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CITY OF BALTIMORE

BRANDON M. SCOTT

Mayor

DEPARTMENT OF RECREATION AND PARKS

Reginald Moore

Director

CONTRACT RP 22805

Volume 2 of 2

FOR

Gwynns Falls Campground

Restoration & Improvements

4201 Gwynns Falls Parkway, Baltimore, MD 21216

Gwynns Falls Campground
Restoration & Improvements

RRMM Project No. 20635

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Gwynns Falls Campground
Restoration & Improvements
Baltimore, Maryland

00 01 01
Project Directory

RRMM Project Number: 20635 Date: February 13, 2026

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END OF SECTION 00 01 15

00 73 16.01
COMPENSATION, LIABILITY AND PROPERTY DAMAGE INSURANCE

Refer to section 00 73 16.01 in the "City of Baltimore Department of Public Works Specifications for Materials, Highways, Bridges, Utilities, and Incidental Structures" 2006, with the following modifications:

Add the following after Section 00 73 16.01-A of the Standard Specification.

The Contractor shall indemnify, defend and hold harmless the City, its elected/appointed officials, employees, and agents from any and all claims, demands, suits, and actions, including attorney's fees and court costs, connected therewith, brought against the City, its elected/appointed officials, employees, and agents, arising as a result of any direct or indirect willful, or negligent act or omission of the Contractor, its officials, employees, and agents, EXCEPT for activities caused by the sole negligent act or omission of the City, its elected/appointed officials, employees and agents arising out of this contract.

Delete Section 00 73 16.01-E of the Standard Specification and replace with the following:

E. COMMERCIAL GENERAL LIABILITY INSURANCE

1. The Contractor shall purchase and maintain commercial general liability insurance in an amount of not less than two million dollars ($2,000,000) combined single limit per occurrence for all damages arising out of bodily injuries or death and property damage and with those policies with aggregate limits; four million dollar ($4,000,000) aggregate limit is required. In case any Work is subcontracted, the Contractor shall require the Subcontractor or anyone directly or indirectly employed by any of them to procure the same coverage.
    a. Such insurance shall include:
        1) Products - Completed operations insurance.
        2) Contractual liability insurance.
        3) Premises and operations insurance.
        4) Personal injury and advertising

2. There shall be no exclusions pertaining to collapse of or damage to any building or structure, damage to underground property, or injury or damage arising out of blasting or explosion, products/completed operations, independent contractors, broad form property damage, contractual liability, or cross liability. The provision shall apply to operations by the Contractor or any Subcontractor in the performance of this contract.

Add the following after Section 00 73 16.01-J.2.e of the Standard Specification.

f. The Contractor's insurance shall apply separately to each insured against whom claim is made and/or lawsuit is brought, except with respect to the limits of the insurer's liability.

Supplement Section 00 73 16.01 of the Standard Specification with the following:

N. ENVIRONMENTAL LIABILITY COVERAGE

The Contractor shall purchase and maintain during the life of this contract Environmental Liability Coverage. The limits of liability shall not be less than three million dollars ($3,000,000) per claim or in the aggregate. If the coverage is written on a claims-made form:

1. The "Retro Date" must be shown and must be before the date of the contract or the beginning of contracted work.
2. Insurance must be maintained and evidence of insurance must be provided for at least three (3) years after completion of the contract work and acceptance by the City.
3. If the coverage is cancelled or not renewed or replaced with another claims-made policy form with a "Retro Date" prior to the contract effective date, the Contractor must purchase "Extended Reporting" coverage for a minimum of three (3) years after completion of the contract work.
4. A copy of the claims reporting requirements must be submitted to the City for review.
5. The Mayor and City Council of Baltimore must be named as "Additional Insured".

O. BUILDER'S RISK

The Contractor shall have and maintain during the life of the Contract/Agreement "All Risk Builders' Risk", insurance including theft, vandalism windstorm and hail, flood and quake at a limit of not less than 100% of the full complete value of structure'(s)/work associated with this project. This insurance shall protect the City, as its interest may appear in the work, and shall insure against the perils of fire and extended coverage, theft, vandalism and malicious mischief. All Risk insurance may not contain exclusions relating to flood, earthquake, mysterious disappearance, hail and terrorism.

If the Property Insurance contains a co-insurance provision, the Contractor shall be responsible for the amount of insurance satisfying the co-insurance amount so as to make the co-insurance clause inoperable. If not covered otherwise, the Contractor shall have and maintain during the life of the Contract similar Property Insurance on portions of the work stored off the site or in transit when such portions of the work are to be included in any payment.

END OF SECTION 00 73 16.01

VI. CONSTRUCTION DETAILS AND MATERIALS (Divisions 01 – 37)

01 10 00
SUMMARY

GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes (not exclusively) the following:

Work covered by the Contract Documents.

2. Type of the Contract.
3. Use of premises.
4. Work restrictions.
5. Specification formats and conventions.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Identification: Gwynns Falls Campground Restoration and Improvements

B. Location: 4201 Gwynns Falls Parkway, Baltimore, MD 21216

C. Engineer: City of Baltimore Department of Recreation and Parks.

D. Architect: RRMM Architects

E. The work consists of, but is not restricted to, the following:
   1. Creation of group and individual campsites
   2. Restoration of the existing pavilion structure and associated terrace
   3. Repairs and modifications to the existing access roadway as required for emergency vehicle access and stormwater management
   4. Installation of composting toilet facilities, a wash basin, and a septic field
   5. Site improvements including but not limited to repairs at the existing amphitheater, new paths, and modifications to the existing parking
   6. Installation of a new water line

TYPE OF CONTRACT

A. Project will be constructed under a single prime contract.

USE OF PREMISES

General: Contractor shall have limited use of premises for construction operations, as limited to the area of work required for new work shown on the construction documents, and for the time period required to perform said work.

B. Use of Site: Limit use of premises to areas within the Contract limits indicated, and for the time period required to perform said work. Do not disturb portions of Project site beyond areas in which the Work is indicated.

Driveways and Entrances: Keep loading areas, and entrances serving premises clear and available to Engineer, Engineer 's employees and contractors, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

a. Schedule deliveries to minimize use of loading areas and entrances.
b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

2. Owner reserves the right to require contractor to vacate specific locations/portions of the project where construction is substantially complete. At that time Contractor will adjust construction fencing and/or barriers to match reduced construction site. This vacation is commensurate with contractor ceasing all use, and Owner assuming responsibility for conditions of, said location.

1.6 CONSTRUCTION SEQUENCE

A. Demolition shall be accomplished in a carefully planned phased manner in order to maintain the structural integrity of structures on site that are existing to remain.

WORK RESTRICTIONS

Existing Utility Interruptions: Do not interrupt utilities serving facilities currently occupied by others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

Notify Engineer not less than 11 days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Engineer's written permission.

SPECIFICATION FORMATS AND CONVENTIONS

Specification Format: The Specifications are organized into Divisions and Sections using the 50-division format and CSI/CSC's "Master Format" numbering system.

Section Identification: The Specifications use Section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete because all available Section numbers are not used.
2. Division 1: Sections in Division 1 govern the execution of the Work of all Sections in the Specifications.

Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.

    a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

3. The word "days" refers to Calendar days unless specified otherwise.

4. "*Days of Completion*" in the Bid Form refers to a period beginning at *Notice to Proceed* and ending at *Final Completion.*

PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00

01 20 00
MEASUREMENT AND PAYMENT

PART 1-GENERAL

1.01 BASIS OF PAYMENTS

A. Payment for work completed under this Contract will be made for the lump sum price and for the unit bid price. All prices shall include the furnishing of all labor, tools, equipment and materials and the performance of all work required to satisfactorily complete the Project as indicated and specified in the Contract documents and as determined by the Engineer. References to methods of measurement and/or payment in Standard Specifications, which are made part of the Specifications by reference for materials and construction, will not apply. Only the methods of measurement and payment outlined in this section will apply to the Bid items.

PART 2-DESCRIPTION OF PAYMENT

2.01 BID ITEM # 101- Project Complete

A. The lump sum price for this item shall include full compensation for all work shown on the Drawings as outlined in the Specifications.

B. Measurement of unit quantities for this item will not be made.

C. Partial payment for this item will be made on the basis of percentage complete of the construction categories listed in the SCHEDULE OF VALUES. See 01 29 00.

2.02 BID ITEMS # 201, # 202, # 203, # 204- Unit Prices

A. Payment will be made for actual quantities completed/installed based upon unit pricing provided.

END OF SECTION 01 20 00

01 22 00
UNIT PRICES

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for unit prices.

1.2 DEFINITIONS

A. A unit price is an amount proposed by the Contractor as part of the bid process to establish a price per unit of measurement for materials or services added to or deducted from the Contract Sum by incorporating the unit price stipulated in the Contractor's bid form, and multiplying the unit price by the amount of work completed (work that is subject to unit pricing) to arrive at the amount of compensation to be paid the Contractor for the unit price work.

1.3 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, labor, equipment, installation, insurance, applicable taxes, overhead, and profit.

B. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor.

C. A list of unit prices is included in Part 3. Specification sections referenced in the schedule contain requirements for materials described under each unit price.

D. The Owner reserves the right to withdraw the work described in the unit prices from the Work of the Contract and reduce the Contract stipulated fee by the dollar values assigned to the respective unit prices.

E. The Owner reserves the right to increase the Contract lump sum amount using the respective unit prices, if the measurement of the volume of unit price work exceeds the amount included in the Contract.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 LIST OF UNIT PRICES

A. General: Provide a cost for each unit price item on the Bid Form:

Bid Item # 201 Contingent Tree Removal to Ground- 4"-15" Diameter at breast height:
Removal of trees 4"-15" in diameter at breast height, deemed to be unsatisfactory by BCRP, Forestry, and the project landscape architect. Payment will be made for the actual number of trees removed.

Bid Item # 202 Contingent Tree Removal to Ground- Diameter of 15" and above at breast height:
Removal of trees 15" and above in diameter at breast height, deemed to be unsatisfactory by BCRP, Forestry, and the project landscape architect. Payment will

be made for the actual number of trees removed.

Bid Item # 203 Contingent Stone wall repair:

Removal and replacement of deteriorated stone masonry in accordance with specification section 04 40 00 "Stone Masonry Repairs". Payment will be made for the actual square footage of stone wall repairs completed.

Bid Item # 204 Contingent Rock Excavation:

Rock excavation in utility trenches; backfill with Engineered Fill in accordance with specification section 31 23 33 "Trenching and Backfilling". Payment will be made for the actual number of cubic yards of rock removed.

