbs/acre
Winter (10/1 - 4/ 1)	Mulch w/Dormant Seed	80 lbs/acre*
Spring (4/1 - 7/1)	Oats	80 lbs/acre
	Annual Ryegrass	40 lbs/acre
		seed rate only

D. Sedimentation Basin:
   1. Sedimentation basins shall be areas where water is temporarily delayed or slowed down, constructed where shown on the plans or as directed by the Engineer.
   2. Capacity shall be equal to the volume of sediment expected to be trapped at the basin during the planned useful life of the structure, or if the periodic removal of debris is practical, the capacity may be proportionately reduced.
   3. Design shall be in accordance with the Standards for Ponds, Grade Stabilization Structure or USDA Soil Conservation Service Engineering Memorandum No. 27 and/or as shown on the Drawings.

E. Siltation fences shall consist of porous filter fabric with a wire mesh backing and shall be supported by posts as per manufacturer's recommendations. Fabric shall be approved by the Engineer.

F. Mulch All Areas Receiving Seeding:

   Anchor mulch with peg and twine (1 sq. yd./block); mulch netting (as per manufacturer); asphalt emulsion (0.04 gallons per sq. yd.); liquid asphalt (0.10 gallons per sq. yd.); wood cellulose fiber (750 lbs/acre); chemical tack (as per manufacturers specifications). Wetting for small areas may be permitted. Biodegradable netting is recommended in areas to be exposed to drainage flow.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Temporary Erosion Checks:
   1. Temporary erosion checks shall be constructed in ditches and at other locations designated by the Engineer. The Engineer may modify the Contractor's arrangement of silt fences, bales and bags to fit local conditions.

2. Baled hay, silt fences, or sandbags, or some combination, may be used in other areas as necessary to inhibit soil erosion.
3. Siltation fence, if called for in the plans, shall be located and installed as shown.
4. Sedimentation ponds shall be sited and constructed to the grades and dimensions as shown on the Drawings and will include drainage pipe and an emergency spillway.

B. Maintenance:

Erosion control features shall be installed prior to excavation wherever appropriate. Temporary erosion control features shall remain in place and shall be maintained until a satisfactory growth of grass is established. The Contractor shall be responsible for maintaining erosion control features throughout the life of the construction contract. Maintenance will include periodic inspections by the Owner or Engineer for effectiveness of location, installation and condition with corrective action taken by the Contractor as appropriate.

C. Removing and Disposing of Materials:

1. When no longer needed, material and devices for temporary erosion control shall be removed and disposed of as approved by the Engineer.
2. When removed, such devices may be reused in other locations provided they arc in good condition and suitable to perform the erosion control for which they are intended.
3. When dispersed over adjacent areas, the material shall be scattered to the extent that it causes no unsightly conditions nor creates future maintenance problems.
4. Sedimentation basins, if no longer required, will be filled in, the pipe removed, the surface loamed and grass cover shall be established.

END OF SECTION

SECTION 02271

RIPRAP AND STONE DITCH PROTECTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work consists of furnishing all plant, labor, equipment, and materials and performing all work necessary to place a protective covering of erosion-resistant material on the slopes of embankments, spillways, streambanks, slopes of channels, or as directed by the Engineer. The work shall be done in accordance with these Specifications and in conformity with the lines and grades shown on the Drawings or established by the Engineer.

B. Types of riprap included in this specification:

1. Dumped Riprap - Dumped riprap consists of stone dumped in place on a prepared slope of either a filter blanket or a filter fabric backing to form a well-graded mass with a minimum of voids.
2. Filter Blanket - A filter blanket consists of one or more layers of graded material placed on the bank before placing the riprap in order to prevent the bank material from passing through the riprap protection. The thickness and gradation of filter blanket will be shown on the plans.
3. Filter Fabric Backing - A filter fabric backing consists of a filter fabric overlain by a layer of coarse aggregate placed on the bank before placing the riprap to prevent the bank material from passing through the riprap protection. Filter fabric backing shall be used in lieu of a filter blanket where specifically called for on the plans or where approved by the Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Definition of the materials:

1. Dumped Riprap:

a. Stone used for dumped riprap shall be hard, durable, angular in shape; resistant to weathering and to water action; free from overburden, spoil, shale and organic material; and shall meet the gradation requirements for the class specified. Neither breadth nor thickness of a single stone should be less than one-third its length. Rounded stone or boulders shall not be accepted without written permission of the Engineer. Broken concrete may be substituted for stone with written authorization of the Engineer. Shale and stone with shale seams are not acceptable. The minimum weight of the stone shall be 155 pounds per cubic foot as computed by multiplying the specific gravity (bulksaturated-surface-dry basis, AASHTO Test T 85) times 62.3 pounds per cubic foot.

b. Each load of riprap shall be reasonably well graded from the smallest to the maximum size specified. Stones smaller than the specified 10 percent size and spalls shall not be permitted in an amount exceeding 10 percent by weight of each load.

2. Filter Blanket - The filter blanket shall consist of one or more layers of screened gravel of the thickness as shown on the plans. The gradation of materials in the filter blanket shall be as shown on the Drawings. All material comprising the filter blanket shall be composed of tough, durable particles, reasonably free from thin, flat and elongated pieces, and shall contain no organic matter nor soft, friable particles in quantities in excess of those approved by the Engineer.
3. Filter Fabric Backing:
   a. Coarse Aggregate:
      1) Filter Fabric shall be as specified in Section 02260.

B. Gradation of Coarse Aggregate for Filter Fabric Backing:

Sieve Size	% Passing By Weight
2-1/2"	100
2”	85 - 100
1”	35 - 70
1/2"	10 - 30
No. 4	0 - 5

C. Gradation of Riprap Stone:

Size of Stone	% of Total Weight Smaller Than The Given Size
Class I	
100 lb.	100
60 lb.	80
25 lb.	50
2 lb.	10
Class II	
700 lb.	100
500 lb.	80
200 lb.	50
20 lb.	10

Class III

2,000 lb.	100
1,400 lb.	80
700 lb.	50
40 lb.	10

PART 3 - EXECUTION

3.1 CONSTRUCTION DETAILS

A. Slopes to be protected by riprap shall be free of brush, trees, stumps, and other objectionable material and be dressed to a smooth surface. All soft or spongy material shall be removed to the depth shown on the Drawings or as directed by the Engineer and replaced with approved material. Filled areas will be compacted thoroughly. A toe trench as shown on the Drawings shall be dug and maintained until the riprap is placed.

1. Dumped Riprap

a. Stone for riprap shall be placed on the prepared slope or area in a manner which will produce a reasonably well- graded mass of stone with the minimum practicable percentage of voids. The entire mass of stone shall be placed in conformance with the lines, grades, and thicknesses shown on the Drawings. Riprap shall be placed to its full course thickness in one operation and in such a manner as to avoid displacing the underlying material. Placing of riprap in layers, or by dumping into chutes, or by similar methods likely to cause segregation will not be permitted.

b. The larger stones shall be well distributed and the entire mass of stone shall conform to the gradation specified on the Drawings. All material going into riprap protection shall be so placed and distributed so that there will be no large accumulations of either the larger or smaller sizes of stone.

c. It is the intent of these Specifications to produce a compact riprap protection in which all sizes of material are placed in their proper proportions. Hand placing or rearranging of individual stones by mechanical equipment may be required to the extent necessary to secure the results specified.

d. Unless otherwise authorized by the Engineer, the riprap protection shall be placed in conjunction with the construction of the embankment with only sufficient lag in construction of the riprap protection as may be necessary to allow for proper construction of the portion of the embankment protected and to prevent mixture of embankment and riprap. The riprap protection shall be maintained until accepted, and any material displaced by any cause shall be replaced.

e. Riprap stone shall not be dropped from a height greater than one foot onto the filter blanket.

2. Filter Blanket:

a. A filter blanket shall be placed on the prepared slope or area to the full specified thickness using methods which will not cause segregation of particle sizes within the bedding. The surface of the finished layer should be reasonably even and free from mounds or windrows.

3. Filter Fabric Backing:

a. A filter fabric shall be placed in the manner and at the locations shown in the Drawings or as directed by the Engineer. At the time of installation, fabric shall be rejected if it has defects, rips, holes, flaws, deterioration or damage incurred during manufacture, transportation or storage. The fabric shall be placed with the long dimension parallel to the centerline of the channel or shoreline unless otherwise directed by the Engineer, and shall be laid smooth and free of tension, stress, folds, wrinkles, or creases. The strips shall be placed to provide a minimum width of 36 inches of overlap for each joint. Overlap joints and seats shall be measured as a single layer of cloth. Securing pins with washers shall be inserted through both strips of overlapped cloth at not greater than the following intervals along a line through the midpoint of the overlap.

Pin Spacing	Slope
2 feet	Steeper than 3:1
3 feet	3:1 to 4:1
5 feet	Flatter than 4:1

The fabric shall be turned down and buried two (2) feet at all exterior limits.

b. Additional pins regardless of location shall be installed as necessary to prevent any slippage of the filter fabric. The fabric shall be placed so that the upstream strip of fabric will overlap the downstream strip. Should the Engineer direct that the fabric be placed with the long dimension perpendicular to the centerline of the channel or shoreline, the lower strip of fabric shall overlap the next higher strip. Each securing pin shall be pushed through the fabric until the washer bears against the fabric and secures it firmly to the foundation. The fabric shall be protected at all times during construction from contamination by surface runoff and any fabric so contaminated shall be removed and replaced with uncontaminated fabric. Any damage to the fabric during its installation or during placement of riprap shall be replaced by the Contractor. The work shall be scheduled so that the filter blanket shall be covered with riprap as soon as possible following filter blanket placement. Any damage to the filter material during placement of riprap shall be corrected prior to proceeding with the work.

c. Securing pins for anchoring filter fabric shall be 3/16 inch steel bars, pointed at one end and fabricated with a head to retain a steel washer having an outside diameter of not less than 1.5 inches. The length of the pin shall not be less than 18 inches.

d. A layer of coarse aggregate shall be placed on the filter fabric to the full specified thickness using methods which will not cause segregation of particle sizes. The surface of the finished layer shall be reasonably even and free from mounds or windrows.

END OF SECTION

SECTION 02401

DEWATERING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Furnish, operate and maintain, as incidental to the project, dewatering equipment for the control, collection and disposal of ground and surface water where necessary to complete the work.

B. Related Work Specified Elsewhere: (When Applicable)

1. Trench Excavation - Earth, Trench Excavation - Ledge, Structural Excavation, and Trench Backfilling, Compaction, Control and Testing, and Earthwork are specified in the appropriate sections in this division.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.1 PERFORMANCE

A. General:

1. Keep work areas dewatered until the structures, pipes, and appurtenances to be built there have been completed to such an extent that they will not be damaged by water.
2. Thoroughly brace or otherwise protect against flotation all pipelines and structures which are not stable.

B. Disposal of Water:

1. Dispose of water pumped or drained from the construction site in a suitable manner to avoid public nuisance, injury to public health, damage to public and private property, and damage to the work completed or in progress.
2. Provide suitable temporary channels for water that may flow along or across the construction site.

C. Damage:

1. Any damage resulting from the dewatering operations, or the failure of the Contractor to maintain the work in a suitably dry condition shall be repaired by the Contractor at no additional cost to the Owner.

D. Temporary Underdrains:

1. When necessary, temporary underdrains may be placed in excavations.

2. Underdrain pipe shall be perforated, concrete, corrugated metal or PVC pipe.
3. Entirely surround the underdrain and fill the space between the underdrain and the pipe or structure with underdrain material.

E. Excavation Sump Pumping:
1. When necessary and where appropriate to the geotechnical conditions encountered, excavations may be over excavated 6 to 12 inches and filled with 3/4-inch crushed stone to allow sump pumping of groundwater.
2. The system shall be installed with suitable screens and filters so that pumping of fines does not occur.

F. Well and Wellpoint System:
1. If necessary dewater the excavations and trenches with an efficient well or wellpoint system to drain the soil and prevent saturated soil from flowing into the excavated wells and area.
2. Wellpoint and well system shall be of the type designed for dewatering work and shall be installed with suitable screens and filters so that pumping of fumes does not occur.
3. Pumping units shall be capable of maintaining sufficient suction to handle large volumes of air and water at the same time.

END OF SECTION

SECTION 02434

CULVERTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

Provide and install culvert pipe and sections of the type(s), size(s) and in the location(s) shown on the Drawings and as specified herein.

B. Related Work Specified Elsewhere:

1. Excavation and backfill, dewatering, pavement, borrow and bedding material are specified in the appropriate sections in this division.

1.2 SUBMITTALS

A. Submit, in duplicate, sworn certificates of inspections and tests performed at the location of manufacturers.

B. Submit shop drawings in accordance with the General Conditions of the Construction Contract.

1.3 DELIVERY, STORAGE AND HANDLING

A. Exercise care when handling culvert pipe to prevent damage of any nature to pipe and finish.

B. Immediately remove damaged materials and replace at no additional cost to the Owner.

C. Store materials above ground on platforms, skids or other adequate supports.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Pipe shall be one of the following at the option of the Contractor and with approval of the Engineer.

1. Bituminous Coated Corrugated Metal Pipe
2. Corrugated Aluminum Pipe
3. Bituminous Coated, Smooth Lined, Corrugated Iron or Steel Pipe
4. Smooth Lined Corrugated Aluminum Pipe
5. Precoated, Smooth Lined Corrugated Iron or Steel Pipe
6. Reinforced Concrete Pipe

B. Materials for pipes shall conform to AASHTO Standards.

1. Bituminous Coated Corrugated Metal Pipe: These pipes and the coupling bands shall conform to the requirements of AASHTO M 36 for the specified sectional dimensions and gauges. Special sections, such as elbow and flared end section, for these conduits shall be of the gauge called for on the plans and conform to the applicable requirements of AASHTO M 36. Modification of coupling bands resulting in strength requirements which equal or exceed the requirements of AASHTO M 36 will be allowed upon approval of the Engineer. Shop-formed elliptical pipe and shop strutted pipe shall be furnished where specified. After fabrication, the pipe shall be coated inside and outside in accordance with AASHTO M 190, Type A.
2. Corrugated Aluminum Pipe: These pipes shall conform to the requirements of AASHTO M 196. Special sections, such as elbows, and metal end sections shall be of the gauge called for on the plans and shall conform to the applicable requirements of AASHTO M 196. Shop-formed elliptical pipe and shop strutted pipe shall be furnished where specified.
3. Bituminous Coated, Smooth Lined Corrugated Iron or Steel Pipe: This pipe shall conform to the requirements of AASHTO M 36, Type IA Pipe and to the gauge called for on the plans. After fabrication, the pipe shall be coated with bitumen on the exposed surfaces of the inside and outside of the pipe in accordance with AASHTO M 190, Type A.
4. Smooth Lined Corrugated Aluminum Pipe: This pipe shall conform to the applicable requirements of AASHTO M 196, Type IA pipe and to the gauge called for on the plans.
5. Precoated, Smooth Lined, Corrugated Iron or Steel Pipe: This pipe shall conform to the requirements of AASHTO M 245, Type IA pipe and to the gauge called for on the plans. The heavier coating shall be on the exposed inside surface of the liner. After fabrication, the pipe shall be coated with bitumen on the exposed surfaces of the inside and outside of the pipe in accordance with AASHTO M 190, Type A except that the minimum thickness of bitumen may be 0.03 inches.
6. Reinforced Concrete Pipe: Reinforced concrete pipe shall conform to the requirements of AASHTO M 170 for the specified diameters and strength classes. Elliptical pipe shall conform to the requirements of AASHTO 207. Unless otherwise specified, pipe wall design and use of elliptical reinforcement in circular pipe are optional.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas to receive piping for the following:

1. Obstructions that adversely affect the installation and quality of the work.
2. Deviations beyond allowable tolerances for clearances.

B. Examine pipe and fittings before installation to assure no defective materials are incorporated.
C. Start the work only when conditions are satisfactory.
D. Remove and replace all defective materials at no additional cost to the Owner.

3.2 INSTALLATION

A. Do not install culverts, nor backfill, between December 15 and April I without the written permission of the Engineer.
B. Begin laying the culvert at the downstream end.
C. Place metal culverts with the longitudinal laps of seams at the sides and the outside laps of circumferential joints pointing up grade.
D. Lay paved or partially lined culverts with the lining on the bottom.
E. Join flexible culvert sections and metal end sections by coupling bands.
F. Assemble the plates for structural plate arches according to the manufacturer's assembly instructions and as shown on the Drawings.

END OF SECTION

SECTION 02480

LANDSCAPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Perform the following items of work as required to complete the work of this section as shown on the Drawings and as specified hereunder:
   a. Spread stockpiled topsoil and furnish and spread any additional topsoil, required to meet the requirements of this section.
   b. Furnish and sow grass seed/or sod in all areas within the work area to the extent indicated on the Drawings, and in existing grass areas which have been damaged or disturbed by the work of this Contract.
   c. Furnish and install plant materials in all areas within the work area as indicated on the Drawings.
   d. Provide maintenance services as specified hereunder.
2. Examine all other sections of the Specifications and all Drawings for the relationship of the work under this section and the work of other trades. Cooperate with all trades in performing the work under this section.

1.2 SUBMITTALS AND TESTING

A. Seed:

1. Furnish the Engineer with duplicate signed copies of a statement from the vendor, certifying that each container of seed delivered to the project site is **fully** labeled in accordance with the Federal Seed Act and is at least equal to the specification requirements.
2. This certification shall appear in, or with, all copies of invoices for the seed.
3. Each lot of seed shall be subject to sampling and testing, at the discretion of the Engineer, in accordance with the latest rules and regulations under the Federal Seed Act.

B. Topsoil:

1. Inform the Engineer, within 30 days after the award of the Contract, of the sources from which the topsoil is to be furnished. It is the intent of this section that all topsoil which can be recovered from the site shall be used. Furnish additional topsoil as required.
2. Obtain representative soil samples, taken from several locations in the area under consideration for topsoil removal, to the full stripping depth.
3. Have soil samples tested by an independent soils testing laboratory, approved by the Engineer, at the Contractor's expense.

4. Have soil samples tested for physical properties and pH (or lime requirement), for organic matter, available phosphoric acid, and available potash, in accordance with standard practices of soil testing for agricultural use.

5. Approval, by the Engineer, to use topsoil for use in the work will be dependent upon the results of the soils tests.

C. Lime and Fertilizer:

1. Furnish the Engineer with duplicate copies of invoices for all lime and fertilizer used on the project showing the total minimum carbonates and minimum percentages of the material furnished that pass the 90 and 20 mesh sieves and the grade furnished.
2. Each lot of lime and fertilizer shall be subject to sampling and testing at the discretion of the Engineer.
3. Sampling and testing shall be in accordance with the official methods of the Association of Official Agricultural Chemists.
4. Upon completion of the project, a final check may be made comparing the total quantities of fertilizer and lime used to the total area seeded. If the minimum rates of application have not been met, the Engineer may require the Contractor to distribute additional quantities of these materials to meet the minimum rates.

1.3 DELIVERY, STORAGE AND HANDLING

A. Seed:

1. Furnish all seed in sealed standard containers, unless exception is granted in writing by the Engineer.
2. Containers shall be labeled in accordance with the United States Department of Agriculture's rules and regulations under the Federal Seed Act in effect at the time of purchase.

B. Fertilizer:

1. Furnish all fertilizer in unopened original containers.
2. Containers shall be labeled with the manufacturer's statement of analysis.

1.4 JOB CONDITIONS

A. Topsoil:

1. Do not place or spread topsoil when the subgrade is frozen, excessively wet or dry, or in any condition otherwise detrimental, in the opinion of the Engineer, to the proposed planting or to proper grading.

B. Seeding and Planting:

1. Work Seasons - Perform seeding and planting work only between the dates of I May to 20 June and 15 August to I October, except as otherwise directed in writing by the Engineer.
2. Weather Conditions:
   a. Do not perform seeding work when weather conditions are such that beneficial results are not likely to be obtained, such as drought, excessive moisture, or high winds.

b. Stop the seeding work when, in the opinion of the Engineer, weather conditions are not favorable.

c. Resume the work only when, in the opinion of the Engineer, conditions become favorable, or when approved alternate or corrective measures and procedures are placed into effect.

PART 2 - PRODUCTS

2.1 MATERIALS FOR GRADING AND SEEDING

A. Topsoil:

1. Additional topsoil from offsite, if required to meet minimum depths, shall be friable topsoil, typical of cultivated topsoils of the locality, containing at least three percent of decayed organic matter (humus). It shall be taken from a well drained arable site. It shall be reasonably free from subsoil, stones, earth, clods, sticks, roots, or other objectionable extraneous matter or debris, and contain no toxic materials.

B. Fertilizer:

1. Fertilizer shall be used to counteract soil deficiencies as indicated by the soil analysis and as approved by the Engineer. It should be a complete fertilizer, a standard product complying with the state and federal fertilizer laws, part of the elements of which are derived from organic sources, containing the following percentages by weight:

Nitrogen	10N - Minimum 75 percent organic
Phosphorus	6 P -
Potash	4K-

The fertilizer shall be delivered to the site in the original unopened containers bearing the manufacturer's guaranteed statement of analysis, or a manufacturer's certificate of compliance covering analysis shall be furnished to the Engineer. The fertilizer shall be spread at the rate of 17 to 20 lbs/1000 sq-ft.

C. Lime:

1. Provide lime which is ground limestone containing not less than 85 percent of total carbonate and of such fineness that 90 percent will pass a No. 20 sieve and 50 percent will pass a No.100 sieve.
2. Coarser materials will be acceptable provided the specified rates of application are increased proportionately on the basis of quantities passing a No. 100 sieve. No additional payment will be made to the Contractor for the increased quantity.

D. Soil Enrichers:

1. They shall be one of the following materials:
   a. Peat Moss - Finely shredded and consisting of not less than 90 percent organic matter.
   b. Sawdust - rotten.
2. They shall be natural and suited to horticultural use. They shall not contain lumps, roots or other foreign matter over two inches in diameter. They shall be free from

noxious weeds, seeds and other elements harmful to lawns. They shall be subject to inspection approval by the Engineer at the source and upon delivery and shall contain not more than 35 percent moisture by weight at the time of incorporation into the soil.

E. Mulch for Hydro Seeding:

1. Mulch material shall meet the following requirements:
   a. Hay or straw - Hay or straw mulch shall consist of long fibered hay or straw, reasonably free from noxious weeds or other undesirable material. No material shall be used which is so wet, decayed, or compacted as to inhibit even and uniform spreading. No chopped hay, grass clippings or other short fibered material shall be used unless directed.
   b. Wood cellulose fiber - Wood cellulose fiber mulch shall consist of natural wood cellulose fiber containing no materials which will inhibit seed germination or plant growth. Sufficient non-toxic water soluble green dye shall be added to provide a definite color contrast to the ground surface to aid in even distribution. Wood fiber mulch shall be supplied in uniform packages not exceeding 100 pounds each. Each package shall be marked to show the air dry weight.

F. Mulch Binder for Hydroseeding:

1. Material for mulch binder shall be emulsified asphalt.
   a. Emulsified asphalt mulch binder shall be a type acceptable to the Engineer and may be diluted with water to assure even distribution.

G. Grass Seed Mixture

1. Fresh, clean, new crop seed. Seed may be mixed by an approved method on the site, or may be mixed by the dealer. If the seed is mixed on the site, each variety shall be delivered in the original containers which shall bear the dealer's guaranteed statement of the composition of the mixture and the percentage of purity of each variety. The Dealers Guarantee Statement shall be delivered to the Engineer.
2. Grass seed shall be composed of the following varieties which shall be mixed in the proportions and shall test to 80 percent minimum purity, and 80 percent germination.

Percent Proportion by Weight:

a. MDOT Park Mixture:
   1) Creeping red fescue - 50 percent
   2) Kentucky Bluegrass - 30 percent
   3) Annual Rye Grass - 20 percent

NOTE: Add 1 pound White or Dutch Clover per acre.

b. MDOT Roadside Mixture (Slopes):
   1) Creeping Red Fescue - 40 percent.
   2) Kentucky Bluegrass- 25 percent.
   3) Kentucky 31 Fescue 30 percent.
   4) White Clover - 5 percent.

NOTE: Add 1 pound White or Dutch Clover per acre.

c. Lawn Areas:
1) Kentucky 31 Fescue - 25 percent.
2) Chewing Fescue - 15 percent.
3) Creeping Red Fescue - 15 percent.
4) Pennfine Perennial Rye - 25 percent.
5) Lynn Perennial Rye - 10 percent.
6) Common Annual Rye - 10 percent.

H. Sod:

1. Preferable two year growth, at least 85 percent weed-free, solid landscaping sod composed of perennial rescues, Kentucky bluegrass's. Submit one 12 by 12 inch piece of sod, with source location, for approval of the Engineer, before ordering sod for the work.

2.2 MATERIALS FOR PLANTING

A. Water:

1. The Contractor shall arrange and pay for water required for the planting. Water shall be clean and suitable for domestic consumption.

B. Manure:

1. Manure shall be well rotted, unleached, horse or cow manure or a combination of both. It shall be free from any chemicals used to hasten decomposition artificially, or any other injurious substance.
2. Manure shall be at least nine months old and not more than two years old, free from sawdust, hay, tanbark or wood shavings, or refuse of any kind. Manure shall consist of not more than 25 percent straw or other acceptable material.

C. Stakes shall be white cedar or approved equal, of size and length as shown on the Drawings.

D. Hose for guying shall be new black or green two-ply fiber garden hose, not less than 1/2 inch inside diameter. Seconds rejected by the factory are acceptable.

E. Burlap for wrapping shall be first quality burlap at least eight ounces in weight and six inches in width.

F. Wire for tree guys shall be galvanized annealed steel wire, No. 14 gauge, as detailed.

G. Tree paint shall be waterproof, adhesive and elastic, free from kerosene, coal tar creosote or any other material injurious to the life of the trees. Tree paint shall contain an antiseptic.

H. Pine bark mulch shall be clean, shredded, free of weeds, seeds, insects and extraneous materials.

I. Plant Materials:

1 . Plant materials shall conform to American Standard for Nursery Stock (April 15, 1951), sponsored by the American Association of Nurserymen, Inc., Standard Plant Names (1942) shall be the authority for plant names. Plant materials shall be of standard quality true to name and type and first class representatives of their species or variety.
2. All plants shall conform to the varieties specified in the Plant List. No substitutions will be permitted unless approved in writing by the Engineer.

Each bundle of plants and all separate plants shall be properly identified by name on legible, waterproof labels, securely attached thereto before delivery to the site.

3 . Plant materials shall be free of damage as a result of handling and transportation.

4. All plant material shall be certified by the supplier to be free of disease and infestation.

5. All plants shall be subject to approval at their source prior to shipment. The Contractor shall accompany the Engineer to inspect the materials, and shall request such inspection at least one week in advance.

6. All plants shall be typical of their species or variety and shall have a normal habit of growth. They shall be first quality, sound, healthy, vigorous, well branched and densely foliated. They shall be free of disease, insect pests, eggs or larvae, and shall have healthy, well furnished root systems. Plants lacking compactness or proper proportions, and plants injured by too close planting in nursery rows will not be accepted.

7. All plants shall conform to the measurements specified in the Plant List. Measurements specified shall be the minimum acceptable for each variety. Plants that meet these requirements specified, but do not possess a normal balance between height and spread, will not be accepted. Plants shall not be pruned prior to delivery.

8. All plants and all tree trunks shall be measured when the branches are in their normal position. Dimensions noted for height and spread refer to the main body of the plant, and not from branch tip to branch tip. Height is defined as the approximate dimension from ground to top of last year's growth. Top spread is defined as the approximate spread to top or principal width. The height of tree trunks need not be specified if the required height can be obtained by pruning the lower branches without leaving unsightly scars or otherwise damaging the trunk. Shade trees shall be free of branches up to five feet, with a single leader, well branched and reasonably straight stems. No trees which have had their leaders cut, or are so damaged that cutting is necessary, will be accepted. Trees which had their tops cut off some years previous will only be acceptable if the scar has not decayed. No trees with cut off tops will be accepted unless corrective surgery has been performed so as to effect a complete healing of the stem.

9. Trees shall be calipered one foot above ground.

10. Plants larger in size than those specified in the Plant List may be provided if approved by the Owner or the Engineer, but the use of larger plants shall not increase the cost of the Contract. If the use of larger plants is approved, the ball of earth or spread of roots shall be increased in proportion to the size of the plant. If plants required to be bare rooted are furnished in sizes greater than specified, they shall be balled and burlapped.

11. All trees shall have straight trunks with single leader intact. There shall be no abrasion of the bark and no fresh cuts of limbs over 1-1/4 inch which have not completely callused over.

12. All plants shall be grown in nurseries and cultivated, sprayed, pruned, and fertilized annually in accordance with good horticultural practice. All plants shall have been grown under climatic conditions similar to those in the locality of the project, or shall have been acclimated to the conditions of the locality for at least two years.
13. All plants shall be freshly dug; neither heeled in plants nor plants from cold storage will be accepted. All plants shall have been transplanted or root pruned at least once in the past three years. Balled and burlapped plants shall come from soil which will hold a firm ball.
14. Plants marked "B&B" in the Plant List shall be adequately balled and burlapped with firm natural balls of soil, of diameter of sufficient depth to include all the roots. No plant required to be balled and burlapped shall be accepted if the ball is cracked or broken either before or during the process of planting, or when burlap, stakes, ropes or platform required in this connection have been removed.
15. All plants shall be handled so that the roots are adequately protected at all times. During shipment all plants shall be properly protected by a tarpaulin or other suitable covering. No plants shall be so bound with rope or wire at any time so as to damage the bark, break branches, or destroy its natural shape. All balled and burlapped plants which cannot be planted immediately on delivery shall be set on the ground and well protected with soil or other acceptable material including watering. Until planted, all material shall be properly maintained.

2.3 STORAGE OF MATERIAL

A. Materials such as fertilizers, ground limestone, etc. shall be stored in weatherproof storage areas and in such a manner that their effectiveness will not be impaired.

PART 3 - EXECUTION

3.1 PREPARATION

A. Equipment:
1. Provide all equipment necessary for the proper preparation of the ground surface and for the handling and placing of all required materials.
2. Demonstrate to the Engineer that the equipment will apply materials at the specified rates.

B. Subsoil Preparation:
1. Before spreading topsoil, the subgrade shall be raked by approved means. Remove all stones greater than four inches and all debris or rubbish to a depth of six inches. Such materials shall be removed from the site.

C. Screening:
1. All topsoil shall be screened clear of all stones greater than one inch, sticks, plants, and all other foreign materials before being spread.
2. During the screening of topsoil, commercial fertilizers and lime as required by the soil analysis shall be mixed with the topsoil so that they are evenly distributed throughout the screened topsoil.
3. At the completion of this operation, topsoil is referred to as improved topsoil for the purpose of this specification and the Drawings.

3.2 SEED AND SOD BED PREPARATION

A. Spread improved topsoil uniformly over subgrade and all areas where the existing grade has been changed and areas disturbed by construction operations except for those areas indicated on the site plans to be paved. No subsoil, topsoil, or improved topsoil shall be handled in any way when in a wet or frozen condition.
B. Fine rake surface to receive seed or sod.
C. After natural settlement and a light rolling, the completed work shall conform to the lines, grades, pitches, and spot elevations shown on the plans.
D. Seeding may be done immediately thereafter, provided the seed bed has remained in a good friable condition and has not become wet.

3.3 SEASON

A. Do all seeding work within the dates herein specified.
B. If special conditions exist which may warrant a variance in the above dates, submit a written request to the Engineer stating the conditions and proposed variance. Permission for the variance will be given if, in the opinion of the Engineer, the variance is warranted.
C. If seeding is authorized between May 15 and August 15, annual rye shall be sown separately in addition to the specified seed mix. Sow at the rate of six to eight pounds per 1000 square feet.

3.4 SEEDING AND SODDING

A. Immediately before seeding and sodding, the ground shall be restored as necessary to a loose friable condition by discing or other approved method to a depth of not less than two inches. The surface shall be cleared of all debris and of all stones one inch or more in diameter.
B. Seed all areas to be seeded with the specified grass seed, sowing evenly with an approved mechanical seeder at the rate specified in the seed mix schedule. Sow one half the seed in one direction and the other half at right angles to the first seeding. Cultipacker or approved similar equipment may be used to cover the seed and to firm the seed bed in one operation. In areas inaccessible to Cultipacker, the seeded ground shall be lightly raked and rolled in two directions with a water ballast roller. Extreme care shall be taken during seeding and raking to insure that no change shall occur in the finished grades and that the seed is not raked from one spot to another.

C. The hydraulic spray method of sowing seed may be used where approved by the Engineer. This work shall be done with an approved machine operated by a competent crew. Seed and fertilizing materials shall be mixed with water in the tank of the machine and kept thoroughly agitated so the materials are uniformly mixed and suspended in the water at all times during operation. The spraying equipment must be designed and operated to distribute seed and fertilizing materials evenly and uniformly on the designated areas at the required rates. If the Engineer finds the application uneven or otherwise unsatisfactory, he may require the hydraulic spray method to be abandoned and the balance of the work done as specified herein. Seed must be lightly raked into the surface of the soil unless seeding is to be followed within 24 hours by mulching.

1. Applying Mulch - At the option of the Contractor, any of the following types of mulch material may be applied.
   a. Hay or straw mulch shall be spread evenly and uniformly over the designated areas. Unless other directed, mulch shall be applied to a thickness of I". Too heavy application of mulch shall be avoided and lumps and thick spots shall be thinned. Unless otherwise authorized, the mulch shall be anchored in place by uniformly applying an asphalt mulch binder. Application of a concentrated stream of mulch binder will not be allowed. Asphalt mulch binder may be omitted when authorized by the Engineer and when there is a danger of the asphalt contaminating the surface of nearby structures, houses, vehicles, or other objects. Other methods of anchoring mulch may be used subject to the approval of the Engineer.
   b. Wood fiber mulch shall be applied as a water-borne slurry. The wood fiber and water shall be thoroughly mixed and sprayed on the area to be covered so as to form a uniform mat of mulch at the rate of not less than 30 pounds per 1,000 square feet unit of area. Wood fiber mulch may be mixed with the proper quantities of seed, fertilizer and lime as required in this section, or may be applied separately after seeding has been carried out. In the latter case, it must be applied within 24 hours after seeding.
2. Maintenance - The Contractor shall maintain the mulch by repairing any damaged mulch and by correcting any shifting of the mulch due to wind, water or other causes, until an acceptable growth of grass has been achieved, regardless of the acceptance status of the seeding. He shall supply additional mulch necessary as a result of damage or seed failure. Repairs to mulched areas and furnishing of additional mulch shall be incidental to this item. If wood fiber is used, any reseeding will require additional wood fiber mulch.

D. Do not perform broadcast seeding work during windy weather.

E. Compacting:

1. Compact the entire area immediately after the seeding operations have been completed.
2. Compact by means of a cultipacker, roller, or other equipment approved by the Engineer weighing 60 to 90 pounds per linear foot of roller.

3. If the soil is of such type that a smooth or corrugated roller cannot be operated satisfactorily, use a pneumatic roller (not wobbly wheel) that has tires of sufficient size to obtain complete coverage of the soil.
4. When using a cultipacker or similar equipment, perform the final rolling at right angles to the prevailing slopes to prevent water erosion, or at right angles to the prevailing wind to prevent dust.

F. Thoroughly wet soil surfaces before sodding. Place sod pieces tightly together, tamping gently into position as the work progresses. After each area of sodding is completed, roll the entire surface in two directions with a water ballast roller, and soak the newly sodded areas.

G. After the grass has started, all of the areas greater than five square feet which fail to show a uniform stand of grass for any reason whatsoever shall be reseeded repeatedly until all areas are covered with a satisfactory growth of grass.

H. At the time of the first cutting, set mower blades two inches high. All lawns shall receive at least three mowings before acceptance.

I. Maintenance shall also include all temporary protection fences, barriers and signs and all other work incidental to proper maintenance.

J. Maintain grass areas until a full stand of grass is indicated, which will be a minimum of 45 days after all seeding or sodding work is completed, and shall not necessarily relate to Substantial Completion of the General Contract.

K. Protection and maintenance of grass areas shall consist of watering, weeding, cutting, repair of any erosion and reseeding as necessary to establish a uniform stand of the specified grasses, and shall continue until Provisional Acceptance by the Engineer of the work of this section. It shall also include the furnishing and applying of such pesticides as are necessary to keep grass areas free of insects and disease. All pesticides shall be approved by Engineer prior to use.

3.5 SEEDING AND SODDING INSPECTION FOR PROVISIONAL ACCEPTANCE

A. The Engineer shall inspect all work for Provisional Acceptance upon written request of the Contractor. The request shall be received at least ten calendar days before the anticipated date of inspection.

B. Upon completion and reinspection of all repairs or renewals necessary in the judgment of the Engineer, the Engineer shall certify in writing to the Owner as to the Provisional Acceptance of the work of this section.

C. Upon approval of the Provisional Acceptance by the Owner, the Owner will assume maintenance of the lawn areas.

3.6 GUARANTY

A. The Contractor shall submit a written guarantee to the Engineer, after Provisional Acceptance of grass, covering reseeding of grass areas which do not survive through one full growing season after the date of Provisional Acceptance, at no cost to the Owner.

3.7 CLEAN-UP

A. Any soil or similar material which has been brought on to paved areas by hauling operations or otherwise shall be removed promptly, keeping these areas clean at all time.

B. Upon completion of work under this section all excess stones, debris, and soil resulting from work under this section, which have not previously been cleaned up, shall be removed from the project site.

3.8 PLANTING METHOD

A. The Contractor shall excavate plant pits, furnish and place all plants, and then maintain them in a satisfactory manner until final acceptance.

B. All pits shall be of size and shape as shown on the Drawings.

C. For tree and shrub planting, soil used for backfilling shall be improved topsoil as recommended by soil analysis, with the following additions:

1. For deciduous plants use a mixture of four parts topsoil and one part of manure.
2. For evergreen plants use a mixture of four parts topsoil and one part of peat moss as specified under Soil Enrichers.

D. Plant pits within or near paved areas shall be prepared prior to the laying of the pavement. Where tree pits in paved areas are to be covered with mulch, trees shall be placed at sufficient depth below finished grade to allow for the depth of the mulch.

E. Plants shall be set plumb and straight, and at such a level that after settlement, a normal or natural relationship of the crown of the plant with the ground surface is established. Each plant shall be planted in the center of the pit. When balled, burlapped and platformed plants are set, the platform shall first be removed from the pit and the soil shall be carefully tamped under and around the base of each ball to fill all voids. All burlap, ropes, and wires shall be removed from the sides and tops of balls, but no burlap shall be pulled out from under the balls, except for plastic burlap, which shall be completely removed from the pit.

F. All seals shall remain unbroken and visible on plant material until final inspection by Engineer. The Contractor shall remove all seals immediately after final inspection.

3.9 PLANTING SEASON

A. Do all planting work within the dates herein specified.

3.10 PRUNING, PAINTING, SPRAYING

A. Pruning:

1. Each tree and shrub planted shall be pruned to preserve the natural character of the plant and in a manner appropriate to the particular requirements of the landscape design. In general, approximately one third of the wood shall be removed by thinning or shortening branches, but no leaders shall be cut.

2. All pruning shall be done with sharp tools. All pruning cuts shall be made flush and clean, especially where lower branches have been removed from collected trees.

B. Painting:

1. Pruning cuts over one-half inch in diameter shall be painted with tree paint specified under "Materials" on all exposed cambium as well as other exposed living tissues.

3.11 STAKING

A. All staking shall be done immediately after wrapping. Stakes shall be driven perpendicular into the ground around the periphery of the ball of the tree. Plants shall stand plumb after staking.

3.12 WATERING

A. Plantings shall be watered in a satisfactory manner during and immediately after planting, not less than twice per week, until provisional acceptance.

B. Suitable water for maintaining plants shall be provided by the Owner. The Contractor shall furnish the hose and hose connections from the outlets where water is furnished. Contractor is responsible for all watering until provisional acceptance.

3.13 MAINTENANCE

A. Maintenance shall begin immediately after each plant is planted. Plants shall be watered, mulched, weeded, fertilized, cultivated and otherwise maintained and protected until provisional acceptance.

B. Guys shall be tightened and repaired. Defective work shall be corrected as soon as possible after defects become apparent, and weather and season permit.

3.14 TREE SURGERY

A. Existing trees shall be trimmed of all dead and diseased limbs at the direction of the Engineer. All cuts shall be made close to the trunk and those over one inch in diameter shall be covered with an acceptable tree paint manufactured for this speci**fic** purpose. In the case of important large trees where a small amount of cavity work would prolong their lives, such work should be done. The services of a qualified tree surgeon are recommended.

3.15 INSPECTION AND PROVISIONAL ACCEPTANCE

A. The Engineer will inspect all planting work for provisional acceptance upon request of the Contractor.

B. The Contractor shall furnish full and complete written instructions for maintenance of the planting to the Owner at the time of provisional acceptance.

C. After all necessary corrective work has been completed and maintenance instructions have been received by the Owner, the Engineer will certify in writing the provisional acceptance of the planting.

3.16 GUARANTEE PERIOD

A. All plants shall be guaranteed by the Contractor for a period of not less than one full year from time of provisional acceptance.

B. At the issuance of provisional acceptance, the Owner shall take over maintenance of the planting. Nevertheless, the guarantee of all plant material will remain with the Contractor. The Contractor shall ascertain that the Owner properly waters and maintains all planting during the one year guarantee period.

C. At the end of the guarantee period, any plant that is missing, dead, not true to name or size as specified, or not in satisfactory growth, as determined by the Engineer, shall be replaced. In case of reasonable doubt or question regarding the condition and satisfactory establishment of a rejected plant, the Engineer may allow such a plant to remain through another complete growing season, at which time the rejected plant, if found to be dead, in an unhealthy or badly impaired condition, shall be replaced at once. The Contractor will not be required to replace an inspected and accepted plant more than once.

D. Replacements shall be plants of the same kind and size as specified in the Plant List. They shall be furnished and planted as specified herein. The cost of replacement shall be borne by the Contractor, except where it can be definitely shown that loss resulted from Owner's failure to maintain planting as instructed.

3.17 FINAL INSPECTION AND FINAL ACCEPTANCE

A. At the end of the guarantee period, inspection will be made by the Engineer, at the request of the Contractor.

B. After all necessary corrective work has been completed, the Engineer will certify in writing the final acceptance of the planting.

3.18 CLEAN UP

A. Upon completion of work under this section, all excess stones, debris and soil resulting from planting work shall be removed from project site. The site shall be restored to a better condition than was present prior to construction.

END OF SECTION

SECTION 02485

LOAMING AND SEEDING

PART 1- GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish, place, and test topsoil, seed, lime, and fertilizer where shown on the Drawings and protect and maintain seeded areas disturbed by construction work, as directed by the Engineer.

B. Related Work Specified Elsewhere (When Applicable): Earthwork, excavation, backfill, compaction, site grading and temporary erosion control are specified in the appropriate Sections of this Division.

1.2 SUBMITTALS

A. Seed:

1. Furnish the Engineer with duplicate signed copies of a statement from the vendor, certifying that each container of seed delivered to the project site is fully labeled in accordance with the Federal Seed Act and is at least equal to the specification requirements.
2. This certification shall appear in, or with, all copies of invoices for the seed.
3. The certification shall include the guaranteed percentages of purity, weed content and germination of the seed, and also the net weight and date of shipment. No seed may be sown until the Contractor has submitted the certificates and the certificates have been approved.
4. Each lot of seed shall be subject to sampling and testing, at the discretion of the Engineer, in accordance with the latest rules and regulations under the Federal Seed Act.

B. Topsoil:

1. Inform the engineer, within 30 days after the award of the Contract, of the sources from which the topsoil is to be furnished.
2. Obtain representative soil samples, taken from several locations in the area under consideration for topsoil removal, to the full stripping depth.
3. Have soil samples tested by an independent soils testing laboratory, approved by the Engineer, at the Contractor's expense.
4. Have soil samples tested for physical properties and pH (or lime requirement), for organic matter, available phosphoric acid, and available potash, in accordance with standard practices of soil testing.
5. Approval, by the Engineer, to use topsoil for the work will be dependent upon the results of the soil tests.

C. Lime & Fertilizer:

1. Furnish the Engineer with duplicate copies of invoices for all lime and fertilizer used on the project showing the total minimum carbonates and

minimum percentages of materials furnished that pass the 90 and 20 mesh sieves and the grade furnished.

2. Each lot of lime and fertilizer shall be subject to sampling and testing at the discretion of the Engineer.
3. Sampling and testing shall be in accordance with the official methods of the Association of official Agricultural Chemists.
4. Upon completion of the project, a final check may be made comparing the total quantities of fertilizer and lime used to the total area seeded. If the minimum rates of application have not been met, the Engineer may require the Contractor to distribute additional quantities of these materials to meet the minimum rates.

1.3 DELIVERY, STORAGE AND HANDLING

A. Seed:
1. Furnish all seed in sealed standard containers, unless exception is granted in writing by the Engineer.
2. Containers shall be labeled in accordance with the United States Department of Agriculture's rules and regulations under the Federal Seed Act in effect at the time of purchase.

B. Fertilizer:
1. Furnish all fertilizer in unopened original containers.
2. Containers shall be labeled with the manufacturer's statement of analysis.

1.4 JOB CONDITIONS

A. Topsoil: Do not place or spread topsoil when the subgrade is frozen, excessively wet or dry, or in any condition detrimental, in the opinion of the Engineer, to the proposed planting or proper grading.

B. Seeding:
1. Planting Seasons: The recommended seeding time is from April 1 to September 15. The Contractor may seed at other times. Regardless of the time of seeding, the Contractor shall be responsible for each seeded area until it is accepted.
2. Weather Conditions:
   a. Do not perform seeding work when weather conditions are such that beneficial results are not likely to be obtained, such as drought, excessive moisture, or high winds.
   b. Stop the seeding work when, in the opinion of the Engineer, weather conditions are not favorable.
   c. Resume work only when, in the opinion of the Engineer, conditions become favorable, or when approved alternate or corrective measures and procedures are placed into effect.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Seed:

1. Provide the grass seed mixture approved by the Engineer, having the following composition:
    a. Park Mixture:
        50 percent Creeping Red Fescue
        30 percent Kentucky Bluegrass
        20 percent Annual Ryegrass
    b. Roadside Mixture:
        50 percent Creeping Red Fescue
        15 percent Kentucky Bluegrass
        5 percent White Clover
        2 percent Red Top
        3 percent Birdsfoot Trefoil
        25 percent Annual Ryegrass
2. Do not use seed which has become wet, moldy, or otherwise damaged in transit or during storage.

B. Topsoil:

1. Provide the quantity of topsoil necessary, in the opinion of the Engineer, to complete the work.
2. Provide topsoil that is natural, friable clay-loam soil possessing the characteristics of representative soils in the vicinity which produce heavy growths of crops, grass, or other vegetation.
3. Provide topsoil that is reasonably free from subsoil, brush, objectionable weeds, other litter, clay lumps, stones, stumps, roots, objects larger than 2 inches in diameter, and toxic substances which might be harmful to plant growth or be a hindrance to grading, planting, and maintenance operations.
4. Obtain topsoil from naturally well drained areas.

C. Lime:

1. Provide lime which is ground limestone containing not less than 85% of total carbonate and of such fineness that 90% will pass a No. 20 sieve and 50% will pass a No. 100 sieve.
2. Coarser materials will be acceptable provided the specified rates of application are increased proportionately on the basis of quantities passing a No. 100 sieve. No additional payment will be made to the Contractor for the increased quantity.

D. Fertilizer:

1. Provide a commercial fertilizer approved by the Engineer.
2. Provide fertilizer containing the following minimum percentage of nutrients by weight:
    10% Available phosphoric acid

10% Available potash
10% Available nitrogen (75% of the nitrogen shall be organic)

PART 3 – EXECUTION

3.1 PREPARATION

A. Equipment:
1. Provide all the equipment necessary for the proper preparation of the ground surface and for the handling and placing of all required materials.
2. Demonstrate to the Engineer that the equipment will apply materials at the specified rates.

B. Soil: Perform the following work prior to the application of lime, fertilizer or seed.
1. Scarify the subgrade to a depth of 2 inches to allow the bonding of the topsoil with the subsoil.
2. Apply topsoil to a depth of 4 inches as directed on areas to be seeded.
3. Trim and rake the topsoil to true grades free from unsightly variations, humps, ridges or depressions.
4. Remove all objectionable material and form a finely pulverized seed bed.

3.2 PERFORMANCE

A. Grading:
1. Grade the areas to be seeded as shown on the Drawings or as directed by the Engineer.
2. Leave all surfaces in even and properly compacted condition.
3. Maintain grades on the areas to be seeded in true and even conditions, including any necessary repairs to previously graded areas.

B. Placing Topsoil:
1. Uniformly distribute and evenly spread topsoil in designated areas.
2. Spread the topsoil in such a manner that planting work can be performed with little additional soil preparation or tillage.
3. Correct any irregularities in the surface resulting from topsoiling or other operations to prevent the formation of depressions where water may stand.
4. Thoroughly till the topsoil to a depth of at least 3 inches by plowing, discing, harrowing, or other approved method until the condition of the soil is acceptable to the Engineer.

C. Placing Fertilizer:
1. Distribute fertilizer uniformly at a rate determined by the soils test over the areas to be seeded.
2. Incorporated fertilizer into the soil to a depth of at least 3 inches by discing, harrowing, or other methods acceptable tot he Engineer.
3. The incorporation of fertilizer my be part of the tillage operation specified above.

4. Distribution by means of an approved seed drill equipped to sow seed and distribute fertilizer at the same time will be acceptable.

D. Placing Lime:
1. Uniformly distribute lime immediately following or simultaneously with the incorporation of fertilizer.
2. Distribute lime uniformly at a rate determined from the pH test, to a depth of at least 3 inches by discing, harrowing, or other methods acceptable to the Engineer.

E. Seeding:
1. Level out any undulations or irregularities in the surface resulting from tillage, fertilizing, liming or other operations before starting seeding operations.
2. Hydroseeding:
   a. Hydroseeding may be performed where approved and with equipment approved by the Engineer.
   b. Sow the seed over the designated areas at a minimum rate of 5 pounds per 1000 square feet.
   c. Seed and fertilizing materials shall be kept thoroughly agitated in order to maintain a uniform suspension within the tank of the hydroseeder.
   d. The spraying equipment must be designed and operated to distribute seed and fertilizing materials evenly and uniformly on the designated areas at the required rates.
3. Drill Seeding:
   a. Drill seeding may be performed with approved equipment having drills not more than 2 inches apart.
   b. Sow the seed uniformly over the designated areas to a depth of ½ inch and at a rate of 5 pounds per 1000 square feet.
4. Broadcast Seeding:
   a. Broadcast seeding may be performed by equipment approved by the Engineer.
   b. Sow the seed uniformly over the designated area at a rate of 5 pounds per 1000 square feet.
   c. Sow half the seed with the equipment moving in one direction and the remainder of the seed with the equipment moving at right angles to the first sowing.
   d. Cover the seed to an average depth of ½ inch by means of a brush harrow, spike-tooth harrow, chain harrow, cultipacker, or other approved devices.
   e. Do not perform broadcast seeding work during windy weather.

F. Compacting:
1. Seeded areas must be raked lightly after sowing unless seeding is to be directly followed by application of an approved mulch.
2. Compact the entire area immediately after the seeding operations have been completed.

3. Compact by means of a cultipacker, roller, or other equipment approved by the Engineer weighing 60 to 90 pounds per linear foot of roller.
4. If the soil is of such type that a smooth or corrugated roller cannot be operated satisfactorily, use a pneumatic roller (not wobbly wheel) that has tires of sufficient size to obtain complete coverage of the soil.
5. When using a cultipacker or similar equipment, perform the final rolling at right angles to the prevailing slopes to prevent water erosion, or at right angles to the prevailing wind to prevent dust.

3.3 PROTECTION AND MAINTENANCE

A. Protection:

1. Protect the seeded area against traffic or other use.
2. Erect barricades and place warning signs as needed.

B. Maintenance:

1. At the time of the first cutting, set mower blades two inches high. All lawns shall receive at least two mowings before acceptance. Coordinate schedule for mowing with Engineer.
2. Maintenance shall also include all temporary protection fences, barriers and signs and all other work incidental to proper maintenance.
3. Maintain grass areas until a full stand of grass is indicated, which will be a minimum of 45 days after all seeding work is completed, and shall not necessarily related to substantial completion of the general contract.
4. Protection and maintenance of grass areas shall consist of watering, weeding, cutting, repair of any erosion and reseeding as necessary to establish a uniform stand for the specified grasses, and shall continue until acceptance by the Engineer of the work of this section. It shall also include the furnishing and applying of such pesticides as are necessary to keep grass areas free of insects and disease. All pesticides shall be approved by the Engineer prior to use.

3.3 ACCEPTANCE

A. At final acceptance of the project all areas shall have a close stand of grass with no weeds present and no bare spots greater than three inches in diameter over greater than five percent (5%) of the overall seeded area.

END OF SECTION

SECTION 02513

BITUMINOUS CONCRETE PAVING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Furnish all plant, labor, equipment and materials required to install bituminous concrete pavement courses, including sidewalks, driveways, temporary and permanent trench paving and restoration of pavement markings as shown on the Drawings and as specified herein.
2. Remove bituminous asphaltic and/or Portland cement pavement, and replace bituminous asphaltic pavement, sub-base, binder courses and surface courses, including temporary pavement, within the area(s) shown on the Drawings and as directed by the Engineer.
3. Keep pavement removal to a minimum width suitable for the required construction.
4. Apply pavement markings to the permanent paving as specified.

B. Work Not Included: Removal and replacement of paving for the convenience of the Contractor will not be considered for payment.

C. Related Work Specified Elsewhere (When Applicable):

1. Excavation, backfill, aggregate base and subbase.

1.2 QUALITY ASSURANCE

A. Materials: Use only materials furnished by a bulk bituminous concrete producer regularly engaged in the production of hot mixed, hot laid bituminous concrete.

B. Equipment: Provide, maintain and operate pavers, dump trucks, tandem, 3-wheel and pneumatic tired rollers well suited to the mixtures being placed. Provide, maintain and operate hand equipment as required. When applicable, provide, maintain and operate trimming equipment and materials.

C. Mix Requirements, Method of Placement and Compaction: All mixes shall conform to the State of Maine, Department of Transportation's SUPERPAVE mix standards.

1.3 SUBMITTAL

A. A certificate of compliance shall be furnished to the Engineer that the materials supplied comply with the specification requirements.

B. Delivery slips shall be furnished with each load of mix delivered to the project. Information shall include:

1. Vehicle identification.
2. Date.
3. Project.
4. Identification of material.
5. Gross, tare and net weights.

6. Signed by the bituminous concrete producer.
7. Stamped by a licensed public weighmaster.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Hot Bituminous Paving Mix:
   1. Binder Course - Maine D.O.T. Type 19.0 mm Superpave Mix
   2. Surface Course - Maine D.O.T. Type 12.5 mm Superpave Mix
   3. Sidewalks and Drives - Maine D.O.T. Type 9.5 mm Superpave Mix

B. Composition of Mixtures – Control Points

GRADING

Sieve Size	Type 19 mm	Type 12.5 mm	Type 9.5 mm
	Percent by Weight Passing – Combined Aggregate		
37.5 mm			
25 mm	100		
19mm	90 – 100	100	
12.5 mm	-90	90 – 100	100
9.5 mm	-	-90	90 – 100
4.75 mm	-	-	-90
2.36 mm	23-49	28-58	32-67
1.18 mm	-	-	-
0.60 mm	-	-	-
0.30 mm	-	-	-
0.075 mm	2-8	2-10	2-10

C. Bituminous Surface Treatment:

1. Prime Coat - MC 70 or MC 250
2. Seal Coat - MC 250 or MC 800
3. Sand Cover:

Sieve	Percent Passing
3/4	100
No. 4	40-100
No. 200	0-5

D. Mineral Filler:
   1. Limestone dust, Portland cement, or other inert material complying with ASTM D 242 or AASHTO M 17.
E. Tack Coat:
   1. Emulsified type, Grade RS-1, CRS-1, HFMS-1, CSS-1, 1h
F. Pavement markings shall conform to AASHTO Designation M248-74 for ready mixed white and yellow traffic paints, Type 1.

PART 3 - EXECUTION

3.1 GENERAL

A. Grade Control:
   1. The Contractor shall establish and maintain the required lines and grades, including crown and cross-slope, for each course during construction operations.
B. Trench areas shall receive initial paving as the work progresses where trenches are in paved streets. Not more than 300 linear feet of backfill trench shall be left unpaved.
C. Reset all existing manholes to finished grade as required at no additional cost to the Owner.

3.2 PAVEMENT REMOVAL

A. General:
   1. Exercise extreme care in the removal of pavement so that pavement will not be unnecessarily disturbed or destroyed.
   2. Mechanically cut pavement to be removed to a straight line, unless otherwise directed by the Engineer.
   3. All pavement removed shall become the property of the Contractor and disposed of at locations acceptable to or designated by the Owner at no additional cost to the Owner.
B. Maine DOT Areas:
   1. When removing pavement under the jurisdiction of the Maine DOT, strictly adhere to all DOT regulations controlling pavement openings.

3.3 SURFACE PREPARATION

A. Prime and tack coats shall conform to Section 410 of the Maine D.O.T. Standard Specifications.
B. Prime Coat:
   1. Apply at the rate of 0.50 gallons per square yard over compacted base. Apply material to penetrate and seal, but not flood, surface. Cure and dry as long as necessary to attain penetration and evaporation of the dilution agent.

C. Tack Coat:

1. Apply to contact surfaces of previously constructed asphalt or Portland cement concrete and surfaces abutting or projecting into asphalt concrete pavement. Distribute at rate of 0.05 to 0.15 gallons per square yard of surface.

3.4 WEATHER AND SEASONAL LIMITATIONS

A. The State is divided into 2 paving zones as follows:

1. Zone 1 – Areas north of U.S. Route 2 from Gilead to Bangor and north of Route 9 from Bangor to Calais.
2. Zone 2 – Areas south of Zone 1 including U.S. Route 2 and Route 9 boundaries.

B. The Contractor may place Hot Mix Asphalt Pavement for use other than a traveled way wearing course in either Zone between the Dates of April 15th and November 15th, provided that the air temperature as determined by an approved thermometer (placed in the shade at the paving site) is 2º C (35.6º F) or higher and the area to be paved is not frozen. The Contractor may place Hot Mix Asphalt Pavement as a traveled way wearing course in Zone 1 between the dates of May 1st and the Saturday following October 1st and in Zone 2 between the dates of April 15th and the Saturday following October 15th, provided the air temperature determined as above is 10ºC (50ºF) or higher. For the purpose of this Subsection, the traveled way includes truck lanes, ramps, approach roads and auxiliary lanes.

C. Hot Mix Asphalt Pavement used for curb, driveways, sidewalks, islands, or other incidentals is not subject to seasonal limitations, except that conditions shall be satisfactory for proper handling and finishing of the mixture. Unless otherwise specified, the Contractor shall not place Hot Mix Asphalt Pavement on a wet or frozen surface, and the air temperature shall be 2ºC (35.6º F) or higher.

3.5 PLACING THE MIX

A. General:

1. Place asphalt concrete mixture on prepared surface. Minimum allowable temperature for placing is 275ºF. Maximum shall be 325°F. Place in areas inaccessible to paving machine and small areas by hand. Place each course to required grade, cross-slope and compacted thickness.

B. Protection:

After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened to the extent that the pavement will not be damaged.

3.5 PAVEMENT MARKINGS

A. Material, approved by the Engineer, is to be furnished and applied after the installation of permanent paving.

B. Apply pavement markings in accordance with existing markings. Match paint color, marking dimensions, layout and other details with existing markings in the vicinity of the project.

END OF SECTION

SECTION 02601

MANHOLES, COVERS AND FRAMES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Construct manholes, covers, frames, brick masonry, inverts and apply waterproofing in conformance with the dimensions, elevations, and locations shown on the Drawings and as specified herein.

B. Related Work Specified Elsewhere (when applicable):
   1. Final sewer testing is specified in this Division.
   2. Pipe, excavation, backfill, paving and dewatering are specified in the appropriate Sections in this Division.
   3. Concrete and grout are specified in Division 3.

1.2 QUALITY ASSURANCE

A. Precast Manhole Base, Barrel and Top Sections:
   1. Conform to ASTM C478-84 (AASHTO Ml 99-82) except as modified herein, and on the Drawings.
   2. Average strength of 4,000 psi at 28 days.
   3. Testing:
      a. Determine concrete strength by tests on 6-inch by 12-inch vibrated test cylinders cured in the same manner as the bases, barrels and tops.
      b. Have tests conducted at the manufacturer's plant or at a testing laboratory approved by the Engineer.
      c. Have not less than 2 tests made for each I 00 vertical feet of precast manhole sections.

B. Manhole Steps
   1. Acceptable Manufacturers:
      a. Aluminum Company of America.
      b. Reliance Steel Products, Inc.
      c. M. A. Industries, Inc.
      d. Or equivalent.

C. Frames and Covers:
   1. Acceptable Manufacturers:
      a. Etheridge Foundry Co.
      b. Neenah Foundry Co.
      c. E. L. LeBaron Foundry Company.
      d. Or equivalent.

D. Masonry:
   1. Brick: Shall comply with the ASTM Standard Specifications for Sewer Brick (made from clay or shale), Designation C32, for Grade SS, hard brick. (AASHTO M91-78).
   2. Cement: ASTM C-150(AASHTO M85-79I).
   3. Hydrated Lime: ASTM C-207
   4. Sand: ASTM C33 (AASHTO M6-65 (1974)).

E. Waterproofing:
   1. Acceptable Manufacturers:
      a. Minwax Fibrous Brush Coat, Minwax Co., N.Y., N.Y.
      b. Tremco 121 Foundation Coating, Tremco Mfg. Co., Newark, N.J.
      c. Or approved equal.

1.3 SUBMITTALS TO THE ARCHITECT / ENGINEER

A. Submit shop drawings and manufacturer's literature in conformance with Section 01340 and the Standard General Conditions of the Construction Contract.

B. Precast Manhole Sections: Submit test results and receive approval from the Engineer prior to delivery to the site.

PART 2 - PRODUCTS

2.1 PRECAST MANHOLE SECTIONS

A. Dimensions, shall be as shown on the Drawings:

Base & Riser Sections:
   a. Diameter: Regular Manholes: 4 foot diameter minimum, Inside Drop Manholes: 5 foot diameter minimum, Wet Wells: 6 foot minimum diameter.
   b. Length: As required.
   c. Wall Thickness: Not less than 5 inches.
   d. Joints: Bell-and-spigot or tongue-and-groove formed on machine rings to insure accurate joint surfaces.

2. Tops:
   a. Diameter: Eccentric cone type, 24 inches I.D. at top, 48 inches I.D. (minimum) at bottom unless otherwise shown on the Drawings.
   b. Length: 4 feet.
   c. Wall thickness: Not less than 5 inches at the base, tapering to not less than 8 inches at the top.
   d. Joints: Bell-and-spigot or tongue-and-groove formed on machine rings to insure accurate joint surfaces.

3. Flat Slab Tops:
   a. Location: Where shallow installations do not permit the use of a conetype top and where indicated on the Drawings.
   b. Slab thickness: Not less than 6 inches.
   c. Constructed to support an HS-20 wheel loading.

B. Openings:

1. Provide openings in the risers to receive pipes entering the manhole.
2. Make openings at the manufacturing plant.
3. Size: To provide a uniform annular space between the outside wall of pipe and riser.
4. Location: To permit setting of the entering pipes at the correct elevations.
5. Openings shall have a flexible watertight union between pipe and the manhole base.
   a. Cast into the manhole base and sized to the type of pipe being used.
   b. Type of flexible joint being used shall be approved by the Engineer. Install materials according to the Manufacturer's instructions.
      1. Lock Joint Flexible Manhole Sleeve made by Interpace Corporation.
      2. Kor N Seal made by National Pollution Control System, Inc.
      3. Press Wedge 11 made by Press-Seal Gasket Corporation.
      4. A-Lok Manhole Pipe Seal made by A-Loc Corporation.
      5. Or equivalent.

C. Joints:

1. Joint gaskets to be flexible self seating butyl rubber joint sealant installed according to manufacturer's recommendations. For cold weather applications, use adhesive with joint sealant as recommended by manufacturer.

   Acceptable Materials:
   a. Kent-Seal No. 2
   b. Ram-Nek
   c. Or equivalent.
2. Joints between precast sections shall conform to related standards and manufacturer's instructions.
3. All manholes greater than 6 ft. diameter and all manholes used as wet wells, valve pits and other dry-pit type structures shall be installed with exterior joint collars. The joint collar shall be installed according to the manufacturer's instructions. Acceptable materials:
   a. MacWrap exterior joint sealer as manufactured by Mar-Mac Manufacturing Company.
   b. Or equivalent.

D. Waterproofing:

1. The exterior surface of all manholes shall be given two coats of bituminous waterproofing material.
2. The coating shall be applied after the manholes have cured adequately and can be applied by brush or spray in accordance with the manufacturer's written instruction.
3. Sufficient time shall be allowed between coats to permit sufficient drying so that the application of the second coat has no effect on the first coat.

E. Frost Protective Wrapping
   1. The frost protective wrap shall be constructed of an ultraviolet resistant polyethylene material and shall be a minimum thickness of 6 mils.

2.2 FRAMES AND COVERS

A. Standard Units:
   1. Made of cast iron conforming to ASTM A48-76, Class 30 minimum.
   2. Have machined bearing surfaces to prevent rocking.
   3. Castings shall be smooth with no sharp edges.
   4. Constructed to support an HS-20 wheel loading.
   5. Dimensions and Style shall conform to the Drawings, Standard castings differing in non-essential details are subject to approval by the Engineer:
      a. Covers - solid with sewer in 3-inch letters diamond pattern.
      b. Frame - 24-inch diameter clear opening, with flange bracing ribs.
   6. Minimum weight of frame and cover shall be 430 lbs.

B Water Tight Units:
   1. Same features as above for Standard Units, with 22-inch diameter minimum clear opening.
   2. Sealing features:
      a. Inner lid held by a bronze tightening bolt in a locking bar.
      b. Neoprene gasket
      c. Water tight pick hole.
   3. Minimum weight of frame and cover shall be 510 lbs.

2.3 MANHOLE STEPS

A. Aluminum or polyethylene coated steel safety type designed with a minimum concentrated live load of 300 pounds.

B. Thoroughly clean all surfaces to be embedded with a suitable cleaning agent to ensure that the surfaces are free from all foreign matter such as dirt, oil and grease.

C. Aluminum surfaces to be embedded shall be given a protective coating of an approved heavy-bodied bituminous material. The steps shall become thoroughly dry before being placed into the concrete.

D. All steps shall be cast into walls of the precast section so as to form a continuous ladder with a distance of 12-inches between steps.

2.4 MASONRY

A. Brick:
   1. Sound, hard, uniformly burned, regular and uniform in shape and size, compact texture, and satisfactory to the Engineer.
   2. Immediately remove rejected brick from the work.

B. Mortar:
   1. Composition (by volume):
      a. 1 part portland cement.

b. 1/2 part hydrated lime.
c. 4-1/2 parts sand.

2. The proportion of cement to lime may vary from 1: 1/4 for hard brick to 1: 3/4 for softer brick, but in no case shall the volume of sand exceed 3 times the sum of the volume of cement and lime.

C. Cement shall be Type II portland cement.
D. Hydrated lime shall be Type S.
E. Sand:
1. Shall consist of inert natural sand.
2. Grading:

Sieve	Percent Passing
#3/8	100
4	95-100
8	80-100
16	50-85
50	10-30
100	2-10
Fineness Modulus	2.3 - 3.1

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Precast Manhole Sections:
1. Perform jointing in accordance with manufacturer's recommendations and as approved by the Engineer.
2. Install riser sections and tops level and plumb.
3. Make all joints watertight.
4. When necessary, cut openings carefully to prevent damage to barrel sections and tops. Solidly fill annular spaces around pipes entering the manholes with non-shrink grout or sealant approved by the Engineer. Replace damaged manhole sections and tops at no additional cost to the Owner.
5. When manhole steps are included in the Work, install barrel sections and tops so that steps are in alignment.

B. Drop Manholes:
1. The difference in elevation between the invert of the inlet pipe to the invert of the outlet pipe shall not exceed 24 inches without use of a drop structure.
2. Where difference in elevation exceeds 24 inches, construct a drop manhole as shown on the Drawings or as directed by the Engineer.

C. Adjust to Grade:
1. Adjust tops of manholes to grade with brick masonry.
2. Concrete rings are not acceptable for adjusting to grade.

D. Pipe Connections to Manholes: Connect pipes to manholes with joint design and materials approved by the Engineer.

E. Invert Channels:

1. Smooth and semicircular in shape conforming to the inside of the adjacent sewer section.
2. Make changes in direction of flow with smooth curves having a radius as large as permitted by the size of the manhole.
3. Stop the pipes at the inside face of the manhole where changes of direction occur.
4. Form invert channels with brick. Precast inverts may be used with permission of the District.
5. Shape invert to make smooth transition in vertical grade.
6. Slope the floor of the manhole to the flow channel, as shown on the Drawings.

F. Masonry:

1. Laying Brick:
   a. Use only clean bricks in brickwork for manholes.
   b. Moisten the brick by suitable means until they are neither so dry as to absorb water from the mortar nor so wet as to be slippery when laid.
   c. Lay each brick in a full bed and joint of mortar without requiring subsequent grouting, flushing, or filling, and thoroughly bond as directed.
   d. Construct all joints in a neat workmanlike manner. Construct the brick surfaces inside the manholes so they are smooth with no mortar extending beyond the bricks and no voids in the joints. Maximum mortar joints shall be 1/2 inch.
   e. Outside faces of brick masonry shall be plastered with mortar from 1/4 inch to 3/8-inch thick.
   f. Completed brickwork shall be watertight.

2. Curing:
   a. Protect brick masonry from drying too rapidly by using burlaps which are kept moist, or by other approved means.
   b. Protect brick masonry from the weather and frost as required.

G. Frames and Covers:

1. Set all frames in a full bed of mortar, true to grade and concentric with the manhole opening.
2. Completely fill all voids beneath the bottom flange to make a watertight fit.
3. Place a ring of mortar at least one inch thick around the outside of the bottom flange, extending to the outer edge of the manhole all around its circumference.
4. Clean the frame seats before setting the covers in place.

H. Plugging and Patching:

1. Fill all exterior cavities with non-shrink grout and with bituminous waterproofing once the concrete and mortar has set.

2. Touch up damaged water proofing.

I. Cleaning:

1 . Thoroughly clean manholes, steps, frames and covers of all debris and foreign matter.

J. Bedding and Backfilling:

1. Bedding of manholes shall be 6 inches of 3/4" screened stone.
2. Backfill a minimum of 18 inches all around manhole with gravel borrow.

K. Frost Protective Wrap

1. The Contractor shall comply with the manufacturer's instructions for the particular conditions of installations in each case.
2. Clean each manhole exterior of all dirt and remove any sharp protrusions.
3. Apply two (2) 6-inch wide vertical strips of bituminous waterproofing material and/or duct tape from the top to bottom of the manhole per layer.
4. Prior to installing pipe through each manhole or valve pit, wrap each manhole to the maximum depth of frost penetration, but not less than five (5) feet below grade, with four (4) layers of the polyethylene material by beginning the wrap at the adhesive strip and proceeding around the manhole, valve pit, etc., continuously by overlapping the adhesive strip by 24 inches on the final layer. Cut the polyethylene wrap in areas where piping exits the manhole. The size of the cut is to be equivalent to the pipe's outside diameter.
5. Tuck and pleat the polyethylene wrap at the top of each manhole in a continuous manner, minimizing the size of each fold. Extend the wrap past the top of the manhole frame and temporarily tuck the remainder inside the frame, until final backfill and paving.
6. In paved areas, cut the polyethylene wrap flush with the manhole rim after the pavement is in place.
7. In unpaved areas, pull the polyethylene wrap together, and tie around the frame with galvanized wire.
8. Protect the installed frost barrier from harmful weather exposures and from possible physical abuses, where possible by prompt installation of concealing work or, where that is not possible, by temporary covering or enclosure.
9. Backfill around the manhole/frost barrier with material as outlined in Section 02200 – Earthwork.

3.2 MANHOLE TESTING

A. General:

1. Perform either a vacuum test or a combination of the exfiltration and infiltration tests on all manholes.
2. All testing must be performed in the presence of the Engineer.
3. Suitably plug all pipes entering each manhole and brace plugs to prevent blow out.

B. Exfiltration Tests After Backfilling:

1. Fill each manhole with water to the top of the manhole frame.

2. A period of up to 2 hours may be permitted, if the Contractor so wishes, to allow for absorption.
3. At the end of the absorption period, refill each manhole with water to the top of the manhole frame and begin the 4-hour test period.
4. At the end of the 4-hour test period, refill each manhole to the top of the manhole frame and measure the volume of water added. The leakage for each manhole shall not exceed 1/16 gallon per foot of diameter per vertical foot (above ground water) per 4-hour period.

C. Infiltration Tests:
1. When the groundwater is above the bottom of the manhole, infiltration testing may be performed on that portion of the manhole below water level.
2. After a 15-minute period, if no water is visibly moving down the interior surfaces of a manhole, the portion of the manhole below groundwater may be considered to be satisfactorily watertight.
3. The remaining portion above the groundwater level must be tested for exfiltration as specified above.

D. Vacuum Test:
1. The manhole shall be tested by a vacuum test after assembly of the manhole, connection piping and backfilling.
2. Plug all lifting holes completely with non-shrink grout.
3. Properly tighten all boot clamps and brace all plugs to prevent them from being sucked into the manhole.
4. Install the testing equipment according to the manufacturer's instructions.
5. A vacuum of 10 inches of Hg shall be drawn on the manhole and the loss of I inch of Hg vacuum timed. The manhole shall be considered to have passed the test if the time for the loss of 1 inch of Hg vacuum is two (2) minutes or longer.
6. If the manhole fails the initial test, the Contractor shall locate the leak(s) and make repairs. The manhole shall be retested until a satisfactory test result is obtained.
7. If a satisfactory vacuum test cannot be obtained, the manhole shall be water exfiltration tested and repaired as necessary.

E. Manhole Repairs:
1. Correct leakage by reconstruction, replacement of gaskets and/or other methods as approved by the Engineer.
2. The use of lead-wool or expanding mortar will not be permitted.

F. After the manholes have been backfilled and prior to final acceptance, any signs of leaks or weeping visible inside the manholes shall be repaired and the manhole made watertight.

END OF SECTION

SECTION 02610

PIPE & PIPE FITTINGS - GENERAL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish, install, support, and test pipe and pipe fittings of the type(s) and size(s) and in the location(s) shown on the Drawings and as specified herein.

B. Related Work Specified Elsewhere (When Applicable):
   1. Excavation and backfill are specified in Division 2.
   2. Concrete cradles, arches, and encasements are specified in Division 3.
   3. Field painting is specified in Division 9.
   4. Valves, gates, pipe hangers, pipe supports, pipe and equipment insulation, and plumbing are specified in the appropriate Sections in Division 15.
   5. Pipe materials are specified in the appropriate sections of Division 2 and/or Division 15.

C. Other Trades: Cooperate with all other trades whose work is to be coordinated with piping work.

1.2 SUBMITTALS TO THE ENGINEER

A. Submit shop drawings in accordance with SECTION 01340 and the General Conditions of the Construction Contract.

B. Submit manufacturers "Certification of Conformance" that pipe and fittings and other piping appurtenances meet or exceed the requirements of these Specifications.

C. Submit other documents as specified in the appropriate Sections of this Division.

1.3 DELIVERY, STORAGE AND HANDLING

A. Exercise care during loading, transporting, unloading, and handling to prevent damage of any nature to interior and exterior surfaces of pipe and fittings.

B. Do not drop pipe and fittings.

C. Store materials on the project site in enclosures or under protective coverings in accordance with manufacturer's recommendations and as required by the Engineer.

D. Assure that materials are kept clean and dry.

E. Do not store materials directly on the ground.

F. Follow manufacturer's specific instructions, recommendations and requirements.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Materials are specified in the following Sections in this Division or Division 15.

2.2 COATINGS (unless otherwise specified)

A. Before exposure to the weather and after thorough cleaning to remove all rust, dirt, grease, and other foreign matter, the equipment and appurtenances specified herein shall be painted in the shop as specified hereinafter.

B. Ferrous surfaces which will be submerged, including the full height of the sluice gates, shall be blast-cleaned to near-white metal in accordance with Steel Structures Painting Council Surface Preparation No. 10, Designation SSPC-SPIOO-63T, immediately before painting.

C. Following cleaning, the surfaces shall be painted in the shop as follows:

1. Interior surfaces of all hydrants, iron body piping, valves, the exterior surfaces of buried valves and gates, and miscellaneous piping appurtenances shall be given a shop finish of an asphalt varnish.
2. Floorstands and similar parts customarily finished at the shop shall be given coats of paint filler and enamel or other acceptable treatment customary with the manufacturer, all suitable for the intended service.
3. Ferrous surfaces which will be submerged shall be shop primed immediately after blast-cleaning to near-white metal, with one coat of polyamide epoxy having not less than 43 percent solids content by volume, applied to a minimum of 3 mils dry film thickness, and which shall be Koppers 654 Primer made by Koppers Co., Inc., Pittsburgh, Pa.; Carboline 193 Primer made by Carboline Co., St. Louis, Mo.; Tnemec 66-1211 made by Tnemec Co., Inc., North Kansas City, Mo.; or an acceptable equivalent product.
4. Ferrous surfaces which are not submerged shall be given two shop coats of Inertol Rustinhibitive Primer 621 made by Koppers Co., Inc., Pittsburgh, Pa.; Carboline Admiral AD-1567 Primer made by Carboline Company, St. Louis, Mo.; Tnemec 77 Chem-Prime made by Tnemec Co., North Kansas City, Mo.; Chromox 13R50 Primer made by Mobil Chemical Co., Edison, N.J.; or an acceptable equivalent product.
5. Ferrous surfaces obviously not to be painted shall be given a shop coat of grease or other suitable protective coating.

D. Shop coats shall be compatible with and made by the same manufacturer as the field applied coats and shall not require special intercoat preparation for good topcoat bond. All coating surface preparation and coating use, mixing, application, and curing shall be in accordance with the current printed instructions of the coating manufacturer and be as specified herein.

PART 3 - EXECUTION

3.1 INSPECTION

A. Provide all labor necessary to assist the Engineer to inspect pipe, fittings, gaskets, and other materials.

B. Carefully inspect all materials at the time of delivery and just prior to installation.

C. Carefully inspect all pipe and fittings for:
   1. Defects and damage.
   2. Deviations beyond allowable tolerances for joint dimensions.
   3. Removal of debris and foreign matter.

D. Examine areas and structures to receive piping for:
   1. Defects, such as weak structural components, that adversely affect the execution and quality of work.
   2. Deviations beyond allowable tolerances for pipe clearances.

E. All materials and methods not meeting the requirements of this Contract will be rejected.

F. Immediately remove all rejected materials from the project site.

G. Start work only when conditions are corrected to the satisfaction of the Engineer.

3.2 INSTALLATION

A. General:
   1. Install all pipe and fittings in strict accordance with the manufacturer's instructions and recommendations and as specified herein.
   2. Install all pipes and fittings in accordance with the lines and grades shown on the Drawings and as required for a complete installation.
   3. Install adapters, acceptable to the Engineer, when connecting pipes constructed from different materials.
   4. Support all piping not being installed in trenches in accordance with the "Pipe Hangers & Supports" Section in Division 15.

B. Installation in Trenches:
   1. Firmly support the pipe and fittings on bedding material as shown on the Drawings and as specified in the appropriate Sections of these Specifications.
   2. Do not permanently support the pipe or fittings on saddles, blocking stones, or any material which does not provide firm and uniform bearing along the outside length of the pipe.
   3. Thoroughly compact the material under the pipe to obtain a substantial unyielding bed shaped to fully support the pipe.
   4. Excavate suitable holes for the joints so that only the barrel of the pipe receives bearing pressure from the supporting material after placement.
   5. Lay each pipe length so it forms a close joint with the adjoining length and bring the inverts to the required grade.
   6. Set the pipe true to line and grade.

7. Do not drive the pipe down to grade by striking it with a shovel handle, timber, rammer, or any other unyielding object.
8. Immediately after making a joint, fill the holes for the joints with bedding material, and compact.
9. When each pipe length has been properly set, place and compact enough of the bedding material between the pipe and the sides of the trench to hold the pipe in correct alignment.
10. After filling the sides of the trench, place and lightly tamp bedding material to complete the bedding as shown on the Drawings.
11. Take all necessary precautions to prevent floatation of the pipe in the trench.
12. Bedding and backfill for all pipe materials shall be as specified in Section 02200 and as shown on the Drawings.

C. Temporary Plugs:
1. When pipe installation work in trenches is not in progress, close the open ends of the pipe with temporary watertight plugs.
2. If water is in the trench when work is resumed, do not remove plugs until all danger of water entering the pipe is eliminated.
3. Do not use the pipelines as conductors for trench drainage during construction.

3.3 CLEANING AND TESTING

A. Cleaning & Testing Piping - General:
1. Thoroughly clean all piping prior to testing. Remove all dirt, dust, oil, grease and other foreign material. Exercise care while cleaning to avoid damage to linings and coatings.
2. When the installation is complete, test all pipelines in the presence of the Engineer and the plumbing or building inspector in accordance with the requirements of the local and state plumbing codes and the appropriate Sections of these Specifications, at no additional cost to the Owner. All testing shall be performed prior to backfilling or concealing, unless otherwise acceptable to the Engineer.
3. Equipment: Supply all labor, equipment, materials, gages, and pumps required to conduct the tests.
4. Retesting: Perform all retesting required by the Engineer at no additional cost to the Owner.

C. Sewer Lines:
1. Outside Sewer Lines: Refer to the appropriate Section in Division 2.
2. Building Interior Sewer System: Clean and test in accordance with the "Plumbing General" Section in Division 15.

D. All Other Piping Systems:

1. Pressure Test:
   a. The section of pipe to be tested shall be filled with water of approved quality, and all air shall be expelled from the pipe. If blowoffs are not available at high points for releasing air the Contractor shall make the necessary excavations, backfilling and taps at such points and shall plug said holes after completion of the test.
   b. The section under test shall be maintained full of water for a period of 24 hours prior to the combined pressure and leakage test being applied.
   c. Perform pressure and leakage test at 1 1/2 times the maximum system pressure or 100 psi which ever is greater (based on the elevation of the lowest point of the section under test and corrected to the gage location).
   d. While maintaining this pressure, the Contractor shall make a leakage test by metering the flow of water into the pipe. If the average leakage during a two-hour period on buried pipelines exceeds a rate of 10 gallons per inch of diameter per 24 hours per mile of pipeline the section shall be considered as having failed the test. All pipes within structures and chambers and all flanged joints shall have no visible leakage.
   e. If the section fails to pass the pressure and leakage test, the Contractor shall do everything necessary to locate, uncover, and repair or replace the defective pipe, fitting, or joint, all at his own expense and without extension of time for completion of the work. Additional tests and repairs shall be made until the section passes the specified test.
2. Connection to Work by Others.
   a. If work involves connection of pipe lines to pipes or structures provided by others, pressure tests pipe line prior to making the connection.
   b. After successfully passing the pipe line pressure test, make the necessary connections to the work by others, and pressure test the connection.
   c. The connection shall be pressurized to the pipe line test pressure, for a minimum of 4 hours. The connection shall have no visible leakage.
   d. Correct any leakage at no cost to the Owner and retest until connection passes.
3. Cleaning: Perform all specialized cleaning as specified or required by system.

END OF SECTION

SECTION 02615

DUCTILE IRON PIPE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Provide and install ductile iron pipe of the type(s) and size(s) in the location(s) shown on the Drawings and as specified herein.

B. Related Work Specified Elsewhere: "Pipe and Pipe Fittings - General" is specified in
the appropriate Section in this Division.

1.2 QUALITY ASSURANCE

A. Standards (As Applicable):

1. Cement-mortar lining for water: ANSI A21.4 (AWWA C104).
2. Rubber gasket joints: ANSI A21.11 (AWWA C111).
3. Ductile iron pipe thickness: ANSI A21.50 (AWWA C150).
4. Ductile iron pipe centrifugally cast in metal or sand lined molds: ANSI A21.51 (AWWA C151).
5. Pipe flanges and fittings: ANSI B16.l and ANSI A21.10 (AWWA C110).
6. Threaded, flanged pipe: ANSI A21.15 (AWWA C115).
7. Cast and ductile iron fittings: ANSI A21.10 (AWWA C110).

1.3 DELIVERY, STORAGE & HANDLING

A. Exercise extra care when handling ductile iron pipe because it is comparatively brittle.

B. Exercise extra care when handling cement lined pipe because damage to the lining will render it unfit for use.

C. Protect the spherical spigot ends and the plain ends of all pipe during shipment by wood lagging securely fastened in place.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pipe:

1. Unless otherwise shown on the Drawings, the minimum thickness of ductile iron pipe shall be:
   a. For pipe 4 inches in diameter and smaller: Class 51.
   b. For pipe 6 inches in diameter and larger: Class 50.
   c. Pipe with flanges: Class 53.
2. Pipe for use with sleeve type couplings shall have plain ends (without bells or beads) cast or machined at right angles to the axis.

3. Pipe shall be double thickness cement lined and seal coated unless noted otherwise on the Drawings and except for air piping lines which shall be completely unlined.
4. Pipe for use with split type couplings shall have ends with cast or machined shoulders or grooves that meet the requirements of the manufacturer of the couplings.
5. Factory applied bituminous coatings shall be furnished on the exterior of all underground piping unless specified otherwise.
6. The outside of pipe within structures and exposed shall not be coated with bituminous coating, but shall be thoroughly cleaned and given one shop coat of Intertol Rustinhibitive Primer 621 by Koppers Co.; Multiprime by PPG Industries; Chromox 13R50 Primer made by Mobil Chemical Co.; or equivalent.

B. Joints (as shown on Drawings or as specified):

1. Flanged:
   a. Provide specially drilled flanges when required for connection to existing piping or special equipment.
   b. Flanges shall be long-hub screwed tightly on pipe by machine at the foundry prior to facing and drilling.
   c. Gaskets:
      (1) Ring type of rubber with cloth insertion.
      (2) Thickness of gaskets 12 inches in diameter and smaller: 1/16 inch.
      (3) Thickness of gaskets larger than 12 inches in diameter: 3/32 inch.
      (4) On high temperature applications such as air lines, the gaskets shall be suitable for service from 40'F to 200'F.
   d. Fasteners:
      (1) Make joints with bolt, studs with a nut on each end, or one tapped flanged with a stud and nut.
      (2) The number and size of bolts shall meet the requirements of the applicable ANSI standard.
      (3) Nuts, bolts, and studs shall be Grade B meeting the requirements of ASTM A307.
      (4) After jointing, coat entire joint with bituminous material compatible with pipe coating unless other coating required by Section 09900.
   e. When applicable, provide and install flange clamps as shown on the Drawings.
2. Push-on and Mechanical Joint:
   a. The plain ends of push-on pipes shall be factory machined to a true circle and chambered to facilitate fitting the gasket.
   b. Provide gaskets manufactured from a composition material suitable for exposure to the fluid to be contained within the pipe. On high temperature applications such as air lines, the gaskets shall be suitable for service from 40 'F to 200'F.
   c. Bolts and nuts for buried mechanical joints shall be made of A588 steel.
3. Grooved split ring couplings, sleeve couplings, flexible joints and couplings, shall be supplied as specified in "Couplings and Connectors" Section.

4. Joint Bracing:
   a. Provide joint bracing to prevent the piping from pulling apart under pressure as required and as shown on the Drawings.
   b. Types of bracing:
      (1) Pipe and fittings furnished with approved lugs or hooks cast integrally for use with socket pipe clamps, tie rods, or bridles. Bridles and tie rods shall be a minimum of 3/4 inch diameter except where they replace flange bolts of a smaller size, in which case they shall be fitted with a nut on each side of the pair of flanges. The clamps, tie rods, and bridles shall be coated with bituminous paint in buried installations and shall be coated with the same coatings as the piping system in interior installations after assembly or, if necessary, prior to assembly.
      (2) Mechanical joint ductile iron pipe retainer glands.
         (a) Ductile iron.
         (b) Ductile iron or A588 steel set screws.
      (c) Working pressure 350 psi, up to 8 inches; 250 psi, 8 inches to 16 inches.
      (d) Test pressure two times working pressure

PART 3 - EXECUTION

3.1 INSPECTION

A. Provide all labor necessary to assist the Engineer to inspect pipe, fittings, gaskets, and other materials.
B. Carefully inspect all materials at the time of delivery and just prior to installation.
C. Carefully inspect all pipe and fittings for:
   1. Defects, such as weak structural components, that adversely affect the execution and quality of work.
   2. Deviations beyond allowable tolerances for pipe clearances.
D. Immediately remove all rejected materials from the project site.

3.2 INSTALLATION

A. Assembling Joints:
   1. Push-on Joints:
      a. Insert the gasket into the groove of the bell.
      b. Uniformly apply a thin **film** of special lubricant over the inner surface of the gasket that will contact the spigot end of the pipe.
      c. Insert the chambered end of the plain pipe into the gasket and push until it seats against the bottom of the socket.
   2. Bolted Joints:
      a. Remove rust preventive coatings from machined surfaces prior to assembly.

b. Thoroughly clean and carefully smooth all burrs and other defects from pipe ends, sockets, sleeves, housings and gaskets.