END OF SECTION 01 22 00

01 25 00
SUBSTITUTION PROCEDURES

GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

1.3 DEFINITIONS

Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
2. Substitutions for Convenience: Changes proposed by Contractor or Engineer that are not required in order to meet other Project requirements but may offer advantage to Contractor or Engineer.

1.4 ACTION SUBMITTALS

Substitution Requests: Submit to the Engineer one electronic copy of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

Substitution Request Form: Use CSI Form 13.1A or facsimile of form provided in Project Manual.

2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.

b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Engineer and separate contractors, that will be necessary to accommodate proposed substitution.

c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.

d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects with project names and addresses and names and addresses of Engineers.
h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within **7** business days of receipt of a request for substitution. Engineer will notify Contractor of acceptance or rejection of proposed substitution within **21** days of receipt of request, or **7** business days of receipt of additional information or documentation, whichever is later.

Forms of Acceptance: Change Order, Construction Change Directive, or Engineer's Supplemental Instructions for minor changes in the Work.

b. Use product specified if Engineer does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than **21** days prior to time required for preparation and review of related submittals, in order to meet Construction Schedule.

1. Conditions: Engineer will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Engineer will return requests without action, except to record noncompliance with these requirements:

Requested substitution is consistent with the Contract Documents and will produce indicated results.

b. Substitution request is fully documented and properly submitted.
c. Requested substitution will not adversely affect Contractor's construction schedule.
d. Requested substitution has received necessary approvals of authorities having jurisdiction.
e. Requested substitution is compatible with other portions of the Work.
f. Requested substitution has been coordinated with other portions of the Work.
g. Requested substitution provides specified warranty.
h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

Substitutions for Convenience: Not allowed.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 25 00

01 26 00
CONTRACT MODIFICATION PROCEDURES

GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

1.3 MINOR CHANGES IN THE WORK

Engineer will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1.4 PROPOSAL REQUESTS

A. Engineer-Initiated Proposal Requests: Engineer will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

Work Change Proposal Requests (WCPR) issued by Engineer are not instructions either to stop work in progress or to execute the proposed change.

Within time specified in Proposal Request after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
c. If Contractor determines Construction Schedule will require modification, include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. If Contractor determines Construction Schedule will require modification, include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
5. Comply with requirements in Section 01 25 00 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
6. Proposal Request Form: Use AIA Document G709 for Proposal Requests.

1.5 CHANGE ORDER PROCEDURES

A. On Engineer's approval of a Work Changes Proposal Request, Engineer will issue a Change Order for signatures of Engineer and Contractor on AIA Document.

1.6 CONSTRUCTION CHANGE DIRECTIVE

Construction Change Directive: Engineer may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 26 00

01 29 00
PAYMENT PROCEDURES

GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.3 DEFINITIONS

Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's Construction Schedule.

1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:

a. Application for Payment forms with continuation sheets.
b. Submittal schedule.

Submit the schedule of values to Engineer at earliest possible date, within fifteen (15) days after Notice of Award, and no later than seven days before the date scheduled for submittal of initial Applications for Payment.

3. The Schedule shall add up to the full 100% value of the lump sum bid. The Schedule shall be used for the purpose of arriving at a basis of partial payments to the Contractor for each construction category.

4. Engineer reserves the right to require line item breakdowns in the Schedule of Values as required to facilitate accurate payment applications and approvals for the project. Initial Applications for Payment may not be submitted until Engineer has approved the Schedule of Values including any line item breakdowns required.

5. If Erosion and Sediment Control is included in the work, an Erosion and Sediment Control item shall be subdivided into the costs for incremental installation of sediment control devices as required by the Sequence of Construction indicated on the Drawings. Payment

under this break down will be limited to an initial payment of 50 percent of the value for devices installed for each increment of sediment control required for that Sequence of Construction at the first monthly estimate after satisfactory installation. The remaining sum will be paid incrementally as a percent of the remaining time the sediment control devices will be installed as long as those devices are required and properly maintained to the satisfaction of the Engineer.

Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the schedule of values:

    a. Project name and location.
    b. Name of Engineer.
    c. Engineer's project number.
    d. Contractor's name and address.
    e. Date of submittal.

Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:

    a. Related Specification Section or Division.
    b. Description of the Work.
    c. Name of subcontractor.
    d. Name of manufacturer or fabricator.
    e. Name of supplier.
    f. Change Orders (numbers) that affect value.
    g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

        1) Labor.
        2) Materials.
        3) Equipment.

Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts where appropriate.

4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.

Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

    a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.

6. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.

Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown as separate line items

Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Engineer and paid for by Engineer.

1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

Payment Application Times: The date for each progress payment is indicated in the Agreement between Engineer and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.

Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Engineer will return incomplete applications without action.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

1. Provide certificate of insurance, evidence of transfer of title to Engineer, and consent of surety to payment, for stored materials.
2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
3. Provide summary documentation for stored materials indicating the following:

   a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
   b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.

c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

Transmittal: Submit three signed and notarized original copies of each Application for Payment to Engineer by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit conditional final or full waivers.
3. Engineer reserves the right to designate which entities involved in the Work must submit waivers.

Waiver Forms: Submit executed waivers of lien on forms acceptable to Engineer.

Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of values.
3. Contractor's construction schedule (approved if not final).

Products list (approved if not final).

5. Schedule of unit prices.
6. Submittal schedule (approved if not final).
7. List of Contractor's staff assignments.
8. List of Contractor's principal consultants.
9. Copies of building permits.
10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
11. Initial progress report.
12. Report of preconstruction conference.

Certificates of insurance and insurance policies.

14. Performance and payment bonds.
15. Data needed to acquire insurance.

I. Application for Payment at Substantial Completion: After Engineer issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.

2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Engineer occupancy of designated portions of the Work.

J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

Evidence of completion of Project closeout requirements.

2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."

AIA Document G707, "Consent of Surety to Final Payment."

7. Evidence that claims have been settled.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 29 00

01 29 73
SCHEDULE OF VALUES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Procedures for preparation and submittal of Schedule of Values.

1.2 FORMAT

A. Follow Table of Contents of Project Manual for listing component parts. Identify each line item by number and title of major Specifications Section.

B. Identification: Include the following Project identification on the Schedule of Values:
   1. Project name and location.
   2. Name of Architect.
   3. Architect and Owner's project number.
   4. Contractor's name and address.
   5. Date of submittal.

C. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
   1. Related Specification section or division.
   2. Description of work.
   3. Name of subcontractor.
   4. Name of manufacturer or fabricator.
   5. Name of supplier.
   6. Change Orders (numbers) that affect value.
   7. Dollar value
   8. Percentage of Contract Sum to nearest one-hundredth percent, adjusted total 100 percent.

1.3 CONTENT

A. List installed value of each major item of work and each subcontracted item of Work as a separate line item to serve as a basis for computing values for Progress Payments as extracted/determined from the cost loaded Progress Schedule. Round off values to nearest dollar. Indicate material cost separate from related labor cost.

B. For each major subcontract, list products and operations of that subcontract as separate line items.

C. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate. Include separate line items under required principal subcontracts for operation and maintenance manuals, punch list activities, Project Record Documents, and demonstration and training.

D. Allowances Unit Prices and Alternates: Provide a separate line item in Schedule of Value for each allowance, Unit Price and Alternate. Show line-item value of unit prices, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the

Contract documents to determine quantities.

E. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
   1. Application for Payment forms with Continuation Sheets.
   2. Submittals Schedule.
   3. Contractor's Construction Schedule.
   4. List of subcontractors.
   5. Schedule of allowances.
   6. Schedule of alternates.
   7. List of products.
   8. List of principal suppliers and fabricators.

F. Component listings shall each include a directly proportional amount of Contractor's overhead and profit. Temporary facilities and other major cost items that are not direct cost of actual work-in-place shall be shown as separate line items in the Schedule of Values.

H. For items on which payments will be requested for stored products, list sub-values for cost of stored products.

I. The sum of values listed shall equal total Contract Sum.

1.4 SUBMITTAL

A. Submit 2 copies of the Draft Schedule of Values 15 calendar days prior to first Application for Payment to the Owner and two copies to the Architect. Form and content shall be acceptable to Owner.

B. Transmit under transmittal letter. Identify Project by title and number; identify Contract by number.

C. Schedule Updating: Update and resubmit the Schedule of Values before the next Application for Payment when change Orders or Construction change Directives result in a change in the Contract Sum.

1.5 SUBSTANTIATING DATA

A. When the Owner and/or the Architect/Engineer require substantiating information, submit data justifying line item amounts in question.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

END OF SECTION 01 29 73

01 31 00
PROJECT MANAGEMENT AND COORDINATION

GENERAL

1.1 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on The Project including, but not limited to, the following:

1. General coordination procedures.
2. Project meetings.
3. RFIs.

DEFINITIONS

RFI: Request for Information. Request from City, Engineer, or Contractor seeking information required by or clarifications of the Contract Documents.

1.3 INFORMATIONAL SUBMITTALS

Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

GENERAL COORDINATION PROCEDURES

Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Removal of any existing elements and constructions necessary for proper completion of the Work, including but not limited to those explicitly shown on the plans, is part of this contract.
3. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
4. Coordination and provision of any labor and materials required to meet the intent of the drawings and specifications herein, including any labor and materials from trades and suppliers other than the primary component described, are required to be provided by the Contractor as part of this contract.

5. Make adequate provisions to accommodate items scheduled for later installation.

Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner/Engineer and separate contractors if coordination of their Work is required.

Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's Construction Schedule.
2. Preparation of the Schedule of Values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.

Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Engineer's property.

1.5 REQUEST FOR INFORMATION (RFI)

General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Engineer will return without response those RFIs submitted to Engineer by entities other than Prime Contractor.

Content of the RFI: Include a detailed, legible description of item(s) needing information or interpretation and the following:

1. Project name.
2. Project number.
3. Date.
4. Name of Contractor.
5. Name of Engineer
6. RFI number, numbered sequentially.
7. RFI subject.
8. Specification Section number and title as appropriate.
9. Drawing number and detail references, as appropriate.
10. Field dimensions and conditions, as appropriate.
11. Clarifying sketches and/or photographs as appropriate.
12. Related specification, submittal, etc., paragraphs, as appropriate.

13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
14. Contractor's signature.
15. Attachments: Include sketches, descriptions, measurements, photos (include surrounding context), Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
    b. Include a description of attachments, including the number of pages.

C. RFI Forms: AIA Document G716.

1. Attachments shall be electronic files in Adobe Acrobat PDF format.

D. Engineer's Action: Engineer will review each RFI, determine action required, and respond. Allow 14 days for Engineer's response for each RFI. RFIs received by Engineer after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be rejected:

    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for approval of Contractor's means and methods.
    d. Requests for coordination information already indicated in the Contract Documents.
    e. Requests for adjustments in the Contract Time or the Contract Sum.
    f. Requests for interpretation of Engineer's actions on submittals.
    g. Incomplete RFIs or inaccurately prepared RFIs.