3. Flanged Joints:
   a. Insert the nuts and bolts (or studs), finger tighten, and progressively tighten diametrically opposite bolts uniformly around the flange to the proper tension.
   b. Execute care when tightening joints to prevent undue strain upon valves, pumps, and other equipment.
4. Mechanical Joints:
   a. Thoroughly clean, with a wire brush, surfaces that will be in contact with the gaskets.
   b. Lubricate the gasket, bell, and spigot by washing with soapy water.
   c. Slip the gland and gasket, in that order, over the spigot and insert the spigot into the bell until properly seated.
   d. Evenly seat the gasket in the bell at all points, center the spigot, and firmly press the gland against the gasket.
   e. Insert the bolts, install the nuts finger tight, and progressively tighten diametrically opposite nuts uniformly around the joint to the proper tension with a torque wrench.
      The correct range of torque (as indicated by a torque wrench) and the length of wrench (if not a torque wrench) shall not exceed:
      (1) Range or Torque: 60-90 ft.-lbs.
      (2) Length of Wrench: 10 inches.
   f. If effective joint sealing is not attained at the maximum torque specified above, disassemble, thoroughly clean, and reassemble the joint. Do not overstress the bolts to tighten a leaking joint.
5. Bell and Spigot Joints:
   a. Thoroughly clean the bell and spigots and remove excess tar and other obstructions.
   b. Insert the spigot firmly into place and hold securely until the joint has been properly completed.

B. Fabrication:
1. Tapped Connections:
   a. Make all tapped connections as shown on the Drawings or as required by the Engineer.
   b. Make all connections watertight and of adequate strength to prevent pullout.
   c. Drill and tap normal to the longitudinal axis of the pipe.
   d. The maximum sizes of taps in pipes and fittings without busses shall not exceed the sizes listed in the appendix of ANSI A21.51 based on 2 full threads for ductile iron.
2. Cutting:
   a. Perform all cutting as set forth in AWWA C600.
   b. Carefully chamfer all cut ends to be used with push-on joints to prevent damage to gaskets when pipe is installed.

C. Pipe Deflection:
   1. Push-on and Mechanical Joints:
      a. The maximum permissible deflection of alignment at joints shall be limited to that given in AWWA C600.

   2. Flexible Joints:
      a. The maximum deflection in any direction shall not exceed the manufacturer's instructions and recommendations.

END OF SECTION

SECTION 02616

CAST & DUCTILE IRON PIPE FITTINGS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish and install cast iron and/or ductile iron pipe fittings of the type(s) and size(s) in the location(s) shown on the Drawings and as specified herein.

B. Related Work Specified Elsewhere: "Pipe & Pipe Fittings - General" is specified in this Division.

C. Options: Either gray cast iron or ductile iron fittings may be furnished.

1.2 QUALITY ASSURANCE,

A. Standards:

1. Cement-mortar lining for water: ANSI A21.4 (AWWA C 1 04).
2. Cast and ductile iron fittings: ANSI A21.10(AWWA C110).
3. Rubber gasket joints: ANSI A21.11(AWWA C111).
4. Pipe flange and fittings: ANSI B16.1 and ANSI A21.10(AWWA C110).

PART 2 - PRODUCTS

2.1 MATERIALS

A. Standard Fittings:

1. Pressure rating of 250 psi unless indicated otherwise on the Drawings or as specified.
2. Flange fittings shall be ANSI B 1 6. 1, Class 125 unless indicated otherwise.
3. Joints the same as the pipe with which they are used or as shown on the Drawings.
4. Provide fittings with standard bases where shown on the Drawings.
5. Cement lining and seal coat unless noted otherwise on the Drawings, and except for air piping applications where the fittings shall be unlined.
6. Factory applied bituminous coatings shall be furnished for all underground fittings. All interior or exposed fittings shall receive one shop coat of rust inhibitive primer as per SECTION 15050.
7. On high temperature applications such as air lines, the gaskets shall be suitable for service from 40'F. to 200' F.

B. Non-Standard Fittings:

1. Fittings having non-standard dimensions shall be subject to the Engineer's review and acceptance.
2. Non-standard fittings shall have the same diameter and thickness as standard fittings and shall meet the specification requirements for standard fittings.
3. The laying lengths and types of joints shall be determined by the particular piping to which they connect.

4. Flanged fittings not meeting the requirements of ANSI A21-10 (i.e., laterals or reducing elbows) shall meet the requirements of ANSI B16.1 in Class 125.

C. Wall Castings:

1. Size, type and location as shown on the Drawings.
2. Dimensions shall conform to ANSI A21.10 except where required. A flange substantially flush with the face of a concrete or masonry wall shall be drilled and tapped for studs.
3. Other dimensions shall be identical to the corresponding parts of standard bell and spigot fittings.
4. A central fin not less than 1/2 inch thick and of the same diameter as a flange shall be cast on the barrel at a point that will locate it midway through the wall to form a waterstop.

2.2 MANUFACTURER

A. Tyler

B. Or equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Install in strict accordance with the pipe and fitting manufacturer's instructions and recommendations and as specified or as shown on the Drawings.
2. Concrete thrust blocks or other acceptable thrust resistant system is required at all fittings on pressure pipe. Where thrust blocks are used, these shall be placed against undisturbed soil or screened gravel compacted to 95 percent and shall be placed so that the joints are accessible for repairs.

B. Fabrication:

1. Tapped Connections:
   a. Make all tapped connections as shown on the Drawings and/or as required by the Engineer.
   b. Make all connections watertight and of adequate strength to prevent pullout.
   c. Drill and tap normal to the longitudinal axis of the pipe.
   d. The maximum sizes of taps in pipes and fittings without busses shall not exceed the sizes listed in the appendix of ANSI A21.51 based on 3 full threads for cast iron and 2 full threads for ductile iron.
   e. Taps in fittings shall be located where indicated by the manufacturer for that particular type of fitting.

C. Castings in Masonry:

1. Accurately set and align castings to be encased **in** masonry.
2. Thoroughly clean castings immediately prior to being set in place. Remove all rust, scale and other foreign material.

END OF SECTION

SECTION 02622

POLYVINYL CHLORIDE (PVC) NON-PRESSURE PIPE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

Provide and install PVC non-pressure pipe and fittings of the size(s) and type(s) and in the location(s) shown on the Drawings and as specified herein.

B. Related Work Specified Elsewhere: (When Applicable)

1. Excavation and backfill, dewatering, pavement, borrow and bedding material, and cleaning and testing requirements are specified in the appropriate sections of this division.
2. Pipe & Pipe Fittings – General is specified in Division 15.

1.2 QUALITY ASSURANCE

A. Manufacturers:

1. Certain-Teed.
2. Johns-Manville.
3. Or equivalent.

1.3 SUBMITTALS TO THE ENGINEER

A. Submit shop drawings in accordance with the General Conditions of the Construction Contract.

B. Submit manufacturer's "Certification of Conformance" that pipe and fittings meet or exceed the requirements of these Specifications.

C. Submit other documents as specified in the appropriate Sections of this Division.

1.4 DELIVERY STORAGE AND HANDLING

A. Provide all labor necessary to assist the Engineer to inspect pipe, fittings, gaskets and other materials.

B. Carefully inspect all materials at the time of delivery and just prior to installation.

C. Carefully inspect all pipe and fittings for:

1. Defects and damage
2. Deviations beyond allowable tolerances for joint dimensions.
3. Removal of debris and foreign matter.

D. Examine area and structures to receive piping for:

1. Defects, such as weak structural components that adversely affect the execution and quality of work.
2. Deviations beyond allowable tolerance for pipe clearances.

E. All materials and methods not meeting the requirements of the Contract Documents will be rejected.
F. Immediately remove all rejected materials from the project site.

2.1 MATERIAL

A. Pipe and Fittings:
1 . The polyvinyl chloride pipe and fittings, including those required for stubs, shall conform to ASTM standard specification for PVC Sewer Pipe and Fittings, Designation D 3034 (SDR 35) (4” to 15"), F679 (18” to 27”).
2. Straight pipe shall be furnished in lengths of not more than 13 feet.
3. Saddles will not be allowed.

B. Joints:
1. Joints for the polyvinyl chloride pipe shall be push-on joints using factory installed elastomeric ring gaskets.
2. The gaskets shall be securely fixed into place by the manufacturer so that they cannot be dislodged during joint assembly.
3. The gaskets shall be of a composition and texture which is resistant to common ingredients of sewage and industrial wastes, including oils and ground water, and which will endure permanently under the conditions of the proposed use.
4. The joints shall conform to ASTM Specifications for Joints for Drain and Sewer Plastic Pipes using Flexible Elastomeric Seals, Designation D3212-76.

C. Pipe Couplings and Adapters
1. All couplings and adapters shall be solid sleeve. Constructed of materials which will pass the strength and chemical requirements of ASTM C954.

D. Wye Connections
1. PVC material to be ASTM D 3034, SDR-35. All wyes shall bear the manufacturer’s identifying mark and size.

E. Sweeping Tee
1. PVC material to be ASTM D 3034, SDR-35. All sweeping tee’s shall bear the manufacturer’s identifying mark and size.

F. Cleanouts.
1. Construction shall be in accordance with the International Plumbing Code (2000).
2. Cleanouts shall be installed at all changes in vertical and horizontal directions greater than 22 degrees. Where changes in direction are less than 22 degrees, cleanouts shall be located every 80 feet.
3. All service lateral cleanout piping (vertical stack piping), shall be a minimum of four (4) inches in diameter. Cleanouts shall have a threaded cap. Glued caps or plugs are not acceptable.
4. Cleanouts located in paved areas or in areas where vehicular traffic may occur require a cleanout cover to be installed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Inspection:

1. Each pipe unit shall be inspected before being installed. No single piece of pipe shall be laid unless it is generally straight.
2. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than 1/16 inch per foot of length.
3. If a piece of pipe fails to meet this requirement for straightness it shall be rejected and removed from the site.
4. Any pipe unit or fitting discovered to be defective either before or after installation shall be removed and replaced with a sound unit.

B. Jointing:

1. All pipe and fittings shall be cleared of all debris, dirt, etc., before being installed and shall be kept clean until accepted in the completed work.
2. Pipe and fittings shall be installed to the lines and grades indicated on the drawings or as required by the Engineer. Care shall be taken to insure true alignments and gradients.
3 . All joint surfaces shall be cleaned. Immediately before jointing the pipe, the bell or groove shall be lubricated in accordance with the manufacturer's recommendation.
4. Each pipe unit shall than be carefully pushed into place without damage to pipe or gasket. Suitable devices shall be used to force the pipe units together so that they will fit with a minimum open recess inside and outside and have tightly sealed joints. Care shall be taken not to use such force as to wedge apart and split the bell or groove ends.
5. Joints shall not be "pulled" or "cramped" unless permitted by the Engineer.

C. Testing:

1. Clean and test pipe in accordance with 02755 and other sections of this division, as appropriate.

3.2 LAYING PIPE

A. General.

1. Following trench excavation, pipe laying shall proceed upgrade with pipe laid carefully, hubs upgrade, spigot ends fully centered into adjacent hubs, and true to lines and grades given.
2. Each section of pipe shall rest upon 6”of approved stone pipe bedding for the full length of its barrel, with recesses excavated to accommodate bells and joints. Each pipe shall be firmly held in position so that the invert forms a continuous grade with the invert of the pipe previously placed.

a. Utilize portable laser to establish grades of sewers, laser shall be used in accordance with manufacturer's written instructions.

1) Grade shown on Drawings is that of Sewer invert. Tolerance + ¼-inch.

3. Under no conditions shall pipe be laid in water, on subgrade containing frost, and/or when trench conditions are unsuitable for such work. In all cases, water shall be kept out of the trench until concrete cradles, supports, encasement, where used, and materials in the joints have hardened.
4. Any pipe that has its grade or joint disturbed after laying shall be taken up and relaid. Any section of pipe already laid and found to be defective shall be taken up and replaced with new pipe.
5. Walking or working on top of the completed pipeline, except as may be necessary in backfilling or tamping, shall not be permitted until the trench has been backfilled to a height of at least 2 feet over the top of the pipeline.
6. Maintain pipelines free and clear of debris during the progress of the work.
7. At times when pipe laying is not in progress, the open ends of the pipe shall be closed by watertight plug.
8. Contractor shall maintain a log of service connection locations and lateral pipe lengths and sizes. The locations shall be based upon sewer line stationing and shall indicate if the lateral is in service or plugged.

3.2 CLEANOUTS

A. Service Laterals.
   1. All service laterals shall have cleanouts located not more than 90 feet apart.

B. Change in Direction.
   1. Cleanouts shall be installed in accordance with the International Plumbing Code (2000) requirements. Access shall be provided to all cleanouts.

C. Traffic Boxes.
   1. Traffic boxes shall be installed on all cleanout stacks located in grass areas or paved areas.

3.3 CONCRETE FOUNDATIONS

A. Where required by ENGINEER, or where shown on the Drawings, pipe shall be placed on a formed concrete cradle, or unformed concrete shall be placed around pipes for bedding and encasement.

B. Concrete cradles shall consist of structures requiring forms and be composed of concrete, built-in trenches to support pipes, and to the dimensions shown on the Detail Drawings.

C. Concrete bedding and encasement shall be composed of concrete placed in trenches, without forms as pipe bedding, or encased around pipes, to the dimensions and in the locations indicated on the Detail Drawings.

END OF SECTION

SECTION 02628

POLYETHYLENE PIPE

PART 1-GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish, install and test all polyethylene pipe, pipe fittings and appurtenances of the type(s) and size(s) and in the location(s) as shown on the Drawings and as herein specified.

B. Related Work Specified Elsewhere: "Pipe and Pipe Fittings - General" is specified in this Division.

1.2 QUALITY ASSURANCE

A. Provide pipe and fittings manufactured by a single manufacturer.

B. Pressure rating or pressure class of pipe as shown on the Drawings.

C. Standards:

1. ASTM D 1248 Polyethylene Plastics Molding and Extrusion Materials.
2. ASTM D 1505 Density of Plastics by the Density Gradient Technique.
3. ASTM D 1693 Environmental Stress Cracking of Ethylene Plastics.
4. ASTM D 1928 Preparation of Compression Molded Polyethylene Test Samples.

D. Acceptable Manufacturers:

1. Ryerson & Son, Inc. "Mono-Line"
2. Dupont, "Aldyl-D"
3. Sheldon "Sclairpipe"
4. Or approved equal.

PART 2 - PRODUCTS

2.1 MATERIALS

A. The pipe shall be obtained by polymerization of no less than 85% ethylene and no less than 95% of total olefins by weight.

B. The polyethylene resin shall be classified as a Type III, Class C, Category 5, Grade P34, nominal density shall be 0.941 to 0.959.

C. The polyethylene compound shall be suitably protected against degradation by ultraviolet light by means of carbon black, well dispersed in a concentration of not less than 2%.

D. The polyethylene resin compound shall have a resistance to environmental stress cracking as determined by procedure detailed in ASTM D 1693 with sample preparation by procedure C of ASTM D 1928 of not less than 192 hours.

E. Pipe shall be homogeneous throughout and free of visible cracks, holes, foreign material, blisters, or other deleterious faults.

F. Polyethylene fittings shall have the same pressure rating as the pipe itself.

G. Adapters: When applicable, provide adapters for connecting polyethylene pipe to pipes constructed from other materials. All flanges shall have nylon coated Type 316 stainless steel backing rings and a neoprene or rubber compound gasket.

2.2 FABRICATION

A. Thermal Butt-Fusion:
1. Join the pipe to itself, or to the polyethylene fittings or to the flange connections by means of thermal butt-fusion, in accordance with the recommendations of the pipe manufacturer and as specified herein.
2. Have all fusion performed by personnel trained by the pipe supplier or other qualified persons, using tools approved by the pipe supplier.
3. The polyethylene fittings and flanged connections to be joined by thermal butt fusion shall be from the same type, grade and class of polyethylene compound as the polyethylene pipe unless otherwise approved.
4. Joint strength must be equal to that of the adjacent pipe.
5. Each length of pipe shall be cleaned before jointing.
6. Butt-fused joints shall be made in the dry, and by heating the squared-off faces of the pipe ends in a suitable apparatus until softened and pressing the ends together under controlled pressure.

B. Mechanical Connections:
1. The mechanical connections of the polyethylene pipe to auxiliary equipment shall be in accordance with the pipe suppliers written instructions.
2. Polyethylene flange connections shall be thermally butt-fused to the ends of the pipe.
3. Metal back-up flanges shall be AWWA Standard Class B, 125 psig, nylon coated Type 316 stainless steel flange rings with Type 316 stainless steel bolts, nuts, and washers conforming to ASTM A-276 and ASTM A-307.
4. Rubber gaskets shall be 1/8 inch flat reinforced rubber, conforming to ANSI B16.21.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPES AND FITTINGS

A. The depth and width of the trench shall be as shown on the Contract Drawings.

B. The pipe and fittings shall be installed in compliance with the pipe manufacturers recommendations, in accordance with the best practices and methods and shall comply with these specifications.

C. Sections of the polyethylene pipe shall be assembled into suitable installation lengths by use of butt-fusion joints. Installation lengths shall be joined by means of flanged connections.

D. In no case shall threaded male or female adapters of any plastic material be used for adapting polyethylene pipe to systems, fittings, or auxiliary equipment of other materials, or for its joining the installation lengths together.

E. Lay the pipe and fittings down on a 3/4 inch stone granular base. At flanges, valves and such connections, the trench bottom shall be dug out with sufficient length, width and depth to ensure clearance between the undisturbed trench bottom and the flanges, pipe anchors and all connections. The pipe shall be uniformly supported along its entire length. Final adjustments shall be made as required and the pipe bedded to the spring line.

F. Install flange connections at heavy fittings, manholes and rigid structures in such a manner that there is no subsequent relative movement between the polyethylene pipe at the flanged joint and the rigid structures.

G. Where required, place concrete anchor blocks on pipe as shown on the Drawings or as directed by Engineer.

H. The concrete weight anchor system shall be bedded in place prior to pipe installation. Concrete anchors shall conform to Division 3 of these specifications and the attaching bolts, nuts, and washers shall be Type 316 stainless steel conforming to ASTM A-276 and ASTM A-307.

I. A rubber cushion strip shall fill the space between the pipe and concrete anchor and shall be 1/4 inch rubber sheet stock. Rubber cushion shall be cemented to the concrete anchors with rubber cement. Rubber cushions shall extend 1/2 inch beyond the edges of the concrete.

J. Care shall be exercised in handling the pipe such that slings are not positioned at fused joints and the pipe is not allowed to contact sharp or cutting objects that might damage it.

K. The handling of the pipe to its final position in the trench shall be done in such a manner that the pipe shall not be bent to a smaller radius than recommended by the manufacturer, that any portion of the pipe shall not be overstressed or damaged, or that installation stresses are not imposed upon the pipe.

L. The pipe profile shall conform approximately to the locations as shown on the Drawings, and pipe shall slope uniformly as shown on the Drawings with no local high points.

M. Rapid changes in slope, which would require special joints or fittings, or which would produce stresses in the pipe shall not be allowed.

N. Never attempt to flange up a pipeline that is too short by drawing the bolts together, thus stretching the line.

P. After the pipe is installed in the trench, a thorough inspection shall be made prior to backfill.

Q. After inspecting, carefully backfill the excavation as shown on the Drawings. 3/4 inch crushed stone shall be used as backfill. Prior to placing the final riprap the gravity line and service connections shall be pressure tested in accordance with the procedure specified hereinafter.

3.2 CLEANING AND TESTING

A. General:

1. The gravity line, and appurtenant work, in order to be eligible for acceptance, shall be subject to tests that will determine the degree of water tightness and horizontal and vertical alignment.
2. Thoroughly clean all piping prior to joint fabrication. Remove all dirt, dust, oil, grease, and other foreign material. Exercise care while cleaning to avoid damage to the pipe.
3. Test the pipe in the presence of the Owner in accordance with the requirements of these specifications.
4. Supply all labor, equipment, materials, gages, and pumps required to conduct the tests.
5. Perform all retesting required by the Owner at no additional cost to the Owner.
6. Remedial Work:
    a. Perform all work necessary to correct deficiencies discovered as a result of testing and or inspection.
    b. Completely retest all portions of the original construction on which remedial work has been performed.
    c. Perform all remedial work and retesting in a manner and at a time acceptable to the Owner at no additional cost to the Owner.

B. Pressure Test:

1. Test pipe after installation.
2. Install approved end caps and purge all air from the line.
3. Apply water pressure equal to 25 psig.
4. Initial pressure test shall be applied and allowed to stand without makeup pressure for two (2) hours to allow for diametric expansion or pipe stretch to stabilize.
5. After this equalization period, the test pressure shall be returned to 25 psig. The allowable amount of makeup water for expansion during the pressure test is 1 gallon per 100 feet of pipe (PPI Technical Report TR 31/9-79). The pump is then turned off, and a final test pressure held for two hours.
6. The total allowable leakage shall be less than two (2) gallons, for this final test.
7. If the installation fails the pressure test, determine the source of the leakage and repair or replace the defective work and retest until the line passes.

END OF SECTION

SECTION 02629

POLYVINYL, CHLORIDE (PVC) PRESSURE PIPE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish and install polyvinyl chloride (PVC) pipe of the size (s) and type (s) and in the location (s) shown on the Drawings and as specified herein.
B. Related Work Specified Elsewhere: "Pipe & Pipe Fittings - General" is specified in this Division

1.2 QUALITY ASSURANCE-

A. Standards:
   1. Schedule 40 and 80 Pipe: ASTM D - 1785.
   2. Pressure Rated (SDR) Pipe: ASTM D-2241 (less than 4 inch)
      AWWA C 900 (4 inch to 12 inch)
      UNI-B - 11 (14 inch to 24 inch)
   3. Materials: ASTM 1784
      a. PVC Normal Impact: Type 1, Grade 1, PVC 1120.
      b. PVC Normal Impact: Type 1, Grade 11, PVC 1220.
      c. PVC High Impact: Type 11, Grade 1, PVC 2110.
      d. CPVC (high temperature): Type IV, Grade 1, PVC 4120.
   4. Pipe for use with domestic potable water shall have NSF seal of approval.
B. Manufacturers:
   1. Certain-Teed.
   2. Johns-Manville.
   3. Harvel.
   4. Cabot.
   5. Or approved equal.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Piping Outside Buildings:
   1. Pipe and Fittings:
      a. Pipe and fittings shall be gasketed style utilizing twin gasket coupling or single gasket bell and spigot.
      b. Pipe class shall be as follows, unless otherwise shown on the Drawings:
         1) 4 inch and larger - Class 150 (DR 18)
         2) Less than 4-inch - Class 200 (SDR 21)
      c. PVC Class Water Pipe: Made to cast iron O.D.'s instead of IPS, or as shown on the Drawings and/or as approved by the Engineer.

d. Pipe Lengths: Laying lengths of 20 feet or as shown on the Drawings.

2. Joints:
   a. Provide rubber gaskets in sufficient quantity to allow for loss.
   b. Pipe 4 inch and larger shall have all gaskets installed in the bell by the Manufacturer.
   C. Provide couplings of the same quality as the pipe that will maintain tight joints when subjected to the same hydrostatic tests designated for the pipe,
3. Adapters: When applicable, provide adapters for connecting polyvinyl chloride pipe to pipes constructed from other material.

B. Piping Inside Buildings:
   1. Pipe and fittings:
      a. Solvent weld type unless otherwise shown on the Drawings or specified in other Sections in the Division.
      b. Piping, fittings and components: Schedule 40 PVC, normal impact unless otherwise shown on the Drawings or specified in other Sections in this Division.
   2. Joints:
      a. Joints: Solvent weld using solvent supplied by or approved by pipe manufacturer.
      b. Threaded and Screwed Joints: Permitted only on Schedule 80 and heavier pipe.
      c. Couplings and Fittings: Minimum schedule and pressure rating as the pipe.

3. Provide suitable adapters for connections to equipment and other piping systems.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Jointing:
   1. Clear each pipe length, coupling and fitting of all debris and dirt before installing.
   2. Provide and use coupling pullers for jointing the pipe when required.
   3. Shove home each length of pipe against the pipe previously laid and hold securely in position.
   4. Do not pull or cramp joints.

B. Fabrication:
   1. Cutting:
      a. Use a hand saw or pipe cutter with blades (not rollers).
      b. Examine all cut ends for possible cracks caused by cutting.
   2. Connecting:
      a. Solvent weld connections as recommended by the manufacturer.

b. Connect pipe and fittings only when temperature is above the minimum recommended by the manufacturer.
c. Threaded adapters shall be connected only with plastic male into metal female.

END OF SECTION

SECTION 02640

REPAIRING DAMAGED WATER FACILITIES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Work Included:

1. The Contractor will be working in close proximity to both underground and overhead utilities. The locations of existing drains, sewers, water mains, power lines, telephone cables and other utilities as shown on the drawings are approximate only.
2. Any damage to facilities maintained or operated by the Boothbay Region Water District, caused by or arising from the Contractor's operations, shall be fully repaired by the Contractor to the complete satisfaction of the Water District and as specified herein.

B. Related Work Specified Elsewhere:

1. Earthwork, pipe, pipe fittings, borrow and bedding materials are specified in the appropriate sections of this division.

1.2 QUALITY ASSURANCE

A. If any part of the water distribution system is disturbed, compromised, or destroyed as a result of the Contractor's operations, the Water District must be alerted immediately.

B. All repair materials and methods shall be specified below and shall be subject to Water District approval prior to installation.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Ductile Iron Pipe

1. For pipe 4 inches in diameter and smaller: Class 51
2. For pipe 6 inches in diameter and larger: Class 52
3. Pipe for use with sleeve type fittings shall have plain ends machined at right angle to the axis.
4. Factory applied bituminous coatings shall be furnished on the exterior of all underground piping.
5. All cutting of pipe shall conform to AWWA C600.

B. Ductile Iron Push-On and Mechanical Joints:

1. The plain ends of push-on pipes shall be machined to a true circle and chamfered.
2. Provide gaskets manufactured from a composited material suitable for exposure to the fluid contained in the pipe.
3. Bolts and nuts for buried mechanical joints shall be made of A588 steel.

4. Joints shall be Dresser Type 360, 126, or 153.

C. Copper Pipe and Fittings:
1. Domestic Water: Type K, soft annealed.
2. The use of compression fittings will not be allowed.

D. Pipe Bedding and Backfill:
1. All pipe bedding shall be screened stone. Minimum thickness of the bedding shall be 12 inches. The bedding shall completely surround the pipe to a minimum thickness of six inches.
2. All backfill shall be of select quality. Compaction of all backfill shall be to at least 95 percent of maximum dry density (ASTM D1557).
3. All backfill shall be of eight inch lift maximum.
4. All backfill shall be compacted by vibratory or mechanical means.

E. Concrete:
1. Construction of cradles, arches, thrust blocks, and encasement shall be made of class C concrete.

PART 3 – EXECUTION

3.1 PERFORMANCE

A. Ductile Iron Pipe:
1. If any ductile iron pipe is disturbed or broken within four feet of a joint, the entire section of the pipe shall be replaced. All other breaks shall be saw cut at 90 degrees to the axis, at least three feet on each side of the break, a new piece of ductile iron pipe shall be installed with proper mechanical fittings.
2. Joint bracing shall be employed to stabilize all repairs. The utilization of concrete encasements shall be made in place, trench wide, extend a minimum of 12 inches each side, beyond each joint of the repair. The encasement shall be wrapped with polyethylene. The piping shall be adequately braced to prevent floating while concrete is applied.
3. The use of thrust blocks shall be employed on all downstream sides of any deflection in the pipe greater than 11 degrees. The thrust block shall be encased after curing.
4. The use of mechanical joints shall be employed on all disrupted service laterals.

B. Copper Pipe:
1. If crimped or broken, the entire pipe shall be removed and replaced from the corporation to the curb stop at no additional cost to the Owner.
2. The repairs will be made to the satisfaction of the Water District.
3. if the repair is not made to the satisfaction of the Water District, they reserve the right to repair the pipe with all costs back charged to the Contractor.

END SECTION

SECTION 2650

BURIED UTILTIY MARKINGS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Work Included:

1. This work shall consist of providing utility line markings installed above all buried lines installed as part of this work as indicated on the Drawings and replacing markers disturbed as part of this work.

B. Related Work Specified Elsewhere:

1. Pipe, excavation, backfill, insulation are specified in the appropriate Sections in this Division.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Materials and colors shall be in accordance with latest AASHTO specifications for pipe and utility marking.

B. For ferrous pipe material use 0.004” minimum polyethylene film; 6” wide clearly marking type of buried utility.

C. For non-ferrous pipe material (e.g. Concrete, PVC, PE, etc.) use detection tape composit of polyethylene and metallic core 6” wide clearly marking type of buried utility.

D. Seton Identification Products, New Haven, CT, or equal.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Marking tape shall be installed over utility lines centerline and buried 24” below grade.

B. Markings damaged during opening of trench shall be reinstalled with a 2’ overlap at broken sections.

END OF SECTION

SECTION 02751

SEWER FLOW CONTROL

PART 1 – GENERAL

1.2 DESCRIPTION

C. Work Included: During the replacement of sewer lines the Contractor shall by-pass each section temporarily out of service. During sewer line joint testing the Contractor shall control flows in sewer lines when they exceed ¼ of the pipe diameter or when inspection of the complete periphery of the pipe is necessary to effectively conduct inspection operations.

D. Related Work Specified Elsewhere:

1. Sewer line cleaning is specified in the appropriate sections in this Division.
2. Final sewer testing is specified in Division 2

1.2 PERFORMANCE

E. Plugging or Blocking:

a. Insert plug at a manhole upstream of line to be inspected and tested.
b. Plug shall be so designed that all or any portion of the sewage flows can be released.
c. Flows shall be shut off or substantially reduced during line testing.

F. Pumping and Bypassing:

a. When required, supply the necessary pumps, conduits and other equipment (including standby equipment) to divert flow of sewage around the line in which work is being performed.
b. Furnish the necessary labor and 24-hour supervision to set up and operate the pumping and bypassing system.
c. When required on a 24-hour basis, all engines shall be equipped with silencers.

END OF SECTION

SECTION 02752

SEWER LINE CLEANING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Provide all equipment necessary for the proper cleaning of the sewers prior to the joint testing operations.

B. Related Work Specified Elsewhere: Sewer line joint testing is specified in this Division.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Hydraulic Cleaning Equipment:

1. Movable dam type constructed such that a portion of the dam may be collapsed during cleaning to prevent flooding of the sewer.
2. The movable dam shall be the same diameter as the pipe being cleaned and shall provide a flexible scraper around the outer periphery to ensure total removal of grease.
3. Take precautions against flooding prior to using sewer cleaning balls or other such equipment that cannot be collapsed instantly.

B. High Velocity Hydro-Cleaning Equipment shall:

1. Have a minimum of 500 feet of high pressure hose.
2. Have two or more high velocity nozzles capable of producing a scouring action from 15 degrees to 45 degrees in all size lines to be cleaned.
3. Include a high velocity gun for washing and scouring manhole walls and floor.
4. Be capable of producing flows from a fine spray to a long distance solid stream.
5. Include a water tank, auxiliary engines and pumps, and a hydraulically driven hose reel.
6. Have equipment operating controls located above ground.

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Select cleaning equipment based on the conditions of the lines at the time the work commences.

1. Light cleaning (small amounts of debris exist within the sewer line): Use balls, scooters, high pressure water jetting equipment, brushes and swabs.
2. Heavy cleaning (large deposits of debris or heavy root growth exist within the sewer line): Use high pressure waterjetting equipment.

B. Use selected equipment to remove all dirt, grease, rock and other deleterious

materials and obstructions.

C. Protect existing sewer lines from damage caused by improper use of cleaning equipment.
D. Take precautions to avoid damage or flooding to public or private property being served by the line being cleaned.
E. Use sewage flow in the sewer lines to provide necessary pressures for hydraulic cleaning devices whenever possible.
F. Removal of Materials:
   1. Remove all solids and semi-solids at the downstream manhole of the section being cleaned.
   2. Passing material from one section of a line to another will not be permitted.
G. Disposal of Materials: Remove from the site and dispose of all solids or semi-solids recovered during the cleaning operations in an approved manner.

3.2 FIELD QUALITY CONTROL

A. Acceptance of this portion of the work shall be made upon completion of the joint testing and shall be to the complete satisfaction of the Engineer.

END OF SECTION

SECTION 02753

TELEVISION INSPECTION OF SEWERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish all necessary labor, materials, supervision and equipment to satisfactorily inspect gravity sewer lines and sewer service pipes as required by the Contract Documents by means of a closed circuit television system.

B. Related Work Specified Elsewhere: Sewer line cleaning and sewer flow control are specified in the appropriate sections in this Division.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. The cameras shall be designed and constructed for sewer line inspection work. The mechanical design of the lens shall allow it to turn and rotate 360 degrees to provide a close up view of sewer pipe walls and sewer service pipes. The camera shall be designed to maintain proper orientation of the picture while the lens is turning and rotating.

B. The cameras shall be operative in 100% humidity conditions.

C. The lighting for the cameras shall be suitable to allow a clear picture of service pipes and the entire periphery of the mainline sewer pipe, such that joints, root intrusions, cracks, offset joints, deposits, etc. can be seen and identified by the Engineer.

D. The lens focus and rotational capabilities and the light intensity will be remotely controlled from an above ground television "studio".

E. The cameras shall produce a continuous, full color picture with a quality acceptable to the Engineer.

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Flow Control:

1. A minimum of 75% of the periphery of the sewer line shall be visible at all times.
2. The Engineer may require that the line be plugged so that the entire periphery can be inspected. For details on sewer flow control, see Section 02751.

B. Operation:

1. Perform inspection of sewer lines after lines have been suitably cleaned.
2. When inspecting newly constructed sewer lines, introduce water into the

sewer lines to be tested from the upstream manhole prior to the television inspection, but no more than 24 hours in advance of the inspection.

3. Lines will be suitably isolated from the remainder of the sewer line as required.
4. Move the cameras through the line in either direction at a uniform rate as directed by the Engineer.
5. The Engineer may require Contractor to pull cameras back to get a second view of a section of the pipe.
6. Use manual winches, power winches, television cable reel powered rewinds, high-pressure hose and reels on jet-cleaning trucks, or a flexible pole, to move the camera through the sewer.
7. The screen monitor and winch operators shall be in full communication at all times.
8. Remove all wires, screens, sand bags, etc. used in the television inspection process from the sewers at the completion of inspection of each sewer section.

C. Measurement:
   1. Measurement for location of defects, service connections, etc., shall be accurate to two tenths (0.2) of a foot over the length of the section being inspected.

D. Records:
   1. Printed records shall be provided, reflecting location of defects, service connections, etc., shall be recorded and stored to "Wincan" digital reporting software (or equivalent).:
      a. Keep records and supply to the Engineer when the work has been completed.
      b. Show the exact location in relation to adjacent manholes, of each infiltration point discovered by the television camera.
      c. Show locations of laterals, unusual conditions, roots, break-in storm sewer connections, collapsed sections, presence of scale and corrosion, and other discernible features.
   2. Inventory the houses and apparent empty lots bordering each section of sewer line that is inspected and compare results to the number and location of house services found during the inspection. Log inconsistencies and report them to the Engineer.
   3. Video / Photographs:
      a. A copy of the video shall be provided to the Engineer in DVD format.
      b. The video shall be digitally recorded, indexed by pipe section (labeled by manhole number or other means acceptable to Engineer) and allow for printing of still photographs.

c. Photographs shall be printed at Engineer's request and shall be identified on the back as follows:

Date _____
Section, MH#_____ to MH#_____
Diameter of Sewer _____
Distance from MH#_____ is _____
Description of item photographed _____
_____

END OF SECTION

SECTION 02755

FINAL SEWER TESTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Final sewer testing work includes the performance of testing and inspecting each and every length of sewer pipe, pipe joints and each item of appurtenant construction.
2. Perform testing at a time acceptable to the Engineer, which may be during the construction operations, after completion of a substantial and convenient section of the work, or after the completion of all pipe laying operations.
3. Provide all labor, pumps, pipe, connections, gages, measuring devices and all other necessary apparatus to conduct tests.

B. Related Work Specified Elsewhere (When Applicable):

1. Excavation, backfill, dewatering, pipe, pipe fittings and manholes are specified in the appropriate Sections in this Division and/or Division 15.
2. Manhole testing is specified in Section 02601 - Manholes, Covers and Frames.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.1 PERFORMANCE

A. General:

1. All sewers, manholes, and appurtenant work, in order to be eligible for acceptance by the Engineer, shall be subjected to tests that will determine the degree of watertightness and horizontal and vertical alignment.
2. Thoroughly clean and/or flush all sewer lines to be tested, in a manner and to the extent acceptable to the Engineer, prior to initiating test procedures.
3 . Perform all tests and inspections in the presence of the Engineer and the plumbing or building inspector in accordance with the requirements of the local and state plumbing codes.
4. Perform testing by test patterns determined by or acceptable to the Engineer.
5. Remedial Work:
   a. Perform all work necessary to correct deficiencies discovered as a result of testing and/or inspections.

b. Completely retest all portions of the original construction on which remedial work has been performed.
c. Perform all remedial work and retesting in a manner and at a time acceptable to by the Engineer at no additional cost to the Owner.

B. Line Acceptance Tests (Gravity sewers with no active service connections):

1. Test all gravity sewer lines with no active service connections for leakage by conducting a low pressure air test.
2. Equipment:
   a. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be inspected.
   b. Pneumatic plugs shall resist internal test pressures without requiring external bracing or blocking.
   c. All air used shall pass through a single central panel.
   d. Connect 3 individual hoses:
      (1) From the control panel to the pneumatic plugs for inflation,
      (2) From the control panel to the sealed sewer line for introducing the low pressure air,
      (3) From the sealed sewer line to the control panel for continually monitoring the air pressure rise in the sealed line.
3. Testing Pneumatic Plugs:
   a. Seal test all pneumatic plugs prior to using them in the actual test.
   b. Lay one length of pipe on the ground and seal both ends with the pneumatic plugs to be tested.
   c. Pressurize the sealed pipe to 5 psig.
   d. The pneumatic plugs are acceptable if they remain in place without bracing.
4. Testing Sewer Pipeline:
   a. After the sewer pipe has been cleaned and the pneumatic plugs checked, place the plugs in the sewer line at each manhole and inflate them.
   b. Introduce low pressure air into the sealed sewer pipeline until the air pressure reaches 4 psig greater than the average groundwater pressure.
   c. Allow a minimum of 2 minutes for the air pressure to stabilize to a minimum of 3.5 psig greater than the groundwater pressure. Groundwater is assumed to be at ground surface unless the Contractor can prove by otherwise by test pitting.
   d. After the stabilization period, disconnect the air hose from the control panel to the air supply.
   e. The pipeline will be acceptable if the pressure decrease is not greater than 1/2 psig in the time stated in the following table for the length of pipe being tested:

Pipe Diameter (inches)	Time (Min.) for Length of Pipe 0-100 ft.	101-200 ft.	201-300 ft.	301-400 ft.
4	2.0	2.0	2.0	2.0
6	3.0	3.0	3.0	3.0
8	4.0	4.0	4.0	5.0
10	5.0	5.0	6.0	8.0
12	5.5	5.5	8.5	11.5
15	7.0	8.5	13.0	17.0
18	8.5	12.0	19.0	25.0
21	10.0	17.5	26.0	35.0
24	11.5	23.0	34.0	45.5
27 and larger	14.5	29	43.0	58.0

6. Test Results:
   a. If the installation fails the low pressure air test, determine the source of leakage.
   b. Repair or replace all defective materials and/or workmanship and repeat low pressure air test at no additional cost to the Owner.

C. Line Acceptance Tests (Gravity sewers with active services):
1. Test all new gravity sewer lines with active services by conducting a low-pressure air test on all joints using a packer after all services have been connected or capped at the property line and all trenches backfilled but before the surface course of permanent pavement is installed.
2. Equipment:
   a. Closed-circuit television system.
   b. Testing devices (packer):
      (1) Capable of isolating individual joints by creating a scaled void space around the joint being tested.
      (2) Constructed such that low pressure air can be admitted into the void area.
      (3) Shall contain a pressure gauge accurate to one tenth (0.1) psi in-line with the feed line to monitor the void pressure.
      (4) Capable of performing in sewer lines where flows do not exceed 1/4 of the pipe diameter without resorting to any method of flow control.
3 . Testing Sewer Pipeline Joints:
   a. Test all joints except those with visible infiltration.
   b. Procedure:
      (1) Pull television camera through sewer line in front of the packer.

      (2) Position the packer on each joint to be tested.

      (3) Inflate the sleeves on each end of the packer.

(4) Apply four (4.0) psi pressure above the existing hydrostatic pressure on the outside of the joint to the void area created around the inside perimeter of the joint.
(5) Shut off the supply of air once the pressure has stabilized at the required amount.
(6) Monitor the void pressure for thirty (30) seconds.
(7) Repair the joint if the pressure drops more than one half (1/2) psi in the thirty (30) seconds.

c. Water or chemical pressure testing may be used in lieu of air testing subject to review and approval by the Engineer.
d. Re-clean and re-inspect all lines not approved by the Engineer at no additional cost to the Owner.
e. Repairing of Joints:
   1. When a joint fails the pressure test, excavate and repair the failed joint. Repairing joints with chemical grout will not be permitted.
f. The Engineer may request checking of the testing equipment for accuracy-
   1. Perform standard air test on a clean continuous section of pipe.
   2. Repair the equipment if the void pressure drops.
g. Testing Operation Inspection:
   1 . Reset each joint, as specified herein, prior to acceptance and final payment for joint testing. Retest all joints that fail until the test requirements are met.
h. The contractor will supply a black and white photograph of every joint that fails the pressure test.

D. Alignment Tests (Gravity Sewers):
1. Perform tests for the correctness of horizontal and vertical alignment on each and every length of gravity sewer pipeline between manholes.
2. Alignment tests to be conducted after all pipe has been installed and backfilled.
3. The observation test shall be conducted after all upstream work has been completed and the pipeline cleaned of debris.
4. Notify the Engineer at least 24 hours in advance of the proposed observation testing.
5. Introduce water into the sewer lines to be tested from the upstream manhole prior to the observation test but no more than 24 hours in advance of the test.
6. Beam a source of light, acceptable to the Engineer, through the pipeline from both ends and the Engineer will directly observe the light in the downstream, and/or upstream manhole of each test section.
7. The length of pipe between manholes, diameter of pipe and amount of light observed in the manhole at the end of each pipe section will determine acceptance of the alignment test by the Engineer.
8. The amount of vertical and horizontal deflection shall not be greater than the ASTM allowance and (manufacturer's recommendations) for the pipe being tested.

9. No standing water shall be allowed, The presence of standing water shall be cause for rejection of that pipe (including manhole) section.
10. Improper alignment will be corrected by re-excavation and resetting of pipe at no additional cost to the Owner.

E. Pipe Deflection: (Gravity Sewers)
1. Pipe provided under this specification shall be installed so there is no more than a maximum deflection of 5.0 percent. Such deflection shall be computed by multiplying the amount of deflection (normal diameter less minimum diameter when measured) by 100 and dividing by the nominal diameter of the pipe.
2. The Contractor shall wait a minimum of 30 days after completion of a section of sewer, including placement and compaction of backfill, before measuring the amount of deflection by pulling a specially designed gage assembly through the completed section. The gage assembly shall be in accordance with the recommendations of the pipe manufacturer and be acceptable to the Engineer.
3. Should the installed pipe fail to meet this requirement, the Contractor shall do all work to correct the problem as the Engineer may require without additional compensation.

F. Testing Pressure Sewers:
1 . The section of pipe to be tested shall be **filled** with water of approved quality, and all air shall be expelled from the pipe. If blowoffs are not available at high points for releasing air, the Contractor shall make the necessary excavations backfilling and taps at such points and shall plug said holes after completion of the test.
2. The section under test shall be maintained full of water for a period of 24 hours prior to the combined pressure and leakage test being applied.
3 . Perform pressure and leakage test at 11/2 times the maximum system pressure or 100 psi which ever is greater (based on the elevation of the lowest point of the section under test and corrected to the gage location).
4 . While maintaining this pressure, the Contractor shall make a leakage test by metering the flow of water into the pipe. If the average leakage during a two-hour period exceeds a rate of 10 gallons per inch of diameter per 24 hours per mile of pipeline the section shall be considered as having failed the test. All joints within chambers and all flanged joints shall have no visible leakage.
5. If the section fails to pass the pressure and leakage test, the Contractor shall do everything necessary to locate, uncover, and repair or replace the defective pipe, fitting, or joint, all at his own expense and without extension of time for completion of the work. Additional tests and repairs shall be made until the section passes the specified test.

G. Manhole Leakage Testing:
1 . Specified in the "Manholes, Covers and Frames" Section in Division 2.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Formwork, shoring, bracing, and anchorage
B. Concrete reinforcement and accessories
C. Concrete

1.2 RELATED SECTIONS

A. Section 01340 - Submittals
B. Section 01400 - Quality Control
C. Section 03305 - Concrete Testing
D. Section 03318 - Concrete Cradles, Arches, Encasements & Thrust Blocks
E. Section 03346 - Concrete Curing, Finishing and Repairs
F. Section 03420 - Precast Concrete Structures
G. Section 03604 - Non-Shrink Grout
H. Section 15094 - Pipe Hangers and Supports
I. Section 16050 - Basic Materials and Methods

1.5 REFERENCES

A. ACI 211.1-91 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
B. ACI 301-89 - Specifications of Structural Concrete for Buildings
C. ACI 302. 1 R-89 - Guide for Concrete Floor and Slab Construction
D. ACI 304.2R-91 - Placing Concrete by Pumping Methods
E. ACI 305R-91 - Hot Weather Concreting
F. ACI 306R-88 - Cold Weather Concreting
G. ACI 308-92 - Standard Practice for Curing Concrete
H. ACI 309R-87 - Guide for Consolidation of Concrete
1. ACI 318-89 - Revised 1992 - Building Code Requirements for Reinforced Concrete
J. ACI 347R-88 - Guide to Formwork for Concrete
K. ACI 35OR-89 - Environmental Engineering Concrete Structures
L. ASTM A82-90A - Specification for Steel Wire, Plain, for Concrete Reinforcement
M. ASTM Al 85-90a - Specification for Steel Welded Wire Fabric, Plain for Concrete Reinforcement
N. ASTM A615/A-92b - Specification for Deformed and Plain Billet - Steel Bars for Concrete Reinforcement

O. ASTM A706/A-92b - Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement.
P. ASTM A775/A-92 - Specification For Epoxy-Coated Reinforcing Steel Bars
Q. ASTM C33-90 - Specification for Concrete Aggregates
R. ASTM C94-92 - Specification for Ready Mixed Concrete
S. ASTM C 1 50-92 - Specification for Portland Cement
T. ASTM C260-86 - Specification for Air Entraining Admixtures for Concrete
U. ASTM C309-91 - Specification for Liquid Membrane-Forming Compounds for Curing Concrete
V. ASTM C494-92 - Specification for Chemical Admixtures for Concrete
W. Concrete Reinforcing Steel Institute - Manual of Standard Practice
X. Concrete Reinforcing Steel Institute - Placing Reinforcing Bars

1.6 QUALITY ASSURANCE

A. Perform work in accordance with ACI 301, ACI 318 and ACI 35OR as modified here-in.
B. Maintain copies of ACI 301, ACI 318, and ACI 35OR on site.

1.7 SUBMITTALS

A. Submit layout drawings showing the location and extent of all joint waterstops, the type and size of all waterstops to be used and splice locations for each joint. Submit these layout drawings for review prior to the submittal of the reinforcing shop drawings and the start of concrete work.
B. Submit shop drawings for concrete reinforcement prior to fabrication, showing bar bends, details and placement.
C. Submit Concrete Mix designs
D. Submit Current Cement Manufacturer's Certificates of conformance with ASTM C150.
E. Submit product data and material safety data sheets for concrete admixtures.
F. Submit product data and material safety data sheets for concrete accessories.
G. Submit sample concrete mix delivery slip.
H. Submit product data and material safety data sheets for form release agent.
1. Submit product data and layout drawing for Architectural Form Liner and Rustification Strips.
J. Submit product data and sample for form ties.

1.8 CONCRETE MIX DESIGNS
A. Conform to ACI 301 Section 3.9; submit substantiating data.
1.9 PRE-CONCRETE CONFERENCE-

A. Hold meeting more than 14 days prior to submittal of concrete mixes to review concrete procedures.
B. Attendance: Contractor; concrete supplier; mix design laboratory; Independent Testing Laboratory; concrete subcontractor; admixture manufacturer; concrete pumping contractor.
C. Meeting Minutes: Contractor shall record minutes of meeting and distribute to attending parties, within 5 days of meeting.

D. Notify engineer more than 10 days prior to meeting. Engineer will attend.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Plywood: APA, B-B Plywood Class I exterior.
B. Lumber: Southern pine, No. 2 grade or equal.
C. Steel: Minimum 16 ga. sheet, well matched, tight fitting, stiffened to resist loads without excess deflection.
D. Form Liner: Plywood conforming to PS-1, Grade B-B exterior (concrete form) not less than 1/4 inch thick.
E. Form Ties: Factory fabricated assembly providing at least 1.5 inch break back dimension with at least a 1 inch diameter conical wood or plastic cones to leave a uniform hole for patching. Single rod ties require a tightly fitted waterstop washer at the mid point. Multi rod ties do not require washers.
F. Form release agent: non-staining colorless, compatible with finishes, and nontoxic for potable water. Super-X by A.H. Harris & Sons, Inc. or equal.
G. Conform to ACI 301 and ACI 347
H. Architectural Form Liner.
I. Rustication Strips by Symons Elasto-Tex Model Number 30757 or equal.
J. Form circular structures with circular or segmented wooden or steel forms. Segmented forming of circular structures will be allowed only if the contractor or subcontractors performing the concrete work (forming and placement) can demonstrate a proven track record of building high quality segmental formed curved concrete structures. If segmental forms are used, all tangent intersections shall blend smoothly with the adjacent segments and the net visual appearance shall be of a uniform concentric circular walls.

2.2 REINFORCING STEEL

A. Bars: ASTM A615 Grade 60; deformed new materials; ASTM A706 for bars to be welded.

B. Welded wire fabric: ASTM A185

C. Epoxy coated bars: ASTM A775

D. Tie wire: ASTM A82, annealed, Epoxy coated for Epoxy-coated reinforcing.

E. Bolsters, chairs and supports: plastic coated, stainless steel, or epoxy coated.

F. Spiral Reinforcement: ASTM A82 or ASTM A615 Grade 60.

G. Expansion Joint Dowel Bar: ASTM A675 Grade (60) (70), smooth new material.

2.3 FABRICATION OF REINFORCING STEEL

A. Conform to CRSI Code of Standard Practice-Fabrication.

B. Cold bend bars.

C. Bend bars around revolving collar of recommended size.

2.4 CONCRETE MATERIALS

A. Portland cement: ASTM C150; Type II. Tricalcium Aluminate (C3A) content in cement less than 8%. Cement shall be furnished from one source during the project.

B. Aggregates:

1. Fine aggregate shall consist of washed inert natural sand conforming to the requirements of ASTM Specification C-33.

2. Coarse aggregate shall consist of a well graded crushed stone or a washed gravel conforming to the requirements of ASTM Specification C-33.

C. Water: potable from municipal water supply or equal.

D. Admixtures: All from one common manufacturer.

2.5 ADDMIXTURES

A. Low Range Water Reducer: Pozzolith 122-N by Master Builders; WRDA with HYCOL by Grace Construction Products Division; or equal meeting ASTM C494 Type A

B. High Range Water Reducer (superplasticiser): Rheobuild I 000 by Master Builders; Daracem 100 by W. R. Grace; or equal meeting ASTM C494 type F.

C . Air entraining agent: Micro-Air by Master Builders, DAREX 11 AEA by Grace Construction Products; or equal meeting ASTM C260.

D. Non-corrosive non-chloride accelerator: Pozzutec 20 by Master Builders; or equal meeting ASTM C494 type C or E.

E. Not permitted: Calcium chloride, thiocyanates or admixtures containing more than 0.05% chloride ions.

2.6 ACCESSORIES

A. Joint filler and slab perimeters: J-Joint polyethylene foam with tear off strip for sealant or approved equal; joint filler to be slab thickness in depth less 0.5 inch for sealant.

B. Expansion joint filler: Self expanding cork by W.R. Meadows or W.R. Grace or equal size as indicated on the Drawings.

C. PVC water-stops shall be extruded polyvinylchloride with virgin resin and shall be either the dumbbell type, flat ribbed type or wire reinforced flat ribbed type:

1. Dumbbell Type Waterstop: [NOTE TO SPECIFIER: VERIFY LOCATION]
   a. Construction and Control Joints: 0.375 inch thick by 9 inches wide. Style 751 by Greenstreak Plastic Products, Hom/Durajoint Type DB-4 by A.C. Hom, Type D9-38 by Vinylex Corporation.
   b. Expansion Joints: 0.375 inch thick by 9 inches wide with 1-1/2 inch O.D. center bulb. Style 753 by Greenstreak Plastic Products, Hom Durajoint type DB-6 by A.C. Hom, Type DB9-38 by Vinylex Corporation.
2. Flat Ribbed Type Waterstop:
   a. Construction and Control Joints: 0.375 inch thick by 9 inches wide. Type R9-38 by Vinylex Corporation, Style 773 by Greenstreak Plastic Products.
   b. Expansion Joints: 0.375 inch thick by 9 inches wide with a center bulb. Type RLB9-38 by Vinylex Corporation, Hom/Durajoint Type 7C by A.C. Hom.
3. Wire Reinforced Flat Ribbed Type Waterstop:
   a. Construction and Control Joints: 0.375 inch thick by 9 inches wide. Type FR-9380 by Paul Murphy Plastic Company.
   b. Expansion Joints: 0.375 inch thick by 9 inches with a center bulb, Type CR-9380 by Paul Murphy Plastic Company.
4. Split Type Waterstop: (Size as shown on the Contract Drawings).
   a. Construction and Control Joints: 0.375 inch thick by 6 inches wide. Style 724 by Greenstreak Plastics Products or equal, or 0.375 inch thick by 9 inches wide. Style 727 by Greenstreak Plastics Products.
   b. Expansion Joints: 0.375 inch thick by 9 inches wide. Style 727 by Greenstreak Plastics Products Type SR-9380 by Paul Murphy Plastic Company.

Use prefabricated vinyl comers, tees and crosses.

D. Metal waterstops shall be fabricated nickel-copper roofing sheet conforming to ASTM B127. Thickness of waterstops shall be No. 24 gauge U.S. standard (0.025 in). Widths shall be as shown on the Drawings. Waterstops shall be pre-fabricated to fit the contour of the joints and shall be folded, bent and/or crimped in accordance with the details shown or approved. Bends and crimps shall be made with a minimum radius of 1/2-in. Waterstops shall be finished in maximum lengths available to reduce the number of joints required.

E. Surface applied waterstops: Waterstop RX by American Colloid Company 3/4"x3/8" size or; Swellseal Plus by de neef America.

F. Dovetail anchor slots: 1 inch by 0.625 inch by I inch, 24 gage, galvanized, 10 foot lengths, foam filled by Heckman Building Products, Hohman & Bamard or equal.

G. Epoxy adhesive: Water based epoxy resin/Portland cement bonding agent: Armatec I IO by Sika corporation or equal.

H. Expansion anchors: Stainless Steel AISI Type 304 or 316. Kwik-Bolt by Hilti Fastening Systems or Tru Bolt by Ramset Fastening System with flat and lock washers and nuts or equal.

I. Epoxy capsule anchors: Non-expanding chemical type, 6" minimum projection and nut; Parabond Capsule Anchor by Molly Fastener or HVA Adhesive anchor by Hilti Fastening Systems or equal.

J. Structural inserts: of type and size shown on the drawings; Richmond Screw Anchor or Heckman Building Products, Hohman and Bamard, Dayton Sure-Grip or equal.

K. Wood grounds (embedded nailers): 2 inch by 4 inch nominal size KD, No. 2 Hemlock, Southern Pine, or Spruce, pressure treated with 0.4 PCF CCA.

L. Sand Cement Slurry: specified concrete mix Class A without coarse aggregate.

M. Bond Breaker: Thompson's Water Seal or equal, or form oil.

N. Expansion Dowel Cups: No. 87 dowel cups as manufactured by Heckmann Building Products, Inc., Type F-46 Dowel cups by Dayton Sure-Grip and Shore Co. or equal.

2.7 DOWEL BAR SPLICERS

A. Thread bars in shop only

B. Provide plastic plugs in female end at form.

C. Develop 125% of yield strength of specified bar size across joint.

D. Acceptable Manufacturers: Richmond DB-SAE Splicer System, Lenton Form Saver or Dayton Superior dowel bar replacement system.

E. Submit product data with strength tests.

2.8 MECHANICAL BAR SPLICERS

A. Develop 125% of yield strength of bar across mechanical splice.
B. Use metal filled sleeve type: Richmond DB-SAE Splicer Systems or equal.

2.9 CONCRETE MIX

A. Concrete proportioning shall conform to ACI 301 Section 3.9 except as modified in the table below:

Class	Specified Strength (f_c)	Minimum Average Required Strength (f_{cr})	Coarse Aggregate Size	% Air ±(1.5%)	Min.-Max. Slump	Min.-Max. Cem.Fac.	High Range Max.Water W/C Reducer	
A	4000 PSI	4600 PSI	No. 57 (1")	6	1-3	564-620	0.42	Yes
B	4000 PSI	4600 PSI	No. 67 (3/4")	6	1-3	564-620	0.42	Yes
C	3000 PSI	-----	No. 8 (3/8")	6	2-5	517-564	0.50	No
D	2500 PSI	-----	No. 4 (11/2”)	4	2-5	470-517	0.55	No

B. The maximum slump as indicated in the above table will be as measured at the batch plant.
C. Pumped Concrete: Conform to Chapter 4 - ACI 304.2
D. High range water reducer shall be added on site to obtain 4" - 8" slump.
E. No water is to be added on site.
F. Concrete shall be furnished from one source during the project.

2.10 STORAGE OF MATERIALS

A. Protect materials from ground and the elements.
B. Maintain cement in dry condition.
C. Store reinforcement on skids.
D. Remove defective materials from site. Do not store on site.

PART 3 - EXECUTION

3.1 FORMWORK

A. Conform to ACI 301 and ACI 347
B. Verify lines, levels and measurements before proceeding.
C. Erect plumb and straight. Maintain rigid. Brace sufficiently.
D. Allow no concrete leakage.
E. Treat forms with form release agent. Protect reinforcing from contact with form release agent.
F. Earth forms not permitted.
G. Camber formwork as necessary.
H. Provide port holes in wall and column forms to allow cleaning and inspection every 8'-0" on center.

I. Chamfer all exposed outside comers and edges 0.75 inch unless otherwise noted.
J. Maintain specified tolerances.
K. All concrete formwork, including reinforcing steel and embedment items, shall have a temperature greater than or equal to 35º F at the time of concrete placement.
L. Maintain forms and shores supporting the cast concrete for the time periods indicated:

1. Walls and Vertical Surfaces (non-water retaining)	* 36 Hours
2. Walls and Vertical Surfaces (water retaining)	* 48 Hours
3. Beams and Slabs spanning less than 20 feet	* 14 Days
4. Beams and Slabs spanning more than 20 feet	*21 Days

These periods represent cumulative number of days or hours during which the temperature of the air surrounding the concrete is above 50°F and the concrete has been damp and no loss of moisture has occurred.

M. Reshore as required.
N. Clean out inside of forms of all foreign materials prior to concrete placement.
O. Form pressures increase with the use of concrete with High Range Water Reducers. Design forms accordingly.
P. Install architectural form liner and rustication strips according to Manufacturer's recommendations.

3.2 REINFORCEMENT

A. Conform to the CRSI Code of Standard Practice - Field Erection for surface condition, bending, spacing and placement tolerance.
B. Weld no reinforcement unless no exceptions are taken by Engineer in writing.
C. Splicing reinforcement: conform to ACI 318; welded wire fabric to be lapped 11/2 courses or 12 inches; tie fabric at 24 inches on center maximum spacing.
D. Provide bar supports: on grade use concrete brick; elsewhere use manufactured wire supports.
E. Do not bend reinforcing partially embedded in the concrete.
F. Mechanical connections shall be installed in accordance with splice device manufacturer's recommendations.
G. Epoxy coating damaged shall be repaired with patching material conforming to ASTM A775.
H. All parts of mechanical connections on epoxy coated reinforcing bars, including steel splice sleeves, bolts and nuts shall be coated with the same material used for repair of epoxy coating damage.

3.3 EMBEDDED ITEMS

A. Coordinate installation of embedded items.

B. Place anchor bolts, dovetail slots, waterstop, pipes, conduit, pipe hanger inserts, nosings, rail posts and other required items and secure.

C. Expansion joint dowels shall be held horizontally in forms to prevent displacement and to allow at least one inch of expansion after installation.

D. Place dowels for masonry according to dowel layout provided by the mason.

E. Pipes or Conduits for embedment within a slab, wall or beam, other than those merely passing through, shall satisfy the following:

1. Shall not be larger in outside diameter than one-third (1/3) the thickness of the slab, wall or beam.
2. Shall not be spaced closer than 3 diameters on center.
3. Shall not impair significantly the strength of the concrete.

3.4 WATERSTOP

A. Nail surface applied waterstops to concrete at 12 inches on center. Protect from contact with water.

B. Splice vinyl waterstops as recommended by manufacturer; develop 80% tensile strength in splice; form continuous seal at joint intersections; terminate with 2" concrete cover where designed to discontinue.

C. Secure waterstops on both sides at 12" on center maximum spacing; dumbell type with manufactured clips; place center of waterstop at joint.

D. Place concrete uniformly to avoid displacing waterstop.

E. Thoroughly vibrate concrete around waterstop to avoid honeycombing and voids in concrete and to insure complete contact between waterstop and concrete.

F. Notify Engineer 24 hours prior to installing waterstops.

G. Joints: hold vinyl waterstop rigid with split bulkhead forms.

H. Use prefabricated vinyl comers, tees and crosses, bending waterstop around comers will not be acceptable.

I. Metal waterstops in existing concrete shall be placed in saw cut regrets as shown on the Drawings and the reglet filled with non-shrink grout. Care shall be exercised to protect the waterstop from damage in the intervals between placing waterstops and the subsequent placing of concrete.

Exposed portion of metal waterstop shall be held in position by tying to reinforcing steel prior to placing concrete. All joints in metal waterstops shall be lapped and pre-tinned at least 1 -in, riveted and soldered, to make the stops continuous and watertight. Solder shall be a minimum of 50 percent tin and the remainder lead. Rivets shall be nickel-copper alloy conforming to the requirements of ASTM B164, Class A.

J. Place great importance on the successful installation of joint waterstops.

3.5 PLACING CONCRETE

A. Notify Engineer and Independent Testing Laboratory 24 hours minimum prior to each placement.

B. Assure placement and proper location of all embedded items.

C. Place no concrete on frozen ground.

D. Place concrete from mixing truck to final location quickly and without segregation.

E. Place concrete within 90 minutes of batching.

F. Freefall: 4 feet maximum.

G. Place continuously and against plastic concrete only.

H. Do not place partially hardened concrete.

I. Consolidate concrete by vibrating. Penetrate preceding lift 4 inches to blend layers. Do not use vibrator to move fresh concrete laterally. Insert vibrator at approximately 18 inch intervals. Consolidate concrete without segregation. Conform to ACI 309.

J. Conform to ACI 306R for cold weather concreting when environmental conditions exist as defined in Section 03346, Part 1.5.

1. Temperature limitations on concrete when delivered to site:

		Section size, minimum dimension, in.			
		<12 in.	12-36 in.	36-72 in.	>72 in.
Item	Air Temperature				
	Minimum concrete temperature as placed and maintained				
1		55 F	50F	45 F	40 F
	Minimum concrete temperature as mixed for indicated air temperature				
2	Above 30 F	60 F	55 F	50 F	45 F
3	0 to 30 F	65 F	60 F	55 F	50 F
4	Below 0 F	70 F	65 F	60 F	55 F

K. Conform to ACI 305R for Hot Weather Concreting when environmental conditions exist as defined in Section 03346 Part 1.5.

1. Temperature of concrete placed shall not exceed 90º F.

L. Provide concrete Delivery Slil2 prepared at batch plant with each truck load of concrete showing ticket number, date, truck number, mix strength, maximum stone size, weight of coarse aggregate, weight of fine aggregate, cement weight, volume of concrete, gallons of water added at plant, time water added at plant, quantities of all admixtures used.

M. High Range Water Reducing admixtures shall be used for all concrete to be pumped or with a specified water/cement ratio below 0.50. Maximum slump 8 inches with admixture.

N. Use non-corrosive, non-chloride accelerator when placing concrete in air temperatures below 50º F.

O. Thoroughly moisten subgrade materials prior to placing slabs on grade.

P. Horizontal wall construction joints deeper than 8' from top of placement, place one inch of sand cement slurry prior to placing concrete.

Q. Where shown on the drawings, apply epoxy adhesive to existing concrete to bond to new concrete.

3.6 JOINTS

A. Saw cut control joints for slabs on grade within 24 hours of placement.

B. Provide joints only where shown on the drawings or as otherwise approved after written request.

C. Install waterstops in construction, control and expansion joints as shown on the Drawings.

D. Apply bondbreaker to surface of control joints.

3.7 MODIFICATIONS OR REPAIRS TO EXISTING CONCRETE

A. Field measurements shall be taken at the required structures to determine the quantity of concrete to be removed and/or repair and the amount of patching to be done.

B. When removing materials or portions of existing structures and when making openings in existing structures, all precautions shall be taken and all necessary barriers and other protective devices shall be erected to prevent damage to the structures beyond the limits necessary for the new work, and to prevent damage to the structures or contents by falling or flying debris.

C. Remove concrete to the depths shown or required. Roughen concrete surfaces by chipping, sandblasting or scarifying.

D. Surfaces must be clean and sound. Surfaces may be dry, damp, or wet, but free of standing water. Remove dust, laitance, grease, curing compounds, impregnations, waxes, foreign particles, and disintegrated materials by mechanical abrasion methods such as sandblasting.

E. Exposed reinforcement shall be cleaned by wire brushing and where shown the reinforcement shall be cut or bent. Additional reinforcement shall be provided as shown on the Drawings.

3.8 CUTTING OF HOLES

A. Core drill holes where shown or as directed by the Engineer.

3.9 DRILLING AND GROUTING DOWELS

A. Drill and grout dowels where shown or as directed by the Engineer.

B. Clean hole; blow out or vacuum.

C. Fill hole with non-shrink grout; insert dowel with twisting motion; add grout as needed.

D. Maintain dowel stationary until grout cures.

3.10 TOLERANCES

A. Maximum allowable deviations from dimensions, elevations, slopes and positions

as indicated.

1. Variation from plumb:

   A. In the lines and surfaces of columns, piers, walls, and in arises:
      In any 10 ft. of length 1/4 in
      Maximum for the entire length 1 in
   B. For exposed comer of columns, control-joint grooves, and other conspicuous lines:
      In any 20 ft. Length 1/4/in
      Maximum for the entire length 1/2 in
2. Variation from the level or from the grades specified in the contract documents:
   A. In slab soffits, ceilings, beam soffits and in arises, measured before removal of supporting shores:
      In any 10 ft. of length 1/4 in
      In any bay or in any 20 ft. Length 3/8 in
      Maximum for the entire length 3/4 in
   B. In exposed linters, sills, parapets, horizontal grooves, and other conspicuous lines:
      In any bay or in 20 ft. Length 1/4 in
      Maximum for the entire length 1/2 in
3. Top elevation of columns, piers, walls and arises 1/4 in
4. Top elevation of slabs 1/4 in
5. Variation of the linear building lines from established position in plan and related position of columns, walls, and partitions:
   In any bay 1/2 in
   In any 20 ft. of length 1/2 in
   Maximum for the entire length 1 in
6. Variation in the sizes and location of sleeves, floor openings, 1/4 in and wall openings
7. Variation of cross-sectional dimensions of columns and beams and in the thickness of slabs and walls:
   Minus 1/4 in
   Plus 1/2 in
8. Footings*
   A. Variations in dimensions in plan:
   Minus 1/2 in
   Plus 2 in
   B. Misplacement or eccentricity:
      2 percent of the footing width in the direction of misplacement but not more than 2 in

C. Thickness:
   Decrease in specified thickness 5 percent
   Increase in specified thickness no limit

D. Elevation of top 1/4 in

9. Variation in steps:

A. In a flight of stairs:

Rise	+- 1/8 in.
Tread	± 1/4 in.

B. In consecutive steps:

Rise	± 1/16 in.
Tread	± 1/8 in.

*Tolerances apply to concrete dimensions only, not to positioning of vertical reinforcing steel, dowels, or embedded items.

3.11 DEFECTIVE CONCRETE

A. Defective concrete is defined as concrete in place which does not conform to strength, shapes, alignments, appearances and/or elevation as shown on the drawings and/or presents faulty surface areas.

B. Concrete surfaces not finished or cured in accordance with Section 03346 Concrete Finishing, Curing, and Repairs shall be classified as defective concrete.

C. Formed surfaces larger or smaller than dimensional tolerances specified in this Division may be rejected. If the Engineer permits the Contractor to correct the error, such correction shall be as directed and in such a manner as to maintain the strength, function and appearance of the structure.

D. Concrete members cast in the wrong location may be rejected and shall be removed at no additional cost to the Owner if the strength, appearance or function of the structure is adversely affected.

E. Inaccurately formed surfaces exposed to view may be rejected and shall be repaired or removed and replaced at no additional cost to the Owner.

F. Concrete exposed to view with defects which adversely affect the appearance of the specified finish shall be repaired. If, in the opinion of the Engineer, the defects cannot be repaired, the concrete may be accepted or rejected in accordance with the decision of the Engineer.

G. The strength of the structure in place will be considered potentially deficient if it fails to comply with any of the following requirements:

1. Concrete strength as evaluated by the requirements of this Division.
2. Reinforcing steel size, quantity, strength, position, or arrangement at variance with the Drawings.
3. Concrete which differs from the required dimensions or locations in such a manner as to reduce the strength.

3.12 CONCRETE MIX CLASS USAGE

A. Reinforced concrete sections greater than IO" thick: Class A

B. Reinforced concrete sections equal to or less than 10" thick: (,'lass B

C. Concrete fill**:** Class C

D. Topping for precast hollow core slabs: Class C

E. Mud slab: D
F. Sand/Cement Slurry: Class A without Coarse Aggregate.

3.13 PROTECTION FROM COLD

A. Concrete structures shall be covered, insulated and heated as required to prevent frost penetration beneath the structures until acceptance by the Owner.

END OF SECTION

SECTION 03305

CONCRETE TESTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Field testing of cast-in-place concrete.
B. Plant inspection.

1.2 RELATED SECTIONS

A. Section 01340 - Submittals
B. Section 01400 - Quality Control
C. Section 03300 - Cast-In-Place Concrete
D. Section 03300 - Concrete Topping for Precast Concrete
E. Section 03346 - Concrete Finishing, Curing and Repairs
F. Section 03604 - Non-Shrink Grout

1.3 REFERENCES

A. ASTM C31-91 - Practice For Making and Curing Concrete Test Specimens in the Field
B. ASTM C39-86 - Test Method For Compressive Strength of Cylindrical Concrete Specimens
C. ASTM C172-90 - Method of Sampling Freshly Mixed Concrete
D. ASTM C231-91b - Test Method For Air Content of Freshly Mixed Concrete by the Pressure Method
E. ASTM E329-90 - Practice For Use in the Evaluation of Testing and Inspection Agencies as Used in Construction

1.4 QUALIFICATIONS

A. Independent Testing Laboratory shall conform to concrete testing requirements of ASTM E329.
B. Key personnel must be qualified and experienced in concrete quality assurance.
C. Perform concrete field quality control testing with personnel certified as a Concrete Technician according to the American Concrete Institute (ACI) or equal.

1.5 SUBMITTALS

A. Owner shall submit Independent Testing Laboratory qualifications, for Engineer's and Contractor's review and acceptance.
B. The Contractor shall be responsible for the submittals for review and acceptance by the Engineer at no additional cost to the Owner.
C. Independent Testing Laboratory shall submit one copy each of all test reports to each of the following: Engineer, Resident Project Representative, Contractor.

D. Independent Testing Laboratory shall submit reports within 5 days of testing or inspection.
E. Independent Testing Laboratory shall telephone the Engineer within 24 hours if tests indicate deficiencies.

PART 2 - PRODUCTS - not used

PART 3 - EXECUTION

3.1 CAST-IN-PLACE CONCRETE

A. An Independent Testing Laboratory, selected and paid for by Owner, shall test and sample concrete for strength, slump and air content as follows:
B. Obtain 5 standard test cylinder samples (6" x 12") of each 100 cubic yards or less of each class of concrete placed in any one day.
C. Test 2 cylinders at 7 days; 2 cylinders at 28 days. Hold one cylinder for later testing.
D. Perform slump tests and air entrainment tests on each truck and at each sampling. Perform slump and air entrainment tests before addition of High Range Water Reducer and after addition of High Range Water Reducer.
E. Sample concrete for testing at the discharge end of hose when concrete is pumped.
F. Perform strength, slump and air entrainment tests at other times when directed by the Engineer.
G. Additional testing and sampling required as a result of deficient results or improper curing shall be paid for by Owner. The cost of resampling and retesting will be determined by Engineer, and Owner will invoice Contractor for this cost. If unpaid after 60 days, this invoice amount will be deducted from the Contract Price.
H. Contractor shall provide and maintain an insulated, heated concrete cylinder curing box, 4 foot square minimum, with a min.-max. thermometer and maintain the temperature between 60F and 80F.

3.2 PRECAST STRUCTURAL CONCRETE

A. Independent Testing Laboratory shall inspect precast plant(s) during first major casting of product for project.
B. Notify Independent Testing Laboratory 72 hours in advance of first major casting.
C. Independent Testing Laboratory shall inspect batching and mixing equipment, storage of materials, placement of reinforcement and forms, mix design, concrete testing, concrete placement, curing, general quality control procedures.
D. Independent Testing Laboratory shall provide report to Engineer and Contractor within 5 days.

END OF SECTION

SECTION 03318

CONCRETE CRADLES, ARCHES, ENCASEMENTS & THRUST BLOCKS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish and construct cradles, arches, encasements, and thrust blocks for pipes in the location(s) and of the dimension(s) and shapes shown on the Drawings, as directed by the Engineer and as required to rigidly support pipes.

B. Related Work Specified Elsewhere (When Applicable): Concrete procedures, cast in-place concrete, and concrete finishing and curing are specified in the appropriate Sections in this Division.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Construct cradles, arches, encasements, and thrust blocks of Class C concrete, unless otherwise shown on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Construct cradles, arches, encasements, and thrust blocks the full width of the trench and/or as shown on the Drawings.

B. Secure pipe to prevent movement and floatation during the placement of the concrete.

END OF SECTION

SECTION 03346

CONCRETE FINISHING, CURING AND REPAIRS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Concrete Curing
B. Concrete Finishing
C. Concrete Repairs

1.2 RELATED SECTION

A. Section 01340 Submittals
B. Section 03300 - Cast-in-Place Concrete
C. Section 03604 - Non-Shrink Grout
D. Section 07115 - Resealable Membrane Waterproofing
E. Section 07120 - Fluid Applied Waterproofing
F. Section 07150 - Dampproofing
G. Section 07900 - Joint Sealers
H. Section 09900 - Painting

1.3 REFERENCES

A. ACI 301-89 Specifications for Structural Concrete for Buildings
B. ACI 302.1R-89 Guide for Concrete Floor and Slab Construction
C. ACI 305R-91 Hot Weather Concreting
D. ACI 306R-88 Cold Weather Concreting
E. ACI 308-92 Standard Practice for Curing Concrete
F. ACI 350R-89 Environmental Engineering Concrete Structures
G. ASTM C309-91 - Specification For Liquid Membrane - Forming Compounds for Curing Concrete

1.4 SUBMITTALS

A. Submit product data and material safety data sheets for curing compounds, floor sealers and hardeners, and repair materials.
B. Submit procedures prior to concrete placements for cold weather protection, hot weather protection and curing methods.

1.5 ENVIRONMENTAL CONDITIONS

A. Cold Weather and Hot Weather are defined when temperatures will fall below 40'F during the week following placement or will be above 900F, respectively.

PART 2 - PRODUCTS

2.1 LIQUID CURING COMPOUND MATERIALS [NOTE: Non-toxic for potable water structures]

A. Curing and Sealing Compound; ASTM C309 Type I Class B; 30% solids type minimum. Application rate 200 square feet per gallon. Super Kurseal 830 by A.H. Harris & Sons, Inc. Super Rez-Seal by Euclid Chemical Company or equal.
B. Dissipating Resin Curing Compound: ASTM C309 type 1; Film must break down in two to four weeks. Application rate 200 square feet per gallon. Kurez-DR by Euclid Chemical Company or equal.
C. Curing/Hardening Compound: Sodium Silicate Type. Application rate 200 square feet per gallon. Eucosil by Euclid Chemical Company or equal.

2.2 FINISHING MATERIALS

A. Slab Sealer: Siloxane based 96% chloride ion screen, Euco-Guard by Euclid Chemical, Sikaguard 70 by Sika Corporation or equal. Do not apply to surfaces cured with curing compounds, except for that specified in paragraph 2.1.B.
B. Bonding Admixture: Latex, non-rewetable type SBR Latex or Flex-con by Euclid Chemical, Daraweld C by W.R. Grace or equal.
C. Grout Paint: mix 1 part Portland Cement, 1.5 part fine sand, 50:50 mixture of bonding admixture to consistency of thick paint.
D. Patching Mortar: 1 part of a mixture of white and grey portland cement to 2.5 parts of damp loose sand. Cement type to match substrate.
E. Acid Resistant Epoxy Coating: Two component, 100% solids epoxy resin with Silica sand for skid resistance. Gray color, PG-2112 by Permagile - Salmon LTD, or approved equal.

2.3 REPAIR MATERIALS

A. Epoxy Adhesive: Armatec 110 by Sika Corporation or equal.
B. Repair Mortar: polymer improved, cementitious, 2 component, trowel grade mortar equal to Concrete Coat by Euclid Chemical; Sikatop 122 by Sika Corp. or equal.

PART 3 - EXECUTION

3.1 FINISHES

A. Finish concrete surfaces as scheduled.
B. Complete all finishing as soon as possible but always within 7 days of concrete placement. Special requirements will apply after 7 days.
C. Repair all holes and defects and allow to set prior to finishing concrete.
D. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete.

3.2 FINISHING SLABS AND FLATWORK

A. Screed to bring concrete surface to proper contour and elevation.
B. Highway straightedge, bull float or darby float the concrete surface immediately after screeding.
C. Allow bleed water to evaporate or remove.
D. (STF) Steel Troweled Finish: Float the surface with magnesium or cast aluminum

float or with a power finishing machine. Steel trowel surface immediately after floating to produce smooth surface. Steel trowel again after concrete has hardened enough so that mortar does not adhere to trowel edge. Ringing sound should be apparent when performing second troweling due to tilted, compacting motion.

E. (WFF) Wood Float Finish: allow concrete to stiffen; float surface twice or more to a uniform sandy texture.

F. (LBF) Light Broom Finish: wood float finish as in E above; while plastic draw a soft-bristled broom, over the concrete in long even strokes with downward pressure.

G. Finish to receive concrete fill: do not bull float; remove water scum, laitance and loose aggregate from surface after concrete has started to harden with stiff bristle brush to partially expose coarse aggregate. Clean surface with brooms, water jets or air jets. Maintain wet for 12 hours immediately before placing fill concrete. As fill concrete is placed and just ahead of placement, broom in grout paint to the damp concrete surface. Do not allow grout paint to set prior to placement of concrete fill.

H. Tolerances for trowel finished floors: ACI 302 class BX. 5/16 inch maximum deviation from 10 foot long straightedge placed anywhere on the surface.

3.3 FINISHING OTHER THAN SLABS

A. (RFF) Rough Form Finish: Repair structural defects only. Patch tie holes. Fins exceeding 1/4 in. in height to be removed by grinding and/or rubbing.

B. (SFF) Smooth Form Finish: Remove fins flush by grinding and/or rubbing. Repair surface defects. The concrete surface shall be of uniform color, texture and free of all irregularities.

C. (SRF) Smooth Rubbed Finish: moisten surface; rub or grind with a carborundum brick to remove all form impressions. Rub until a small accumulation of the grained paste is produced. Spread paste with a moist whitewash brush to uniform appearance over entire concrete surface. Keep damp for 36 hours. Complete rubbed finish within 3 days of placing concrete,

D. (GCF) Grout Cleaned Finish: provide smooth form finish; wet surface of concrete thoroughly; apply grout paint with the consistency of a thick paint with brushes or spray gun to match the color of the surrounding concrete; vigorously scrub grouted surface with a cork float or stone to coat and fill all air bubbles and holes. While the grout is still plastic, remove excess grout paint with rubber float, sack or other means. After surface whitens rub vigorously with clean burlap. Maintain moist for 36 hours.

3.4 SLAB SEALER

A. Cure concrete for 30 days.

B. Clean surface of oil, grease, dirt, foreign materials as recommended by the manufacturer.
C. Apply when slab temperature is between 40'F and 800F.
D. Apply in strict conformance to manufacturers recommendations.
E. Maximum coverage: 125 square feet per gallon.

3.5 CURING

A. Curing: Curing shall begin immediately following the initial set of concrete or after slab surface finishing has been completed and shall continue after form removal per Section 03300, 3.1.K. All concrete shall be cured to attain strength and durability by one of the following methods for a minimum of seven days after placement regardless of the ambient air temperature:
   1. Ponding or continuous sprinkling. Intermittent wetting and drying is not an acceptable curing method.
   2. Application of absorptive mats of fabric kept continuously wet.
   3. Continuous application of steam or fog spray.
   4. Application of waterproof sheet materials.
   5. Application of concrete curing compounds. If applying slab sealing compounds, use dissipating resin curing compound. Allow dissipating resin curing compound to chemically break-down, and remove residuals and other foreign material, prior to applying slab sealing compound.
B. Moisture loss from surfaces placed against wooden or metal forms exposed to heating by the sun shall be minimized by keeping the forms wet until they can be safely removed. After form removal, the concrete shall be cured by one of the methods described above, for the balance of time remaining as specified above.
C. Cold Weather:
   1. Maintain concrete temperature between 50F and 70F for a minimum of seven days after placement, enclose and heat, insulate as required.
   2. Protect concrete from damage due to concentrated heat sources.
   3. Reapply curing compounds every two days during heating period.
   4. The maximum allowable temperature drop of the concrete surfaces during the first 24 hours after the end of the curing period shall not exceed 5'F in any I hour and shall not exceed the following total gradual temperature drop in the first 24 hours:

Section size, minimum dimensions, in.			
< 12 in.	12 to 36 in.	36 to 72 in.	> 72 in.
50F	40 F	30F	20 F

D. Hot Weather: Concrete temperature shall not be greater than 90F. Protect from loss of slump, flash set, plastic cracking and rapid evaporation of water.

E. Place concrete quickly, shade from direct sun and protect from wind. Concrete shall be cured by one of the methods described in paragraph 3.7.A for seven days after placement.

3.6 SCHEDULE OF FINISHES

A. Provide finishes on concrete surfaces according to the following schedule:

	Finish	Comments
Exterior Exposed Walls to 6" below grade	SFF/GCF	Moist cure or apply two coats dissipating curing compound at right angles to each other
Exterior unexposed walls	RFF	Moist cure or apply two coats curing and sealing compound at right angles to each other
Exterior slabs-on-grade	LBF	Moist cure and apply two coats of slab sealer
Slabs (not coated)	STF	Apply two coats of curing/hardening compound
Slabs (coated)	LBF/STF	Apply two coats of dissipating resin curing compound at right angles to each other

NOTE: Coordinate compatibility of curing compounds with dampproofing and waterproofing compounds.

3.8 SURFACE DEFECTS

A. Repair all tie holes, honeycombed areas and surface blemishes including air voids and bug holes with a nominal diameter or depth greater than 1/2 inch within 7 days of placing concrete. Rat holes larger than 50 cubic inches are considered a structural defect. Consult with Engineer to determine remedial action.

B. Preparation: remove all loose aggregate paste and debris and scrub clean; thoroughly wet area to be repaired; brush and scrub grout paint into the substrate of the area to be repaired.

C. Repair: apply stiff consistency patching mortar to the area with trowel; apply prior to the set of the grout paint (but after it has lost its water sheen); leave patch surface slightly higher than surrounding surface; do not finish for 1 hour minimum; keep damp for 36 hours.

D. Mix patching mortar using as little water as possible; allow to stand with frequent manipulation of trowel to achieve stiffest consistency; blend white and grey

portland cement to achieve best color match with surrounding concrete.

E. Structural defects: when approved use above procedures except substitute repair mortar for patching mortar and epoxy adhesive for grout paint. Consult with Engineer for additional requirements and repair instructions.

F. Finished flatwork exceeding specified tolerances shall be repaired by grinding high spots, providing proper clearances are maintained between the concrete surfaces and the reinforcing steel or patching low spots with an approved epoxy grout.

3.9 PROTECTION

A. Protect concrete from high and low temperatures for seven days.

B. Protect against vibration until concrete has attained 33% of its 28 day strength.

C. Protect against premature loads until the 28 day strength has been attained.

END OF SECTION

SECTION 03420

PRECAST CONCRETE STRUCTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Precast concrete structures.
B. Joint sealants.
C. Waterproofing.

1.2 RELATED SECTIONS

A. Section 01340 - Submittals
B. Section 02200 - Earthwork
C. Section 02601 - Manholes, Covers and Frames
D. Section 03300 - Cast-in-Place Concrete
E. Section 03305 - Concrete Testing
F. Section 03346 - Concrete, Finishing, Curing and Repairs
G. Section 03604 - Non-Shrink Grout
H. Section 05500 - Metal Fabrications
1. Section 15092 - Pipe Sleeves and Seals

1.3 REFERENCES

A. ACI 308-92 - Revised 1992 - Standard Practice for Curing Concrete
B. ACI 318-89 - Building Code Requirements for Reinforced Concrete
C. ACI 350R-89 - Environmental Engineering Concrete Structures
D. ASTM A82-90a - Specification for Steel Wire, Plain, for Concrete Reinforcement
E. A185-90a- Specification for Steel Welded Wire Fabric, Plain for Concrete Reinforcement
F. ASTM A615/A-92b- Specification for Deformed and Plain Billet - Steel Bars for Concrete Reinforcement
G. ASTM C33-90 - Specification for Concrete Aggregates
H. ASTM C94-92 - Specification for Ready Mixed Concrete
I. ASTM C150-92 - Specification Portland Cement
J. ASTM C260-86 - Specification for Air Entraining Admixtures for Concrete
K. ASTM C309-91 - Specification for Liquid Membrane-Fonning Compounds for Curing Concrete
L. ASTM C494-92 - Specification for Chemical Admixtures for Concrete
M. Concrete Reinforcing Steel Institute - Manual of Standard Practice
N. Concrete Reinforcing Steel Institute - Placing Reinforcing Bars

1.4 DESIGN REQUIREMENTS

A. Design shall be for "Normal Sanitary Exposure" (Z=l 15) and shall be done by "Alternate Design Method" ACI 318, Appendix B or "Strength Design Method" ACI 318 and as amended by ACI 350R.
B. Minimum 28 day compressive strength: fc'= 5,000 psi.
C. Reinforcing Steel: ASTM A615 grade 60 deformed bars.
D. Concrete cover on reinforcing steel: 1 V2 inches minimum.
E. The structures shall have a minimum of 8" thick walls, top slabs and base slabs.
F. The precast concrete structure shall support its own weight plus the following minimum superimposed loads:
   1. Live load on top slab: H-20 vehicular loading.
   2. Dead load of soil on top slab: 125 PCF.
   3. Equivalent lateral fluid pressure - 90 PCF. The top of the pressure diagram shall be assumed to originate at Finish Grade as shown on the drawings.
   4. Uniform live load surcharge of 125 psf applied horizontally to the sides of the precast structure.
   5. Ground water shall be assumed to originate at finish grade.
   6. Factor of safety of 1.15 shall be used against flotation based on weights of empty structure and soil directly over footing extensions.

1.5 SUBMITTALS

A. Manufacturer's Data:
   1. Submit manufacturer's specifications and instructions for all manufactured materials and products. Include manufacturer's certifications and laboratory test reports as required.
   2. Contractor shall submit the proposed erection procedure for precast units, sequence of erection, and required handling equipment.
   3. A copy of handling and installation instructions and procedures shall be transmitted to the Erector.
B. Shop Drawings:
   1. Submit shop drawings showing complete information for the fabrication and installation of precast concrete units.
   2. Submit member dimensions and cross section, location, size, type and details of reinforcement, including special reinforcement and lifting devices necessary for handling and erection, joints and waterstops.
   3. Submit layout, dimensions, and identification of each precast unit corresponding to the sequence and procedure of installation. Indicate welded connections by AWS standard symbols. Detail inserts, connections, and joints, including accessories and construction at opening in precast units.
   4. Submit location and details of anchorage devices that are to be embedded in other construction. Furnish templates if required for accurate placement.

5. Submit structural design calculations and drawings demonstrating the structural integrity of all precast concrete units for the intended use and a buoyancy analysis with a factor of safety against flotation of 1.15 with the assumptions of the ground water table at finished grade and the precast concrete tank empty. Calculations and Drawings shall be prepared and stamped by a Professional Engineer registered in the State of Maine.
6. Submit concrete mix design including product data for concrete accessories and waterproofing materials.

1.6 QUALITY ASSURANCE

A. The manufacture shall exhibit satisfactory performance on projects of similar magnitude under similar or equal service conditions for a period not less than five (5) years. Submit past job list with Owner contact information.

1.7 WARRANTY

A. The precast concrete manufacturer shall guarantee all precast concrete members against excessive movement after erection, causing separation of joints, cracking or misalignment of adjacent units. The Precaster shall further guarantee all joints between concrete sections against leakage and all members against infiltration of water through the concrete; the precast concrete erector shall repair and restore any unsatisfactory conditions or damage to the building resulting from and related to the precast concrete work, to the extent of replacement if so required at no expense to the Owner.

1.8 DELIVERY- STORAGE AND HANDLING

A. Deliver precast concrete units to the project site in such quantities and at such times as will assure the continuity of the installation.