2. Engineer's action may include a request for additional information, in which case Engineer's time for response will date from time of receipt by Engineer of additional information.
3. Engineer's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit a Change Proposal according to Section 01 26 00 "Contract Modification Procedures."

    a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Engineer in writing, with detailed descriptions, within 10 days of receipt of the RFI response.

E. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

1.6 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Engineer of scheduled meeting dates and times.

2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.

3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Engineer, within three days of the meeting.

Preconstruction Conference: Conduct a preconstruction conference before starting construction, at a time convenient to Engineer, but no later than 21 days after execution of the Agreement.

Responsibilities and personnel assignments will be reviewed.

2. Attendees: Authorized representatives of Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect progress, including the following:

    a. Tentative construction schedule.
    b. Phasing.
    c. Critical work sequencing and long-lead items.
    d. Designation of key personnel and their duties.
    e. Lines of communications.
    f. Procedures for processing field decisions and Change Orders.
    g. Procedures for RFIs.
    h. Procedures for testing and inspecting.
    i. Procedures for processing Applications for Payment.
    j. Distribution of the Contract Documents.
    k. Submittal procedures.

Preparation of record documents.

    m. Use of the premise and existing building.
    n. Work restrictions.
    o. Working hours.
    p. Engineer 's occupancy requirements.
    q. Responsibility for temporary facilities and controls.
    r. Procedures for moisture and mold control.
    s. Procedures for disruptions and shutdowns.
    t. Construction waste management and recycling.
    u. Parking availability.
    v. Office, work, and storage areas.
    w. Equipment deliveries and priorities.
    x. First aid.
    y. Security.
    z. Progress cleaning.

4. Minutes: Contractor will record and distribute meeting minutes.

Project Closeout Conference: A project closeout conference, at a time convenient to Engineer, but no later than 90 days prior to the scheduled date of Substantial Completion, shall be conducted.

1. Requirements and responsibilities related to Project closeout will be reviewed.
2. Attendees: Authorized representatives of City, Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall

attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
   a. Preparation of record documents.
   b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
   c. Submittal of written warranties.
   d. Requirements for preparing operations and maintenance data.
   e. Requirements for delivery of material samples, attic stock, and spare parts.
   f. Requirements for demonstration and training.
   g. Preparation of Contractor's punch list.
   h. Procedures for processing Applications for Payment at Substantial Completion and for Final Payment.
   i. Submittal procedures.
   j. Coordination of separate contracts.
   k. City's partial occupancy requirements.
   l. Requirements for final inspections/occupancy certification.
   m. Demobilization procedures.
   n. Installation of furniture, fixtures, and equipment.
   o. Removal of temporary facilities and controls.

Minutes: Contractor will record and distribute meeting minutes.

D. Progress Meetings: Conduct progress meetings at minimum Monthly intervals unless otherwise directed by Engineer.

Coordinate dates of meetings with preparation of payment requests.

Attendees: In addition to representatives of Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with the Project and authorized to conclude matters relating to the Work.

Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

   1) Review schedule for next period.

b. Review present and future needs of each entity present, including the following:

1) Interface requirements.
2) Sequence of operations.

Status of submittals.

Deliveries.

5) Off-site fabrication.
6) Access.
7) Site utilization.
8) Temporary facilities and controls.
9) Progress cleaning.
10) Quality and work standards.
11) Status of correction of deficient items.
12) Field observations.
13) Status of RFIs.
14) Status of proposal requests.
15) Pending changes.
16) Status of Change Orders.
17) Pending claims and disputes.
18) Documentation of information for payment requests.

c. Minutes: Contractor will record and distribute the meeting minutes to each party present and to parties requiring information.

d. Schedule Updating: Revise construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 00

01 32 00
CONSTRUCTION PROGRESS DOCUMENTATION

GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Preliminary Construction Schedule.
2. Contractor's Construction Schedule.
3. Submittals Schedule.
4. Field condition reports
5. Special reports.

1.3 DEFINITIONS

Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

Event: The starting or ending point of an activity.

Major Area: A story of construction, a separate building, or a similar significant construction element.

D. Milestone: A key or critical point in time for reference or measurement.

1.4 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

1. Working electronic copy of schedule file, where indicated.

PDF electronic file.

B. Preliminary construction schedule.

Approval of cost-loaded, startup Construction Schedule will not constitute approval of Schedule of Values for cost-loaded activities.

C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.

D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

Submit a working electronic copy of schedule, labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.

E. Construction Schedule Updating Reports: Submit with Applications for Payment.

F. Site Condition Reports: Submit at time of discovery of differing conditions.

G. Special Reports: Submit at time of unusual event.

Qualification Data: For scheduling consultant.

1.5 COORDINATION

Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

Bar-Chart Schedule: Submit startup, horizontal, bar-chart-type construction schedule within 15 days of date established for commencement of the Work.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

REPORTS

Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

SPECIAL REPORTS

General: Submit special reports directly to Engineer within three days of an occurrence. Distribute copies of report to parties affected by the occurrence.

Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Engineer in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

Contractor's Construction Schedule Updating: At each meeting or other activity where revisions have been recognized or made, update schedule to reflect actual construction progress and activities. Additionally, issue schedule concurrent with the report of each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate final completion percentage for each activity.

B. Distribution: Distribute copies of approved schedule to Engineer, and separate contractors, testing and inspecting agencies and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 01 32 00

01 32 33
CONSTRUCTION PHOTOGRAPHS

PART 1 - GENERAL

1.1 SECTION INCLUDES
- A. Construction Photography.
- B. Submittals.

1.2 PHOTOGRAPHY SERVICES
- A. Provide (2) complete compact disk copies of digital photographs, of site and construction throughout progress of work.

1.3 PHOTOGRAPH FORMAT
- A. Full color; minimum 16.0 mega pixel digital resolution photograph file; converted to JPG format for viewing.
- B. Identification: Provide an individual file number for each digital photograph. Provide a separate Microsoft Word file that lists the photograph number, name of Project, phase, orientation of view, and date of view.

PART 2 - PRODUCTS

2.1 PHOTOGRAPH FILES
- A. Deliver digital file copies of photographs to Owner, at each Application for Payment submission. Catalog and index photograph files in chronological sequence; provide typed table indicating photograph number, date, and subject matter.
- B. Provide photographer's release of copyrights at job completion.

PART 3 - EXECUTION

3.1 TECHNIQUE
- A. Provide factual presentation.
- B. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.

3.2 QUANTITY OF PHOTOGRAPHS
- A. Take sufficient number of photographs to document progress of the work at the end of each work day; not less than (10) different views each day.

END OF SECTION 01 32 33

SECTION 01 33 00
SUBMITTAL PROCEDURES

GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

1.3 DEFINITIONS

Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

C. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 ACTION SUBMITTALS

Submittal Schedule: Submit a Schedule of Submittals, arranged in chronological order by dates required by Construction Schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Engineer and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate Submittal Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.

Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.

3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.

a. Submit revised Submittal Schedule to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in a tabular format:

Scheduled date for first submittal.

b. Specification Section number and title.
c. Submittal category: Action; informational.
d. Name of subcontractor.
e. Description of the Work covered.
f. Scheduled date for Engineer's final release or approval.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

Engineer's Digital Data Files: Electronic digital data files of the Contract Drawings may be provided by Engineer at the request of the General Contractor and at the Engineer's approval, for Contractor's use in preparing submittals. Any costs associated with preparing these files will be assumed by the General Contractor.

Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.

Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

a. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's acceptance of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 21 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 21 days for review of each resubmittal. Allowing procedure in "Concurrent Consultant Review" Subparagraph below may cause tracking problems for Architect and Construction Manager, if any. Delete if not allowed. See Evaluations.
4. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Engineer and to Engineer's consultants, allow 21 days for review of each submittal. Submittal will be returned to Engineer before being returned to Contractor.

Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.

2. Name file with submittal number or other unique identifier, including revision identifier.

File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).

Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Engineer.

4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Engineer, containing the following information:

    a. Project name.
    b. Date.
    c. Name and address of Engineer.
    d. Name of Construction Manager.
    e. Name of Contractor.
    f. Name of firm or entity that prepared submittal.
    g. Names of subcontractor, manufacturer, and supplier.
    h. Category and type of submittal.
    i. Submittal purpose and description.
    j. Specification Section number and title.
    k. Specification paragraph number or drawing designation and generic name for each of multiple items.
    l. Drawing number and detail references, as appropriate.
    m. Location(s) where product is to be installed, as appropriate.
    n. Related physical samples submitted directly.
    o. Indication of full or partial submittal.
    p. Transmittal number, numbered consecutively.
    q. Submittal and transmittal distribution record.
    r. Other necessary identification.
    s. Remarks.

E. Options: Identify options requiring selection by Engineer.

F. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Engineer on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

G. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Engineer's action stamp.

H. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

I. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

Submit electronic submittals via the selected Construction Project Management platform (this will most likely be BCRPs proprietary platform called *RDMS*) as PDF electronic files.

a. Engineer will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

Action & Informational Submittals: Distribute copies of each submittal unless otherwise indicated.

3. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.

Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.

Product Data: Collect information into a single submittal for each specification section, unless required otherwise by the Engineer.

1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

   a. Manufacturer's catalog cuts.
   b. Manufacturer's product specifications.
   c. Standard color charts.
   d. Statement of compliance with specified referenced standards.
   e. Testing by recognized testing agency.
   f. Application of testing agency labels and seals.
   g. Notation of coordination requirements.
   h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

   a. Wiring diagrams showing factory-installed wiring.

b. Printed performance curves.
c. Operational range diagrams.
d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before or concurrent with Samples.

Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

Identification of products.
b. Schedules.
c. Compliance with specified standards.
d. Notation of coordination requirements.
e. Notation of dimensions established by field measurement.
f. Relationship and attachment to adjoining construction clearly indicated.
g. Seal and signature of professional engineer if specified.

Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.
Submit Shop Drawings in PDF electronic file.

Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:

a. Generic description of Sample.
b. Product name and name of manufacturer.
c. Sample source.
d. Number and title of applicable Specification Section.
e. Specification paragraph number and generic name of each item.

Electronic Transmittal: Provide corresponding electronic PDF submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.

4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.

b. Samples not incorporated into the Work, or otherwise designated as Engineer's property, are the property of Contractor.

Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

a. Number of Samples: Submit one full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Engineer will return submittal with options selected.

Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

b. Number of Samples: Submit 2 sets of Samples. Architect will retain 1 Sample set; remainder will be returned. Mark up and retain one returned Sample set as a project record sample.

1) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit paired units that show approximate limits of variations.

Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.

Submit product schedule as PDF electronic file.

F. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of engineers, and other information specified.

G. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

I. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

J. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

K. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

L. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

M. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

N. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

O. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

P. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

Q. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

S. Delegated-Design
1. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

a. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer.

2. Delegated-Design Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file of certificate, signed and sealed by the responsible design professional registered in the state the project is in, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
   a. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.
3. By agreeing to contract the services involved in Delegated Design, it is the responsiblitliy of the contractor to work in good faith with the Engineer, in the event a Change Order, Construction Change Directive, or other official Change to the Contract affects delegated design work either already engineered or already installed to ensure both the intent of the Engineer and the constinuity of the delegated design liability.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer.

B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 "Closeout Procedures."

C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ENGINEER'S ACTION

Action Submittals: Engineer will review each submittal, make marks to indicate corrections or revisions required, and return it. Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.

Informational Submittals: Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. Engineer will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Engineer.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Submittals not required by the Contract Documents may be returned by the Engineer without action.

END OF SECTION 01 33 00

01 35 00
SPECIAL PROCEDURES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The types of minimum requirements for procedures and performance or control work of a general nature include but are not necessarily limited to the following categories:
   1. General installation provisions
   2. Coordination and meetings
   3. Surveys and records
   4. Limitations for use of site
   5. Workmanship
   6. Cleaning and protection
   7. Conservation and salvage

1.2 EXISTING SITE CONDITIONS

The Owner makes no guarantee as to the accuracy of the data shown on the drawings as existing conditions. The Contractor shall verify all pre-existing conditions on the site prior to the start of work.

1.3 PERMITS AND INSPECTIONS BY AGENCIES HAVING JURISDICTION

A. Permits:
The Owner will pay for the initial Building Permit application. The Contractor shall obtain and pay for the Building Permit, except for the filing fee. The Contractor shall be responsible for obtaining and paying for any and all extensions of the Building Permit should extensions become necessary. The Contractor shall be responsible for safeguarding the permit and shall pay all costs for replacement of the permit documents should it become lost, stolen, damaged or otherwise removed from the site. The Contractor shall be responsible for the expense of all trade and any other permits required by Agencies having jurisdiction.

B. Inspection by Agencies Having Jurisdiction:
The Contractor shall be responsible for the timely scheduling of inspections of the Work by Agencies having jurisdiction. The Contractor shall be responsible for notification of the appropriate Agencies, coordination with the inspection procedures of the Agencies, and providing adequate access for inspectors

1.4 SITE UTILITIES

A. Coordinate construction operations of all trades involved in the project to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations that depend on each other for proper installation, connection, and operation.

B. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.

C. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.

D. Make adequate provisions to accommodate items scheduled for later installation.

1.5 SMOKING
Smoking is strictly prohibited at the job site at all times.

1.6 CONSTRUCTION MANAGEMENT SOFTWARE
The contractor is responsible for accessing and utilizing the Owner's preferred web-based construction management software program for collaborative document management throughout the construction process.

1.7 OWNER'S SYSTEM VENDORS
The contractor is responsible for coordination with the owner's system vendors. Contractor to coordinate construction operations that depend on each other for proper installation, connection, and operation, and appropriately allocate time in the construction schedule to allow for coordination with the owner's system vendors.

PART 2 – PRODUCTS

NOT APPLICABLE

PART 3 – EXECUTION

3.1 LAYING OUT WORK

A. The Contractor shall lay out their own work and be responsible for all lines, elevations, and measurements of work they execute under Contract. They must exercise proper precaution to verify figures shown on Drawings before laying out work.

B. The Contractor shall take field measurements prior to preparation of shop drawings and fabrication, to ensure proper fitting of work.

3.2 MANUFACTURER'S DIRECTIONS
All manufactured articles, materials, equipment, fixtures, and accessories shall be handled, stored, applied, installed, connected, erected, used, cleaned, and conditioned as manufacturers direct, unless Architect otherwise indicates, specifies, or directs, in writing.

3.3 GENERAL INSTALLATION PROVISIONS

A. Manufacturer's Instructions

1. Where installations include manufactured products, comply with manufacturer's applicable instructions and recommendations for installation, to the extent these are more explicit or more stringent than requirements indicated in the contract documents.
2. All manufactured articles, materials, equipment, fixtures, and accessories shall be handled, stored, applied, installed, connected, erected, used, cleaned, and conditioned as manufacturers direct, unless Architect otherwise indicates, specifies, or directs, in writing.
3. Inspect each item of materials or equipment immediately prior to installation and reject damaged and defective items.
4. Provide attachment and connection devices and methods for securing work properly as it is installed; true to line and level, and within recognized industry tolerances if not otherwise indicated. Allow for expansion and building movements. Provide uniform joint widths in exposed work, organized for best possible visual effect.

Refer questionable visual effect choices to the Architect for final decision.

5. Recheck measurements and dimensions of the work, as an integral step of starting each installation.
6. Install work during conditions of temperature, humidity, exposure, forecasted weather, and status of project completion which will ensure best possible results for each unit of work, in coordination with entire work. Isolate each unit of work from non-compatible work, as required to prevent deterioration.
7. Coordinate enclosure of work with required inspections and tests, so as to minimize the necessity of uncovering work for that purpose.

B. Mounting Heights

Where mounting heights are not indicated, mount individual units of work at industry recognized standard mounting heights for applications indicated. Refer questionable mounting height choices to the Architect for final decision.

3.4 COORDINATION OF ALL WORK OF THE CONTRACT

A. General

Prepare, communicate and distribute to each entity performing work at the project instructions on required coordination activities, including required notices, reports and attendance at meetings. Take all necessary action to coordinate separate contractors where interfacing of work is required. The Contractor is responsible for reviewing all of the separate systems, equipment, finishes and appurtenances of the project in advance of their fabrication, delivery, and construction. The Contractor shall layout all work of the contract in advance of fabrication, delivery and construction, and shall resolve all interference between the separate systems, equipment, finishes and appurtenance components.

B. Coordination Drawings

Where work by separate entities requires off-site fabrication of products and materials which must be accurately interfaced and closely intermeshed to produce required results, prepare coordination drawings to indicate how work shown by separate shop drawings will be interfaced, intermeshed, and sequenced for installation. Comply with submittal requirements of "Submittals" section.

C. Responsibility for Quality Assurance:

The Contractor is responsible for the timing and/or scheduling of the ordering, shipping, fabrication, delivery and installation of all materials at all times throughout the contract. Payment by the Owner for stored materials shall not be an indication of acceptance of those materials with regards to the quality, size, fit or dimensional accuracy. The Owner does not waive the Owner's right to reject unsatisfactory, unacceptable materials, by way of payment for stored materials.

3.5 LIMITATIONS FOR USE OF SITE

A. General

In addition to site utilization limitations and requirements shown on the drawings, and indicated by other contract documents, administer allocation of available space equitably among entities needing access and space, so as to produce the best overall efficiency in performance of total work of project. Schedule deliveries so as to minimize space and time requirements for storage of materials and equipment on site.

3.6 TRADESPERSONS AND WORKMANSHIP STANDARDS

A. General

Investigate and maintain procedures to ensure that persons performing work at site are skilled and knowledgeable in methods and craftsmanship needed to produce required quality levels for workmanship in completed work. Remove and replace work which does not comply with workmanship standards as specified and as recognized in the construction industry for applications indicated. Remove and replace other work damaged or deteriorated by faulty workmanship or its replacement.

3.7 CLEANING AND PROTECTION

A. General

During handling and installation of work at the project site, clean and protect work in progress and adjoining work on a basis of perpetual maintenance. Apply suitable protective covering on newly installed work where reasonably required to ensure freedom from damage or deterioration at time of substantial completion; otherwise, clean and perform maintenance on newly installed work as frequently as necessary through remainder of construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

B. Limiting Exposures of Work

To the extent possible through reasonable control and protection methods, supervise performance of work in a manner and by means which will ensure that none of the work is subject to dangerous, damaging, or otherwise deleterious exposures during construction period. Such exposures include (where applicable, but not by way of limitation) static loading, dynamic loading, internal pressures, external pressures, high or low temperatures, thermal shock, high or low humidity, air contamination or pollution, water, ice, solvents, chemical, light, radiation, puncture, abrasion, heavy traffic, soiling, bacteria, insect infestation, combustion, electrical current, high speed operation, improper lubrication, unusual wear, misuse, incompatible interface, destructive testing, misalignment, excessive weathering, unprotected storage, improper shipping/handling, theft and vandalism.

3.8 CONSERVATION AND SALVAGE

It is a general procedural requirement for supervision and administration of the work that construction operations be carried out with maximum practical consideration for conservation of energy, water and materials; and with maximum practical consideration for salvaging materials and equipment involved in performance of the work but not incorporated therein. Refer to other sections for required disposition of salvage materials and equipment which are Owner's property.

END OF SECTION 01 35 00

01 40 00
QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve the Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.3 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.

1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

D. Mockups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

1. Mockups are used for one or more of the following:

   a. Verify selections made under Sample submittals.
   b. Demonstrate aesthetic effects.
   c. Demonstrate the qualities of products and workmanship.
   d. Demonstrate successful installation of interfaces between components and systems.
   e. Perform preconstruction testing to determine system performance.

2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.

3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.

E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) in accordance with 29 CFR 1910.7, by a testing agency accredited in accordance with NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."

I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.4 DELEGATED DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents,

provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.5 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.6 INFORMATIONAL SUBMITTALS

A. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

B. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

C. Reports: Prepare and submit certified written reports and documents as specified.

D. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee

payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.7 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, telephone number, and email address of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement of whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement of whether conditions, products, and installation will affect warranty.

5. Other required items indicated in individual Specification Sections.

1.8 QUALITY ASSURANCE

A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.

F. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

G. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

a. Build site-assembled test assemblies and mockups, using installers who will perform same tasks for Project.

b. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to

Contractor. Interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.

I. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups of size indicated.
2. Build mockups in location indicated or, if not indicated, as directed by Architect.
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
5. Demonstrate the proposed range of aesthetic effects and workmanship.
6. Obtain Architect's approval of mockups before starting corresponding Work, fabrication, or construction.

    a. Allow **seven** days for initial review and each re-review of each mockup.

7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
10. Demolish and remove mockups when directed unless otherwise indicated.

1.9 QUALITY CONTROL

A. Engineer Responsibilities: Where quality-control services are indicated as Engineer's responsibility, Engineer will engage a qualified testing agency to perform these services.