B. Store units at the project site to ensure against cracking, distortion, staining, or other physical damage, and so that markings are visible. Lift and support units at the designated lift points only.

1.9 JOB CONDITIONS

A. Erector must examine all parts of the supporting structure and the conditions under which the precast concrete work is to be erected, and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the installation until satisfactory conditions have been corrected in a manner acceptable to the Erector.

B. Deliver anchorage items which are to be embedded in other construction before the start of such work. Provide setting diagrams, templates, instructions and directions as required for installation.

PART 2-PRODUCTS

2.1 MANUFACTURERS

A. Superior Concrete Company, Inc., Auburn, Maine.

B. Equal.

2.2 MATERIALS

A. All precast units shall be tongue and grooved and of shape and section as shown on the Drawings.

B. Cement for all units shall be Type II Portland cement, ASTM C 1 50.

C. Minimum compressive strength of concrete 5000 psi at 28 days.

D. Entrained air content of concrete: 6% ± 1%.

E. Reinforcing steel shall conform to ASTM A 615 grade 60 deformed bars.

F. Cast-in-place plates shall conform to ASTM A 36.

G. Liquid Asphalt Dampproofmg: Non-fibrated asphalt emulsion for below grade wall dampproofing.

1. First coat Sonnebom Building Products - Hydrocide 600 or equal.

2. Second coat Sonnebom Building Products - Hydrocide 700 Mastic, or equal.

H. Entrance Hatches: Provide openings as shown on the Drawings.

1. Manhole Steps:

I . Aluminum or polyethylene coated steel safety type designed with a minimum concentrated live load of 300 pounds.

2. Thoroughly clean all surfaces to be embedded with a suitable cleaning agent to ensure that the surfaces are free from all foreign matter such as dirt, oil and grease.

3. Aluminum surfaces to be embedded shall be given a protective coating of an approved poly-amide epoxy paint. The steps shall be thoroughly dry before being placed into the concrete.

4. All steps shall be cast into walls of the precast section so as to form a continuous ladder with a distance of 12-inches between steps.

J. Manhole covers and frames to be provided in Specification Section 0260 1.

PART 3 - EXECUTION

3.1 FABRICATION AND PLACING REINFORCEMENT

A. Detailing and fabrication of reinforcement shall conform to details on drawings, and otherwise to the CRSI Code of Standard Practice.

B. Bars when placed shall be clean and free from loose mill scale and rust and from coatings that reduce bond.

C. Place reinforcement of structural members on accessory bolsters and chairs as specified in SECTION 03300, for reinforcement of cast-in-place structural members. Accessories shall be stainless steel or have plastic tips.
D. Specifications for splicing bars given in the ACI Code are applicable to this work.
E. All reinforcing shall have adequate cover as required by ACI 318 and 350R.

3.2 PRODUCTION AND CURING

A. Production and curing of the precast units shall in all respects conform to the provisions of ACI Standards.
B. Each precast unit shall be an integral pour without any construction or cold joints. Floor slabs shall be an integral pour with the wall section where practical.
C. Structures shall be fabricated from the minimum number of precast sections while keeping with transportation and installation restrictions.

3.3 STORAGE, HANDLING, TRANSPORTATION

A. Units shall be stored in moist condition for at least 14 days and shall be supported in such a way as to avoid any deformation, discoloration, or permanent set. Handling and transportation shall not produce stresses beyond the allowable stresses or cause cracks and spalls.

3.4 CONDITIONS OF UNITS AND PATCHING

A. Damaged, cracked, or chipped units shall be satisfactorily repaired and patched if structurally and architecturally acceptable. The Engineer shall be sole judge as to acceptability and his decision shall be final if made within these specifications. The Precasters assumes responsibility for any damage or impairment of the precast units until the unit is erected and permanently fastened. All exposed to view units to be cleaned to obtain a uniform finish before acceptance is made.

3.5 INSPECTION

A. Material and workmanship shall be at all times subject to inspection by the Engineer and ready access for such inspection shall be permitted to all work during fabrication and erection.
B. Material and workmanship not in conformity with the provisions of this specification may be rejected at any time defects are found during the progress of the job.

3.6 EMBEDDED AND ATTACHED ITEMS

A. Pipe sleeves, inserts, bolts, lifting hooks dowels, and all other items required for transportation and erection shall be patched so that they shall have adequate concrete cover in the finished structure. Location to be as shown on Drawings or as required for handling and erection.

3.7 ERECTION

A. Install all precast structures and/or structure sections level and plumb to the elevations and in the locations shown on the Drawings.

B. Installation Tolerances: Install precast units without exceeding the following tolerance limits:

1. Variations from Plumb: 1/4" in any 20' run or story height ; 1/2" total in any 40' or longer run.
2. Variations from Level or Elevation: 1/4" in any 20' run; 1/2" in any 40' run; total plus or minus 1/2" at any location.
3. Variation from Theoretical Position in Plan: Plus or minus 1/4" maximum at any location.
4. Offsets in Alignment of Adjacent Members at Any Joint: 1/16" in any 10' run: 1/4" maximum.

C. Perform jointing in strict accordance with the manufacturer's recommendations.

D. Make sure all joints are watertight.

3.8 CLEANING, REPAIRING AND PROTECTION

A. After erection is complete, any chipped or damaged units and any depressions left by removal of lifting devices shall be properly repaired by the erector. Also, all erection dirt incurred during the erection process shall be removed. Muriatic acid or similar products are not to be used without the specific consent of the manufacturer and the Engineer.

B. All finished work in any way exposed shall be protected by the General Contractor against damage. Cutting and patching of any precast concrete shall only be allowed with the express permission of the Engineer. Any such work shall only be done by the Erector, either at this own expense should the fault be his, or at the expense of the party responsible for the damage for the additional work required.

3.9 LIQUID ASPHALT DAMPPROOFING APPLICATION

A. Apply dampproofing to all concrete tank walls below grade.

B. First Coat - Brush or spray on at a rate of 125-150 square feet per gallon, filling all voids in concrete surfaces, completely.

C. Allow first coat to dry before applying second coat.

D. Second Coat - Trowel apply at a rate of 20-25 square feet per gallon.

E. Do not place backfill for at least 24 to 48 hours after application.

3.10 CLEANING

A. Clean any adjacent materials effected by the application of the penetrating dampproofing with a material recommended by the dampproofing manufacturer.

3.11 TESTING

A. General:

1. Perform leakage tests on all precast concrete tanks.
2. All testing must be performed in the presence of the Engineer.
3. Suitably plug all pipes entering precast concrete tank and brace plugs to prevent blow out.

B. Exfiltration Tests Prior to Backfilling:

1. Fill precast concrete tank with potable water furnished by the Contractor to the top of the cover.
2. A period of up to 2 hours may be permitted, if the Contractor so wishes, to allow for absorption.
3. At the end of the absorption period, refill precast concrete tank with water to the top of the precast concrete tank cover and begin the 4-hour test period.
4. At the end of the 4-hour test period, refill precast concrete tank to the top of the precast concrete tank cover and measure the volume of water added. The leakage for each precast concrete tank shall not exceed I gallon per 50 square feet of tank wall per 4-hour period.

3.12 PRECAST CONCRETE TANK REPAIRS

A. Correct leakage by reconstruction, replacement of gaskets and/or other methods as approved by the Engineer.

B. The use of lead-wool or expanding mortar will not be permitted.

C. Subsequent to the repair, tanks shall be refilled as previously described and retested until such time as the structures can demonstrate compliance with the testing requirements and at no additional cost to the Owner.

D. The Contractor shall dispose of the water as directed by the Engineer.

END OF SECTION

SECTION 03604

NON-SHRINK GROUT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Non-shrink grouting.

1.2 PRODUCTS INSTALLED BUT NOT FURNISHED

A. Dowels - Section 03300, Cast-in-Place Concrete
B. Anchor Bolts - Section 05500, Metal Fabrications.
C. Rail Posts - Section 05500, Metal Fabrications.

1.3 RELATED SECTIONS

A. Section 01340 - Submittals
B. Section 03300 - Cast-in-Place Concrete
C. Section 03346 - Concrete Curing, Finishing and Repairs

1.4 REFERENCES

A. ASTM C33-90 Specification For Concrete Aggregates
B. ASTM C109-92 Test Method For Compressive Strength of Hydraulic Cement Mortars
C. ASTM C827-87 Test Method For Changes In Height at Early Ages of Cylindrical Specimens From Cementitiuos Mixtures
D. CRD-C611-80 Test Method for Flow of Grout Mixtures
E. CRD-C621-81 Specification for Non-Shrink Grout

1.5 SUBMITTALS

A. Submit product data and material safety data sheets for products to be used.
B. Submit test data when required.
C. Submit manufacturers installation instructions for products used.

1.6 QUALITY ASSURANCE

A. Conform to Army Corps of Engineers Specification CRD-C621-81
B. Grouts shall exhibit non-shrink characteristics when tested according to ASTM C827.

1.7 DELIVERY- STORAGE AND HANDLING

A. Deliver in sealed, labeled containers.
B. Store in dry conditions above freezing and below 90F.

C. Keep unused portions of opened containers dry and warm.
D. Store aggregate covered and protected from the elements.

1.8 ENVIRONMENTAL CONDITIONS
A. Do not place grout when exposed to precipitation.
B. Place grout when temperature of substrate and ambient air are above 40F and below 90F.
C. Place grout outside these limits when approved by heating substrates, enclosing work, shading, cooling or other measure to mitigate adverse weather conditions.

PART 2 PRODUCTS

2.1 MATERIALS
A. Aggregates : ASTM C33 fine aggregate, washed
B. Pea Stone: ASTM C33 coarse aggregate, size number 8 (max. size 0.375 inches), washed
C. Water: Potable, from municipal water supply.

2.2 GROUT FOR-INSTALLING DOWELS AND ANCHOR BOLTS
A. Super Por-Rok by Minwax Construction Products
B. Crystex by L&M Construction Chemicals
C. Masterflow 713 by Master Builders
D. Or equal.

2.3 GROUT FOR BEAM REARING PLATES AND COLUMN BASE PLATES
A. Crystex by L&M Construction Chemicals
B. Masterflow 713 by Master Builders
C. Sikagrout 212 by Sika Corporation
D. Or equal.

2.4 GROUT FOR INSTALLING RAILING POSTS
A. Super Por-Rok by Minwax Construction Products
B. Crystex by L&M Construction Chemicals
C. Masterflow 713 by Master Builders
D. Or equal.

2.5 TESTS
A. All grouts shall achieve a minimum 28 day strength of 6,000 psi according to ASTM C109.
B. Grouts when tested by flow cone according to CRD-C 611-80 shall take more than 20 seconds to flow as a maximum limit on fluidity.
C. Test grout when requested.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of loose aggregate, dust, laitance, dirt, oil, grease by bushhamering, chipping or brushing.
B. Thoroughly dampen the concrete substrate.
C. Follow manufacturers instructions.
D. Heat the substrate, enclose the area or make other necessary preparations.
E. Install forms, leak proof, to retain grout in shapes shown on Drawings.

3.2 MIXING

A. Mix only as much grout as can be placed in 20 minutes.
B. Mix according to manufacturer's instructions.
C. Minimize water for the application.
D. Add no more water after mixing.
E. For applications greater than 2 inches thick may add up to 50 lbs of pea stone per 100 lbs of grout, dry measure, to extend the grout. Test according to ASTM C 109 and C827.
F. Do not exceed maximum flowability.

3.3 PLACING

A. Place quickly and continuously; pouring, pumping or by gravity pressure.
B. Obtain approval for dry pack placement.
C. Install horizontal anchor bolts or dowels using a trowel consistency grout.
D. Place so as to avoid entrapping air.
E. Trim grout shoulders.

3.4 CURING

A. Moist cure for 3 days.
B. Cover with moist cloths, curing blankets or curing compound.

3.5 PROTECTION

A. Protect from vibration due to adjacent operations until the grout is well set up.
B. Protect bolts and dowels from force or impact until grout has achieved 50% of its 28 day strength.

END OF SECTION

SECTION 05500

METAL FABRICATION

PART 1-GENERAL

1.1 SECTION INCLUDES

A. Items fabricated of metals shown to be provided on the plans and not included in other sections.

B. Shop paint

1.2 RELATED SECTIONS

A. Section 01340 - Submittals

B. Section 03300 - Cast-in-Place Concrete

C. Section 03604 - Non-Shrink Grout

D. Section 09900 - Painting

1.3 REFERENCES

A. ASTM A36/A-91 - Specification for Structural Steel

B. ASTM A48-92 - Specification for Gray Iron Castings

C. ASTM A53-90b- Specification for Pipe, Steel, Black and Hot-dipped Zinc-coated welded and Seamless,

D. ASTM A123-89a - Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron & Steel Products

E. ASTM Al 53-82 - Specification for Zinc Coating (Hot-Dip) on Iron (I 987) and Steel Hardware

F. ASTM A307-92a - Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength

G. ASTM A325-92a- Specification for High-strength Bolts for Structural Steel Joints

H. ASTM A570/A-92 - Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality

I. ASTM B209-92a - Specification for Aluminum and Aluminum - Alloy Sheet & Plate

J. ASTM B221-92a - Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wires, Shapes and Tubes

K. ASTM B308/B-92a- Specification for Aluminurn-Alloy 6061-T6 Standard Structural Shapes, Rolled or Extruded

L. ASTM B429-92a Specification for Aluminum-Alloy Extruded Structural Pipe and Tube

M. ASTM F593-91 Specification for Stainless Steel Bolts, Hex Cap screws and Studs

N. ASTM F594-91 Specification for Stainless Steel Nuts
O. SSPC Steel Structures Painting Council
P. SSPC-SP6 - Commercial Blast Cleaning
Q. SSPC-SPIO - Near-White Blast Cleaning
R. Designation System for Aluminum Finishes - Aluminum Association
S. Specifications for Aluminum Structures - Aluminum Association
T. Engineering Data for Aluminum Structures - Aluminum Association
U. Manual of Steel Construction - American Institute of Steel Construction (AISC)
V. The National Association of Architectural Metal Manufacturers (NAAMM) Standard Amp 510-92 Metal Stairs Manual.

1.4 SUBMITTALS

A. Submit complete shop drawings showing fabrication, welding, connections, erection, finishes, materials and dimensions.
B. Submit product data where required.
C. Submit design computations when required.
D. Submit certification from galvanizer that galvanizing is in accordance with Specifications.

1.5 QUALITY ASSURANCF

A. Conform to AISC Specification for the Design, Fabrication and Erection of Structural Steel.
B. Conform to AWS Standard Code for Arc and Gas Welding in Building Construction.
C. Conform to Specifications for Aluminum Structures by the Aluminum Association.

1.6 COORDINATION

A. The Contractor shall coordinate with the work of other Sections. Verify at the site both the dimensions and the work of other trades adjoining items before fabrication and installation of items herein specified.
B. Furnish to the pertinent trades all items included under this Section that are to be built into the work of other Sections.

1.7 FIELD MEASUREMENTS

A. Field measurements shall be taken at the site to verify or supplement indicated dimensions and to insure proper fitting of all items.

1.8 DELIVERY, STORAGE, AGE, HANDLING

A. Coordinate delivery of products
B. Protect products from damage prior to and after installation.

C. Remove damaged material from the site.

PART 2 - PRODUCTS

2.1 FABRICATION

A. Shop fabricate items to the extent practical.
B. Grind all parts free of burrs and nicks.
C. Weld in conformance with AWS Structural Welding Code.
D. Perform all welding prior to galvanizing.
E. Provide a minimum of 2 fasteners per connection.
F. Maximum gap at grating edges: 0.25 inches.
G. Fasteners: Stainless Steel AISI Type 304 or 316 unless otherwise noted for aluminum fabrications; ASTM A307 unless otherwise noted for steel fabrication galvanized as required.

2.2 ALUMINUM LADDERS

A. Material ASTM B221 alloy 6063 temper T6
B. Finish: Clear Anodized (AA M12C22A41)
C. Welding: filler alloy 5556
D. Rungs: Extruded aluminum with I inch wide serrated non-slip surface.

2.3 MISCELLANEOUS FABRICATIMI

A. Aluminum: 6061-T6
B. Steel: ASTM A36

2.4 MANHOLE STEPS

A. Safety type equal to New Jersey Aluminum Co. Stock No. F-14-1-MMI-B, New Brunswick, New Jersey.
B. Other Manufacturers: Aluminum Company of American and Allegheny Foundry Co., Pittsburgh, PA
C. Co-polymer polypropylene by M.A. Industries, Inc. or equal.

2.5 FASTENERS

A. Concrete anchorage: expansion anchors - stainless steel AISI Type for galvanized and aluminum fabrications; cadmium plated for painted steel fabrications.
B. Bolted Joints: stainless steel ASTM F593 & F594 Alloy groups 1,2 or 3 for aluminum fabrications; ASTM A325 for painted steel; galvanized ASTM A325 for galvanized steel.
C. Provide all fasteners with nuts, flat washers and lock washers of the same material as the anchors or bolts.

2.6 MISCELLANEOUS STAINLESS STEEL FABRICATIONS

A. Material: Bolts, bars and shapes AISI, Type 304.

B. Material: Plate and sheet AISI, Type 302.

2.7 SHOP PAINT

A. Shop coats shall be compatible with and made by the same manufacturer as the field top coats specified in Section 09900. General contractor shall coordinate.

B. Shop paint non-galvanized steel before shipping.

C. Polyamide Epoxy Primer: High Solids Epoxy Mastic, 25P by DuPont, 66-1211 HiBuild Epoxoline Primer by Tnemec Co. or equal.

D. Rust Inhibitive Primer: 77 chem-Prime by Tnemec Co. Inc., or equal.

E. Surfaces In Contact with Potable Water: Polyamide Epoxy Primer: 20-1255 Pota-pox Primer by Tnemec Co. or equal.

2.8 FIELD PAINTING

A. Refer to Specification Section 09900 for Field Painting.

PART 3 - EXECTJTION

3.1 SHOP PAINTING AND TOUCH UP

A. Definitions:

1. Submerged surfaces shall be defined as those surfaces which are below the maximum water surface level as indicated on the drawings, and/or extend 3-feet above the maximum water surface for uncovered tanks. All surfaces contained within covered tanks shall be considered submerged.

2. Enclosed surfaces shall be those non-submerged surfaces enclosed and/or protected within a building in such a manner that it cannot be exposed to UV light or weather conditions.

3. Weather exposed surfaces shall be all other conditions which do not fall into the definition of submerged or enclosed surfaces as noted above.

B. Submerged ferrous surfaces shall be blast cleaned to near white metal in accordance with SSPC-SPIO. Shop prime with one (1) coat of Polyamide Epoxy Primer with a minimum dry film thickness of four (4) mils.

C. Enclosed ferrous surfaces shall be commercial blast cleaned in accordance with SSPCSP6. Shop prime with one (1) coat of Rust Inhibitive Primer with a minimum dry film thickness of 2.5 mils.

D. Weather exposed ferrous metals shall be blast cleaned to SSPC-SP6. Shop prime with one (1) coat of Rust Inhibitive Primer with a minimum dry @ thickness of 2.5 mils.

E. Galvanized Metals:
1. Blast clean to near white metal in accordance with SSPC-SP IO.
2. Assembled and non-assembled steel as indicated on Drawing shall be coated by hot-dip zinc.
3. Galvanize items after assembly when possible.
4. Coating shall not be less than 2 oz. per square foot.
5. Galvanizing shall provide a visually acceptable substrate for applied coatings and shall be free of lumps, globules, sharp edges or heavy deposits which will interfere with intended use or a esthetic appearance of materials.

F. Touch-up
1. Non-galvanized metals: After erection touch-up all abrasions and field welds with same paint used on shop coat.
2. Galvanized metals; After erection touch-up all abrasions and field welds with ZRC Cold Galvanizing Compound.

G. Metals in contact with or embedded in concrete or masonry shall receive one (1) coat of a polyamide epoxy primer with a dry film thickness of four (4) mils applied to the areas in contact.

3.2 INSTALLATION

A. Layout, locate level and plumb items, to be installed. Coordinate items to be installed in substrates.
B. Drill and otherwise prepare substrates for fastening. Install non-shrink grout as required.
C. Coat surfaces of aluminum in contact with masonry, concrete or dissimilar metals with Polyamide Epoxy Primer.
D. Splice pipe rails in field with internal sleeves fastened with set screws on one end and welded on other.

3.2 CLEANING

A. Clean surfaces of all work of this section as well as the areas in the vicinity.

3.3 PROTECTION

A. Protect installed work.
B. Protect from splatter or debris from adjacent construction.
C. Protect work from excess construction loading.

END OF SECTION

SECTION 09900

PAINTING

PART I - GENERAL

1.1 SECTION INCLUDES

A. Examine the various SECTIONS of the SPECIFICATIONS and be thoroughly familiar with all provisions regarding painting and finishing work included therein.

B. Apply specified finish coats of paint to all pre-primed surfaces and complete finishing system to unprimed items.

C. Paint all mechanical, structural and electrical work exposed to view including equipment, piping, electric panels and other items unless specified in the respective SECTIONS to be prefinished. Piping runs above suspended ceilings shall be considered exposed and shall receive coatings in accordance with applicable sections of this Specification.

D. Backprime, with specified interior first coat, all surfaces of wood finish and trim which will be concealed after installation.

E. Apply paint on finish surfaces only to the extent specified herein and indicated on the Room Finish Schedule.

F. Pipe, pump and valve identification markers.

G. Skid resistant floor coating where shown on the Drawings.

1.2 RELATED SECTIONS

A. Section 01340 - Submittals

B. Section 03300 - Cast-in-Place Concrete

C. Division 5 - Metals: Shop priming and touch-up of steel and accessories

D. Division 11 - Equipment

E. Division 15 - Mechanical

F. Division 16 - Electrical

G. Shop painting of materials and equipment specified under the various sections relating thereto.

1.3 PREFINISHED ITEMS NOT REQUIRING PAINT OR FINISH

A. Items and equipment which have received the manufacturer's standard primer and finish coats in the factory.

B. Copper, bronze, brass, chromium plate, nickel, stainless steel, aluminum or monel metals (unless otherwise noted).

C. Concrete slabs and foot traffic surfaces except skid resistant floor coatings.

D. Parking lines on bituminous concrete specified under Section 02513.

1.4 REFERENCES

A. ASTM D2247 - Practice for Testing Water Resistance of Coatings in 100 Percent Relative Humidity.
B. ASTM D 2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
C. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
D. Federal Test Method No. 141 - Method 6141, Stain Removal.
E. ANSI Al 3.1 - Scheme for the Identification of Piping Systems.
F. SSPC - Steel Structures Painting Council.
G. SSPC-PAI, "Standard for Shop, Field, and Maintenance Painting".
H. SSPC-PA2, "Measurement of Dry Paint Thickness with Magnetic Gauges".
I. SSPC-SPI, "Solvent Cleaning".
J. SSPC-SP2, "Hand Tool Cleaning".
K. SSPC-SP3, "Power Tool Cleaning".
L. SSPC-SP6, "Commercial Blast Cleaning".
M. SSPC-SPIO, "Near-White Blast Cleaning".
N. SSPC-PA Guide 3, Standard "A Guide to Safety in Paint Application", latest revision.
O. VOC Standards - All coatings shall be in accordance with all applicable State and Federal VOC Standards.
   1. OSHA 29 CFR 1925.55 Gases, Vapors, Fumes, Dusts and Mists.
   2. 38 MRSA: Section 584A; Air Protection and Improvement Law.

1.5 SUBMITTALS

A. Submit product data under provisions of Section 01340.
B. Submit color charts for color selection by Engineer.
C. Submit schedule with list of items to be coated, type and manufacturer of shop coating and type of field coating, including primers.
D. Color scheme shall be in accordance with schedules provided by the Engineer, and all tinting and matching shall be to the satisfaction of the Engineer.
E. Submit coating manufacturer's certification that proposed field coatings are compatible with shop coatings.

1.6 MOCKUP

A. When requested by the Engineer, prepare test samples and store at the project site. Provide all facilities for comparison and adjustment of colors, and place final samples for review directly on the surface to be finished. Machine mixing by the manufacturer's representative will be permitted where advantageous, but only after final review of colors involved by the Engineer. Select samples at random from sealed containers.

1.7 QUALITY ASSURANCE

A. All materials used on work shall be exactly as specified in brand and quality. No

claim by the Contractor as to unsuitability or unavailability of any material specified, or his unwillingness to use same, or his inability to produce first class work with same, will be entertained unless such claims are made in writing and submitted to the Engineer at least seven (7) days prior to the date established for receipt of General Bids.

B. Before purchasing materials for the work, the Contractor shall submit to the Engineer a list of the products he proposes to use, and the list shall be reviewed by the Engineer and no exceptions taken and reviewed by him before commitment for materials is made.

C. Materials selected for coating systems for each type of surface shall be the products of a single manufacturer.

D. Include on label of all containers:
   1. Manufacturer's name
   2. Type of paint
   3. Manufacturer's stock number
   4. Color
   5. Instructions for reducing, where applicable
   6. Label analysis
   7. Shelf life dates

E. Field Quality Control:
   1. Contractor shall request review by the Engineer, of first finished room, space or item of each color, texture and method of applications, prior to proceeding with additional painting.
   2. Use first acceptable room, space or item as the project standard for each color scheme.
   3. For spray application, when applicable, paint a surface not smaller than 100 square feet as the project standard.
   4. Repainting of materials failing to meet the requirements of the Specifications or Drawings, shall be performed by the Contractor, at no additional cost to the Owner.
   5. The number of coats and total mil thickness specified in the paint schedule are minimums. If the specified minimum film thickness is not achieved, additional coats shall be applied to achieve the total film thickness specified.

F. Paints submitted shall meet all Federal and State regulations pertaining to Volatile Organic Compounds (VOC) compliance.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver coating materials in sealed containers with labels legible and intact.

B. Store only acceptable project materials on the project site.

C. All painting materials shall be stored and mixed in a single location coordinated with the Engineer. The Contractor shall not use any plumbing fixture or pipe for mixing or for disposal of any refuse. The Contractor shall carry all necessary water to the mixing room, and shall dispose of all waste outside of the building in

a suitable receptacle.

D. Restrict storage location to paint materials and related equipment and supplies.

E. Keep storage location neat and clean.

F. Remove all soiled and used rags, waste and trash from the storage location and building at the end of each work day.

G. Repair all damage to the storage location, caused by painting materials and equipment at no additional cost to the Owner.

H. Comply with all applicable health and fire codes and regulations including safety precautions recommended by the manufacturer. Storage space shall be provided with a suitable fire extinguisher fully charged at all times.

I. Heat shall be provided in the storage area if paints are to be stored during winter months. The temperature shall be maintained above 40 degrees F at all times.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems shall be applied.

B. Do not apply coatings in areas where dust is being generated.

C. Do not apply coatings when the air or material surface temperature is below 50 degrees Fahrenheit [10 degrees C] and unless the temperature is at least 5 degrees Fahrenheit above the dew point.

D. Do not apply exterior coatings in frosty, damp or rainy weather or while surfaces are exposed to hot sunlight.

1.10 EXTRA MATERIALS

A. One gallon of each type and each color of touch-up paint shall be provided to the Owner by the Contractor in unopened containers.

PART 2 – PRODUCTS

2.1 MANUFACTURERS (PAINT)

A. Tnemec Company, Inc.

B. DuPont Company

2.2 MANUFACTURERS (STAIN)

A. Sherwin Williams

B. Glidden Company

2.3 MANUFACTURERS (VARNISH AND URETHANE)

A. Sherwin Williams

B. Glidden Company

2.4 MATERIALS

A. Polyamide epoxy primer (for surfaces in contact with potable water):

1. No. 20-1255 Pota-Pox primer, by Tnemec Co., Inc.

B. Polyamide Epoxy (for surfaces in contact with potable water):
   1. No. 20-2000 Pota-Pox, by Tnemec Co., Inc.
C. Polyamide epoxy primer:
   1. No. 66-1211 Hi-build epoxoline, by Tnemec Co., Inc.
   2. No. 25P high solids epoxy mastic, by DuPont Co.
D. Polyamide Epoxy:
   1. No. 66 Series Hi-Build epoxoline, by Tnemec Co., Inc.
   2. No. 25P high solids epoxy mastic, by DuPont Co.
E. Rust Inhibitive Primer:
   1. 37-77 Chem-Prime, by Tnemec Co., Inc.
F. Emulsified Acrylic Latex:
   1. Tnemec-Cryl, by Tnemec Company.
G. Silicone Aluminum Primer:
   1. No. 39-1261, by Tnemec Co., Inc.
   2. No. 612-C706, by DuPont Co.
H. Silicone Aluminum Paint:
   1. System 39-2, by Tnemec Co., Inc.
   2. No. 612-C706, by DuPont Co.
I. Masonry Block Filler (for epoxy):
   1. No. 54-562 masonry filler, by Tnemec Co., Inc.
J. Masonry Block Filler (for latex):
   1. No. 54-560 masonry filler, by Tnemec Co., Inc.
   2. No. 3894-268 filler, by DuPont Co.
K. Exterior Stain (opaque):
   1. Series Al 4 solid color exterior stain, by Sherwin Williams
   2. Spec. No. 52.1 alkyd stain, by Pratt and Lambert
   3. No. 9700 solid stain, by Glidden
L. Exterior Stain (semi-transparent):
   1. Series Al 4 semi-transparent wood preservative stain, by Sherwin Williams
   2. Spec. No. 52.5 alkyd-natural stain, by Pratt and Lambert
   3. No. 890 wood preservative semi-transparent stain, by Glidden Co.
M. Exterior Varnish
   1. Series A67 exterior varnish, by Sherwin Williams
   2. No. 6151 glid-thane one aromatic series, by Glidden Co.
N. Interior Urethane
   1. No. 81 (gloss or No. 82 (satin), by Glidden Co.
O. Undercoater (For plaster and drywall surfaces to receive latex)
   1. No. 36-603 undercoater, by Tnemec Company, Inc.
P. Undercoater (for epoxy topcoats)
   1. No. 51-792 PVA sealer, by Tnemec Co.
Q. Undercoater (for wood surfaces)
   1. Glidden UH 405 Ultrahide ALKYD enamel undercoat, by Glidden Co.
R. Primer for Galvanized Metals

1. Series 66-1211 epoxoline primer, by Tnemec Co.
2. Imron 62 polyurethane primer, by DuPont Co.

S. Skid Resistant Coating:
1. Series S67 Epoxy-Polyamide floor coating by Tnemec Co, or equal.

T. Polyurethane:
1. No. 71 series aliphatic polyester polyurethane enamel, by Tnemec Inc.
2. No. 333 polyurethane enamel, by DuPont Co.

2.5 COMPONENTS

A. All finish coats shall be compatible with shop prime coats.
B. Turpentine shall be pure spirits of turpentine.
C. Shellac shall be four pounds and shall meet the U.S. Government specifications as issued by the Bureau of Commerce.
D. When interior or exterior wood and metal are primed in the mill or shop as part of painting contract, use the materials specified in every case for such surfaces and use in accordance with manufacturer's directions for first or priming coat.

2.6 MIXING AND TINTING

A. Deliver paints and enamels ready-mixed to project site.
B. Accomplish job mixing and job tinting only when required and no exceptions taken by the Engineer.
C. Mix only in mixing pails placed in suitably sized nonferrous or oxide resistant metal pans.
D. Use only tinting colors recommended by the manufacturer for the specific type of finish.
E. Fungicidal agents, when applicable, shall be incorporated into the paints and stains by the manufacturer.
F. Mix and prepare paints in strict accordance with Manufacturers recommendations.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine surfaces scheduled to receive paint and finishes for conditions that will adversely affect execution, permanence or quality of work and which cannot be put into an acceptable condition through preparatory work as included in Part 3.2, Surface Preparation.
B. Immediately notify the Engineer in writing when a surface to be finished cannot be put into an acceptable condition.
C. Do not proceed with surface preparation or coating application until conditions are suitable.
D. The Contractor shall be responsible for and shall rectify, at no additional cost to the Owner any unsatisfactory finish resulting from the application of coatings on surfaces not in acceptable condition.

3.2 SURFACE PREPARATION

A. Wood and Plywood to be Painted or Finished Natural -
   1. Clean soiled surfaces.
   2. Except when rough surface is specified, sand to smooth and even surface, then dust off.
   3. Apply shellac to all knots, pitch and resinous sapwood after washing with mineral spirits and, before priming coat is applied.
   4. Fill nail holes, cracks, open joints and other defects with paste wood filler before priming coat surface and color to match finish color. When wood filler is applied on open grain wood, allow the grain to secure a smooth, clean surface. Tint filler to match finished wood.

B. Concrete and Masonry:
   1. Clean all dust, dirt, oil and efflorescence from surfaces.
   2. Fill cracks and irregularities with Portland cement grout to provide uniform surface texture.
   3. Etch dense and smooth concrete, or concrete that has had a hardener applied, with a five (5) percent solution (by weight) of muriatic acid.
   4. Fill concrete masonry unit surfaces with block filler in sufficient thickness to produce a final result which shall fill all voids and pin holes.
   5. Allow surfaces to thoroughly dry prior to application of first coat.

C. Ferrous Metal Surfaces
   1. All submerged ferrous metals shall be sandblast cleaned in accordance to SSPC-SP IO immediately prior to priming.
   2. All other ferrous metals shall be sandblast cleaned in accordance to SSPC-SP6 immediately prior to priming.
   3. Remove dirt, oil and grease by washing surfaces with mineral spirits.
   4. Surfaces shall be dry and free of dust, oil, grease and other foreign material before priming.
   5. Feather edges of sound existing paint by grinding, if necessary.
   6. Clean and touch up weathered, worn or damaged shop coats of paint with the specified primer.
   7. Restore shop coats of paint with identical materials if removed for welding and fabrication.

D. Galvanized Metal:
   1. Thoroughly clean surface with mineral spirits to remove oily residue.
   2. Dry with clean cloth.
   3. Treat surface with copper sulphate or with a compound made for this purpose (Lithofonn, Solfo Metallic Coating, etc.) in accordance with the manufacturer's directions, before applying the primer.

E. Previously Coated Surfaces:
   1. The areas of the coated surface that are blistered, eroded, brittle or otherwise failed shall be completely removed before beginning the specified surface preparation.
   2. The areas where the existing coating is intact shall be sanded to dull the

finish.

3. Before applying the new coating over an existing coating, a test section must be done to ensure compatibility of the new and old coatings.
4. Ferrous metals arriving at the job site with shop primers other than the polyamide epoxy or rust inhibitive primers specified shall be provided with an intermediate coat as necessary for compatibility with an epoxy topcoat.
5. Special attention shall be paid to the potential for epoxy shop and intermediate coats to chalk upon exposure to sunlight. The Contractor shall follow the manufacturer's required surface protection/covering and surface preparation recommendations before any intermediate or top coats can be applied over chalked surface.

3.3 APPLICATION

A. Workmanship:
   1. Employ skilled workmen to insure workmanship of the highest quality.
   2. Materials shall be applied only by craftsmen experienced in the use of the specific products involved.

B. General Requirements:
   1. Apply all coatings under adequate illumination.
   2. Perform no work in the rain, dew, or fog, when the temperature is below 50 degrees Fahrenheit [IO degrees C], and at least 5 degrees Fahrenheit above the dew point, or before the other coats have thoroughly dried.
   3. Do not apply coatings until the material surfaces are thoroughly dry.
   4. Apply paints and varnishes with suitable brushes, rollers or spraying equipment.
      a. The rate of application shall not exceed that as recommended by the paint manufacturer for the surface involved.
      b. Keep brushes, rollers and spraying equipment clean, dry and free from contaminates and suitable for the finish required.
      c. Apply stain by brush. Cover surfaces with a uniform coat and wipe off if required.
      d. Make each coat a different tint from that of the preceding coat, with final coat tinted to the exact shade selected by the Engineer. Lightly sand surfaces between each coat of gloss and semi-gloss finishes, and wipe clean.
   5. Comply with the recommendation of the product manufacturer for drying time between succeeding coats. Contractor shall follow the manufacturer's specific curing requirements for rust inhibitive primer shop coats prior to allowing topcoating.
   6. Sand and dust between each coat to remove defects visible from a distance of five (5) feet.
   7. Finish coats shall be smooth, free of brush marks, streaks, laps or pile up of paints and skipped or missed areas.

8. Inspection:
   a. Do not apply additional coats until the completed coat has been inspected by the Engineer.
   b. Only inspected and reviewed coats will be considered in determining the number of coats applied.
9. Leave all parts of moldings and ornaments clean and true to details with no undue amount of paint in comers and depressions.
10. Make edges of paint adjoining other materials or colors clean and sharp with no overlapping.
11. Apply primer on all work before glazing.
12. Refinish entire wall where portion of finish has been damaged or is not acceptable.
13. Apply one coat of metal primer, of the types specified hereunder, and one coat of flat black metal enamel, to the surfaces of all ductwork behind grilles, for a distance of 18 inches [50 mm].

C. Painted Work:
1. Back prime all exterior and interior wood.
2. Runs on face are not permitted.
3. Back prime all wood siding with specified stain.

D. Stained and Natural Finish:
1. Adjust natural finishes as necessary to obtain identical appearance on veneers and solid stock.

3.4 PROTECTION

A. Furnish and lay drop cloths in all rooms and areas where painting and finishing is being done to adequately protect flooring and other work from damage during the prosecution of the painting work.

B. Remove all canopies of lighting fixtures, all electric switch plates, and similar equipment, set them carefully away, and cover adequately, protect the fixtures, etc.; replace the canopies, plate, etc. in as good condition as when found.

3.5 CLEANING

A. At the completion of the work of this Section, remove all paint spots and oil or grease stains, caused by this work from floors, walls, fixtures, hardware and equipment, leaving their finishes in a satisfactory condition. Remove all materials and debris and leave the site of the work in a clean condition so far as this work is concerned.

3.6 FINAL INSPECTION

A. Protect all painted and finished surfaces against damage until the date of final

acceptance of the work. The Engineer will conduct a final inspection of all painters' work. As part of the final inspection the Contractor shall demonstrate compliance with the specified film thickness with appropriate paint gauges. The Contractor shall be required to repaint, refinish, or retouch any areas found which do not comply with the requirements of this Section.

3.7 PAINT SCHEDULE

A. Definitions

1. Submerged surfaces shall be defined as those surfaces which are below the maximum water surface level as indicated on the drawings, and/or extend 3 feet above the maximum water surface for uncovered tanks. All surfaces contained within covered tanks shall be considered submerged. The full height of all sluice, slide and weir gates shall also be considered as a submerged surface.
2. Enclosed surfaces shall be those non-submerged surfaces enclosed and/or protected within a building in such a manner that it can not be exposed to UV light or weather conditions.
3. Weather exposed surfaces shall be all other conditions which do not fall into the definition of submerged or enclosed surfaces as noted above.

END OF SECTION

SECTION 11000

EQUIPMENT - GENERAL

PART I – GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish, install and test all equipment specified in this Contract and as shown on the Drawings.

B. Related Work Specified Elsewhere (When Applicable):

1. Site work is specified in Division 2.
2. Concrete and grout are specified in Division 3.
3 Metals are specified in Division 5.
4. Field painting is specified in Division 9.
5. Pipe, plumbing, and mechanical work are specified in Division 15.
6. Electrical work is specified in Division 16.

1.2 QUALITY ASSURANCE

A. Provide only equipment of proven reliability manufactured by reputable manufacturers.

B. Acceptable manufacturers are listed in each equipment item section in this Division. Substitute or "or-equal" equipment will be allowed only when indicated.

C. Certificates, patents, licenses or other required legalities, when applicable, are specified in each Section of this Division.

D. Manufacturer's names listed in "Acceptable Manufacturers" section of each specification are intended to indicate the type and quality of materials desired. Where the words "or equivalent" are indicated other manufacturers of equal quality, that comply fully with the specifications, are allowed. Where the words "or equivalent" are not included, the Contractor must provide equipment in compliance with the specifications that is manufactured from the listed manufacturers.

E. The specifications direct attention to certain required features of the equipment but do not purport to cover all details entering into its design and construction. Nevertheless, the Contractor shall furnish the equipment complete in all details and ready for operation for the intended purpose.

F. These Specifications are intended to provide standard equipment of a recognized manufacturer meeting all the requirements of the Specifications. Due to differences in such prefabricated equipment of various manufacturers, submit complete shop drawings, cuts, specifications, etc. to the Engineer to review for compliance with the Contract Documents prior to ordering any equipment. If the equipment differs materially from the dimensions given on the Drawings, submit complete drawings showing elevations, dimensions etc. for the installation. If

Engineer's acceptance is obtained for alternate equipment, make any needed changes in the structures, piping or electrical necessary to accommodate the equipment at no additional cost to the Owner.

G. Workmanship shall be first class in all respects.

1.3 SUBMITTALS

A. Provide shop drawings and samples as specified in the General Conditions and Section 01340 of the Construction Contract.

B. Catalog Data: Submit manufacturer's literature and illustrations for all equipment to be installed, including dimensions, construction details, shop painting details, and materials by generic name.

C. Installation Instructions: Submit complete sets of manufacturer's instructions for each equipment item.

D. Operating Data: Complete operating manuals.

E. Maintenance Data:

1. Maintenance instructions.
2. Parts list.
3. List of special tools (where applicable).

F. Certificates: Submit manufacturer's certification that equipment, accessories and shop painting meet or exceed the Specification requirements. Submit equipment performance testing results as required by these specifications. Should the proposed equipment not comply with all the specification requirements, all deviations from the specification requirements shall be listed.

G. Submit all requirements for interface with controls and/or equipment furnished in Division 16. Submit wiring diagrams as required to accurately depict all such interface requirements to ensure proper operations of each system or item of equipment.

H. Submittals are further specified in this Division.

I. Guarantees/Warranties as specified below.

J. Attention is directed to the fact that the Drawings are based upon a particular piece of equipment. If the equipment accepted requires an arrangement differing from that indicated on the Drawings, the Contractor shall prepare and submit for review, detailed mechanical drawings showing all necessary changes. Such changes shall be at no additional cost to the Owner.

1.4 GUARANTEE/WARRANTIES

A. The Contractor shall obtain a warranty from the manufacturer in the name of the Owner. Submit the equipment manufacturer's warranty to the Engineer for review.

B. Equipment that is supplied by a system supplier and is intended to function as a complete and integrated system shall be warrantied by the system supplier as set forth in this specification section.

C. The manufacturer's warranty must guarantee the equipment to be free of defects

for a period of one year from the date of substantial completion as defined in the General Conditions, unless otherwise stated in the equipment item specification section.

D. All required warranties which run longer than the Contractor's one year warranty period shall be issued to the Owner after the Contractor's one year warranty period has expired. The Contractor will be required to handle warranty problems during the one year warranty period following substantial completion.

E. Any part of mechanical equipment that shows undue or excessive wear, or that fails due to normal operational conditions within the first year of operation after the date of substantial completion, shall be considered as evidence of defective material or defective workmanship, and it shall be replaced with equipment or parts to meet the specified requirements at no cost to the Owner.

1.5 DELIVERY, STORAGE AND HANDLING

A. Coat all machined surfaces subject to corrosion with an easily removable rust preventive compound prior to shipment.

B. Ship fabricated assemblies in the largest sections permitted by carrier regulations, properly labeled for field erection.

C. Deliver equipment in manufacturer's original, unopened and undamaged packages, unless mounted on equipment assembly.

D. Should damage occur, immediately make all repairs and replacements necessary \ to the satisfaction of the Engineer at no costs to the Owner.

E. Store in a manner to protect items with epoxy shop coatings from exposure to UV light which can cause chalking of the epoxy. Length of acceptable exposure prior to providing UV protective measures shall be in accordance with coating manufacturer's recommendations. This includes protection from UV light after installation while awaiting covering or filling of tanks, or prior to topcoating with aliphatic polyester polyurethane for items scheduled to be topcoated.

PART 2 - PRODUCTS

2.1 GENERAL DESIGN OF EQUIPMENT

A. All parts and components of mechanical equipment shall be designed for satisfactory service under continuous duty without undo wear, under the specified operating conditions, for a period of not less than one year.

B. All parts of mechanical equipment shall be amply proportioned for all stresses which may occur during operations, and for any additional stresses which may occur during fabrication and erection. Iron castings shall be tough, close-grained gray iron casting, Class 30, in accordance with ASTM A48, latest revision. Structural steel shall conform to ASTM A36.

C. Mechanical equipment, including drives and electrical motors, unless otherwise noted, shall be supplied and installed in accordance with the Williams-Steiger Occupational Safety and Health Act of 1970 and subsequent amendments. The Contractor's attention is drawn to the requirements for equipment guards. The

noise level of equipment, drives and motors, unless otherwise noted, shall not exceed 90 dBA measured 3 feet from the unit under free field conditions.

D. All equipment and machinery furnished under this Contract shall be the latest improved design suitable for the service specified. All equipment and machinery shall be designed and constructed to operate efficiently, continuously and quietly under the specified requirements with a minimum of maintenance, renewals and repairs. The design and construction of all equipment and machinery shall be such as to permit operation with minimum wear, vibration and noise when properly installed.

E. Provide certified bearing life calculations on all equipment bearings.

F. Ample room for erecting, repairing, inspecting and adjusting of all equipment and machinery shall be provided. The design, construction and installation of all equipment and machinery shall conform to and comply with the latest safety codes and regulations.

G. All equipment of identical size, type and service shall be the product of the same manufacturer.

H. All equipment selected shall suit the general arrangement of the space in which it is to be installed.

I. Wiring of motors and controls shall be in accordance with the requirements of Division 16 and other applicable portions of the Specifications. Electrical variable frequency drives shall be furnished under this specification and installed by the electrical contractor, unless otherwise noted as specified in Division 16.

J. Suitable provisions shall be made for easy access for service and replacement parts.

2.2 BOLTS, ANCHOR BOLTS AND NUTS

A. All necessary bolts, anchor bolts, nuts, washers, lock washers or locking nuts, plates and bolt sleeves shall be furnished by the Contractor in accordance herewith. Anchor bolts shall have suitable washers, lock washers and, where so required, their nuts shall be hexagonal.

B. All anchor bolts, nuts, washers, lock washers, plates, and bolt sleeves shall be galvanized unless otherwise indicated or specified.

C. Expansion bolts shall have malleable iron and lead composition elements of the required number of units and size.

D. Unless otherwise specified, stud, tap, and machine bolts shall be of the best-quality refined bar iron. Hexagonal nuts of the same quality of metal as the bolts shall be used. All threads shall be clean cut and shall conform to AN Standard B 1.1-1974 for Unified Inch Screw Threads (UN and UNR Thread Form).

E. Bolts, anchor bolts, nuts, washers, and lock washers specified to be galvanized, shall be zinc coated, after being threaded, by the hot-dip process in conformity with the ASTM Standard Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip, Designation A123, latest revision or the ASTM Standard Specifications for Zinc Coating (Hot Dip) on Iron and Steel Hardware, Designation Al 53, latest revision as is appropriate.

F. Bolts, anchor bolts, nuts, washers, and lock washers specified to be stainless steel shall be Type 316 stainless steel.

G. Anchor bolts and expansion bolts shall be set accurately. If anchor bolts are set before the concrete has been placed, they shall be carefully held in suitable templates of acceptable design. Where indicated on the Drawings, specified, or required, anchor bolts shall be provided with square plates at least 4 in. by 4 in. by 3/8 in. or shall have square heads and washers and be set in the concrete forms with suitable pipe sleeves, or both. If anchor or expansion bolts are set after the concrete has been placed, all necessary drilling and grouting or caulking shall be done by the Contractor and care shall be taken not to damage the structure or finish by cracking, chipping, spalling, or otherwise during the drilling and caulking.

H. All bolts shall be suitable size for the intended purpose, with direct input from the equipment or product manufacturer. In no case shall anchor bolt size be less than 3/8" diameter.

I. Stainless steel hardware is required in all submerged applications.

2.3 FOUNDATIONS- INSTALLATION AND GROUTING

A. The Contractor shall furnish the necessary materials and construct suitable concrete foundations for all equipment installed by him, even though such foundations may not be indicated on the Drawings. The tops of foundations shall be at such elevations as will permit grouting as specified below.

B. All such equipment shall be installed by skilled mechanics and in accordance with the instructions of the manufacturer.

C. In setting pumps, motors, and other items of equipment customarily grouted, the Contractor shall make an allowance of at least I in. for grout under the equipment bases. Shims used to level and adjust the bases shall be steel. Shims may be left embedded in the grout, in which case they shall be installed neatly and so as to be as inconspicuous as possible in the completed work. Unless otherwise permitted, all grout shall be a suitable nonshrinking grout.

D. Grout shall be mixed and placed in accordance with the recommendations of the manufacturer. Where practicable, the grout shall be placed through the grout holes in the base and worked outward and under the edges of the base and across the rough top of the concrete foundation to a peripheral form so constructed as to provide a suitable chamfer around the top edge of the finished foundation.

E. Where such procedure is impracticable, the method of placing grout shall be as permitted by the Engineer. After the grout has hardened sufficiently, all forms, hoppers, and excess grout shall be removed, and all exposed grout surfaces shall be patched in an approved manner, if necessary, given an burlap-rubbed finish, and painted with at least two coats of an acceptable paint.

2.4 ELECTRIC MOTORS

A. Unless otherwise specified or permitted by the Engineer, all electric motors furnished and installed by the Contractor shall conform to the requirements hereinafter set forth.

1. Ratings of Motors
   a. Every motor shall be of sufficient capacity to operate the driven equipment under all load and operating conditions without exceeding its rated nameplate current or power or its specified temperature limit.
   b. When the horsepower rating is specified for a motor, the motor furnished shall meet the requirements of the output specified. -When the horsepower rating is not specified, the motor shall have sufficient capacity to operate the driven equipment as given in the Detailed Specifications.
   c. All electric motors shall have either UL or FM approval ratings.
2. Type of Motors
   a. All motors shall be of a type having starting characteristics and ruggedness as may be necessary under the actual conditions of operation and, unless otherwise specified, shall be suitable for full-voltage starting.
   b. Motors shall be manufactured by General Electric Co., Reliance, Toshiba, Siemen, or be an equivalent product, that meets all the requirements herein.
   c. All motors shall have Class F insulation with temperature rise in accordance with NEMA Standards for Motors and Generators and based on a maximum ambient temperature of 40 deg. C.
   d. Explosion-proof motors shall comply with all requirements of Class 1, Division 1, Group D, hazardous locations as defined by the National Electrical Code and with all other safety codes pertaining thereto.
   e. All motors shall be high efficiency type. The minimum guaranteed efficiency shall be printed on the motor nameplate. The efficiency values shall be the highest available for the type and size of motor, and exceed the minimum values in the following table for motors with 75 horsepower and less.

HP	Minimum Guaranteed Efficiency (%)		
	1200 RPM	1800 RPM	3600 RPM
5	87.5	86.5	86.5
7.5	89.5	89.5	87.5
10	89.5	89.5	88.5
15	90.2	91.0	89.5
20	91.0	91.7	90.2
25	91.7	92.4	91.0
30	92.4	92.4	91.7
40	93.0	93.0	92.4
50	92.4	93.0	92.4
60	93.0	93.6	93.0
75	93.6	94.1	93.0

3. General Design of Motors
   a. Motors shall comply with the latest NEMA Standards for Motors and Generators, unless otherwise specified.
   b. Motor windings shall be braced to withstand successfully the stresses resulting from the method of starting. The windings shall be treated thoroughly with acceptable insulating compound suitable for protection against moisture and slightly acid or alkaline conditions.
   c. Bearings shall be of the self-lubricating type, designed to ensure proper alignment of rotor and shaft and to prevent leakage of lubricant.
   d. Bearings for open motors shall be of the sleeve or ball type, as specified under the respective items of mechanical equipment. Bearings for totally enclosed and explosion-proof motors shall be of the ball type.
   e. Vertical motors shall be provided with thrust bearings adequate for all thrusts to which they can be subjected in operation.
   f. Vertical motors of the open type shall be provided with drip hoods of acceptable shape and construction. When the drip hood is too heavy to be easily removed, provision shall be made for access for testing.
4. Wound-Rotor Induction Motors
   a. Wound-rotor motors shall be designed for operation of the motor-driven equipment under the conditions specified in the Detailed Specifications.
   b. Motors shall be of the wound-rotor, induction type suitable for speed control by rotor resistance.
   c. The collector rings shall be constructed of hard composition metal of sufficient conductivity and ample contact surface. The rings shall be mounted accurately and securely on the shaft by means of acceptable insulating construction. The leads to the collector rings shall be fastened to and insulated from the shaft in a suitable manner.
   d. The collector rings and brushes for the wound-rotor induction motors shall be suitable for operation in an atmosphere containing moisture.
   e. The brushes shall be of the electrographite type, or other suitable type, of sufficient hardness and conductivity and shall have ample contact surfaces. Brush holders shall be provided with adjustable, spring-tension devices. Brushes shall be connected to the holders with tinned, flexible, copper-wire pigtails so arranged that no appreciable current shall be carried through the sliding contacts or springs. Brushes shall operate without noise or chattering. Rings and brushes shall be located on top of the motor, and shall be easily accessible for inspection and maintenance.
5. Synchronous Motors
   a. Synchronous motors shall comply in all respects with the latest NEMA Standards for Motors and Generators, and AN Standard C50 for Rotating Electrical Machinery.
   b. Synchronous motors shall be designed for operation of the motor-driven equipment under the conditions specified in the Detail Specifications.

c. The temperature rise (based on a cooling temperature not exceeding 40 degrees C. and an altitude not exceeding 3,300 ft.) in the various parts of the motors, when operating continuously at rated voltage, frequency, and power factor, shall conform to the applicable requirements of the above mentioned NEMA Standards.

d. Synchronous motors shall be manufactured by General Electric Co., or be an equivalent product.

6. Single-Phase Motors with Auxiliary Devices

a. Single-phase motors requiring switching devices and auxiliary starting resistors, capacitors, or reactors shall be furnished as combination units with such auxiliaries either incorporated within the motor housings or housed in suitable enclosures mounted upon the motor frames. Each combination unit shall be mounted upon a single base and shall be provided with a single conduit box.

7. Motor Terminal Boxes and Leads

a. Motors shall be furnished with oversize conduit terminal boxes to provide for making and housing the connections and with flexible leads of sufficient length to extend for a distance of not less than 4 inches beyond the face of the box. The size of cable terminals and conduit terminal box holes shall be as permitted by the Engineer. An acceptable type of solderless lug shall be furnished. Totally enclosed and explosion proof motors shall have cast-iron terminal boxes.

8. Special Motors

a. Hoists and other devices complying with special safety codes shall be furnished complete with their control equipment and with all accessories and safety devices for code-approved, safe, and efficient operation.

2.5 DRIVE COUPLINGS

A. Couplings shall be all metal, flexible, designed for both angular and parallel misalignment, provided with a guard, and provided with a means for lubrication.

B. Close-coupled connections shall have machined shouldered joints for motor and pump motor support.

C. Acceptable Manufacturers:

1. H.S. Watson, Co. Toledo, Ohio
   a) Watson-Spicer Shafts
2. Mechanics Universal Joint Division of Borg-Warner Corporation., Rockford, Illinois
   a) Flexible Shafts
3. Or equivalent

D. Drive couplings for mixers which differ from the above referenced all metal type, which are standard integral parts of a mixer manufacturer's assembly may be permitted with review and approval of the Engineer.

2.6 SPECIAL TOOLS

A. For each type of equipment furnished by him, the Contractor shall provide a complete set of all special tools (including grease guns or other lubricating devices) which may be necessary for the adjustment, operation, maintenance, and disassembly of such equipment. Tools shall be high-grade, smooth, forged, alloy, tool steel. Grease guns shall be lever type.

B. Special tools are considered to be those tools which because of their limited use are not normally available, but which are necessary for the particular equipment.

C. Special tools shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such special tools until completion of the work, at which time they shall be delivered to the Owner.

2.7 PROTECTION AGAINST ELECTROLYSIS

A. Where dissimilar metals are used in conjunction with each other, suitable insulation shall be provided between adjoining surfaces so as to eliminate direct contact and any resultant electrolysis.

B. The insulation shall be bituminous impregnated felt, heavy bituminous coatings, nonmetallic separators or washers, or other acceptable materials.

2.8 PAINTING (Unless otherwise specified)

A. Submerged surfaces shall be defined as those surfaces which are below the maximum water surface level, and/or extend 3-feet above the maximum water surface for uncovered tanks. All surfaces contained within covered tanks shall be considered submerged. Non-submerged surfaces shall be defined as all surfaces which are not considered submerged surfaces.

B. All ferrous surfaces shall be factory primed, except ferrous surfaces obviously not to be painted such as gears, bearing surfaces, and other similar items which shall be given a shop coat of grease or other suitable rust resistant coating.

C. All rust, dirt, grease and other material shall be thoroughly removed before painting.

D. Motors, speed reducers and similar parts shall have a surface preparation typical with the manufacturer and suitable for exterior use.

E. All weld splatter, residue, and burrs shall be removed and ground smooth. Sharp edges and comers shall be dulled with a power grinder to improve paint adherence.

F. Submerged ferrous surfaces to be primed shall be blast cleaned to near white metal in accordance with Steel Structures Paint Council (SSPC) Surface Preparation No. 10.

G. Other ferrous surfaces to be primed, other than motors, speed reducers, etc., shall be blast cleaned in accordance with Steel Structures Painting Council (SSPC) Surface Preparation No. 6 for Commercial Blast Cleaning.

H. The shop primer shall be a polyamide epoxy of not less than 56 percent solids by volume and applied with a minimum dry film thickness of 4 mils. The primer shall be Tnemec 66-1211 Hi-Build Epoxoline Primer; Dupont 25P High Solids Epoxy Mastic or an equivalent product compatible with the field coats.

I. The shop primer for non-submerged conditions shall be one coat of Tnemec 37–77 Chem-Prime rust inhibitive primer, or an acceptable equivalent product.

J. All coating surface preparation and coating use, mixing, application and curing shall be in accordance with the current printed instruction of the coating manufacturer and be as specified herein. Special attention should be paid to manufacturer specific curing requirement of phenolic shop coats prior to allowing top coats, and to the potential for epoxy shop coats to chalk upon exposure to sunlight.

K. Shop coats shall be compatible with the field applied topcoats. The General Contractor shall coordinate this requirement during the shop drawing phase. Shop coats shall not require special intermediate coat preparation for good topcoat bond.

L. Field painting is specified under Section 09900.

M. All openings requiring protection shall have a water repellant tape and vapor phase inhibitor treated paper.

N. Touch up paint shall be furnished to the Contractor and Owner.

O. All coatings shall be in accordance with all applicable State and Federal VOC standards.

2.9 ELECTRICAL CONTROLS

A. Additional controls for various items of equipment are specified under Division 13 and/or Division 16, as indicated on the Drawings, and as specified. Due to potential differences in electrical requirements for equipment of various manufacturers, the Contractor shall coordinate the electrical requirements of the equipment supplied with the work specified in Division 13 and/or Division 16.

B. Provide auxiliary contacts as required for remote status and alarm conditions. Contractor to coordinate for each piece of equipment. Refer to the Electrical and Instrumentation Drawings.

PART 3 - EXECUTION

3.1 INSPECTION

A. Carefully inspect receiving structures and anchor supports for defects in workmanship prior to equipment arrival.

B. Carefully inspect all equipment for:
   1. Damage in shipping.
   2. Defects in workmanship and materials.
   3. Tightness of all nuts and bolts.

C. Inspection shall include, but not be limited to, the following as applicable:
   1. Soundness (without cracked or damaged parts).
   2. Correctness of setting, alignment, and relative arrangement of various parts.
   3. Adequacy and correctness of packing, sealing and lubricants.
   4. Completeness in all details, as specified.

D. Field Quality Control

1 . As part of the equipment cost, the Contractor shall provide the services of the manufacturer's service representative to assist the Contractor with equipment adjustment, start-up, and necessary testing to prove that the equipment is in proper and satisfactory operating condition.
2. On completion of his work, the manufacturer's service representative shall provide written certification that the equipment conforms to the requirements of the Contract and is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void, as outlined in the attached equipment certification form.
3. As part of the start up services, the manufacturer's services representative shall provide the Owner's personnel with training in the proper operation and maintenance of all associated equipment. The equipment training certification form shall be used for this purpose.
4. When the work is substantially complete the Contractor will be required to demonstrate, to the satisfaction of the Engineer, the ability of all equipment to operate as intended without defect including binding, vibration, jamming, overheating, etc.
5. All equipment found defective by the Engineer shall be replaced by the Contractor at no expense to the Owner.

3.2 PREPARATION

A. Provide all required adhesives, sealants, insulation, lubricants, waterproofing, fireproofing or other protection specified in each Section of this Division.

3.3 INSTALLATION

A. Contractor shall install equipment in accordance with manufacturer's requirement.
B. Do not install equipment until all defects or inadequacies in receiving structure have been corrected to meet Specifications.
C. Erect and lubricate equipment in strict accordance with the manufacturer's instruction.
D. All equipment mechanisms shall withstand all stresses that may occur during fabrication, erection, and intermittent or continuous operation.
E. Contractor to furnish and install supports as indicated on the Drawings, and as required by the equipment manufacturer.
F. Thoroughly clean all equipment and appurtenant piping to remove all dirt, grease, mill scale, and other foreign matter and touch up factory finish to the satisfaction of the Engineer.

3.4 ADJUSTMENTS

A. Test and adjust all equipment for proper operation and alignment, in the presence of the manufacturer's service representative.
B. Contractor shall provide necessary water or other materials needed for testing.
C. Demonstrate the equipment's ability to operate without overloading jamming, excessive vibration, etc. during normal operation conditions.

3.5 EXISTING EQUIPMENT RELOCATION

A. All relocated equipment shall be reconditioned and serviced prior to operation in the new locations. Equipment shall be cleaned, rust removed, reprimed and painted in accordance with Section 09900, balanced, lubricated, oiled, calibrated and properly wired and plumbed to provide the intended service. Start up of relocated equipment shall be done in accordance with the manufacturers instructions.

3.6 SERVICE CALL

A. In addition to the manufacturer's installation and startup services, the Contractor shall arrange for the manufacturer to provide one additional service call of one 8 hour working day on site upon demand of the Owner for each type of equipment, within the first year of operation at no additional cost to the Owner.

EQUIPMENT CERTIFICATION

Owner:_____ Date: _____

_____

Project:

_____

_____

Contractor:

_____

_____

Equipment Manufacturer:

_____

_____

Equipment: _____

As an authorized representative of the Equipment Manufacturer, the undersigned certifies that the equipment listed above conforms to the requirements of the construction contract between the Contractor and the Owner. The undersigned further certifies that the equipment has been installed in accordance with the Manufacturer's written instructions, that it is ready for permanent operation and that nothing in the installation will render the Manufacturer's warranty null and void.

_____ _____

(Authorized Representative of the Manufacturer) (Date)

_____ _____

(Witness) (Date)

EQUIPMENT TRAINING CERTIFICATION

Owner: _____ Date: _____

_____

Project:

_____

_____

Contractor: _____

_____

Equipment Manufacturer: _____

_____

_____

Equipment: _____

1. I have trained the Owner's personnel in the proper operation and maintenance of the above equipment.

_____ _____
(Authorized Representative of the manufacturer) (Date)

2. The personnel listed below attended the training session.

_____
_____
_____

_____ _____
(Owner's Representative) (Date)

3. Witnessed by _____ _____
(Date)

SECTION 11305

GRINDER PUMP STATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Furnish, install and test the complete (factory built) grinder pump station and all appurtenances necessary to make a complete and operable system as indicated in the Specifications and as shown on the Drawings.

B. Related work specified elsewhere:

1. Additional requirements are specified in Section 11000, Equipment - General, and in the other appropriate Sections in this Division.
2. Site work and dewatering are specified in Division 2.
3. Concrete and grout are specified in Division 3.
4. Metals are specified in Division 5.
5. Pipe and fittings are specified in Division 15.
6. Electrical is specified in Division 16.

1.2 QUALITY ASSURANCE

A. General:

1. The Specifications and Drawings direct attention to certain required features of the equipment and materials of construction, but do not purport to cover all details entering into its design. Nevertheless, the Contractor shall furnish all materials and equipment complete in all details and ready for operation for the intended purpose.
2. Equipment design, construction and installation in accordance with best practice and methods and conforming to the standards of the Hydraulic Institute.
3. All equipment and accessories shall be the manufacturer's latest and proven design.
4. All parts of the equipment shall be amply proportioned for long, continuous and uninterrupted service.
5. Suitable provisions shall be made for easy access for service and replacement of parts.
6. Workmanship shall be first class in all respects.

B. Qualifications of the Manufacturer:

1. Minimum of 5 years experience in the design and manufacture of grinder pump stations.
2. The grinder pump station complete with all appurtenances forms an integrated system, and as such shall be supplied by one grinder pump station

manufacturer who shall provide all the equipment and appurtenances, regardless of manufacturer. The Contractor shall be responsible for the satisfactory operation of the entire system.

3. Pump station installations that have proven reliable in similar applications over the last 5 years.

1.3 SUBMITTALS TO THE ENGINEER

A. The Contractor shall submit the following for Engineer's review:

1. Complete layout drawings illustrating all construction details and dimensions including any manufacturer instructions on installation or handling.
2. Shop drawings, manufacturer's literature, maintenance data, operating instructions and a list of maintenance materials as specified in the General Conditions and specification Sections 01340 and 11000 of the Contract Documents and as required in the Specifications and Drawings. Grinder pump station manufacturer shall integrate all required shop drawings into a common submittal package.
3. Pump manufacturer's performance curves showing total head, pump input horsepower and pump efficiency over the specified capacity range of each PUMP.
4. Submit calculations demonstrating that the pump station has a factor of safety of at least 1.15 against flotation assuming the groundwater level is at finish grade and the wet well is empty.
5. Submit confirmation that the environmental operating requirements of all components will be adequately met by the enclosure.

1.4 GUARANTEE

A. The Contractor shall obtain a warranty by the grinder pump station manufacturer, in the name of the Owner, in strict accordance with Section 11000.

B. The Contractor shall obtain a 5 year (10,000 Hr) prorated warranty from the pump manufacturer, in the name of the Owner, against defects in workmanship and materials, covering parts and labor. The terms of the warranty shall be as follows:

0 - 18 months (3,000 hours)	100%
19 - 39 months (6,500 hours)	50%
40 - 60 months (10,000 hours)	25%

The terms of the warranty shall be from the date of substantial completion as determined by the Engineer.

C. The Contractor shall obtain a 5 year warranty from the access hatch manufacturer, in the name of the Owner, against defects in workmanship and materials, covering parts and labor.

PART - 2 PRODUCTS

2.1 GENERAL

A. Pumping units shall draw sewage from a wet well, grind to a slurry and discharge into a force main against a total dynamic head as specified hereinafter.

B. The pumps shall be controlled automatically by float switches actuated by the change in wet well level. All equipment for the station shall perform automatically.

C. The pump station shall consist of a cylindrical wet well in which the following principal items of equipment shall be factory installed: grinder pumps, slide rail system, valves, internal piping, automatic level controller and all internal wiring. The main control panel, circuit breakers, motor starters and alarm system shall be situated in a weatherproof control panel mounted securely to the indicated service pole or pedestal, as shown on the Drawings.

D. The pump station shall be an explosion-proof system.

2.2 MATERIALS

A. Pump

1. General:

a. All pumps designated for a certain function shall be supplied by the same manufacturer.

b. All parts shall be designed and proportioned to have liberal strength, stability and stiffness to perform required functions.

c. Exposed hardware shall be stainless steel.

d. Provide ample room and fittings for inspection, repairs and adjustments.

e. Pumps shall be mounted on a substantial guide rail system, non-sparking type, with slide away coupling base/discharge elbow.

f. The lower guide holders shall be integral with the discharge connection and shall be anchored to the wet well floor by means of stainless steel anchors.

g. Pump base accurately aligned, sized and rigidly anchored in position in accordance with the manufacturer's requirements and recommendations and allow for complete removal of each pump.

h. No portion of the pump shall bear directly on the floor.

i. There shall be two guide rails per pump which shall be a minimum of 3/4 inch diameter stainless steel pipe.

j. Slide-away coupling shall be designed so that when pump is idle, pump may be removed for service or inspection and then returned to service without entering the wet well to unbolt or unlock the connection between the pump and piping.

2. Submersible Grinder Sewage Pump Schedule:

a. Boothbay Country Club East Side Development

(1) Function: Pump raw sewage

(2) Number: Two (2)

(3) Type: Vertical, single stage, submersible, centrifugal grinder pumps
(4) Capacity: 32 GPM at 109 feet total dynamic head (TDH), and capable of operating at 120 feet TDH without overload.
(5) Speed: 3490 RPM, maximum
(6) Drive: Constant speed, flexible or close-coupled connection
(7) Motor: Maximum 5.4 hp, U.L. Class 1, Group D, Design B, submersible, oil or air filled squirrel cage induction, ball bearing, 3490 RPM, 230 V, 1∅, 60 Hz.
(8) Control: Wet well liquid level and manual control
(9) Suction and Discharge: 2-inch diameter minimum with screwed or flanged connection
(10) Impeller Diameter: 142 mm
(11) Acceptable Manufacturers
(a) ITT Flyght Corp., Woburn MA

3. Submersible Grinder Sewage Pumps:
a. The submersible grinder sewage pumps shall be capable of pumping raw unscreened wastewater at the conditions indicated and shall conform to the requirements specified. The pump shall be capable of macerating all material in normal domestic and commercial wastewater to a fine slurry that will pass freely through the pump and 3 inch discharge piping.

4. Pump Casing:
a. Constructed of gray cast iron, Class 30 (ASTM A48), of ample thickness, capable of prolonged resistance to the abrasive action of solids or foreign matter contained in the liquid passing through the pump.

5. Discharge Nozzles:
a. Minimum size and type indicated in the Pump Schedule.

6. Impeller:
a. The submersible grinder sewage pump impeller shall be of the recessed type to provide an open, unobstructed passage through the volute for the ground solids. The impeller shall be dynamically balanced with a minimum of vanes or blades and be made of bronze.
b. Impeller vanes shall be free from sharp edges and the waterways shall be smooth contours and well-rounded entrances.
c. The impeller hub shall not have ports for the reduction of thrust on the impeller.
d. Impellers shall be key seated and securely attached to shaft by a streamlined locknut or equally efficient method, capable of withstanding a pump reversal to full runaway speed, but still permit easy removal.

e. The grinder mechanism shall consist of a radial cutter securely attached to the motor shaft and a shredding ring. The shredding ring shall be reversible. Both components shall be constructed of 440C stainless steel.

7. Shaft:
   a. The pump-motor shaft shall be stainless steel, accurately machined.
8. Seal:
   a. The pump shaft seal shall be of the double mechanical type, with pump seal leak detection system as specified hereinafter.
9. Motor:
   a. Submersible grinder sewage pump motor ratings shall be as specified in the preceding Pump Schedule.
   b. Motors shall have normal starting torque and low starting current.
   c. Motors shall maintain sufficient capacity to operate pump throughout designated operating range without exceeding name-plate rating for current and power.
   d. Pump motors shall be furnished with ball bearings.
   e. Leads shall be terminated in a cast connection box and shall be clearly identified.
   f. An electric sensing probe shall be mounted in the seal chamber and be connected to a red signal light on the control panel to detect any water leakage past the lower seal.
   g. A heat sensor thermostat shall protect motor against excess heat in compliance with its U.L. Class 1, Group D rating. Sensor shall reset automatically at the motor when motor cools with manual reset at the control panel.
10. Lifting Chain:
   a. Each pump shall be equipped with a stainless steel lifting chain of adequate capacity for the pumps supplied.
11. Spare Parts:
   a. Spare parts shall be delivered at the same time as the equipment to which they pertain.
   b. The contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.
   c. Parts shall be packaged in individual suitable containers labeled with the part number, name and quantity.
   d. Spare parts shall include:
      (1) Two (2) complete set of pump seals and gaskets per each type pump.
      (2) Two (2) complete sets of grinder pump cutter assemblies.
      (3) Any special tools required to service the equipment.

B. Wet Well
   1. The wet well shall be constructed of reinforced precast concrete as indicated on the Drawings and as specified hereinafter.
   2. Precast concrete sections shall meet or exceed the requirements of Specification Section 02601 and ASTM C478, unless otherwise indicated herein, and shall be designed for HS-20 wheel loadings.

3. Concrete shall have a minimum compressive strength at 28 days of 4000 psi.
4. The wet well shall contain safety type manhole steps spaced on 12-inch centers and capable of supporting a concentrated live load of 300 lbs.
5. The entrance hatches, vent fittings and electrical conduits shall be cast into the wet well cover unless shown otherwise on the Drawings.
6. Wall penetrations for pipes shall be by means of integrally cast watertight, flexible manhole type joint, steel pipe sleeve, or cast iron wall casting. (Refer to Sections 02601, and 15092).
7. Access Hatch (where applicable)
   a. Size and type shall be as indicated on the Drawings.
   b. Aluminum door and frame: Door shall open to 90' and lock automatically in the open position. A vinyl grip handle shall be provided to release the door for closing and equipped with a snap lock with removable handle and exterior lock system.
   c. Door leaf and channel frame to be constructed of 1/4-inch aluminum. Door leaf to be equipped with spring operators for easy opening, brass hinges and stainless steel pins.
   d. Hardware: Stainless steel hardware throughout, including hinges, pins, spring operators and automatic hold-open arm with release handle.
   e. The cover frame shall be integrally cast in the top concrete slab. Mill finish with polyamide epoxy coating to the exterior of frame that is in contact with concrete.
   f. Upper guide rail supports shall be fastened to the cover frame (where applicable).
   g. Acceptable Manufacturers:
      (1) The Bilco Co., Norwalk, CT - Type J or JD
      (2) Or equivalent
8. Manhole cover, frames and masonry (where applicable) shall meet the requirements of Section 02601 and or as shown on the Drawings.
9. A welded steel vent line shall be installed in the top of wet well cover as shown on the Drawings. The vent shall terminate 3 feet above the top slab and have a 1/4-inch mesh SS screen sturdily mounted on the above ground opening.

C. Piping and Valves

1. Piping carrying sewage within the pumping station shall be schedule 80 PVC pipe and fittings conforming to the requirements of Polyvinyl Chloride (PVC) Pressure Pipe. (Refer to Section 02629)
2. Check valves in the sewage discharge pipes shall be PVC ball check valves as specified in Section 15118, or equivalent.
3. Ball valves in the discharge piping shall be PVC, with level or T-handle. (Refer to Section 15118)
4. Ball valve size shall be that shown on the Drawings and shall be mounted in the horizontal position and the valve stem shall be oriented vertically upwards.
5. All buried pipe connections to pump station shall have a sleeve type flexible

connection 4'-0" from the pump station.

6. All pipes shall be adequately supported as specified in Section 15094.
7. All pipe lines shall be pressure tested for watertightness.
8. Install brass unions where required for installation.

D. Automatic control (Duplex Systems)

1. The control and the operation of the pumps shall be by means of a non-mercury float switch system which senses the wet well level.
2. Level controls to be weighted non-mercury float switches in unbreakable steel shell encased in solid polyurethane, mounted on a horizontal bracket with strain relief bushings. Furnish 6 weighted non-mercury float switches; one for high water, one for low water, and four operating.
3. Alarms are specified elsewhere in this section.
4. The controls shall be arranged to start and stop the lead and lag pumps at the wet well levels indicated on the Drawings.
5. Intrinsically safe relays shall be supplied to operate with level controls to reduce energy to a level where a spark is not created.
6. Pump motor starters shall be full voltage starters of the magnetic, nonreversing type. Starters shall be as specified in Division 16.
7. All starters shall have thermal overload protection in each phase as specified in Division 16.
8. An automatic solid state alternator shall be provided to reverse the sequence of lead, lag operation on the completion of each pumping cycle.
9. The automatic alternator shall be designed so that failure of the alternator will allow at least one pump to continue operating and allow the stand-by pump to operate should the lead pump fail to start.
10. The pump controls shall include a solid state, adjustable time delay relay to prevent both pumps starting simultaneously after a power failure. Time delay shall be continuously adjustable from 1 to 10 seconds. Time delay relay shall be as specified in Division 16.
11. Automatic controls shall prevent the simultaneous operation of both pumps in duplex stations when power source is obtained from the emergency generator mode.
12. A six digit, non-reseatable, run time meter reading 0.1 hour increments shall be furnished for each pump.
13. "Run" and "Stop" indicator lights shall be provided for each pump. Lights shall be controlled by means of motor starter auxiliary contacts.

E. Alarm System

1. A manual reset and silence alarm system shall be furnished and installed as specified.
2. The alarm system shall activate indicator lights located in the control panel with a flashing outside light and bell for any of the following conditions:
    a. High water - Wet Well
    b. Low water - Wet Well
    c. Loss of power supply

d. Pump seal failure
e. Motor thermal overload

An indicator light shall be provided for each of the above conditions with manual reset button. The interruption of normal power, transfer to battery backup, and retransfer to normal power after its restoration shall not change alarm indicator light status.

3. The exterior alarm light, bell and alarm indicator lights shall be powered by means of a suitable 12 volt D.C. power supply with standby battery pack. Lead-calcium type batteries shall be supplied. The battery pack shall have sufficient capacity to power the load for a period of 8 hours at a battery voltage not below 87 ½% of nominal voltage. The batteries shall be protected from excessive discharge by an automatic low voltage battery cut out circuit. Cut out to be at least at 85% of nominal battery voltage. Connect power supply to dedicated 120V, 20 A circuit.
4. Power supply shall provide means for keeping the battery pack in a constant state of full charge readiness. Power supply shall have capacity to recharge batteries to full charge within 16 hours even under an alarm condition.
5. The outside light shall be a weatherproof, vandalproof bracket fixture with red polycarbonate globe. The outside light shall be a strobe type, 12 volt and shall be Federal Signal 131 series or equivalent.
6. The alarm bell shall be vibratory, weatherproof type, have a vandal resistant guard and be rated for 12 volt DC operation. Bell shall be Federal Signal 600 series or equivalent.
7. Each alarm point shall be provided with auxiliary relay and all relay contacts shall be wired to a terminal strip for future radio telemetry. The terminal strip shall provide terminals for the incoming telemetry wiring and also test switches to simulate alarm conditions.

F. Control Panel

1. All electrical equipment necessary for the automatic controls [future telemetry equipment] and alarm system as specified shall be mounted within a common NEMA Type 4X (FRP or Stainless Steel) enclosure with stainless steel hardware, along with all electrical equipment specified in this section.
2. The enclosure shall be provided with a suitable lockable hinged access door and quick open stainless steel latching devices (screwed or bolt type devices are unacceptable).
3. Control panel shall have a hinged dead front with separate inside hinged door (NEMA 1). Grouped together on the inside door, convenient to the operator, shall be all circuit breaker handles, selector switches, alarm silence switch, indicator lights, all reset buttons, run time meters and convenience outlet. All devices shall be clearly labeled. The main circuit breaker operating handle shall be mounted through the inner door and shall have a lock arrangement that prevents the inner door from being opened when the breaker is in the ON position.
4. Control panel and electrical switchgear shall be mounted securely to 3/4 inch

plywood backboards which in turn shall be mounted to 2-6"x6" posts as shown on drawings.

a. Plywood shall be 3/4" thick Marine grade EXT-APA. Trim all edges with 1/4" x 3/4" solid pine glued and nailed. Paint backboard with one coat exterior primer and two coats of exterior acrylic latex paint with manufacturer's standard color selected by Engineer.
b. 6"x6" posts shall be standard pressure treated (0.4 PCF CCA) dimension lumber.
c. All fastenings shall be hot dipped galvanized. No cut edges after galvanizing or cadmium plated fittings will be permitted.

5. Thermal-magnetic circuit breakers shall be provided for each motor, control and auxiliary circuit and one for incoming power. Provide 15 amp, 120 volt circuit breaker for site lighting, where applicable. The main circuit breaker shall be sized according to the ampacity of the conductors. All branch breakers shall be sized per the National Electrical Code.
6. Provide a 120 volt, 20 ampere duplex ground fault type weatherproof receptacle mounted on the side of the panel to be supplied through its own separate circuit breaker and a 20 ampere duplex receptacle mounted inside the panel fed through its own separate circuit breaker.
7. Panel shall be furnished with one 240/120 volt, three phase, four wire, 60Hz, power feeder. Provide surge arrestors equal to Square D Secondary Surge Arrestors sized according to feeder size. Supply any control and power transformers necessary to make panel functional. All transformers shall have both primary legs and all "hot" secondary legs fused. One secondary leg shall be grounded.
8. A terminal strip with box type connectors shall be supplied to make all power and control connections. All terminals shall be clearly marked for easy identification. A ground terminal strip shall also be provided. At least 20 percent of terminals supplied shall be spare.
9. A complete panel wiring diagram shall be encased in a clear resealable plastic pouch and shall be mounted on the inside surface of the access door.
10. The outside alarm light shall be mounted on the top of the panel and the bell on the side of the panel, unless otherwise indicated on the Drawings. Mounting shall be in such a way as to permit easy removal in the event of failure and yet maintain the NEMA rating of the panel.
11. Indicator lights within the control panel shall be heavy duty, oil tight type with glass lenses. They shall be provided with chrome-plated metal or anodized aluminum mounting rings and name plates.
12. Control panel shall be insulated on the inside of all exterior surfaces with I" thick rigid fiberglass insulation having a minimum "k" value of 0.35 BTU-in/hr-ft^2-°F and be equipped with a built-in heater and adjustable thermostat. Heater shall be sized to maintain 40°F inside panel with an outside ambient temperature of –20 °F and a 15 MPH wind. Thermostat shall measure air temperature not surface temperature. Heater shall be similar to Hoffman Engineering Co. Series

D-AH.

13. Panel must be fitted with a grounded barrier between power and intrinsically safe circuits.
14. Spare parts:
    a. 1 Control switch of each type complete with contact blocks.
    b. 10 indicator lamp bulbs.
    c. O/L Blocks.
    d. 1 Strobe bulb.
    e. Parts shall be inside panel contained in such a way to protect from breakage.
15. The control panel enclosure shall be equipped with a continuously on strip heater sized to maintain the interior panel temperature 10 °F above the exterior temperature for condensation control.

G. Wiring

1. The pump station control panel shall be completely wired at the factory in accordance with the latest edition of the National Electrical Code.
2. All wiring in the pump station control panel shall be color coded, numbered and indicated on the wiring diagram, by the manufacturer.
3. All wiring outside the panel shall be in rigid conduit to the wet well. Provide insulated connecting cable consistent with Class I Division 1, Group D hazardous locations in the wet well. Conduit seals shall be installed at the control panel outlet. Sewage pump motors shall have leads installed in liquidtight flexible cable.
4. Sufficient flexible conduit shall be provided on the motors to allow the motor to be removed without detaching its power leads.
5. A schematic diagram on the Drawings indicates the electrical layout of the pump station.

H. Painting and Waterproofing

1. All precast concrete shall be waterproofed in compliance with Section 02601
2. The pumps shall be factory finished with coats of paint filler and enamel or other acceptable treatment customary with the manufacturer and suitable for the intended service.
3. Ferrous surfaces obviously not to be painted shall be given a shop coat of grease or other suitable rust-resistant coating.
4. Above grade ferrous surfaces, including the wet well vent and control panel, shall receive a minimum one coat of a rust inhibitive primer with a minimum dry film thickness of 1.5 mils and two coats of an alkyd coating with a minimum dry film thickness of 2 mils per coat.
5. Other ferrous surfaces, including piping and fittings, shall receive one shop coat of a rust inhibitive primer and two field coats of a polyamide epoxy with a minimum dry film thickness of 5 mils per coat. The polyarnide epoxy shall be 200HB epoxy made by Koppers Co., Inc. or 60 Series Hi-Build Epoxoline made by Tnemec or equivalent. The rust inhibitive primer shall be compatible with and made by the same manufacturer as the field coats.
6. All coatings shall be applied in accordance with the manufacturer's written

instructions.

7. Coatings damaged in shipment or installation shall be cleaned and touched up in the field with the same materials as original coatings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation of the pump station and related appurtenances shall be done in accordance with written instructions provided by the grinder pump station manufacturer.

B. The Contractor shall provide for the supervisory service of the grinder pump station manufacturer's factory trained engineer and other personnel, who are specifically trained on the type of equipment supplied, to assist the Contractor in installation of the pump station, and related appurtenances, and to assist in start-up and to provide one routine service call during the first year of operation at no additional cost to the Owner.

C. The completed pump station shall be given a test of all equipment to check for excessive vibration, for leaks in the piping or seals, for correct operation of the automatic control system and of all auxiliary equipment. All adjustments shall be made so that the station is ready for operation.

D. A factory trained engineer shall instruct operating personnel in the operation and maintenance of the equipment.

E. Exfiltration Tests Prior to Backfilling:

1. All testing must be performed in the presence of the Engineer.
2. Suitably plug all pipes entering the pump station and brace plugs to prevent blow out.
3. Fill the pump station with water to 3-feet below the top of the cover.
4. A period of up to 2 hours may be permitted, if the Contractor so wishes, to allow for absorption.
5. At the end of the absorption period, refill the pump station with water to 3-feet below the top of the pump station cover and begin the 4-hour test period.
6. At the end of the 4-hour test period, refill the pump station to 3-feet below the top of the pump station cover and measure the volume of water added. The leakage for the pump station shall not exceed ten gallons per I 00 cubic feet of volume per 4-hour period.
7. Correct leakage by reconstruction, replacement of gaskets and/or other methods as approved by the Engineer.
8. The use of lead-wool or expanding mortar will not be permitted.

3.2 FIELD QUALITY CONTROL

A. After installation of the equipment is complete, the Contractor will operate and test each unit in the presence of the Engineer.

B. The Contractor shall provide all labor, piping, equipment and materials necessary for conducting tests.

C. The Contractor shall check the motor and insulation for moisture content and defects.

D. The Contractor shall operate each pump unit to demonstrate its ability to pump

without excessive vibration, motor overloading or overheating. During the test the Contractor shall record pump capacity and motor input.

E. Each pump shall be operated for a sufficient period to permit thorough observation of all pump components and controls.

F. Since sufficient sewage will not be available for the test, the Contractor shall provide water for testing, at no additional cost to the Owner.

G. After installation, all piping shall be tested for tightness in an acceptable manner. Should leaks be found, faulty joints shall be repaired, even to the extent of disassembling and remaking the joint, and all defective pipe and fittings shall be removed and replaced in a manner satisfactory to the Engineer.

H. Repeat tests until results obtained meet the Engineer's approval.

3.3 FINAL ADJUSTMENT

A. Make all adjustments necessary to place equipment in satisfactory working order at the time of testing.

B. All defects or defective equipment shall be corrected or replaced promptly, at the Contractor's expense.

END OF SECTION

SECTION 15088

COUPLINGS & CONNECTIONS

PART I - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish and install couplings and connectors of the type(s) and size(s) in the location(s) shown on the Drawings and as specified herein.

B. Related Work Specified Elsewhere: "Pipe & Pipe Fittings - General" is specified in Division 2.

1.2 QUALITY ASSURANCE

A. Minimum pressure rating equal to that of the pipeline in which they are to be installed.

B. Couplings and connectors, other than those specified herein, are subject to the Engineer's approval.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All Couplings and Connectors:

1. Gasket Materials: Composition suitable for exposure to the liquids to be contained within the pipes.
2. Diameters to properly fit the specific types of pipes on which couplings and connectors are to be installed.

B. Sleeve Type Couplings (When Applicable):

1. Exposed Couplings (When Applicable):
   a. Steel middle ring,
   b. Two steel follower rings,
   c. Two wedge-section gaskets,
   d. Sufficient steel bolts to properly compress the gaskets,
   e. Acceptable Manufacturers:
      (1) Dresser Manufacturing Co. - Style 38,
      (2) Rockwell - Style 43 1,
      (3) Or equivalent.
2. Buried Couplings (When Applicable):
   a. Cast iron or epoxy coated steel middle rings with pipe stops removed,
   b. Two malleable iron or epoxy coated steel follower rings with ribbed construction,
   c. Two wedge-section gaskets,
   d. Sufficient AWWA C- 1 1 1 or galvanized steel nuts and bolts to properly compress the gaskets,

e. Acceptable Manufacturers:
   (1) Dresser Manufacturing Co. - Style 38 and/or 153,
   (2) Rockwell-Style 431, and/or 441,
   (3) Or equivalent.

C. Split Type Couplings (When Applicable):
   I . Constructed from malleable or ductile iron.
   2. For use with grooved or shouldered end pipe with minimum wall thickness as required so as not to weaken pipe.
   3 . Cast in two segments for 3/4 inch through 14 inch pipe sizes, four segments for 15 inch through 24 inch pipe sizes, and six segments for pipe sizes over 24 inch.
   4. Coating: Enamel.
   5. Bolts: Carbon steel.
   6. All gaskets shall be Manufacturers Standard or as required for intended service with respect to fluid, temperature and pressure.
   7. Acceptable Manufacturers:
      a. Victaulic Company of America, Style 77 for IPS Pipe, Style 31 for Ductile Iron Pipe.
      b. Gustin-Bacon Co.,
      c. Or equivalent.

D. Flanged Adapters (When Applicable):
   1. For joining plain end or grooved end pipe to flanged pipes and fittings.
   2. Adapters shall conform in size and bolt hole placement to ANSI standards for steel and/or cast iron flanges 125 or 150 pound standard unless otherwise required for connections.
   3. Exposed Sleeve Type:
      a. Constructed from steel.
      b. Coating: Enamel.
      c. Bolts: Carbon steel or ASTM A588 steel.
      d. Acceptable Manufacturers:
         (1) Dresser Manufacturing Co. - Style 128 for cast iron, ductile iron and steel pipes with diameters of 2 inches through 96 inches,
         (2) Or equivalent.
   4. Buried Sleeve Type:
      a. Constructed from cast iron.
      b. Bolts: ASTM A588 steel or galvanized steel.
      c. Acceptable Manufacturers:
         (1) Dresser Manufacturing Co. - Style 127 locking type for cast iron, ductile iron, asbestos cement and steel pipes with diameters of 3 inches through 12 inches,
         (2) Or equivalent.
   5. Split Type:
      a. Constructed from malleable or ductile iron.
      b. For use with grooved or shouldered end pipe.