1. Project Engineer will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor. Charges will include minimum setup charges for that day or batch, etc.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Engage a qualified testing agency to perform quality-control services.

a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least [24] hours in advance of time when Work that requires testing or inspection will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

D. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform duties of Contractor.

E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.

3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspection equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.10 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Project Engineer will engage a qualified testing agency to conduct Special Tests and Inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:

1. Notifying Project Engineer and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
2. Submitting a certified written report of each test, inspection, and similar quality-control service to Project Engineer with copy to Contractor and to authorities having jurisdiction.
3. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
4. Interpreting tests and inspections, and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's and authorities' having jurisdiction reference during normal working hours.

1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 73 00 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 40 00

SECTION 01 42 19
REFERENCE STANDARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Definitions

B. Requirements relating to referenced standards.

C. Reference standards full title.

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Engineer's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Engineer. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 QUALITY ASSURANCE

A. For products or workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Should specified reference standards conflict with Contract Documents, request clarification from the Engineer before proceeding.

Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of the Engineer shall be altered by the Contract Documents by mention or inference otherwise in any reference document.

PART 2 CONSTRUCTION INDUSTRY ORGANIZATION DOCUMENTS

2.1 AA -- ALUMINUM ASSOCIATION, INC.

2.2 AAMA -- AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION

A. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document).

B. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site.

2.3 AHA -- AMERICAN HARDBOARD ASSOCIATION

2.4 AISI -- AMERICAN IRON AND STEEL INSTITUTE

A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute.

2.5 AMCA -- AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC.

A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating.

B. AMCA 511 - Certified Ratings Program for Air Control Devices.

2.6 ANSI -- AMERICAN NATIONAL STANDARDS INSTITUTE

A. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar.

B. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar.

C. ANSI A108.1c - Specifications for Contractors Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Bed with Dry-Set or Latex-Portland Cement.

D. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive.

E. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar.

F. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy.

G. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout.

H. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout.

I. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework.

J. ANSI A108.12 - American National Standard for Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar.

K. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone.

L. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar.

M. ANSI A118.6 - American National Standard Specifications for Standard Cement Grouts for Tile Installation.

N. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation.

O. ANSI A137.1 - American National Standard Specifications for Ceramic Tile.

P. ANSI/SDI A250.3 - Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames.

Q. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors.

R. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100).

S. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.

2.7 APA -- APA - THE ENGINEERED WOOD ASSOCIATION

2.8 ASCE -- AMERICAN SOCIETY OF CIVIL ENGINEERS

A. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

2.9 ASTM A SERIES -- ASTM INTERNATIONAL

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

B. ASTM A48/A48M - Standard Specification for Gray Iron Castings.

C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-

Coated, Welded and Seamless.

D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

F. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

G. ASTM A449 - Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use.

H. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

I. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.

J. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

K. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

L. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

M. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

N. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

2.10 ASTM B SERIES -- ASTM INTERNATIONAL

A. ASTM B32 - Standard Specification for Solder Metal.

B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

C. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

E. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).

F. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.

2.11 ASTM C SERIES -- ASTM INTERNATIONAL

A. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units.

B. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units.

C. ASTM C140/C140M - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units.

D. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.

E. ASTM C150/C150M - Standard Specification for Portland Cement.

F. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes.

G. ASTM C270 - Standard Specification for Mortar for Unit Masonry.

H. ASTM C373 - Standard Test Method for Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products, Ceramic Tiles, and Glass Tiles.

I. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.

J. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.

K. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.

L. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members.

M. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer.

N. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

O. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.

P. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.

Q. ASTM C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants.

R. ASTM C834 - Standard Specification for Latex Sealants.

S. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board.

T. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications.

U. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.

V. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.

W. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete.

X. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

Y. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base.

Z. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.

AA. ASTM C1072 - Standard Test Method for Measurement of Masonry Flexural Bond Strength.

AB. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems.

AC. ASTM C1148 - Standard Test Method for Measuring the Drying Shrinkage of Masonry Mortar.

AD. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

AE. ASTM C1193 - Standard Guide for Use of Joint Sealants.

AF. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants.

AG. ASTM C1311 - Standard Specification for Solvent Release Sealants.

AH. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms.

AI. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants.

AJ. ASTM C1396/C1396M - Standard Specification for Gypsum Board.

AK. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints.

AL. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels.

AM. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels.

2.12 ASTM D SERIES -- ASTM INTERNATIONAL

A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension.

B. ASTM D570 - Standard Test Method for Water Absorption of Plastics.

C. ASTM D903 - Standard Test Method for Peel or Stripping Strength of Adhesive Bonds.

D. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.

E. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness.

F. ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact) .

G. ASTM D2898 - Standard Test Methods for Accelerated Weathering ofFire-Retardant-Treated Wood for Fire Testing.

H. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.

I. ASTM D3274 - Standard Test Method for Evaluating Degree of Surface Disfigurement of Pain Films by Fungal or Algal Growth, or Soil and Dirt Accumulation

J. ASTM D3359 - Standard Test Method for Measuring Adhesion by Tape Test.

K. ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings.

L. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating.

M. ASTM D4479/D4479M - Standard Specification for Asphalt Roof Coatings - Asbestos-Free.

N. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free.

O. ASTM D5095 - Standard Test Method for Determination of the Nonvolatile Content in Silanes, Siloxanes, and Silane-Siloxane Blends Used in Masonry Water Repellent Treatments.

P. ASTM D5295/D5295M - Standard Guide for Preparation of Concrete Surfaces for Adhered (Bonded) Membrane Waterproofing Systems.

Q. ASTM D5385/D5385M - Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes.

R. ASTM D5957 - Standard Guide for Flood Testing Horizontal Waterproofing Installations

S. ASTM D6878/D6878M - Standard Specification for Thermoplastic Polyolefin Based Sheet Roofing.

2.13 ASTM E SERIES -- ASTM INTERNATIONAL

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

B. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

C. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.

D. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

E. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.

F. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

G. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

H. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

I. ASTM E413 - Classification for Rating Sound Insulation.

J. ASTM E514/E514M - Standard Test Method for Water Penetration and Leakage Through Masonry.

K. ASTM E736/E736M - Standard Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members.

L. ASTM E760/E760M - Standard Test Method for Effect of Impact on Bonding of Sprayed Fire-Resistive Material Applied to Structural Members.

M. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.

N. ASTM E859/E859M - Standard Test Method for Air Erosion of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members.

O. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.

P. ASTM E937/E937M - Standard Test Method for Corrosion of Steel by Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members.

Q. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.

R. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings.

S. ASTM E1966 - Standard Test Method for Fire Resistive Joint Systems.

T. ASTM E1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.

U. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies.

2.14 ASTM F SERIES -- ASTM INTERNATIONAL

A. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use.

B. ASTM F2408 - Standard Specification for Ornamental Fences Employing Galvanized Steel Tubular Pickets.

C. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

2.15 ASTM G SERIES -- ASTM INTERNATIONAL

A. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

2.16 AWPA -- AMERICAN WOOD-PRESERVERS' ASSOCIATION

A. AWPA U1 - Use Category System: User Specification for Treated Wood.

2.17 AWS -- AMERICAN WELDING SOCIETY

A. AWS D1.1/D1.1M - Structural Welding Code - Steel.

2.18 BHMA -- BUILDERS HARDWARE MANUFACTURERS ASSOCIATION

A. BHMA A156.11 - Cabinets Locks

B. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames.

2.19 BIA -- BRICK INDUSTRY ASSOCIATION

A. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing.

B. BIA Technical Notes No. 28B - Brick Veneer/Steel Stud Walls.

C. BIA Technical Notes No. 46 - Maintenance of Brick Masonry.

2.20 CAL -- STATE OF CALIFORNIA

A. CAL Technical Bulletin 117 - Requirements, Test Procedure and Apparatus for Testing the Flame Resistance of Resilient Filling Materials Used in Upholstered Furniture

2.21 CDA -- COPPER DEVELOPMENT ASSOCIATION, INC.

A. CDA A4050 - Copper in Architecture - Handbook.

2.22 EC -- EUROPEAN COMMISSION

2.23 FM -- FACTORY MUTUAL GLOBAL

A. FM (AG) - FM Approval Guide.

B. FM DS 1-28 - Wind Design.

2.24 GA -- GYPSUM ASSOCIATION

A. GA-216 - Application and Finishing of Gypsum Board.

B. GA-600 - Fire Resistance Design Manual.

2.25 GANA -- GLASS ASSOCIATION OF NORTH AMERICA

A. GANA (GM) - GANA Glazing Manual.

B. GANA (SM) - GANA Sealant Manual.

C. GANA (TIPS) - Mirrors: Handle with Extreme Care (Tips for the Professional on the Care and Handling of Mirrors).

2.26 GREENSCREEN -- CLEAN PRODUCTION ACTION

2.27 IAS -- INTERNATIONAL ACCREDITATION SERVICE

A. IAS AC89 - Accreditation Criteria for Testing Laboratories.

2.28 ICC -- INTERNATIONAL CODE COUNCIL, INC.

A. ICC A117.1 - Accessible and Usable Buildings and Facilities.

2.29 ISO -- INTERNATIONAL STANDARDS ORGANIZATION

2.30 ITS -- INTERTEK TESTING SERVICES NA, INC.

A. ITS (DIR) - Directory of Listed Products.

2.31 MPI -- MASTER PAINTERS INSTITUTE (MASTER PAINTERS AND DECORATORS ASSOCIATION)

A. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association.

B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual.

2.32 NAAMM -- THE NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS

A. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames.

B. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames.

C. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames.

D. NAAMM AMP 500-06 - Metal Finishes Manual.

2.33 NFPA -- NATIONAL FIRE PROTECTION ASSOCIATION

A. NFPA 10 - Standard for Portable Fire Extinguishers.

B. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.

C. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives.

D. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.

E. NFPA 268 - Standard Test Method for Determining Ignitibility of Exterior Wall Assemblies Using a Radiant Heat Energy Source.

F. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.

G. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.

2.34 NRCA -- NATIONAL ROOFING CONTRACTORS ASSOCIATION

A. NRCA ML104 - The NRCA Roofing and Waterproofing Manual.

B. NRCA (RM) - The NRCA Roofing Manual.

C. NRCA (WM) - The NRCA Waterproofing Manual.

2.35 SCAQMD -- SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

A. SCAQMD 1113 - South Coast Air Quality Management District Rule No.1113.

B. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168.

2.36 SMACNA -- SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC.

A. SMACNA (ASMM) - Architectural Sheet Metal Manual.

2.37 SPIB -- SOUTHERN PINE INSPECTION BUREAU, INC.

A. SPIB (GR) - Grading Rules.

2.38 SPRI -- SINGLE PLY ROOFING INDUSTRY

A. SPRI ES-1 - Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems.

2.39 SSPC -- SOCIETY FOR PROTECTIVE COATINGS

A. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer.

B. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic").

C. SSPC-SP 1 - Solvent Cleaning.

D. SSPC-SP 2 - Hand Tool Cleaning.

E. SSPC-SP 3 - Power Tool Cleaning.

F. SSPC-SP 6 - Commercial Blast Cleaning.

G. SSPC-SP 13 - Surface Preparation of Concrete; (Reaffirmed 2015).

2.40 TCNA -- TILE COUNCIL OF NORTH AMERICA, INC.

A. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation.

2.41 TMS -- THE MASONRY SOCIETY

A. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures.

2.42 UL -- UNDERWRITERS LABORATORIES INC.

A. UL (DIR) - Online Certifications Directory.

B. UL (FRD) - Fire Resistance Directory.

C. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies.

D. UL 1479 - Standard for Fire Tests of Penetration Firestops.

E. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

F. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems.

2.43 WCMA -- WINDOW COVERING MANUFACTURERS ASSOCIATION

A. WCMA A100.1 - Safety of Corded Window Covering Products.

PART 3 UNITED STATES GOVERNMENT AND RELATED AGENCIES DOCUMENTS

3.1 CFR -- CODE OF FEDERAL REGULATIONS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design.

B. 29 CFR 1926 - U.S. Occupational Safety and Health Standards.

C. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines.

D. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency.

3.2 PS -- PRODUCT STANDARDS

A. PS 1 - Structural Plywood.

B. PS 20 - American Softwood Lumber Standard.

END OF SECTION 01 42 19

01 45 00
QUALITY CONTROL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Quality assurance and control of installation.

B. References.

C. Mock-up.

D. Inspection and testing laboratory services specified in Sections of Divisions 2 through 48 of these Specifications.

E. Manufacturers' field services and reports specified in Sections of Divisions 2 through 48 of these Specifications.

1.2 QUALITY ASSURANCE AND CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, Products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply fully with manufacturers' instructions, including each step in sequence.

C. All manufactured articles, materials, equipment, fixtures and accessories shall be handled, stored, applied, installed, connected, erected, used, cleaned and conditioned, as directed by the manufacturers, unless otherwise indicated, specified, or directed by the Architect in writing. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect **before** proceeding.

D. Comply with specified standards as a minimum quality for the work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform work by persons qualified to produce workmanship of specified quality.

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

1.3 GENERAL WORKMANSHIP

A. Workmanship shall be neat, thorough, substantial and conform to the following, unless otherwise indicated or specified.

B. Units: Set level, plumb, or true to other lines indicated. Fit neatly and closely together and anchor firmly in place.

C. Surfaces:
1. Level, plumb, true to indicated plane;
2. Smooth, flat;
3. Uniform in color and texture;
4. Clean and neat in appearance.

D. Joints and seams: Conceal where possible, except where otherwise indicated or specified.

E. Joints and seams exposed to view:
   1. Neat, straight, tight, flush, smooth, uniform, strong;
   2. Plumb, level or otherwise true to line indicated;
   3. Located where least conspicuous;
   4. Construct to prevent opening;
   5. Equally spaced;
   6. Obtain Architect's written acceptance of joints and seams exposed to view, except where such exposure is shown or specified.

F. Coursing: Uniform, accurately spaced, modular unless otherwise noted.

G. Corners, straight square, sharp, neat, plumb, level or true to other lines indicated.

H. Anchors, fastenings, connections, accessories:
   1. Provide anchors, fastenings, framing, supports, hangers, bracing, brackets, straps, angles, bolts, etc., adequate in size, design and quantity to set and connect work rigidly in place and to safely sustain stresses to which they will normally be subjected.
   2. Conceal such work where possible, except where otherwise indicated or specified.
   3. Such items exposed to view shall be equally spaced, located where least conspicuous and neat in appearance. Obtain Architect's written acceptance of exposed items except where such exposure is shown or specified.

1.4 REFERENCES

A. Where reference is made to publications, tests, standard specifications, manufacturer's directions, data sheets or other literature unless the date is stated, the latest edition published before date of specifications shall apply.

B. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.

C. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.5 FIELD SAMPLES

A. Install field samples at the site as required by individual specifications Sections for review.

B. Acceptable samples represent a quality level for the Work.

C. Where field sample is specified in individual Sections to be removed, clear area after field sample has been accepted by Architect.

1.6 MOCK-UP

A. Assemble and erect specified items, with specified attachment and anchorage devices, flashings, seals, and finishes.

B. If mock-up is permitted by the Contract Documents to be part of the Work, it may be incorporated into the finished Work when approved in advance by the Architect. If mock-up is not permitted to be incorporated in the work, remove mock-up from the site.

1.7 INSPECTION AND TESTING LABORATORY SERVICES

A. Submit name and qualifications of independent testing agencies for approval by the Owner and Architect prior to commencement of the work.

B. The independent firm will perform inspections, test, and other services specified in individual specification Sections and as required by the Architect.

C. Reports will be submitted by the independent firm to the Architect, in triplicate, indicating observations and results of test and indicating compliance or non-compliance with Contract Documents.

D. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage and assistance as requested.
   1. Notify Architect and independent firm 48 hours prior to expected time for operations requiring services.
   2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.

E. Retesting required because of non-conformance to specified requirements shall be performed by the same independent firm on instructions from the Architect. The cost of re-testing shall be borne by the Contractor.

1.8 MANUFACTURERS' FIELD SERVICES AND REPORTS

A. Submit qualifications of observer to Architect 30 days in advance of required observations. Observer subject to approval of Architect and Owner.

B. When specified in individual specification Sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, test, adjust, and balance of equipment as applicable.

C. Contractor shall report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturer's written instructions.

D. Submit report in duplicate to Architect for review, within 15 days of observation.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

END OF SECTION 01 45 00

01 45 29
TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Selection and payment.

B. Laboratory responsibilities.

C. Laboratory reports.

D. Limits on testing laboratory authority.

E. Contractor responsibilities.

F. Schedule of inspections and tests.

1.2 REFERENCES
A. ANSI/ASTM D 3740 - Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

B. ANSI/ASTM E 329 - Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction.

1.3 SELECTION AND PAYMENT
A. Contractor shall employ and pay for services of an independent testing laboratory to perform Certified Inspection and Testing Firm (CITF) when testing is indicated in the separate specification sections of these Contract Documents.

B. Employment of testing laboratory (CITF) shall in no way relieve Contractor of obligation to perform work in compliance with requirements of Contract Documents.

1.4 LABORATORY RESPONSIBILITIES
A. Perform testing on samples submitted by Contractor to testing laboratory.

B. Provide qualified personnel at site. Cooperate with Architect/Project Engineer and Contractor in performance of services.

C. Perform specified inspection, sampling, and testing of products in accordance with specified standards.

D. Ascertain compliance of materials and mixes with requirements of Contract Documents.

E. Promptly notify Contractor and Owner of observed irregularities or non-conformance of Work or products.

F. Perform additional inspections and tests required by Architect/Project Engineer.

G. Attend preconstruction conferences and progress meetings.

1.5 LABORATORY REPORTS
A. After each inspection and test, promptly submit electronic copies of laboratory report to Contractor, Architect/Engineer and Owner.

B. Include:
1. Data issued.
2. Project title and number.
3. Name of inspector.
4. Date and time of sampling or inspection.
5. Identification of product and Specification Section.
6. Location in the Project.
7. Type of inspection or test.
8. Date of test.
9. Results of tests.
10. Compliance with Contract Documents.

C. When requested by Architect/Engineer, provide interpretation of test results.

1.6 LIMITS ON TESTING LABORATORY AUTHORITY

A. Laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.

B. Laboratory may not approve or accept any portion of the Work.

C. Laboratory may not assume any duties of Contractor.

D. Laboratory has no authority to stop the Work unless life-threatening health or safety conditions exist.

1.7 CONTRACTOR RESPONSIBILITIES

A. Deliver to laboratory, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.

B. Cooperate with laboratory personnel and provide access to the Project.

C. Provide incidental labor and facilities to provide access to Work to be tested, to obtain and handle samples at the site or at source of products to be tested, and to facilitate tests and inspections, storage and curing of test samples.

D. Notify CITF and laboratory 24 hours prior to expected time for operations requiring inspection and testing services.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF INSPECTIONS AND TESTS

The following list is not meant to be all inclusive. Refer to individual specification sections for testing requirements

A. Cast-In-Place Concrete

B. Masonry Mortar and Grout

C. Plumbing Systems

D. Heating, Cooling, & Ventilation Systems

E. Electrical Systems

END OF SECTION 01 45 29

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

GENERAL

1.1 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

1.2 USE CAHRGES, AND USE BY OTHER ENTITIES

General: Installation and removal of, and use charges for, temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Engineer's construction forces, Engineer, occupants of Project, testing agencies, and authorities having jurisdiction.

INFORMATIONAL SUBMITTALS

A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.

B. Project Identification and Temporary Signs: Submit fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.

C. Moisture-and Mold-Protection Plan: Indicate procedures and controls for protecting existing context, materials, and construction from water absorption and damage and mold.

QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

PROJECT CONDITIONS

Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Engineer's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile units, with serviceable finishes, temperature controls, and foundations adequate for normal loading, will be allowed if of a size acceptable to the Engineer.

B. Construction Meetings: Meetings may be held on-site in the Field Office

Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

2.2 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

Locate facilities to limit site disturbance, also see Section 01 10 00 "Summary."

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

General: Install temporary service or connect to existing service.

1. Arrange with utility company, Engineer, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

D. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse environmental effects including low temperatures and high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.

E. Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

1. Install electric power service unless otherwise indicated.

F. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, safety, and traffic conditions.

G. Telephone Service: If construction site office is not provided with land-line telephone and internet service, the General Contractor's superintendent shall at a minimum carry a cell phone and have direct access to email.

SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

Maintain support facilities until Engineer schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Engineer.

Traffic Controls: Comply with requirements of authorities having jurisdiction including required coordination and permitting

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs as indicated in Division 1 and Documents.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.

Provide temporary, directional signs for construction personnel and visitors.

3. Maintain and touch up signs so they are legible at all times.

Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

Truck, cranes, and similar devices used only for hoisting materials are considered "tools and equipment" and not temporary facilities.

SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from Engineer and adjacent property Owner to access property for that purpose.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways.