C. Coating: Enamel.
d. Acceptable Manufacturers:
(1) Victaulic Company of America - Style 741 for IPS pipe, or Style 341 for Ductile Iron Pipe, for pipe diameters of 2 inches through 12 inches,
(2) Victaulic Company of America - Style 742 for IPS pipe, or Style 342 for Ductile Iron Pipe, for pipe diameters of 14 inches through 16 inches,
(3) Or equivalent.

E. Flexible Joints:
1. Expansion Joints:
a. Materials shall be capable of withstanding the temperature, pressure and type of material in the pipeline.
b. Shall be the filled arch type that will prevent sediment build up for all sludge, sewage, and other lines with similar service.
c. Supplied with control rods to restrict elongation and compression.
d. Metal retaining rings shall be split and beveled galvanized steel for placement against the flange of the expansion joint.
2. Deflection Joints:
a. Joints designed to permit a nominal maximum deflection of 15 degrees in all directions from the axis of the adjacent pipe length, will prevent pulling apart, and will remain watertight at any angle of deflection under 15 degrees.
b. Material to be manufactured from a composition material suitable for exposure to the liquid, pressure and temperature to be contained within the pipe.
c. Supplied with control rods as required.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Sleeve Type Couplings (When Applicable):
1. Thoroughly clean pipe ends for a distance of 8 inches from the ends prior to installing couplings, and use soapy water as a gasket lubricant.
2. Slip a follower ring and gasket (in that order) over each pipe and place the middle ring centered over the joint.
3. Insert the other pipe length into the middle ring the proper distance.
4. Press the gaskets and followers evenly and firmly into the middle ring flares.
5. Insert the bolts, finger tighten and progressively tighten diametrically opposite nuts uniformly around the adapter with a torque wrench applying the torque recommended by the manufacturer.
6. Insert and tighten the tapered threaded lock pins.

7. Insert the nuts and bolts for the flange, finger tighten and progressively tighten diametrically opposite bolts uniformly around the flange to the torque recommended by the manufacturer.

B. Split Type Flange Adapters (When Applicable): Install in the same manner as Split Type Couplings.

C. Buried Cast Iron Couplings, Adapters and Connectors (When Applicable): Thoroughly coat all exterior surfaces, including nuts and bolts, after assembly and inspection by the Engineer with a heavy-bodied bituminous mastic as approved by the Engineer.

D. Buried Epoxy Coated Steel Couplings: Thoroughly coat all exterior surfaces, including nuts and bolts after assembly and inspection by the Engineer with a coal tar approved by the Engineer. Prior to coating, roughen the epoxy with emory paper and follow with a solvent cleaner (aeromatic similar to xylol). Dry film thickness of the coal tar is to be 12-16 mils.

E. Install thrust rods, supports, and other provisions to properly support pipe weight and axial equipment loads.

F. All interior sleeve interior couplings shall be restrained with tie rods when used on pressurized lines. All buried couplings on pressure lines shall be restrained (solid sleeve) type. All buried couplings on pressure lines shall be restrained (solid sleeve) type.

END OF SECTION

SECTION 15092

PIPE SLEEVES & SEALS

PART I - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish and install wall sleeves and seals of the type(s) and sizes(s) and in the location(s) shown on the Drawings and specified herein.

B. Related Work Specified in Section 02610.

1.1 QUALITY ASSURANCE

A. Provide and install all sleeves of the types specified herein, as shown on the Drawings
and as directed by the Engineer.

B. Provide sleeves that are airtight, gastight or watertight as required.

PART 2 - PRODUCTS

2.1 TYPES AND LOCATIONS

A. New Construction:

I . Concrete Floor Penetrations - Air to Air:

a. Same as interior concrete partitions - Air to Air.
b. Top side extending 2 inches above floor.
c. Bottom flush with underside of slab.
d. Pipe riser clamp used on topside.
e. Refer to details on Process Drawings.

2. Concrete Tank Walls Air to Ground:

a. Schedule 40 galvanized steel pipe with I inch x 1/2 inch integrally cast sealing and anchoring collar in middle, hot-dip galvanize after fabrication.
b. Size of pipe sleeve as required by seal manufacturer.
c. Seal with rubber link compression seal.
d. Alternate wall sleeve system as manufactured by Omni Sleeve, Malden, MA. can be utilized as reviewed and accepted by Engineer, in place of above specified wall sleeve system.
e. Refer to details on Process Drawings.

3. Concrete Walls - Liquid Containing Structures to Air or Ground:

a. For ductile iron and steel piping systems, utilize wall castings. Materials, schedule, class and size to match pipe.
   i. For galvanized steel piping systems, use sleeve with I inch x 1/2 inch welded sealing and anchoring collar in middle, hot-dip galvanized after fabrication.
   ii. For ductile or cast iron piping systems, use casting with 1 inch x 1/2 inch integrally cast sealing and anchoring collar in middle.
   iii. Refer to details on Process Drawings.

b. For plastic piping systems, sleeve and seals to be in accordance with Concrete Walls - Air to Ground requirements noted above. These type penetrations will be allowable only in those locations specifically depicted on the drawings.

4. Other conditions shall be sleeved as shown on the Drawings or as reviewed and accepted by the Engineer.

B. Rubber Link Seals:

I . Multi-rubber link type with pressure plates, bolts, nuts and sealing element providing a leakproof seal.

2. General Service:
   a. Delrin plastic pressure plate.
   b. Carbon steel zinc-phosphated nut and bolt.
   c. Sealing element: EPDM rubber.
   d. -40F to 250F. rating.

3. Corrosive Service: (Where Applicable):
   a. Use: Sludge holding and transfer wells, digesters, and elsewhere as shown on the Drawings.
   b. Pressure plate: Delrin plastic.
   c. Bolt and nut, 18-8 stainless steel.
   d. Sealing element: EPDM rubber.

4. Acceptable Manufacturers:
   a. Link Seal by Thunderline Company
   b. Or equivalent.

5. Refer to details on Process Drawings.

PART 3 – EXECUTION

3.1 INSTALLATION

A. New construction:

I . Concrete: Set sleeves in proper location prior to placing concrete. Sleeves set by mechanical, plumbing, and HVAC trades as appropriate.

2. Masonry: Mechanical, plumbing, and HVAC trades to provide sleeves and locations to masonry trades for installation.

3.Partitions: Set sleeves in place as work progresses.

B. Hollow Concrete Roof or Floor Planks:

1.Provide planks with sleeve cast-in-place at time of construction,

2. Or core drill planks in location reviewed and accepted by Engineer and plank manufacturer. Submit written approval of locations from plank manufacturer.

3. Firmly grout sleeve in place.

C. Rubber Link Seals: Install as required and in strict accordance with the manufacturer's instructions and recommendations.

END OF-SECTION

SECTION 15094

PIPE HANGERS & SUPPORTS

PART 1 -GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish and install pipe hangers and supports to rigidly support pipes, maintain the necessary pitch, prevent vibration, prevent movement, and to allow expansion and contraction of the type(s) and in the location(s) shown on the Drawings and specified herein.

B. Related Work Specified Elsewhere: "Pipe & Pipe Fittings - General" is specified in this Division.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Overhead Hangers:

1. For pipes 8 inches in diameter and smaller:
   a. Adjustable clevis.
   b. Acceptable manufacturers:
      (1) Grinnel Co., Fig. 260.
      (2) Carpenter & Patterson Inc., Fig. I 00.
      (3) Or approved equal.
2. For pipes larger than 8 inches in diameter:
   a. Single pipe rolls and sockets.
   b. Acceptable Manufacturers:
      (1) Grinnel Co., Fig. 171 or 181.
      (2) Carpenter & Paterson Inc., Fig. 142 or 140.
      (3) Or approved equal.
3. For insulated pipe use insulation protection shield, Grinnel Co., Fig. 167 or Carpenter & Paterson Inc., Fig. 265P.
4. For copper piping:
   a. Copper plated malleable iron.
   b. Acceptable manufacturer:
      (1) Grinnel Co., Fig. CT-138-R.
      (2) Carpenter & Paterson Inc., Fig. 8 1 CT.
      (3) Or approved equal.
5. Threaded hanger rods:
   a. Right-hand and left-hand machine threads.
   b. Suspended from beam clamps or galvanized inserts in concrete.
   c. Acceptable manufacturers:
      (1) Grinnel Co., Fig. 140 or 253.

(2) Carpenter & Paterson Inc., Fig. 133 or Fig. 94.
(3) Or approved equal.

B. Pipe Saddle Supports:
1. Adjustable type with pipe and floor flanges.
2. When used under base fittings, substitute matching floor flanges for saddle sections.
3. Acceptable manufacturers:
a. Grinnel Co., Fig. 264.
b. Carpenter & Paterson Inc., Fig. IO 1.
c. Or approved equal.

C. Wall and column supports:
1. Welded steel brackets with anchor chairs.
2. Install additional wall bearing plates where required for wall brackets.
3. Acceptable manufacturers:
a. Grinnel Co., Figs. 194,195, and 199.
b. Carpenter & Paterson Inc., Figs. 49, 84 and 139.
c. Or approved equal.

D. Brick and Concrete Piers:
1. Locate where shown on the Drawings and/or where required for proper support.
2. Construct piers to accurately conform to the bottom one-third to one-half of the pipe.

E. Plastic Pipe Hangers:
1. Plastic coated hangers.
2. Acceptable manufacturers:
a. Grinnel Co., Fig. 97C.
b. Carpenter & Paterson Inc., Fig. 80O PVC.
C. Or approved equal.

F. Miscellaneous Hangers: Submit shop drawings for review and acceptance by Engineer prior to use.

G. All additional supports, braces, brackets, etc. which are not specifically described above, but which are required to provide a system in accordance with the applicable paragraphs of this section, shall be provided and installed. Submit all such devices for shop drawing review and acceptance by the Engineer prior to use.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
1. At a minimum, install hangers, supports, rods, inserts, clamps, brackets, braces, bolts or other supporting devices at all changes in direction and at the end of piping runs. Provide additional devices as required to meet the intent of the specification with respect to support, pitch, vibration, movement, and expansion and contraction.

2. Install all hangers, supports, rods, inserts, clamps, brackets, braces, bolts and other supporting devices of sizes and spacing to prevent loads from exceeding the manufacturer's maximum recommended loading with a safety factor of 5.
3. Provide lock washers or locknuts on hangers, supports, rods, inserts, clamps, brackets, braces, bolts and other supporting devices.
4. Secure hangers to beams or approved concrete inserts where possible.
5. When piping is installed on structural steel supports, provide blocking of pipe rolls to prevent lateral pipe movement.
6. Do not support piping from other pipes or from stairs and walkways.
7. Set all inserts before the concrete is placed.
8. Hangers secured to precast concrete plank construction shall be attached by means of steel plates placed on the upper side of the plank, with the hanger rod extending through the plate and secured by means of a nut and lock washer. The hole in the plank shall be grouted to fill the void through which the hanger rod protrudes in order to distribute the load over the full area of the hanger plate. Plates shall conform to the following schedule.

Size of Pipe Supported (inches)	Plate Thickness (inches)	Minimum Plate Size (inches)
1/2 to 1	3/16	4 x 4
1-1/2 to 2	3/16	5 x 5
2-1/2 to 4	1/4	6 x 6
5 to 6	1/4	lox 10
Over 6	1/4	12 x 12

B. Expansion and Contraction:
1. Rigidly support all piping with adequate provisions for expansion and contraction.
2. Firmly anchor horizontal runs over 50 feet in length at the midpoint of the runs to force expansion equally toward the ends.

C. Spacing:
1. Install hangers and supports at sufficiently close intervals to maintain alignment and prevent sagging.
2. Maximum spacing of hangers and supports:

Pipe Size (inches)	Spacing (fed)
1 & smaller	6
1-1/4 to 2	9
2-1/2 to 3	11
4 and larger	14
C.I. Soil Pipe (all sizes)	5
P.V.C. (all sizes)	As recommended by manufacturer

Fiberglass	As recommended by manufacturer

D. Supporting Vertical Piping:
   1. Support at each floor level.
   2. Support at all points necessary to insure rigid installation with adequate provisions to allow expansion and contraction and prevent vibration.
   3. Support by approved pipe collars, clamps, brackets, or wall rests.

E. Supporting PVC and Fiberglass Piping (when applicable):
   1. Support in strict accordance with the manufacturer's instructions and recommendations for the conditions of operation temperature and size of pipe.
   2. Support in a manner which will prevent subsequent visible sagging of the pipe between supports due to plastic deformation.

F. Drain, waste, and vent piping: Support by adjustable hangers.

G. Valves, Fittings & Specialties: Independently support pipe connected to pumps, equipment and piping systems.

H. Temporary pipe supports:
   1. Lay out each section of pipeline and make connections while the pipe is held in temporary supports.
   2. After the completion of connections in each section of pipeline, hold the section in place with temporary clamps.
   3. Do not remove the temporary clamps until the piping is correctly installed on the permanent supports.

3.2 TESTING

A. Demonstrate compliance with the requirements of this section with respect to support, pitch, vibration, movement, and expansion and contraction by operating all pumping, aeration and other systems under simulated operating conditions in the presence of the Engineer. Review demonstration procedures with Engineer sufficiently prior to the actual demonstration to allow incorporation of comments and concerns of the Engineer.

B. Systems which do not meet the requirements of this section with respect to support, pitch, vibration, movement, and expansion and contraction will be supplemented with additional devices as required and re-demonstrated until compliance is achieved.

END OF SECTION

SECTION 15100

VALVES AND SPECIALTIES - GENERAL

PART I - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish, install, support, and test valves, gates, hydrants, cocks, stops, and faucets, when applicable, (hereinafter referred to as "valves") in the location(s) and of the size(s) and quantities shown on the Drawings and/or as specified herein.

B. Related Work Specified Elsewhere (When Applicable):
   1. Field painting is specified in Division 9.
   2. Pipe, fittings, pipe hangers and supports, and piping insulation are specified in the appropriate Sections in this Division.
   3. Valves for plumbing, heating and air conditioning are specified in the appropriate Sections in this Division.

1.2 SUBMITTALS TO THE ENGINEER

A. Submit shop drawings and operation and maintenance manuals in accordance with Section 01340 and the General Conditions of the Construction Contract.

B. Catalog Data: Submit manufacturer's literature and illustrations for each size of valve furnished.

C. Certificates: Submit manufacturer's certification that valves and accessories meet or exceed the requirements of these Specifications.

1.3 INSTALLATION

A. Shipping:
   1. Prepare valves and accessories for shipment as required for complete protection.
   2. Seal valve ends to prevent entry of foreign matter into valve body.
   3. Box, crate, completely enclose, and protect valves and accessories from accumulations of foreign matter.

B. Storage:
   1. Store valves and accessories in an area on the construction site protected from weather, moisture, or possible damage.
   2. Do not store valves or accessories directly on the ground.

C. Handling: Handle valves and accessories to prevent damage of any nature to the interior and the exterior surfaces.

1.4 INSPECTION

A. Carefully inspect all materials for:
   1. Defects in workmanship and materials.
   2. Removal of debris and foreign material in valve openings and seats.
   3. Proper functioning of all operating mechanisms.
   4. Tightness of all nuts and bolts.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Materials are specified in appropriate Sections in this Division.

B. The specifications direct attention to certain required features of the valves and gates but do not purport to cover all details entering into their design and construction. Nevertheless, the Contractor shall furnish the valves and gates complete in all details and ready for operation for the intended purpose.

PART 3 - EXECUTION

3.1 PREPARATION

A. Apply shop coatings in accordance with Section 02610.

3.2 INSTALLATION

A. Install valves and accessories in strict accordance with manufacturer's instructions and recommendations, as shown on the Drawings and/or as specified herein.

B. Carefully erect all valves and support them in their respective positions free from distortion and strain.

C. Independently support all valves connected to pumps and equipment, and in piping systems that cannot support valves.

D. Repair any scratches, marks and other types of surface damage etc. with original coating as supplied by the factory.

E. Install valves such that "open" and "close" position indicators are easily visible.

F. All valves (and actuators where specified) shall be installed in a manner that will provide for proper clearances and ease of operation. In addition, valve operators must be capable of being rotated in 90' increments to facilitate field installation.

3.3 ADJUSTMENTS

A. Check and adjust all valves and accessories for smooth operation.

3.4 TESTING

A. The Contractor shall test all valves and gates in the presence of the Engineer to demonstrate that each valve and gate complies with specified requirements and allowable leakage rates.

END OF SECTION

SECTION 15104

PLUG VALVES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish, install and test plug valves and actuators of the type(s) and size(s) and in the location(s) shown on the Drawings and as specified herein.
B. Related Work Specified Elsewhere: "Valves and Specialties - General" is specified in Division 2.

1.2 QUALITY

A. All plug valves of same type, style, and duty shall be of one manufacturer.
B. All actuators shall be supplied by the valve manufacturer who shall be responsible for proper operation of all valves with the actuators specified.
C. Acceptable Manufacturers:
   I . DeZurik Corporation.
   2. Or equivalent.

1.3 JOB CONDITIONS

A. Piping as shown on the Drawings is detailed to accommodate standard design flanged plug valves having face-to-face dimensions of standard flanged gate valves.
B. Make all necessary adjustments to piping, subject to review of the Engineer, to accommodate plug valves furnished with face-to-face dimensions not of standard flanged gate valves.
C. Valves 2 inches and smaller may be of screwed type unless indicated otherwise.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Two Way Valves:
   I . Non-lubricated, eccentric type, cast iron body with end type as shown on the Drawings.
   2. Shall have an unobstructed shaped waterway, when open, of not less than 80% of nominal pipe area.
   3. Body shall be of gray cast iron, ASTM A126 Class B with resilient plug facings of neoprene or Buna-N.
   4. Packing shall be BLTNA (VEE) with a maximum temperature of 350'F. Packing shall be adjustable.
   5. Bearings shall be stainless steel or bronze as required.
   6. Suitable for particular service in piping in which installed.
   7. Welded-in nickel or stainless steel seat.

B. Three Way and Four Way Valves:
   I . Equal to that specified for two way valves.
   2. Port location, style, and arrangement as shown on the Drawings and as required.

C. Actuators (type as shown on the Drawings and specified herein):
   I . Lever Actuators: Size and length as required with a 2 inch square socket end for use on 2 inch square actuating nut. Attach handle to valve with a 4 foot length of chain.
   2. Handwheel Actuators:
      a. Totally enclosed gear type.
      b. Sized for the operating conditions encountered.
      c. Use on all valves 8 inches in size and larger, and on smaller valves when valve location does not allow lever actuator.
      d. Plug position indicator required.
   3. Chain Wheel Actuators: (when applicable)
      a. Totally enclosed type.
      b. Chain shall extend to 3 feet above floor unless otherwise shown.
      c. Supplied with chain guides and chain wheel, chain guides shall be galvanized.
      d. Use for all valves that are located with centerline 7 feet or more above floor.
   4. Pneumatic Actuators: (when applicable)
      a. Totally enclosed type.
      b. Supply pressure shall be 60 psi unless otherwise shown on the Drawings.
      c. Spring-to-open, air-to-close unless otherwise shown on the Drawings.
      d. Sized for the operating conditions.
      e. Provide pre-piped, 120 volt electric three way solenoid valve on actuator.
   5. Hydraulic Actuators: (when applicable)
      a. Double acting, solenoid valve controlled with manual override and rapid close feature.
      b. Provide opening and closing speed control valves; switch valve to control cylinder supply; manual/automatic selection; valve position indicator; water fitted cylinder; operating nut to allow manual operation; all preassembled and piped for operation with 120V power and sized to operate with 80 psi hydraulic pressure and a maximum valve shutoff pressure of I 00 psi.
      c. Provide a separate supply line strainer, unpiped for each actuator.
      d. Actuators shall be suitable for operation of valves installed in vertical piping.
      e. Provide time delay relays, contacts and appurtenant equipment to activate an alarm in the pump station control panel if the position indicator switch does not indicate the valve has closed within 2 minutes of receiving a close signal.
      f Opening and closing of the valve shall be activated by high and low wet well levels respectively with the pump starting against a closed valve and stopping as the valve closes to prevent water hammer.
      g. Install hydraulic actuators on the discharge of the sewage pump as required.
      h. All electrical controls to be housed in NEMA 3R enclosure.
      i. DeZurik Pump Check F I G3 9 1,R.

D. Accessories (When Applicable):
   1 . Extension (for lever actuated valves):

a. Shall include extension pipe, bearing plate and couplings of the sizes as required.

2. Floor Stand (for handwheel actuated valves):
   a. Shall include stand, coupling, handwheel mounted on stand and extension rod.
   b. Stand shall have a dial valve position indicator.
3. Extended Actuator Mounting: Supplied when actuators are extended above ground.
4. Floor Boxes:
   a. Iron body, size as required for valve.
   b. Cast iron or bronze screwed cover plate.
   c. Suitable for cast concrete floors of thickness as shown.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install valves with stem position horizontal to vertical.

B. Allow sufficient clearance around valve for proper operation, maintenance and removal.

C. Install and test in accordance with AWWA C500 latest revision and the "Valves and Specialties-General" Section in this Division.

END OF SECTION

SECTION 15110

CHECK VALVES

PART I - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish and install check valves of the type(s) and size(s) and in the location(s) shown on the Drawings and as specified herein.

B. Related Work Specified Elsewhere: "Valves & Specialties - General" is specified in Division 2.

1.2 QUALITY ASSURANCE

A. All check valves of same type and duty shall be by one manufacturer.

B. Qualifications of Manufacturer: Products have proven reliable in similar installations over a reasonable number of years.

1.3 JOB CONDITIONS

A. Whenever possible, install check valves in pipelines conveying sewage or sludge in horizontal positions.

B. When horizontal positions are not possible, provide and install check valves of a type suitable for mounting in a vertical position in pipelines conveying liquids containing high concentrations of solids.

PART 2 - PRODUCTS

2.1 VALVES - 3 INCHES AND LARGER

A. Meet the materials requirement of AWWA C508.

B. Iron body, bronze mounted, single disc.

C. Flanged ends faced and drilled to the 125 lb. Standard.

D. The working water pressure shall be 175 psig up through 12-inch, inclusive and 150 psig for 16-24 inch, inclusive.

E. So constructed that disc and body seat may easily be removed and replaced without removing the valve from the line.

F. Fitted with extended hinge arm with outside lever and weight.

2.2 VALVES - SMALLER THAN 3 INCHES

A. Standard, all brass or bronze, swing check with screwed ends.

B. Suitable for 150 psi. working steam pressure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with the "Valves and Specialties-General" Section in this Division.

END OF SECTION

SECTION 15118

CORROSION RESISTANT VALVES, AND SPECIALTIES FOR USE IN PVC PIPING SYSTEMS

PART I - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish and install corrosion resistant valves and specialties of the type(s) and size(s) and in the location(s) shown on the Drawings and as specified herein.

B. Related Work Specified Elsewhere: "Valves and Specialties - General" is specified in this Division.

1.2 QUALITY ASSURANCE

A. Qualifications of Manufacturer: Products have proven reliable in similar installations over a period of 5 years.

B. Acceptable Manufacturers:

1. Walworth Co.
2. Tube Turns Plastics Inc.
3. Celenese.
4. Harvel.
5. Cabot.
6. Or approved equal.

C. Valves and specialties for use on hypochlorite piping system shall have no metal parts in contact with fluid. Materials of construction shall be completely suitable for intended service.

PART 2 - PRODUCTS

2.1 MATERIALS (WHEN APPLICABLE)

A. Ball Valves (chlorine and/or hypochlorite piping):

1. Material: Polyvinyl chloride, Type 1.
2. Seats: Teflon.
3. Seals: O-ring of chlorine and/or hypochlorite resistant material.
4. Operators: Lever or T-handles.
5. Ends: Flanges or threaded as required.

B. Globe Valve:

1. Rating: 150 PSI@ 75'F.
2. Tight shut-off.
3. Wheel handle.
4. Screwed ends.

C. Diaphragm Valve:
1. Material: Polyvinyl chloride Type 1, Grade 1.
2. Operators: Wheel handle.
3. Ends: Flanged or threaded as required.
4. Replacement of diaphragm without removal of body from pipelines.
5. Rating: 140 PSI @ 70 F.
6. Seats: Teflon.

D. Multiport Ball Valve:
1. Material: Type 1, Grade I Polyvinyl chloride.
2. Operators: Lever or T-handle.
3. Seals: Ball seal of Teflon.
4. Ratings: 140 PSI@ 70'F.
5. Ends: Flanged or threaded as required.

E. Y-Sediment Strainers
1. Materials: Translucent PVC 1, Grade 1.
2. Cylindrical Screen: 8,12, 20 or 30 mesh size.
3. Screens shall be removable for cleaning.
4. Rating: 140 PSI@ 70'F.
5. Ends: Flanged or threaded type as required.

F. Plug Valve:
1. Teflon inserts and self-lubricating.
2. Operators: T-handle.
3. Materials: Polyvinyl chloride (normal impact).
4. Rating: 125 PSI@ 75'F.
5. Ends: Flanged or threaded as required.
6. Teflon-Neoprene gasket.

G. Needle Valves:
1. Materials: PVC (normal impact).
2. Operators: Wheel handle with open or close with less than four complete turns.
3. Rating: 125 PSI@ 75°F.
4. Ends: Threaded with directional flow arrow stamped in valve body.

H. Ball Check Valve:
1. Materials: PVC (normal impact).
2. Seals: Vitron seals with teflon seat rings.
3. Vertical or horizontal installation requiring one ounce of pressure to seal or unseat.
4. Replaceable ball and seals.
5. Ends: Threaded or flanged.
6. Rating: 125 PSI@ 75°F.

I. Gate Valve:
   1. Materials: PVC (normal impact) with teflon V-ring packing.
   2. Rating: 125 PSI@ 75°F.
   3. Operators: Wheel handle.
   4. Ends: Flanged or threaded.

J. Lift Check Valve:
   1. Materials: PVC (normal impact), PVDC (Hi-Temp) and Penton disc.
   2. Primarily for vertical installation.
   3. Require approximately 5 PSI differential pressure to open or close.
   4. Ends: Flanged or threaded.

K. Unions:
   1. Materials: PVC, Type I Grade 1.
   2. Rating: 150 PSI@ 75°F.
   3. Viton "O" ring seals self-lubricating teflon seats.
   4. Ends: Flanged or threaded.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install valves and accessories in strict accordance with manufacturer's instructions and recommendations.

B. Carefully erect all valves and support them in their respective positions free from distortion and strain.

C. Independently support all valves connected to pumps and equipment.

D. Install a union at each valve to permit disassembly.

E. Install in accordance with the "Valves and Specialties-General" Section in this Division.

F. Special care shall be taken when orienting ball check valves so as to ensure proper operation.

END OF SECTION

SECTION 15127

AIR RELEASE VALVES

PART 1-GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish, install and test air release valves of the size (s) and the type (s) and in the location (s) shown on the Drawings and specified herein.

B. Related Work Specified Elsewhere: "Valves and Specialties - General" is specified in this Division.

1.2 QUALITY ASSURANCE

A. All air release valves, for the same service, shall be manufactured by one manufacturer.

B. Acceptable Manufacturers:

1. Multiplex Manufacturing Co. (Crispin Valves)
2. Equal

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:

1. All valves shall be suitable for the intended services.
2. Valve sizing shall be as recommended by the manufacturer to suit the pressure and flow condition of each application.
3. The valve manufacturer shall furnish installation and maintenance manuals with each valve.

B. Sewage and Sludge Service:

1. Air Release Valves.

a. Shall be designed to operate (open) while pressurized, allowing entrained air to escape through the air release orifice. After entrained air escapes through the air release orifice, the valve orifice shall be closed by a needle mounted on float energized compound lever mechanism and prevent sewage media from escaping

b. Shall be specially adapted for use with sewage and sludge.

c. The venting orifice and mechanism and the valve body shall be capable of being back-flushed with water.

d. Cast iron body and covers, stainless steel float and lever pins, bronze seat with the mechanism cast bronze and Buna-N needle.

e. Furnished with 2-inch inlet shutoff valve, 1-inch blow off valve, 1/2-inch valve, quick disconnect coupling and 6 feet of hose to permit

back-flushing without dismantling valve.

f Valve shall be capable of with standing 300 psi line pressure.

g. Equal to Model US105 Crispin sewage air release valve.

2. Combination Air Valves:

a. Shall allow unrestricted venting or re-entry of air, through it, during filling or draining of the force main, to prevent water column separation or pipeline collapse due to vacuum.
b. Valve shall incorporate one upper and one lower stainless steel float, connected by a common stainless steel float guide, thereby maintaining an air gap between the bottom float and top shut-off float. The air gap shall retard waste solids from fouling or clogging the top shut-off float.
c. The internal baffle shall be fitted with a guide bushing and act to protect the shut-off float from direct air flow. The baffle shall retain the 45 Durometer Buna-N seat in place without distortion, for tight shut-off.
d. Cast iron body, cover and baffle; brass internal parts.
e. All internals shall be easily removed through the top covers without removing the main valve from the lines.
f. Both floats shall withstand 1,000 psi or more.
g. Valve shall be fitted with blow off valves, shutoff valves, quick disconnect couplings and minimum 6-feet of hose, to permit back-flushing after installation without dismantling valve.
h. The valve inlet shall have 2-inch N.P.T. and the outlet 1-inch N.P.T.
i. Equal to Model C10 Crispin Combination Air Valve.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install valves in accordance with manufacturer's instructions and recommendations and as shown on the Drawings.
B. Install all valves in the vertical position and allow sufficient clearance around valve for proper maintenance and removal.
C. Provide gate valve between air release valve and pipeline.
D. Inlet piping to the air valves shall be brass.
E. The exhaust lines from the air valves shall terminate in down turned position 18 inches above the floor.

END OF SECTION

SECTION 16010

ELECTRICAL - GENERAL

PART 1 – GENERAL

1.1 DESCRIPTION

A. Provide all labor, materials, equipment, operations, methods and procedures as indicated in the Contract Documents, together with all items necessary for or incidental to the completion of the work.

B. All systems or additions to existing systems indicated in the Contract Documents shall mean all necessary supervision, labor, equipment and materials required to provide complete, properly functioning systems.

C. All systems shall be adjusted, tested, inspected and turned over to the Owner in perfect working order.

D. The words "provide", "supply", "supply and install", "install", "furnish" or "furnish and install", as used in DIVISION 16 or as indicated on the Drawings related to DIVISION 16 shall mean a complete and properly functioning Electrical installation performed by the Contractor.

E. References:

1. Refer to Architectural, Structural, Heating and Ventilating, Plumbing, Process Piping and Instrumentation Drawings to coordinate material and equipment locations and electrical requirements.
2. Applicable portions of DIVISION 0 - BIDDING AND CONTRACT REQUIREMENTS together with DIVISION I - "GENERAL REQUIREMENTS", are part of DIVISION 16.
3. Refer to "SECTION 01630 - SUBSTITUTION AND PRODUCT OPTIONS", for work affecting DIVISION 16. Refer to SECTION 00100 INSTRUCTIONS TO BIDDERS; SECTION 00700 – GENERAL CONDITIONS: SECTION 00800 - SUPPLEMIENTARY CONDITIONS; and as specified herein regarding substitutions of materials and equipment.

F. Work Specified Herein:

1. Visit and examine the project site and become familiar with all existing conditions pertinent to the work to be performed thereon. No additional compensation will be allowed for failure to be so informed.
2. The following scope of work is a brief generalization of the type and extent of the work specified under DIVISION 16. Detailed requirements are indicated on the Drawings and in related sections of the Specifications. The work specified under DIVISION 16 includes, but is not necessarily limited to the following:
   a) Provide Electrical Service and Distribution System as indicated on the drawings and as specified herein.

b) Provide complete branch circuit wiring systems including all raceways, conductors, cables, outlet and junction boxes, wiring devices and device connections.

c) Provide all required 240 Volt, 208 Volt and 120 Volt "Power" wiring and connections and provide all required motor starters for equipment specified under DIVISIONS 11, 13, 14 and 15 except as indicated on the Drawings. Starter sizes, protective device sizes, wire and conduit sizes, holding coil voltages and control voltages shall match the requirements of equipment, systems and devices specified under DIVISIONS 11, 13, 14 and 15. No additional compensation will be allowed for modifications required due to equipment and device sizes, ratings, etc. which differ from those of specified equipment.

d) Provide all required interconnecting wiring for Instrumentation Systems and operations specified and shown on Drawings.

e) Coordinate the work of other trades which will affect the work under DIVISION 16 and direct such trades as required to accomplish all necessary cutting, patching, excavation, trenching, backfill, and concrete work necessary for the completion of the work under DIVISION 16.

f) Include in the Base Bid all Electric Utility Company charges for installation work in order to provide the required services for this project.

G. Work Specified Elsewhere:

1. The materials and methods used for all Electrical Work indicated in the Contract Documents shall meet the requirements specified in Division 16.
2. The following Electrical Work and Work relating to the Electrical Work will be performed under other Divisions of the Contract Documents:
   a) Substitutions, product options, cleaning up and project record documents are specified in DIVISION 1.
   b) Site work and excavation are specified in DIVISION 2.
   c) Concrete Work DIVISION 3.
   d) Metals are specified in DIVISION 5.
   e) Mechanical equipment is specified in DIVISION 11 and/or DIVISION 15.
   f) All interconnecting 24 volt control wiring required for the specified systems, equipment and operations indicated under DIVISION 15 will be provided under DIVISION 15, unless specifically indicated on the Drawings related to DIVISION 16. This shall include, but is not necessarily limited to, wiring for automatic temperature control and control wiring for plumbing systems.

H. Codes and Fees:

Comply with the following codes, standards, regulations and specifications:

a. National Electrical Code (N.F.P.A. No. 70-1993)
b. Life Safety Code (N.F.P.A. No. 101-1991)
c. Occupational Safety and Health Act (O.S.H.A.) - regarding construction practices.

d. Utility Company standards, specifications and requirements.
e. State and local building codes and fire codes for the locale where the work is to be performed.

2. Compliance with the above codes, standards, etc., does not relieve the Contractor from the requirements of the Contract Documents which may exceed these codes, standards, etc. but which are not contrary to them.
3. If it is observed that the Contract Documents are at variance with any of the above codes, standards, etc., promptly notify the Engineer in writing, and necessary changes shall be adjusted by appropriate modification. If any work is performed which is contrary to such codes, standards, etc., the Contractor shall assume full responsibility therefor and shall bear all costs in correcting such work in order to comply with such codes, standards, etc.
4. Secure and pay for all permits, fees and licenses necessary for the proper execution of the work under DIVISION 16.

I. Tests and Procedures Prior To Start-up:
1. All equipment shall be properly identified as indicated in this SECTION.
2. All equipment and materials shall be clean, dry and free of foreign materials. All screw and bolt connections shall be checked for tightness.
3 . Conductor connections and terminations, and all bus bar connections shall be checked for proper tightness and continuity.
4. Provide 2200 volt "Megger" insulation testing on all 600 volt feeder conductors and motor power conductors.
5. Test the grounding system to assure continuity and to assure that resistance to ground does not exceed specified limits.

J. Demonstration of Complete Electrical Systems
1. The Owner will assume no liability or responsibility for any portions of the installation under this Contract until they are demonstrated and accepted in writing. Final demonstrations shall be made only after the Engineer is satisfied that the work has been completed in accordance with the intent of the Contract Documents.
2. After the Electrical system is completed, and when directed by the Engineer, demonstrate the total system operation and make final adjustments to the system. If any system or piece of equipment within a system fails to function properly, rectify such defects or inadequacies and make a final demonstration as directed by the Engineer.
3. Provide the services of authorized manufacturers' representatives to instruct the Owner's representatives in the proper operation of each partial or complete system installed under this Contract.
4. Pay all charges or fees, including the cost of any special test equipment, factory engineers, etc. necessary for the proper performance of the specified tests, demonstrations and instructions.
5. All demonstrations and instructions referred to shall be scheduled at the convenience of the Engineer and the Owner and in no case shall be scheduled without at least seventy-two (72) hours written notice.

K. Identification:

1. All distribution equipment (substations, switchboards, motor control centers, distribution panelboards, transformers, transfer switches, disconnects, starters, etc.) shall have an engraved bakelite tag, mounted adjacent to the manufacturer's nameplate, indicating the equipment's designation and identification number per the Contract Documents.
2. All disconnect switches, control devices, etc., shall be provided with engraved bakelite tags indicating the equipment which they serve or control per the equipment designation and identification number indicated in the Contract Documents.
3. Power conductors shall be continuously polarized and color coded throughout using the following scheme:
   a. White - All neutral conductors, 240/120V systems
   b. Green - All ground conductors
   c. Phase Conductors -

      240/120V
      Systems

      Phase A - Black
      Phase B - Red
   d. For conductors No. 6 and smaller, color coding shall correspond to the color of the conductor insulation. For color coding of wire larger than No. 6, use self-adhesive, wrap-around type markers. These markers shall be used at all panelboards, junction boxes, disconnect switches, circuit breakers, etc.
4. Control conductors shall be identified using numerical tags corresponding to conductor designations indicated on approved shop drawings of schematic diagrams, and as required for clarification of system and equipment connections. Conductors shall be clearly identified at each terminal block, equipment connection and junction.
5. Bakelite tags shall be nominal 1"x 4" with 3/8" white lettering on black background.

1.2 QUALITY ASSURANCE

A. Supply all new materials, devices and equipment in conformance with:
   1. Underwriter's Laboratory, Inc.
   2. National Electrical Manufacturers Association.
   3. American National Standards Institute.
   4. National Electrical Code.
   5. Local power company.

B. All materials provided under this Contract shall be equal in quality, appearance and performance to that specified herein and shall be subject to the review of the Engineer. Verify the availability of all materials proposed to be used in the execution of the work prior to submitting same for the Engineer's review. The

discontinuance of production of any material or product after the Engineer's review has been made shall not relieve the Contractor from furnishing an alternate of equal quality and design without additional cost.

C. Materials and equipment furnished under this Contract shall be standard products of manufacturers regularly engaged in manufacture of such products and shall be manufacturer's latest standard design that complies with Specification requirements. Products shall essentially duplicate material and equipment that have been in satisfactory local use at least three years.

D. The Contractor shall have supplied comparable systems to those specified herein and shall maintain engineering and service departments capable of designing and maintaining these systems. For a period of twelve (12) months from the date of acceptance of the work, provide all necessary supervision, labor, materials, and equipment, in order to correct any defects in any system due to faulty materials, equipment, installation methods, or workmanship and consequent damage resulting from such defects. This work shall be scheduled during normal working hours and at the convenience of the Owner.

1.3 SUBMITALS

A. Substitutions

1. Where new equipment is specified to be provided as part of an extension to an existing system, the manufacturer of that equipment shall match that of the original. Substitutions will not be considered as equal unless specifically noted so.
2. Certain new equipment and systems have been specified with one or more make(s) followed by the phrase "or equal". In such cases, the Contractor may submit a proposed substitution for review by the Engineer. The decision of equality of a proposed substitution rests fully with the Engineer.
3. Certain new equipment and systems have been specified with one or more make(s) WITHOUT the phrase "or equal". In such cases, only one of the manufactured products listed will be allowed.
4. Where substitutions are allowed as "equal" it shall be the Contractor's responsibility to make any and all necessary modifications required to accommodate the installation of the substituted item(s).

B. Shop Drawings and Samples:

1. Submit Shop Drawings in accordance with General Conditions and as indicated herein.
2. Shop Drawings shall be submitted on all items of equipment and systems as indicated in related sections of DIVISION 16.
3. Shop Drawings shall be thoroughly checked by the Contractor for compliance with the Contract Documents. Verify that all equipment and materials proposed to be furnished will fit into available space and maintain specified clearances, and that all equipment is compatible with the general building

construction of the areas into which they are to be installed. The submittal of any Shop Drawing implies that the Contractor has reviewed this Shop Drawing and that the above requirements have been met.

4. Shop Drawings Shall Consist Of-
   a. Project name and location.
   b. Contractor's name.
   c. Index Sheet - Listing the equipment being submitted utilizing equipment designations, or symbols, indicated on the Contract Documents together with the proposed manufacturer, style/ type and catalog number.
   d. Manufacturer's scale or dimensioned drawings along with standard catalog "cut" sheets.
   e. Equipment ratings, service clearances and configuration.
   Listing of accessories to be furnished.
   g. Single-line and schematic diagrams where applicable.
   h. Refer to related sections of the specifications for special shop drawing requirements for individual equipment types.
5. Provide samples of such items as lighting fixtures and wiring devices upon request of the Engineer.

C. Provide all certificates of inspection and approval from all regulatory agencies having jurisdiction over the Work under Division 16.

D. Maintain properly documented and witnessed test and checkout reports and submit these to the Engineer prior to energizing the Electrical system.

E. Upon completion of the Work and before request for final payment, deliver to the Engineer three (3) bound sets of full and complete directions pertaining to the operation and maintenance of all equipment and systems installed under this Contract. These directions shall be neatly bound, consist of typewritten on 8-1/2" x 11" sheets with index tabs, and shall be accompanied by plans, diagrams, etc. of the work installed, parts lists, etc. necessary for the guidance of the Owner in operating, altering or repairing the installation. In addition to the foregoing, furnish the Engineer a written statement from the Owner indicating that he is satisfied with the operating instructions given.

F. Provide the Owner with a list of local service departments of duly authorized distributors of materials and equipment of the type installed, which will stock the manufacturer's standard parts, etc.

G. At the completion of the installation, provide reproducible Record Drawings indicating the final configuration of all Electrical Systems as they were installed. Symbols, equipment designations, etc. shall be consistent with the Contract Documents. Provide exact locations of all work which has been concealed in concrete, masonry or underground.

1.4 DELIVERY, STORAGE AND HANDLING

A. Coordinate material and equipment delivery with the project schedule. Notify the Engineer immediately, in writing, if material or equipment delivery will adversely affect the project schedule, include documentation from equipment suppliers indicating the revised delivery dates and the reason for the delay.
B. Exercise care during loading, transporting, unloading and handling of materials to prevent damage.
C. Check for defective or damaged materials, and for incomplete equipment shipments within seven (7) days after equipment delivery to the project site.
D. Store materials and equipment on the construction site in enclosures or under protective covering in order to assure that materials and equipment are kept undamaged, clean and dry.
E. Replace or repair, to the satisfaction of the Engineer, all materials and equipment that are defective or that have been damaged during installation, at no additional cost to the Owner.

1.5 JOB CONDITIONS

A. Temporary light & power.
   1. Coordinate temporary power usage with all other trades.
   2. Pay for purchased power at no additional cost to the Owner.
   3. Limit temporary service to 100 amperes, 120/240 volt, 1 phase, 3 wire.
   4. Limit power and hand tool usage to motors not exceeding 1/2 HP.
   5. Temporary power shall be separate from process power.
B. Schedules:
   1. Cutting and Patching: Perform all cutting, patching, trenching, trench covers, plastering, chases, slots, furring, grounds, masonry foundations, piers, excavating, pole bases, backfilling, pads, and other work incidental to installation of apparatus as required for electrical work.

1.6 GUARANTEE

A. Guarantee all equipment, materials and workmanship in accordance with the General Conditions of the Construction Contract and Section 11000.
B. Warrant all material furnished and work executed is in accordance with all applicable laws and regulations.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials shall be as specified in the appropriate Sections of DIVISION 16.
B. Approval of materials shall be as indicated in this Section.