1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
2. Inspect, repair, and maintain erosion-control and sedimentation-control measures during construction until permanent vegetation has been established.
3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.

Site Enclosure Fence: Prior to commencing work, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.

1. Extent of Fence: As required to enclose entire Project site or portion, as shown in the Drawings, and as determined sufficient to accommodate construction operations.

Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Engineer.

Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.

I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

J. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.

1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and fire-protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

3.5 MOISTURE AND MOLD CONTROL

Contractor's Moisture-Protection Plan: Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.

1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
3. Indicate methods to be used to avoid trapping water in finished work.

B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

1. Protect materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard and replace stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.

OPERATION, TERMINATION, AND REMOVAL

Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Daily construction cleanup:
   1. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

C. Maintenance: Maintain facilities in good operating condition until removal.

   1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

Temporary Facility Changeover: Do not change over from using temporary facilities to permanent facilities until Substantial Completion or as otherwise indicated in the contract unless explicit permission is given by the Engineer in writing in advance.

E. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

   1. Materials and facilities that constitute temporary facilities are property of Contractor. Engineer reserves right to take possession of Project identification signs.

At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 77 00 "Closeout Procedures."

END OF SECTION 01 50 00

01 50 01
ENGINEER'S FIELD OFFICE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for furnishing, cleaning and maintaining, in good condition, an Engineer's Field Office at a location within the immediate vicinity of the project and approved by the Engineer. The Engineer's office shall be separated from any offices used by the Contractor, and it, and all items therein, shall be for the exclusive use of the City's Engineers and Inspectors. Rented properties that conform to the type of office specified in the Contract Documents will be acceptable.

1.2 INFORMATIONAL SUBMITTALS

A. Office Floor Plan: Show walls, windows, doors, furniture, fixtures, and electrical, plumbing and mechanical elements.

PART 2 -PRODUCTS

2.1 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile unit, with serviceable finishes, temperature controls, and foundations adequate for normal loading.

PART 3 -EXECUTION

3.1 GENERAL

A. The Office shall be set up, equipped and made ready for use a minimum of five (5) days prior to commencement of the Work and shall remain until all field records have been completed, unless otherwise arranged with the Engineer. Upon removal the location shall be restored and left in a condition acceptable to the Engineer.

B. Unless otherwise specified, the Office and all equipment and accessories furnished by the Contractor shall become the property of the Contractor at the completion of the project.

3.2 FIELD OFFICE REQUIREMENTS

A. Provide a field office containing no less than 360 sf. Provide adequate natural light. Windows shall be capable of being opened and closed and be equipped with latches and screens. Each window shall have venetian blinds or shades. Ceiling height shall be a minimum of 7'-6".

B. The Office shall be entirely enclosed, waterproofed, walls shall achieve minimum R11, ceiling/roof shall achieve minimum R30.

C. The Office shall have an outside door that locks.

D. In some cases, Contract Documents will designate a space for the Engineer's office, however when the Contract Documents do not designate an area, it is understood that the Contractor will provide space for the Engineer's office and laydown areas.

E. Unless specified otherwise, The Office shall comply with the Federal Americans with Disability Act (ADA) Accessibility Guidelines for Buildings and Facilities.

F. Provide cleaning once per week, including dusting of all surfaces, and mopping of the floors. Provide additional cleaning at The Engineer's reasonable request during phases of high dust and high traffic on the site.

G. A four foot by one foot (4' X 1') minimum sign with the message "ENGINEER'S OFFICE - BALTIMORE CITY" shall be attached to or mounted in front of the office. The sign shall have a black background with minimum three inch (3") height white lettering. It shall have a one inch (1") wide white border around the entire sign.

H. Electrical service shall conform to national and state electrical codes with satisfactory artificial lighting. The minimum illumination level shall be seventy-five (75) foot-candles.

I. Equipment shall be provided to enable heating the office to at least seventy degrees (70°) F and cooling to at least seventy-eight degrees (78°) F.

J. Fire extinguishers and any other safety equipment required by code shall be provided and maintained.

K. Wireless internet service shall be provided for The Office.

L. Provide, deliver, and regularly maintain self-contained toilet units of type acceptable to Engineer, adequate for Engineer's use at the project site. The Engineer's sanitary facilities shall be separate from any toilet units used by the Contractor. Soap and paper towels will be re-supplied at the Engineer's reasonable request.

M. Provide a minimum of 10 sf of lockable closet space.

N. Provide One (1), twelve (12) cu.ft. refrigerator.

O. Provide One (1), apprx. 1.3 cu ft, 1200-Watt Countertop Microwave.

P. Provide One (1) electric water cooler including bottled water and disposable cups.

Q. Provide a printer/copier machine capable of up to 11x17 black and white output. Contractor shall supply service as necessary, ensure The Engineer can connect to it through Wired and Wireless connection, and a reasonable supply of paper and ink upon request.

R. Provide One (1) 55" LCD Monitor/TV with capability for wired and wireless connections.

S. Provide at least one desk between 36" and 60" in width, and one working table 36" x 54" inches. Provide a minimum of two desk chairs and 4 conference chairs.

3.3 OTHER OFFICE REQUIREMENTS

A. Provide One (1) Laptop.

1. The Laptop will, immediately upon provision, become the permanent property of The Engineer. Provide all necessary payment/warranty information necessary such that the Engineer can invoke warranty service.
2. Provide Dell Precision 55xx series, or approved equal, with latest Windows (64-bit) Operating system pre-installed, Intel i7 Processor, min. 16 gb of Ram, 250 Gb Solid State Hard drive, and CADD-grade graphics chip.

END OF SECTION 01 50 01

SECTION 01 56 39
TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section Includes: General protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.

B. Related Requirements:

1. Section 02 41 13 Minor Selective Site Demolition for removal of existing site features.

2. Section 31 23 16 Excavation for removal of paving which may impact tree roots.

3. Section 01 50 00 "Temporary Facilities and Controls" for temporary controls, utilities, support facilities, temporary site fencing, and, if applicable, temporary erosion and sedimentation controls if not specified in Section 311000 "Site Clearing".

4. Section 31 10 00 "Site Clearing and Grubbing" for removing existing trees and shrubs and for temporary erosion- and sedimentation-control measures if not specified in Section 01 50 00 "Temporary Facilities and Controls".

1.2 DEFINITIONS

A. Caliper: Diameter of a trunk measured by a diameter tape or the average of the smallest and largest diameters at a height 6 inches (150 mm) above the ground for trees up to and including 4-inch (100-mm) size at this height and as measured at a height of 12 inches (300 mm) above the ground for trees larger than 4-inch (100-mm) size.

B. Caliper (DBH): Diameter breast height; diameter of a trunk as measured by a diameter tape or the average of the smallest and largest diameters at a height 54 inches (1372 mm) above the ground line for trees with caliper of 8 inches (200 mm) or greater as measured at a height of 12 inches (300 mm) above the ground.

C. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings.

D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.3 PREINSTALLATION MEETINGS

A. Mandatory Preinstallation Conference: Conduct conference at Project site prior to commencement of excavation or demolition activities.

1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:

a. Tree-service firm's personnel and equipment needed to make progress and avoid delays.
b. Arborist's responsibilities.
c. Quality-control program.
d. Coordination of Work and equipment movement with the locations of protection zones.
e. Trenching by hand or with air spade within protection zones.
f. Field quality control.
g. Procedures for mitigating trees damaged by construction activities.

2. Conference shall includes the Owner, Engineer, Design Team project manager and representatives from Baltimore City Forestry Department.

1.4 ACTION SUBMITTALS

A. Product Data:

1. General protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction

B. Shop Drawings:

1. Staging and Access Plan: Include plans, elevations, and sections showing trees and plants to be protected, locations of protection-zone fencing and signage, and the relationship between equipment-movement routes and material storage locations with protection zones. Clearly indicate the location of any construction access within the critical root zones of trees.
2. Detail fabrication and assembly of protection-zone fencing and signage.
3. Indicate extent of utility boring and trenching by hand or with air spade within protection zones.

C. Tree-Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.

1. Species and size of tree.
2. Location on site plan. Include unique identifier for each.
3. Reason for pruning.
4. Description of pruning to be performed.
5. Description of maintenance following pruning.

D. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.

E. Mitigation Requirements: As required by jurisdiction or as developed by the Owner's Forester, for mitigation of damage to trees and other plantings caused by construction practice which do not comply with the drawings or specifications. Include the following:

1. Minimum 24 hours notice to the Owner to inspect construction damage to protected trees.

2. Local ordinances governing tree mitigation.
3. Standards established under the approved tree mitigation report developed by the arborist.

4. "Digital Guide for Plant Appraisal" by Council of Tree and Landscape Appraisers.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Statements: For arborist and tree service firm.

B. Certification: From arborist, certifying that trees indicated to remain have been protected during construction in accordance with recognized standards and that trees were promptly and properly treated and repaired when damaged.

C. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.

D. Existing Conditions: Field Verified documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.

1. Use sufficiently detailed photographs or video recordings.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

E. Quality-control program.

1.6 QUALITY ASSURANCE

A. Arborist Qualifications: Certified Arborist as certified by ISA.

B. Tree-Service Firm Qualifications: An experienced tree-service firm that has successfully completed temporary tree- and plant-protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.

C. Quality-Control Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work without damaging trees and plantings. Include dimensioned diagrams for placement of protection-zone fencing and signage, the arborist's and tree-service firm's responsibilities, instructions given to workers on the use and care of protection zones, and enforcement of requirements for protection zones.

1.7 FIELD CONDITIONS

A. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Moving or parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.

7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

B.. Do not direct vehicle or equipment exhaust toward protection zones.

C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

D. Take precautions to protect plants from airborne contaminants, such as paint or fireproofing overspray.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Backfill Soil: Planting soil of suitable moisture content and granular texture for placing around tree; free of stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth.

1. Planting Soil Mixture: Well-blended mix of 1/3 existing soil with 1/3 planting soil and 1/3 existing soil.

B. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:

1. Type: Shredded hardwood Ground or shredded bark Wood and bark chips.
2. Size Range: ½" – 2" in length
3. Color: Natural.

4. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch (50-mm) maximum opening in pattern and weighing a minimum of 0.4 lb/ft. (0.6 kg/m); remaining flexible from minus 60 to plus 200 deg F (minus 16 to plus 93 deg C); inert to most chemicals and acids; minimum tensile yield strength of 2000 psi (13.8 MPa) and ultimate tensile strength of 2680 psi (18.5 MPa); secured with plastic bands or galvanized-steel or stainless steel wire ties; and supported by tubular or T-shape galvanized-steel posts spaced not more than 96 inches (2400 mm) apart.

   a. Height: **48 inches (1200 mm)**.
   b. Color: High-visibility orange, nonfading.