PART 3 - INSTALLATION

3.1 INSTALLATION

A. Installation shall be as specified in the appropriate Sections of DIVISION 16.

3.2 TESTS

A. Refer to paragraphs 1.1,I and 1.1,J of this SECTION.

B. Provide additional testing as indicated in the appropriate Sections of DIVISION 16.

3.3 CLEANING

A. Do not allow refuse and surplus materials to accumulate on the project site during the course of the work.

B. Upon completion of the work, remove all refuse and surplus materials and leave the premises neat and clean.

C. Clean all equipment surfaces and touch up all damaged surfaces to the satisfaction of the Engineer.

PART 4 - ABBREVIATION AND SYMBOL SCHEDULE

4.1 GENERAI,

A. The Abbreviations and Symbol Schedule indicated apply to the Drawings and Specifications related to Division 16.

4.2 ABBREVIATIONS

A - AMPERE
AC - ALTERNATING CURRENT
AFF - ABOVE FINISHED FLOOR
AFG - ABOVE FINISHED GRADE
AIC - AMPERES INTERRUPTING CAPACITY
AL - ALUMINUM
ASYM - ASYMMETRICAL
ATS - AUTOMATIC TRANSFER SWITCH
ALJX - AUXILIARY
AWG - AMERICAN WIRE GAUGE
BKR -BREAKER
C - CONDUIT
CAB - CABINET
CB - CIRCUIT BREAKER
CKT - CIRCUIT
CT - CURRENT TRANSFORMER
CU - COPPER
MVA - MEGAVOLT-AMPERE
DISC - DISCONNECT

JB - JUNCTION BOX
KCMIL - THOUSAND CIRCULAR MILS
kV - KILOVOLT
kV - KILOVOLT-AMPERE
kW - KILOWATT
kWh - KILOWATT HOUR
LPS - LOW PRESSURE SODIUM
LTG - LIGHTING
LV - LOW VOLTAGE
MCB - MAIN CIRCUIT BREAKER
MCC - MOTOR CONTROL CENTER
M..H - METAL HALIDE
MLO - MAIN LUGS ONLY
MO - MECHANICALLY OPERATED
MOD - MOTOR OPERATED DAMPER
MTS - MANUAL TRANSFER SWITCH
M.V. - MERCURY VAPOR
DC - DIRECT CURRENT
NC - NORMALLY CLOSED

NO - NORMALLY OPEN
EH - ELECTRICALLY HELD
EM - EMERGENCY
EO - ELECTRICALLY OPERATED
EPR - ETHYLENE PROPYLENE RUBBER
EQUIP - EQUIPMENT
F/A - FIRE ALARM
FC -FOOTCANDLE
FS - FLOW SWITCH (F/A SYSTEM)
FVNR - FULL VOLTAGE NON REVERSING
FLUOR - FLUORESCENT
GEN - GENERATOR
GF - GROUND FAULT
GFI - GROUND FAULT CIRCUIT INTERRUPTER
GND -GROUND
HOA - HAND-OFF-AUTOMATIC
HP - HORSEPOWER
H.P.S. - HIGH PRESSURE SODIUM
HV - HIGH VOLTAGE
HZ - HERTZ
INCAND - INCANDESCENT
IG - ISOLATED GROUND
WP - WEATHERPROOF
XLP - CROSS LINKED POLYETHYLENE
EG - EQUIPMENT GROUND
O/H - OVERHEAD
OL - OVERLOAD
OOA - ON-OFF AUTOMATIC
OSY - OUTSIDE STEM AND YOKE VALVE (F/A SYSTEM)
P - POLE
PB - PUSH BUTTON
PF - POWER FACTOR
PNL - PANEL
PRI - PRIMARY
PT - POTENTIAL TRANSFORMER
PVC - POLYVINYL CHLORIDE
PH - PHASE
S -SURFACE
SEC -SECONDARY
SW - SWITCH
SWBD - SWITCHBOARD
SYM - SYMMETRICAL
TDR - TIME DELAY RELAY
TEL - TELEPHONE
U/G - UNDERGROUND
V - VOLT
VA - VOLT-AMPERE
W - WATT
WH - WATT HOUR
XFMR - TRANSFORMER
XP - EXPLOSION PROOF

END OF SECTION

SECTION 16050

BASIC MATERIALS AND METHODS

PART I - GENERAL

1.1 DESCRIPTION

A. The Drawings are basically diagrammatic, unless detailed dimensioned Drawings are included, and show only approximate locations of equipment, fixtures, panelboards, wiring devices, etc. Exact locations shall be subject to the approval of the Engineer.

B. While the general run of electrical feeders, branch circuits, conduits, etc. is indicated on the Drawings, it is not intended that exact routing be determined therefrom. Circuit designations in the form of "Home Runs" on branches indicate the designation of the branch circuit, the size and quantity of branch circuit conductors, the branch circuit overcurrent device rating and the panelboard or interconnection box from which the branch circuit is served, these designations may be modified subject to field conditions and review of the Engineer.

C. Where the type, size, rating or mounting of equipment, raceways, conductors, wiring devices, etc. indicated in the Contract Documents is not clearly defined, request clarification, in writing, no less than ten (10) days prior to the Bid date. If clarification is not requested within this time frame, provide Electrical work as directed by the Engineer.

D. Measurements shall be made at the site and in the building during construction and all systems installed as the work progresses in such a manner that the equipment, piping, vents, ducts, conduit, etc., will fit in the space provided, maintain head room and if in unfinished areas, be as neatly installed, as obscure and "out-of-the way" as physically possible.

E. Prior to submission for review any item of equipment, determine whether or not it will fit in the space provided. Any changes in the size or location of the material or equipment supplied, which may be necessary in order to meet field conditions or in order to avoid conflicts between trades, shall be brought to the immediate attention of the Engineer and approval received before such alterations are made.

F. All equipment and accessories and its interconnecting piping, ductwork, conduit, etc., shall be installed in such a manner that ample maintenance and passage space will be provided.

G. Where more than one trade is involved in an area, space or chase, all shall cooperate and install their own work to utilize the space equally between them in proportion to their individual requirements. In general ductwork shall be given preference (except where grading of piping becomes a problem) followed by piping then electrical wiring. If, after installation of any equipment, piping, ducts, conduit, etc., it is

determined that ample maintenance and passage space has not been provided, rearrange work and/or furnish other equipment as required to provide this space.

1.2 QUALITY ASSURANCE

A. In General, the workmanship of the electrical installation shall be as described in the N.E.C.A. Electrical Design Guidelines. All methods of construction, details of workmanship, etc. that are not specifically described therein or indicated in the Contract Documents, shall be subject to the control and approval of the Engineer.

B. Equipment and materials shall be of the quality and manufacture indicated in their respective sections of the Specifications.

1.3 SUBMITTALS TO THE ENGINEER

A. Submit shop drawings for the following equipment, materials, products, etc.:
   1. Conduit, Raceway and Tubing.
   2. Conductors and Cable
   3. Wiring Devices
   4. Control Devices and Equipment
   5. Motor Starters
   6. Fuses
   7. Ground Rods
   8. Metal Framing Channel
   9. Relays
   10. Phase Failure Relays
   11. Time Delay Relays

B. Submit Shop Drawings per SECTION 16010.

C. Submit test results on all feeder conductors.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Conduit, Raceway and Tubing
   1. Rigid Heavy Wall Steel Conduit shall be constructed of hot dipped galvanized or electro-galvanized steel. Acceptable Manufacturers: Republic, Triangle PWC, Allied, Wheatland.
   2. Intermediate Metal Conduit shall be hot-dipped galvanized or electrogalvanized steel. Acceptable Manufacturers: Triangle PWC, Republic, Allied, Wheatland.
   3. Flexible Metal Conduit shall be constructed of one continuous length of U. L. Approved electro-galvanized, spirally wound steel strip with interlocking convolutions and interior surfaces free from burrs and sharp edges. Flexible metal conduit installed in damp and wet locations shall be

"liquid-tight" with PVC jacket. Acceptable Manufacturers: Alflex, ElectroFlex.

4. Non-Metallic (P.V.C.) Conduit shall be Schedule 40, heavy wall and U.L. listed for use above ground and direct burial underground. PVC conduit to be direct buried (not encased in concrete) shall be Schedule 80, extra heavy wall and UL Listed for the use intended. Acceptable Manufacturers: Carlton, Rob-Roy, Certainteed.
5. All fittings shall be of the same material as the respective raceway system.
6. Expansion fittings shall be watertight combination expansion and deflection type designed to compensate for movement in any direction. Fittings shall have flexible copper braid bonding jumpers, neoprene sleeve and stainless steel bands. Acceptable Manufacturer: O.Z./Gedney Type DX or approved equivalent,
7. Conduit wall and floor seals for cored holes and sleeved openings shall be Type CSM series as manufactured by O.Z./Gedney Co., or equivalent.
8. Conduit sealing bushings to seal the ends of conduits entering enclosures from below grade shall be O.Z./Gedney Co. Type CSB series, or equivalent.

B. Conductors and Cable

1. All power wiring conductors shall be insulated for 600 volts, unless otherwise noted, and shall be standard AWG and MCM sizes. Conductors shall be 98 percent copper, stranded, heat and moisture resistant and thermal plastic insulated for all sizes No. 12 AWG and larger. Smaller sizes shall not be used except for communications and special systems. For lighting and receptacle circuits, solid wire may be used in lieu of stranded wire, for No. 12 and No. IO AWG only. Conductors shall be labeled with U.L. approval and be marked with the manufacturer's name, wire size and insulation type. Insulation for all 600 volt conductors shall be Type THWN/THHN or Type XHHW. Acceptable Manufacturers: Okonite, Southwire, Pirelli, Cablec, BIW.
2. All control wiring (120 or 24 volt, AC or DC) conductors shall be insulated for 600 volts, unless otherwise noted, and shall be No. 14 AWG minimum size, or larger if so indicated on the Drawings. Conductors shall be 98 percent copper, stranded, heat and moisture resistant, and thermal plastic insulated. Acceptable Manufacturers: Okonite, Southwire, Pirelli.
3. All instrumentation control cables (4-20 mA signal) referred to on the Drawings as "twisted shielded pairs", shall be individually shielded twisted pairs, No. 16 AWG, stranded conductors of tinned copper with polyethylene insulation and aluminum - polyester shielding. Control cable shall be rated 600 volt and shall be UL listed with 100% shield coverage. Belden or equal.

C. Wiring Devices

1. Wiring devices shall be specification grade as described herein. Switch handles, receptacles, etc. shall have a brown finish. Provide device cover plates of satin finish stainless steel in finished areas and cadmium finished sheet steel in

unfinished areas. Although only one manufacturer has been noted, acceptable manufacturers are: Hubbell, General Electric, Arrow-Hart, Pass and Seymor, Bryant, or as noted.

2. Toggle Switches
   a. 20 Ampere, 1 -pole, 277 Volt: Hubbell 1221
3. Fractional Horsepower Manual Motor Starter with Thermal Overload(s):
   a. 120 Volt Single-Pole, Surface Mounted: Square-D FG-IP
   b. 120 Volt Single-Pole, Flush Mounted: Square-D FS-IP
4. Receptacles
   a. 20 Ampere, 125 Volt, Duplex G.F.I. Receptacle: Hubbell GF-5362

D. Control Devices and Equipment:

Control Stations:

a. Control stations shall be heavy duty oil-tight/watertight type unless noted otherwise on the Drawings and shall consist of operators with contact blocks and indicator lights, when indicated, mounted in either a cast or sheet steel enclosure, as specified. Although only one manufacturer has been noted, acceptable manufacturers are Allen Bradley, General Electric and Westinghouse.
b. All operators used in heavy duty oil-tight/watertight control stations shall be Square D type K and shall be suitable for cover mounting in a 1-7/32 inch diameter notch type cover hole and shall be held in place by the locking thrust washer. Push buttons and selector-push buttons shall have removable inserts in eight different colors for function color coding. Push button inserts and selector switch knobs shall be removable from the front of the control station without disturbing the wiring or mounting of the control units. Selector switches shall have removable knobs in eight different colors for function color coding. Operators for selector switches shall be bat wing type.
c. Contract blocks used in heavy duty oil-tight control stations shall be Square D Type K single-pole, single-throw (SPST) or single-pole, double-throw (SPDT) and shall be suitable for mounting side by side and/or in tandem to the base of the operator. Contact block mounting screws shall be captive with a drilled and tapped head to permit easy tandem mounting of contact blocks. Terminals shall be pressure wire type with a self-lifting pressure clamp that will compensate for wire of different size ranging from #12-#18 solid or stranded. Contacts shall be double break. Contact tips shall be silver.
d. Enclosures used in heavy duty oil-tight control stations shall be sheet steel NEMA 13 construction unless noted otherwise on the Drawings. When the Drawings indicate a NEMA 4 enclosure use cast aluminum type. Six unit and larger enclosures shall have hinged covers. All enclosures shall have sufficient depth to accommodate mounting four Class 9001 KA-1 contact blocks side-by-side and in tandem behind a single operator for a maximum of eight circuits, four normally open and four normally closed.

E. Motor Starters

1. For Single Phase Motors (Manual): Shall be fractional horsepower, manual type as indicated in paragraph 2.1, C.3 of this Section.
2. For Single and Three Phase Motors (Magnetic): Shall be combination starter/disconnect type, employing magnetic starter, rated to match the equipment served, with thermal overload protection for each phase and with an M.C.P. type circuit breaker/disconnect sized per the circuit breaker manufacturer's recommendations for coordination with the thermal overload protection. Provide 2 N.O. and 2 N.C. auxiliary contacts.
3. Acceptable Manufacturers:
   Square-D, Westinghouse, General Electric, Fumas, Allen-Bradley, Siemens.

F. Power Distribution Fuses

1 . All fuses rated 600 volts and below shall be rejection type dual-element, time delay type. Acceptable Manufacturers are Bussman, Littlefuse and Shawmut.
2. Fuses shall be U.L. Class and rating as shown on the drawings or as required by the manufacturer of the equipment they are protecting. In general, shall be:
   a. U.L. Class RKI for service entrances and feeders supplying combination motor loads.
   b. U.L. Class RK5 for motor branch circuits.
3. Provide two (2) complete sets of fuses for all fusible disconnect switches.

G. Ground Rods

1. Ground Rods shall be copper-clad steel at least 5/8-inch in diameter and 10 feet long. Die-stamp each near the top with the name or trademark of the manufacturer and the length of the rod in feet. The rods shall have a hard, clean, smooth, continuous, surface throughout the length of the rod.

H. Metal Framing Channel

1. Channel for wet or exterior locations shall be roll formed from 12 gauge steel and shall be hot-dip galvanized after fabrication, material standard A570, Grade 33 and finish standards A153 and A386.
2 . Channel for corrosive locations shall be roll formed from stainless steel AISI Type 304 or FRP.
3. Use fittings of same material as channel. Fittings shall be by same manufacturer.
4. Metal framing shall be B-Line Systems, Inc. of Highland, Illinois or equal.

I. Relays shall be electrically held, electrically operated with 120 volt coils except as noted otherwise on the Drawings. Contacts shall be rated 600 volt, 10 ampere and shall be convertible from Normally Open to Normally Closed. Where relays are used to control single-phase, fractional horsepower motors, contacts shall be rated in accordance with the N.E.C. for the motor to be controlled. Where relays are not installed within system control panels, provide a suitable enclosure as specified in Section 16160, with NEMA ratings as indicated on the Drawings. Relays shall be Square D, Class 8501 Type X or equal.

J. Phase failure relays shall be three phase, three wire rated for use at the voltage indicated on the Drawings. When the relay is in an energized condition, a loss of power or a phase unbalance of more than 10% and/or phase reversal shall cause the output relay to de-energize, returning N.O. contacts to their passive state. The relay shall automatically reset when the correct conditions are re-established. Phase failure relays shall be equipped with a built-in 0.2 second time delay to be mounted within motor starter compartments. Relays shall be Cutler-Hammer Type P or equal.

K. On-Delay Timing Relays shall be solid state type rated for use at 120 volts. Contacts shall be N.O. and/or N.C. as detailed on the Contract Drawings, shall be rated 5 amperes (minimum). On-delay timing shall be as indicated on the Drawings. Where mounted external to control panels, on-delay relays shall be provided with enclosures as specified in Section 16160, with NEMA ratings as indicated on the Drawings. On-delay relays shall be ALLEN BRADLEY 700 series, or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Unless otherwise noted, wiring for all systems indicated in the Contract Documents shall consist of insulated conductors installed in raceways. Raceways shall be continuous from outlet box to outlet box and from outlet box to cabinet, junction or pull box. Secure and bond raceways to all boxes and cabinets such that each system of raceways will be electrically continuous throughout.

B. Unless otherwise indicated on the Drawings, install all wiring in the following applicable raceway system:

1. Wiring 600 volts or less in outdoor, above grade locations: Galvanized rigid heavy wall steel conduit, rigid heavy wall aluminum conduit, or intermediate metal conduit.
2. Underground Raceways:
   a. Underground raceways shall be galvanized rigid heavy wall steel conduit or Schedule 80 extra heavy wall PVC conduit installed as directed below.
   b. All other underground raceways shall be bedded in compacted sand except. Sand shall be 6-inch minimum thickness at top, bottom and sides of raceways, 71/2 inch minimum center-to-center spacing between raceways. Top raceway shall be not less than 30 inches below finished grade.
   c. For all underground raceways, bottom of trench shall be solid undisturbed earth. Earth showing extensive signs of peat, cinders, rubble or any conditions not suitable for a stable foundation should be reported to the Engineer for recommendation. Small packets (up to 1 cu. yd.) of unsuitable soil shall be excavated and replaced with compacted gravel borrow maximum rock size 2 inches. In areas which have had fill work completed during the progress of work under this contract, verify that the bottom of

trench is 95 percent compaction minimum. If compaction is less than 95 percent provide additional compaction in bottom of trench.

d. Provide underground electrical marking tape for the full length of all trenches for underground raceways. Marking tape shall be SETON #210 Electrical or equal.

3. All wiring installed in hazardous locations: Galvanized rigid heavy wall steel conduit.
4. Flexible metal conduit shall be used for final connection to all motors, final connection to rotating or vibrating equipment, final connections to dry type transformers and final connections to recessed lighting fixtures. Liquid-tight flexible conduit shall be used in all wet or damp locations. Maximum length of flexible conduit shall be 36 inches, except that from outlet boxes to lighting fixture maximum length shall be 6 feet.

C. Raceways Shall Be:

1. Sized as indicated on the Drawings. Where sizes are not indicated, raceways shall be sized per the National Electrical Code in accordance with the quantity, size, type and insulation of conductors to be installed; however, raceways shall be minimum one-half inch (1/2") trade size for branch circuit wiring and minimum three-quarter (3/4") trade size for all instrumentation and for all branch circuit "Home Runs".
2. Installed to provide adequate grounding between all outlets and the established electrical system ground.
3. Cut square, free of burrs due to field cutting or manufacture, and bushed where necessary.
4. Installed with exterior surfaces not less than six inches (6") from any surface with a temperature of 200 degrees F or higher.
5. Plugged at the ends of each roughed-in raceway with an approved cap or disc to prevent the entrance of foreign materials during construction.
6. Installed with a minimum of bends and offsets. All bends shall be made without kinking or destroying the cross section contour of the raceway. Factory made bends shall be used for raceways one-inch (1") trade size and larger.
7. Installed with U. L. approved raintight and concrete-tight couplings and connectors.
8. Firmly fastened within three feet of each outlet box, junction box, cabinet or fitting. Raceways shall not be attached to or supported by wooden plug anchors or supported from Mechanical Work such as ductwork, piping, etc.
9. Installed with a #14 AWG fish wire in all "Spare" or "Empty" conduit runs to facilitate future installation of conductors.
10. Arranged in a neat manner for access and allow for access to work installed by other trades.
11. Support adequately by malleable iron pipe clamps or other approved methods. In exterior or wet locations supports shall allow not less than 1/4 inch air space between raceway and wall. Firmly fasten raceway within 3 feet of each outlet box, junction box, cabinet or fitting. The following table lists maximum spacing between supports.

Additional supports may be required due to field conditions, strength of supporting members, etc. Furnish and install such supports at no additional cost to Owner.

Conduit Trade Size	Type of Run	Horizontal Spacing in Feet	Vertical Spacing in Feet
1/2", 3/4"	Exposed	5	7
1", 1-1/4"	Exposed	7	8
1-1/2" & lgr.	Exposed	10	10

12. Provide a bushing at each conduit termination unless fitting at box where conduit terminates has hubs designed in such a manner to afford equivalent protection to conductors. Provide grounding type insulated bushings on all conduit sizes one and one-quarter inch (1-1/4") trade size and larger, and on all feeder raceways regardless of size. Provide standard bushings for conduits one inch (1") and smaller unless otherwise stated. Provide sealing bushings for all conduits entering from below grade.

D. Become familiar with the general construction of the building and place sleeves, inserts, etc., as required. In areas where dampness or gases are present, seal around conduits using fittings as specified in Paragraph 2.1,A,7.

E. Wiring Methods

1. Do not pull conductors into raceways until raceway system, including all outlets, cabinets, bushings and fittings, is completed. Verify that all work of other trades which may cause conductor damage is completed. Use only U.L. approved cable lubricants when necessary. Do not use mechanical means to pull conductors No. 8 or smaller.
2. In general, conductors shall be the same size from the last protective device to the load.
3. All wiring systems shall be properly grounded and continuously polarized throughout, following the color coding specified. Connect branch circuit wiring at panelboards, as required, in order to provide a "balanced" three phase load on feeders.
4. All feeder connections shall be made to bus and other equipment using solderless, pressure type terminal lugs, as manufactured by Bumdy, National, O.Z., T. & B., or equal.
5. For splices and taps, No. 10 AWG and smaller, use solderless "Thread-On" connectors having spiral steel spring and insulated with a vinyl cap and skirt, as manufactured by 3M Co. (pre- insulated "Scotch-Lock") or Ideal ("Wing Nuts").
6. For splices and taps, No. 8 and larger, use solderless "Split Bolt" type connector as manufactured by Anderson, Bumdy, Kearney, Thomas & Betts, or approved equal.
7. Use cast connections, Candlewood or Then-noweld, for ground conductors.

8. Make all splices and connections in accessible boxes and cabinets only.
9. Cover uninsulated splices, joints and free ends of conductor with rubber and friction tape or PVC electrical tape. Plastic insulating caps may serve as insulation.
10. On termination at branch circuit outlets, leave a minimum of eight inches (8") free conductor for installation of devices and fixtures.
11. Feeder conductors shall be continuous from point of origin to load termination without splice. If this is not practical, contact the Engineer and receive written approval for splicing prior to installation of feeder(s). Where feeder conductors pass through junction and pull boxes, bind and lace conductors of each feeder together. For parallel sets of conductors, match lengths of conductors as near equal as possible.
12. Branch circuit conductors installed in panelboards, and control conductors installed in control cabinets and panels shall be neatly bound together using "Ty-Raps" or equivalent.
13. Provide conduit seals and explosion proof devices as indicated on the plans and as dictated by the National Electrical Code for all Hazardous Locations indicated on the Drawings.

F. Junction and Pull Boxes

1. Install junction and pull boxes in readily accessible locations. Access to boxes shall not be blocked by equipment, piping, ducts and the like. Provide all necessary junction or pull boxes required due to field conditions and as required by the National Electrical Code.

G. Hangers and Supports

1. Provide steel angles, channels and other materials necessary for the proper support of electrical equipment. Electrical enclosures shall be secured to equipment backboard and not supported from conduits.

3.2 TESTS

A. Branch circuits shall be tested during installation for continuity and identification and shall pass operational tests to determine that all circuits perform the function for which they are designed.

B. For all feeder wiring rated 600 volts or less, provide 2,200 volt "Megger" insulation test prior to energizing feeders. Use a motor driven megger for all tests. Test voltage shall be applied until readings reach a constant value, and until three (3) equal readings, each one (1) minute apart, are obtained. Minimum megger reading shall be 45 megohms for feeder conductors. Document test results and submit for approval prior to energizing conductors.

END OF SECTION

SECTION 16160

CABINETS AND ENCLOSURES

PART I - GENERAL

1.1 DESCRIPTION

A. The purpose of this Specification is to provide details of cabinets and enclosures for non-hazardous indoor and outdoor locations, which will protect internal equipment from environmental conditions existing in the areas in which the enclosures are to be installed. Also, it is the intent of this Specification to provide consistency between enclosures supplied under different sections of this Contract.

1.2 QUALITY ASSURANCE

A. Supply cabinets and enclosures in accordance with the following:
   1. Underwriter's Laboratory, Inc. listed.
   2. National Electrical Manufacturers Association Standard 250-1991.
   3. American National Standards Institute.
   4. National Electrical Code.

B. Cabinets and enclosures supplied under this Section shall conform to the requirements of Specification Section 16010 Paragraph 1.2, "Quality Assurance".

C. Stock cabinets and enclosures shall be manufactured by Hoffman Engineering Company or equivalent. Custom fabricated enclosures shall be equal in quality, appearance and performance to stock enclosures. All enclosures shall be subject to the review of the Engineer.

1.3 REFERENCES

A. ASTM C1777 - Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.

B. ASTM D149 - Test Methods for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.

C. ASTM D256 - Test Methods for Impact Resistance of Plastics and Electrical Insulating Materials.

D. ASTM A495 - Test Method for High-Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation.

E. ASTM D570 - Test Method for Water Absorption of Plastics.

F. ASTM D638 - Test Method for Tensile Properties of Plastic.

G. ASTM D648 - Test Method for Deflection Temperature of Plastics Under Flexural Load.

H. ASTM D790 - Test Method of Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

I. ASTM D792 - Test Method for Specific Gravity (Relative Density) and Density of Plastic Placement by Displacement.

J. UL94 - Flammability Rating.

1.4 SUBMITTALS TO THE ENGINEER

A. Submit shop drawings in accordance with General Conditions and as indicated herein. Shop drawings shall be submitted for all cabinets and enclosures to be provided under various sections of the Contract.

B. Shop drawings shall be checked by the Contractor for compliance with the Contract Documents. Verify that all enclosures to be furnished will **fit** into available space, will maintain specified clearances, and conform to the NEC ratings of the areas in which they are to be installed.

C. Shop drawings shall consist of the following:

1. Project name and location.
2. Contractor's name.
3. List of equipment being submitted together with proposed manufacturers, types and catalog numbers.
4. Scale or dimensioned enclosure drawings and standard catalog cut sheets where applicable.
5. Enclosure NEMA ratings, required clearances, etc.
6. Provide a specific statement noting that the enclosure/panel furnished will fit in the space provided.
7. Listing of all accessories to be furnished.
8. Wiring diagrams for such items as panel lights, duplex receptacles, panel heaters, cooling fans, etc. where applicable.
9. Submit all control panel faceplate arrangements for review and acceptance.

1.5 DELIVERY, STORAGE AND HANDLING

A. Coordinate delivery of control cabinets and enclosures with the project schedule.

B. Exercise care during loading, transporting, unloading, and handling of cabinets and enclosures to prevent damage. Check for defects or damage to enclosures upon arrival at construction site.

C. Store cabinets and enclosures on the construction site in areas which will afford protection from the weather, as well as excessive condensation and construction dust and debris.

D. Replace or repair, to the satisfaction of the Engineer, any cabinets and enclosures which are defective or have been damaged during installation, at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:

1. NEMA Type 3R Enclosures:

a. Type 3R enclosures shall not be used to house controls or electronics that require heating. See the specific "Special Requirements" for outdoor panels below.

b. Enclosures shall be steel, 16 gauge for box widths up to and including 12", 14 gauge for box widths between 15" and 24", and 12 gauge for box widths of 30" and greater. Free-standing enclosures shall be 12 gauge minimum. Enclosures shall have drip shield top; seam free sides, front, and back; and furnished with knockouts in bottom only. Provide door and body stiffeners where necessary. Large enclosures shall be provided with lifting eyes and, where floor-mounted, with 12-inch floor stands. No floor stands are to be provided for free-standing models.

c. The doors shall have galvanized steel piano-type hinges with stainless steel pins. Latches shall be T-handle or quick-release type only. Latches which require use of tools for access, utilize wing-nuts, etc. will not be acceptable.

d. Panels/enclosures shall be factory coated inside and out with prime and finish coats. Finish coat color to be ANSI 61 gray. Two prime coats shall be applied. Prime coat shall be rust inhibitive primer equal to Koppers Inertol Rustinhibitive Primer 621. Finish coat shall be compatible with prime coat and shall be an alkyd applied in two coats with a minimum dry film thickness of 1.5 mils per coat. Alkyd coating shall be equal to Koppers Glamortex 501 Enamel. Surface preparations shall be in accordance with manufacturer's requirements. Where required, enclosures shall be provided with interior panels painted white, for mounting of components.

e. Panels/enclosures shall be equipped with map pockets, and provisions for locking access doors.

f. Panels/enclosures shall be essentially of the dimensions shown on the Drawings, or as required to contain the necessary apparatus. Final panel/enclosure dimensions shall provide for easy access to all internal components with ease of maintenance considered. Conflicts with panel sizing and available spacing shall immediately be brought to the attention of the Engineer prior to proceeding.

2. NEMA Type 4X Enclosures:

Enclosures are intended for use indoors or outdoors where a degree of protection is needed against corrosion, windblown dust and rain, and splashing and/or hose directed water.

a. Type 4X enclosures shall be fiberglass-reinforced polyester (FRP), Aluminum, or stainless steel. No other metals or plastics will be allowed.

1. Fiberglass enclosures shall have the following properties:

a) Thermal Conductivity 2.0 BTU in/hr - ft2/Degree F (ASTM C 1 77)

b) Dielectric Strength (ASTM 375 VPM D149)
c) Notched IZOD Impact 12 Ft. lb/in. (ASTM D256)
d) Arc Resistance (ASTM 180 Seconds D495)
e) Water Absorption (ASTM 0.30 Percent D570)
f) Tensile Strength (ASTM 8,000 PSI D638)
g) Heat Deflection (ASTM 395 Degree F - 264 PSI D648)
h) Flexural Strength (ASTM 18,000 PSI D790)
i) Service Temperature Range -31 Degrees F to 266 Degrees F

2. Stainless steel enclosures shall be Type 304 and 16 gauge for box sizes up to and including 24" X 24", 14 gauge for box sizes larger than 24" X 24" up 36" width, and 12 gauge for box widths greater than 36 inches.
3. Aluminum enclosures shall be type 5052 H – 32 aluminum, 0.080 inches thick.

b. Finish for fiberglass cabinets and enclosures shall be light gray inside and outside, metal cabinets shall be unpainted with a smooth brushed finish.
c. Enclosures shall be supplied with no holes or knockouts; shall have door and body stiffeners where necessary; rolled lip around door and enclosure opening.
d. Enclosures to be installed outdoors shall be provided with drip shields. Large enclosures shall be provided with lifting eyes and, where floor mounted, with 12-inch floor stands. No floor stands are to be provided for free-standing models.
e. The doors shall have piano-type hinges with stainless steel pins. Provide oil-resistant door gaskets. All enclosure hinges, clamps, etc. shall be stainless steel or fiberglass as appropriate. Latches shall be T-handle or quick-release type only. Latches which require use of tools for access, utilize wing-nuts, etc. will not be acceptable.
f. Enclosures/panels shall be provided unpainted where required, enclosures shall be provided with interior panels painted white, for mounting of components. Panels/enclosures shall be equipped with map pockets, and provisions for locking access doors.
h. Panels/enclosures shall be essentially of the dimensions shown on the Drawings, or as required to contain the necessary apparatus. Final panel/enclosure dimensions shall provide for easy access to all internal components with ease of maintenance considered. Conflicts with panel sizing and available spacing shall immediately be brought to the attention of the Engineer prior to proceeding.

B. Nameplate/Identification:

1. All panels/enclosures, and all contained equipment/instrumentation shall be provided with a nameplate providing identification of the unit. Identification wording shall be as noted on the drawings. In the absence of specific identification of name tag wording, provide general descriptive information of unit function.
2. Enclosure/panel exterior name tags shall be of rigid laminated plastic. Lettering shall be 5/16 inch high, white letters on a black background. Interior name tags can be identical to exterior name tags in quality, or can be stamped stainless steel tags.

3. Name tags shall be mounted below panel mounted items (interior and exterior as appropriate).

C. Control Panel Wiring:

1. All wiring shall conform to the latest requirements of NEC and all local requirements.
2. All control wires internal to panels shall be minimum No. 14 AWG. Wires carrying line voltage shall be minimum No. 12 AWG. All conductors shall be copper. Wire in close proximity to heating devices shall be Type AVA UL approved. All wiring shall be run in PVC wiring channels and bundled with nylon cable ties.
3. Bundles of wires must be secured to the panel structure every 8 inches minimum. All interior wiring will be point to point with no splices. All wiring from and to panels shall be through terminals located in the panel.
4. Shielded wire shall be separated from other wires and equipment with suitable barriers and with terminal blocks for continuous shield grounding to the connecting cables.
5. Intrinsically safe wiring shall be separated by barriers from all other wiring.
6. Wires to the front of panel devices shall be looped, extra flexible and bundled.
7. All wires shall be marked at both ends with numbers by self-sticking wire markers or with slip-on style plastic markers. Color coding shall include the following:

   Red wires - Interior control circuits
   Orange wires - Interlocks powered from external sources
   Blue wires - DC voltages
   See Section 16010 for additional color coding.

8. Terminals shall be arranged in alphabetic and numeric order in columns on removable subplates. A maximum of two connections shall be made to each side of a terminal, including jumpers. Provide an additional 20 percent spare terminals with the following minimum requirements:

   Power terminals - 2 spares
   Control terminals - 10 spares

9. Provide ground terminal for each panel.
10. All control panels shall be provided with spare mountings for additional relays. Number of spare mountings will correspond to 5% of the total number of relays within each panel, with a minimum of one (1) spare mounting.
11. All control panels shall be provided with an appropriately sized surge arrester to protect panel internals. Surge arrestor shall be equal to Square D Model SP3650 in quality and appropriately sized for function.
12. All control panels will be suitable for use with 120v, I phase power. The panels shall be equipped with an internal power supply fuse and disconnect switch. Fuse blocks will be provided as required to allow a separate fuse for each piece of equipment within the panel requiring power.
13. Provide complete wiring diagrams for all control panels.

D. Special Requirements:

1. Outdoor Control Panels
   a. When components requiring a minimum temperature in which to operate, such as solid state devices, are to be installed inside the enclosure, the enclosure shall be NEMA 4 minimum, or 4X where specifically called for, or required. The enclosures shall be insulated and heated. Insulate the inside of all exterior surfaces with 1 inch thick rigid fiberglass insulation board having a maximum thermal conductivity ("k" value) of 0.35 BTUin/hr-ft^2-°F. The insulation shall be finished with manufacturer's standard all service jacket. Coverings containing foil will not be acceptable.
   b. Enclosures shall be equipped with a built-in heater and adjustable thermostat. Heater shall be sized to maintain 40 °F (or higher if required) inside panel with an outside ambient temperature of –30 °F and a 15 MPH wind. The heater shall include a fan to circulate the air within the enclosure to prevent hot spots. Thermostat shall measure air temperature, not surface temperature. Heater shall be similar to Hoffman Engineering Co. series D-AH.
   c. Heating provisions for control of condensation will be provided.
   d. Provide heating requirement calculations for review and acceptance.
2. All Instrument and Control Panels
   a. All instrument and control enclosures shall have the proper NEMA rating for the areas in which they will be installed, as specified above. All frontmounted instruments and devices shall be installed in such a way as to maintain the NEMA rating of the enclosure.
   b. Instrument and control panels which are to be installed outdoors shall have a hinged dead front with a separate inside hinged door (NEMA 1). All control devices and main circuit breaker operating handle shall be mounted through the inner door. The main circuit breaker shall have a lock arrangement that prevents the inner door from being opened when the breaker is in the on position. Where required, the outer door shall have transparent window(s) to allow viewing of instruments or controls while maintaining the NEMA rating. The panels shall be mounted as shown on the Drawings.
   c. Panels shall be supplied with GFI duplex convenience outlet and 100-watt panel light with on-off switch.

E. Spare Parts/Materials:

1. Provide 1 gallon of paint for each enclosure/panel topcoat color utilized.
2. Provide the following spare parts for each panel/enclosure provided. Spare parts shall be contained in the panel/enclosure in such a manner as to permit accessibility and prevent accidental damage.
   a. Provide 10 of each lamp type.
   b. Provide one of each type relay.
   c. Provide one control switch and/or push-button of each type.
   d. Provide 10 fuses of each type and size.

e. Provide 1 of each color and type light lens.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All interconnecting wiring between panels, unless specifically detailed otherwise, shall be by the electrical trade regardless of source of the panel itself.

B. Install enclosures in locations as shown on the Drawings. Large enclosures shall be secured to floor or equipment pad. Small enclosures may be supported on walls using metal framing channels or similar hardware to provide a minimum 1/2 inch air space between enclosure and wall.

1. All framing channels and mounting hardware for NEMA 3R and NEMA 4 enclosures shall be galvanized steel.
2. All framing channels and mounting hardware for NEMA 4X enclosures shall be stainless steel.

C. Mounting heights shall be as shown on the contract drawings or the tops placed a maximum of 72 inches above finished floor or platform when the elevation is not shown.

3.2 TESTS

A. Testing of the enclosures themselves is not required. However, all equipment and controls which are mounted in or on the enclosures shall be tested as specified in applicable sections of DIVISIONS 11, 15 and 16.

3.3 CLEANING

A. Do not allow excess debris to accumulate inside enclosures during the course of construction.

B. Upon completion of the work, remove all debris and surplus materials from inside enclosures and leave them clean.

C. Clean all enclosure surfaces and touch up any scratched or damaged areas to the satisfaction of the Engineer.

END OF SECTION

SECTION 16400

SERVICE AND DISTRIBUTION

PART1-GENERAL

1.1 DESCRIPTION

A. Provide complete services and distribution systems as indicated on the drawings and as specified herein.

1.2 QUALITY ASSURANCE

A. The equipment specified herein is based upon the first manufacturer named after the phrase "Acceptable Manufacturer's". Equipment types, device ratings, dimensions, etc. correspond to the nomenclature dictated by that manufacturer. Equipment of other acceptable manufacturer's shall be equivalent in every way to that of the equipment specified.

B. All equipment shall be tested at the factory. Unless specified elsewhere, standard factory inspection and operational tests will be acceptable.

1.3 SUBMITTALS TO THE ENGINEER

A. Submit Shop Drawings for all service and distribution equipment specified herein including the following information:

1. Manufacturer and equipment type.
2. Standard catalog information sheet.
3. Detailed Shop Drawings indicating plan, elevation, end, and isometric views.
4. Single-line diagram.
5. Complete bill of materials.
6. Additional information necessary to verify equipment to be supplied has features specified.
7. The above shall be submitted in a single complete brochure which shall be in the form of a soft cover binder with index tabs.

B. Provide six (6) copies of all correspondence, including verbal communications, with the utility company to the Engineer. Correspondence shall verify approval of the utility company for the proposed service.

C. Submit documentation of all grounding tests.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Metering:

1. Provide complete KNW meter sockets and mounting cabinets at the secondary service entrances as shown on Drawings and per utility company requirements.

2. Ratings: Shall match voltage and current ratings of services.
3. Acceptable Manufacturers: Anchor Electric or equal.

B. Enclosed Circuit Breakers:
1. Circuit breakers shall be molded case, thermal-magnetic type, ratings as noted, with overcenter, trip-free, toggle-type operating mechanism, quick-make, quick-break action and positive handle indication. Multiple pole breakers shall be common trip type. Each circuit breaker shall have a permanent trip unit containing individual thermal and magnetic trip elements in each pole. Breakers shall be calibrated for operation, an ambient temperature of 40°C and shall be suitable for mounting and operating in any position. Breakers shall have removable lugs, U.L. listed for copper and aluminum conductors. Breakers shall be installed in enclosures as specified in Section 16160, with NEMA ratings as indicated on the Drawings.
2. Acceptable Manufacturers: Square-D, Westinghouse, General Electric, or Siemens.

C. Double-Throw Switches
Shall be non-fusible, 2 pole, with solid neutral. Switches shall be service-entrance rated. NEMA 3R enclosure with quick release latch and hasp. Switch shall be capable of being locked in either position and in "off' position. Ampere rating per service entrance schedules as shown on Drawings. Acceptable manufacturers: Square D or equivalent.

D. Weatherproof Emergency Receptacles:
Shall be rated per service entrance schedules as shown on Drawings. Acceptable manufacturers: Appleton or equivalent. See drawings for catalog numbers.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Grounding:
1. Provide a service entrance ground and equipment grounding system as dictated by Article 250 of the National Electrical Code and as indicated in Section 16450 and on the Contract Documents. Service entrance ground conductors shall be copper with green thermoplastic insulation installed in rigid galvanized steel conduit. Use Cadwell type connectors for all service entrance ground connections.
2. Ground all exposed non-current carrying metallic parts of the electrical system and ground all raceway systems.
3. Ground all secondary neutral connections.
4. Ground all exterior conduit risers.
5. Ground all motor frames using copper bonding conductor between raceway system and motor frame.

B. Inspect all bus bolts prior to energization to check for looseness developed during shipment or handling.

3.2 TESTS

A. Grounding

1. Grounds and grounding systems shall have a resistance to solid earth ground not exceeding following values:

	Ohms
For grounding secondary service neutral.....	25
For grounding non-current carrying metal parts associated with secondary distribution system.....	25

2. Provide grounding tests to verify the above values. Where these values are not met, add additional ground rods in order to meet these values.

END OF SECTION

SECTION 16450

GROUNDING

PART1-GENERAL

1.1 DESCRIPTION

A. Work Included: Provide and install all grounding and appurtenances as shown on the Drawings and as specified herein.

B. Related Work Specified Elsewhere (When Applicable):

1. Instrumentation equipment specified in Division 11.
2. Heating and ventilating specified in Division 15.
3. "Electrical - General" is specified in the appropriate Section in this Division.

1.2 SUBMITTALS TO THE ENGINEER

A. Shop drawings are not required under this Section.

PART2-PRODUCTS

2.1 MATERIALS

A. Provide equipment grounding as shown on the Drawings. Size of main grounding conductor shall be #8 bare stranded copper, minimum.

B. Provide grounding conductors from ground electrodes to equipment as shown on the Drawings.

C. Use 3/4 inch x 10 foot copperweld ground rods for direct burial.

D. Do not use conduit as the ground and/or bonding conductor.

E. Bond ground terminal of receptacles to outlet boxes with #12 AWG green insulated wire.

F. Flexible metallic conduit to be suitable for grounding service.

G. Ground conduit system and neutral conductor of wiring system with a connection at the main electrical service switch.

H. The grounding network to be connected to metallic water piping system, at one location, with stranded copper, #8 AWG, Green Insulated Conductor.

PART 3 - EXECUTIQN

3.1 INSTALLATION

A. Make connections to ground rods with an exothermic welding process. Mechanical connections may be made at equipment only.

B. Ensure that a ground loop is not formed between equipment ground in electrical conduit and grounding electrode conductors directly connected to ground electrodes.

C. Equip exposed "pigtails" or grounding electrode conductors with an armored sheath.
D. Group and bond ground wires to panel boxes, light fixtures, receptacles, etc., not to system neutral.
E. Make connection to water main with a suitable ground clamp or lug connection. If flanged pipes are encountered, make connection with lug bolted to Range connections.

3.2 TESTS

A. The entire grounding network resistance to be meggered and certified results provided. Resistance should not exceed 25 ohms.

END OF SECTION

SECTION 16950

TESTING ELECTRICAL SYSTEMS AND START-UP

PART I – GENERAL

1.1 DESCRIPTION

A. Test and demonstrate, to the satisfaction of the Engineer, all electrical devices in accordance with the following requirements.

B. Prior to energizing switchgear equipment, motor control centers, motors, etc., thoroughly vacuum clean the equipment with an industrial type vacuum cleaner.

C. All motors, contacts, relays, bus, insulators and other electrical apparatus shall be cleaned and dried out if required and/or needed.

D. Prior to applying voltage to any apparatus or circuit, make insulation resistance tests and, if necessary, dry the apparatus until resistance values conform to the standards of IEEE.

E. In drying out, methods will be such that the insulation temperature of the apparatus does not exceed 90 °C.

F. In case of a low resistance circuit insulation, eliminate the problem before the circuit is energized.

G. Make a recheck after apparatus is dry.

H. A record of all insulation values shall be properly recorded and furnished to the Engineer for review.

1. Prior to the start of check out and testing, insure that all equipment is properly and permanently identified according to Section 16010.

J. Before energizing any electrical equipment or apparatus, check and verify that no tools, filings, foreign matter or other materials is left inside equipment or enclosures. Particular attention shall be given to bus conductors, conductors, terminal blocks and windings. All screw and bolt connections and terminal connections shall be checked for tightness prior to final tests and energization. During the checkout and startup period, provide sufficient personnel to aid with the start-up of all electrical equipment, to remove any faults, and to make the necessary adjustments for the proper operation of electrical equipment and installation, including sufficient personnel to aid the operating personnel in their checkout of the electrical equipment and service.

K. Check the bearings of all rotating electrical apparatus and, if required, have supplier fill with the grease or oil as recommended by the manufacturers.

L. A 2200 volt "megger" insulation test shall be available at all times during the construction and check-out period.

M. Motors and motor feeder wires shall be "meggered" from the starters prior to energizing and at the time of final checkout. All power feeders shall be meggered

prior to energizing conductors. Submit written results of all megger tests to engineer for approval. Any deficiencies shall be corrected and retested until satisfactory test results are obtained. Refer to Specification 16050, paragraph 3.2, "Tests", for further information.

N. Three phase motors shall be checked for rotation and, if necessary, reverse the connections at the starter. Single phase and DC motors at motor connection box.

O. All main plant building loops and major equipment grounds shall be tested to remote earth or directly referenced to an extremely low resistance (approximately 1 ohm) reference ground bench mark. Ground testing results shall be properly recorded, witnessed, and reported to the Engineer. Tests shall be made with ground testing ohm meter or "megger" approved by the Engineer for the purpose.

P. The ground resistance of the individual networks shall be measured at two points with the cables at all the test points disconnected.

Q. The cables shall then be reconnected at the test points and a duplicate set of ground resistance measurements shall be made.

R. The entire grounding network resistance to be meggered and certified results provided. Resistance shall not exceed 25 ohms. Drive additional ground rods if necessary.

S. All control circuits shall be functionally checked to see that their operation and sequence are correct. Any adjustable switches such as float switches, limit switches and timers shall be adjusted for proper operation.

T. Maintain written and properly witnessed test and check-out reports and submit these to the Engineer for Owner prior to final acceptance of facilities.

U. All electrical equipment, wiring, switches and insulators found to be defective or to have failed due to poor workmanship shall be replaced promptly at no additional cost to the Owner.

END OF SECTION