5. Gates: Single- swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones; leaf width 36 inches (914 mm).

C. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering and as follows:

1. Size and Text: As indicated on Drawings.
2. Lettering: 3-inch- (76-mm-) high minimum, black characters on white background.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

B. Prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

3.2 PREPARATION

A. Field Locate and clearly identify trees, shrubs, and other vegetation to remain. each tree trunk at 54 inches (1372 mm) above the ground.

B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

3.3 TREE PROTECTION

A. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated. Do not exceed indicated thickness of mulch.

1. Apply 3-inch (50-mm) uniform thickness of organic mulch unless otherwise indicated. Do not place mulch within 6 inches (150 mm) of tree trunks.

2. Install temporary root-protection matting over mulch where construction vehicles will be impacting critical root zones.

B. Trunk Protection: Protect the trunk of each tree to remain as follows:

1. Install 2-by-4-inch (50-by-100-mm) wood planks around trunk at maximum 3 inches (76 mm) apart. Minimum three planks per tree. Band together with no less than three steel bands stapled to the planks to hold them securely in place. Wrap orange plastic construction fencing to a minimum of three layers outside slats. Fasten wrap with wire.

a. Height: 48 inches (1200 mm).

3.4 PROTECTION ZONES

A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people and animals from easily entering protected areas except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections

where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.

1. Plastic Fencing: Stretch fabric taut and secure to posts without bows or sags.

B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Architect. Install one sign spaced approximately every 20 ft. (6 m) on protection-zone fencing, but no fewer than four signs with each facing a different direction.

C. Maintain protection zones free of weeds and trash.

D. Maintain hydration of plants to assure plant survival.

E. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.

1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.5 EXCAVATION

A. General: Excavate at edge of protection zones and for trenches indicated within protection zones in accordance with requirements in Section 312000 "Earth Moving" unless otherwise indicated.

B. Trenching within Protection Zones: Where utility trenches are required within protection zones, excavate under or around tree roots by hand or with air spade, or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots.

3.6 ROOT PRUNING

A. Prune tree roots that are affected by temporary and permanent construction. Prune roots as indicated on Drawings.

1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
2. Cut Ends: Do not paint cut root ends.
3. Temporarily support and protect roots from damage until they are permanently covered with soil.
4. Cover exposed roots with burlap and water regularly.
5. Backfill as soon as possible in accordance with requirements in Section 312000 "Earth Moving."

B. Root Pruning at Edge of Protection Zone: Prune tree roots flush with the edge of the protection zone by cleanly cutting all roots to the depth of the required excavation.

C. Root Pruning within Protection Zone: Clear and excavate by hand or with air spade to the depth of the required excavation to minimize damage to tree root systems. If excavating by hand, use narrow-tine spading forks to comb soil to expose roots. Cleanly cut roots as close to excavation as possible.

3.7 CROWN PRUNING

A. Prune branches that are affected by temporary and permanent construction. Prune branches as indicated on Drawings, under direction of Owner's Forester.

1. Prune to remove only injured, broken, dying, or dead branches unless otherwise indicated. Do not prune for shape unless otherwise indicated.
2. Do not remove or reduce living branches to compensate for root loss caused by damaging or cutting root system.
3. Pruning Standards: Prune trees in accordance with ANSI A300 (Part 1).

    a. Type of Pruning: raising to 15' height as required to prevent damage from construction vehicles.
    b. Specialty Pruning: Structural where indicated.

B. Unless otherwise directed by arborist and acceptable to Engineer, do not cut tree leaders.

C. Cut branches with sharp pruning instruments; do not break or chop.

D. Do not paint or apply sealants to wounds.

E. Provide subsequent maintenance pruning during Contract period as recommended by arborist.

F. Chip removed branches and spread over areas identified by Owner.

3.8 FIELD QUALITY CONTROL

A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.9 REPAIR AND REPLACEMENT

A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or to be relocated that are damaged by construction operations, in a manner approved by Engineer and Owner.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours in accordance with arborist's written instructions.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.

B. Trees: Remove and replace trees indicated to remain that are more than 25 percent dead or in an unhealthy condition before the end of the two-year warranty period or are damaged during construction operations that Engineer determines are incapable of restoring to normal growth pattern.

a. Species: As selected by Owner's Forester.

2. Plant and maintain new trees as specified in Section 32 93 00 "Plants."

3.10 PENALTIES FOR CONSTRUCTION DAMAGE TO TREES

A. General: the Contractor shall pay the following penalties for damage to trees during the construction process.

1. Penalties shall be the equivalent Fee In Lieu charge for removal of specimen trees.
   a. These penalties shall be for the first 60" diameter breast height removed, without the step down requirement.
2. Tree survival will be evaluated by the Owner's Forester within the required two-year warranty period.
3. Construction damage is defined as physical damage to the tree's trunks or branches or practices such as damaging roots without proper treatment, storing materials within the protected critical root zone or compaction to root systems from construction vehicles.

END OF SECTION 01 56 39

SECTION 01 60 00
PRODUCT REQUIREMENTS

GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

1.2 DEFINITIONS

Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.3 ACTION SUBMITTALS

A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Engineer will notify Contractor of approval or rejection of proposed comparable product request within 21 days of receipt of request, or 7 business days of receipt of additional information or documentation, whichever is later.

a. Form of Approval: As specified in Section 01 33 00 "Submittal Procedures."
b. Use product specified if Engineer does not issue a decision on use of a comparable product request within time allocated.

B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 01 33 00 "Submittal Procedures." Show compliance with requirements.

1.4 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.

2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions including temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.

1.6 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on

product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Engineer.

2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.

C. Submittal Time: Comply with requirements in Section 01 77 00 "Closeout Procedures."

PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.

2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Engineer reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Engineer will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

B. Product Selection Procedures:

Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Products:

Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.

b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.

4. Manufacturers:

Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.

b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.

Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

C. Visual Matching Specification: Where Specifications require "match Engineer's sample", provide a product that complies with requirements and matches Engineer's sample. Engineer's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 01 25 00 "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Engineer from manufacturer's full range" or similar phrase, select a product that complies with requirements. Engineer will select color, gloss, pattern, density, or texture from manufacturer's product line.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Engineer may return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.

4. List of similar installations for completed projects with project names and addresses and names and addresses of engineers, if requested.
5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 60 00

01 62 00
PRODUCT OPTIONS

PART 1 - GENERAL

1.1 SUMMARY
- A. Section includes:
  1. Product Options
  2. Substitutions

1.2 PRODUCT OPTIONS
- A. Products specified by reference standards or by description only: Any product meeting those standards or description.

- B. Products specified by naming one or more manufacturers:
  Products of manufacturers named and meeting specifications, no options or substitutions allowed.

- C. Products specified by naming one or more manufacturers with a provision for substitutions: Submit a request for substitution for any manufacturer not named.

1.3 SUBSTITUTIONS
- A. Instructions to Bidders state time restrictions for submitting requests for substitutions during the bidding period.

- B. Submit requests in accordance with the requirements specified in this Section. Substitution acceptance, if any, will be stated by addenda issued prior to Bid Date.

- C. Substitutions may be considered after award of Contract only when a product specified becomes unavailable through no fault of the Contractor.

- D. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Documentation shall include point by point comparison of specified product to proposed substitution.

- E. A request constitutes a representation that the Bidder or Contractor:
  1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
  2. Will provide the same warranty for the substitution as for the specified product.
  3. Will coordinate installation and make changes to other work which may be required for the Work to be completed with no additional cost to Owner.
  4. Waives claims for additional costs or time extension which may subsequently become apparent.

- F. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without prior separate written request, or when acceptance will require revision to the Contract Documents.

- G. Substitution Submittal Procedure:
  1. Submit electronic copies of Request for Substitution for consideration. Limit each request to one proposed substitution.
  2. Submit shop drawings, product data, and certified test results attesting to the

proposed product equivalence.

3. The Architect will make notification in writing, of decision to accept or reject request.

4. List of similar installations for completed projects with project names and addresses and names and addresses of Engineers.

H. Determination of Approved Equal:

The term "Approved Equal", as it is used in the Contract Documents, shall be interpreted as an opportunity for the Contractor to substitute a product that is equal to the specified product in all regards, subject to approval by the Architect of the substitution. The burden of researching the marketplace and finding an "Approved Equal" product shall be the sole responsibility of the Contractor. The use of the term "Approved Equal" shall in no way be interpreted to mean that an equal product is currently manufactured or available. The use of the term "Approved Equal" is intended to communicate to the contractor that the Architect has not conducted an exhaustive search to find equal products, but the Contractor has the opportunity to do so.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

END OF SECTION 01 62 00

SUBSTITUTION REQUEST

TO: _____

PROJECT: _____

SPECIFIED ITEM:

_____	_____	_____	_____
Section	Page	Paragraph	Description

The undersigned requests consideration of the following:

PROPOSED SUBSTITUTION: _____

_____

Attached data includes product description, specifications, drawings, photographs, performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.

Attached data also includes a description of changes to the Contract Documents which the proposed substitution will require for its proper installation.

The undersigned certifies that the following paragraphs, unless modified by attachments, are correct:

1. The proposed substitution does not affect dimensions shown on drawings.
2. The undersigned will pay for changes to the building design, including engineering design, detailing and construction costs caused by the requested substitution.
3. The proposed substitution will have no adverse affect on other trades, the construction schedule, or specified warranty requirements.
4. Maintenance and service parts will be locally available for the proposed substitution.
5. All provisions of Section 01 62 00 apply to this substitution.

The undersigned further states that the function, appearance, and quality of the proposed substitution are equivalent or superior to the specified item.

SUBMITTED BY:

Signature _____ For use by the design consultant

Firm _____ [ ] Accepted [ ] Accepted as noted

Address _____ [ ] Not Accepted [ ] Received too late

_____ By _____

Date _____

Telephone _____ Remarks _____

Attachments:

END OF SECTION 01 62 00.01

01 66 00
PRODUCT STORAGE & HANDLING REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Packaging and Transportation.

B. Delivery and Receiving

C. Product Handling

D. Storage, General

E. Enclosed Storage

F. Exterior Storage

G. Maintenance of Storage

H. Protection of Finished Work

I. Repair and Replacement

PART 2 – PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.1 TRANSPORTATION AND HANDLING

A. Packaging and Transportation

1. Require supplier to package finished products in boxes or crates for protection during shipment, handling, and storage. Protect sensitive products against exposure to elements and moisture.
2. Protect sensitive equipment and finishes against impact, abrasion, and other damage.

B. Delivery and Receiving

1. Arrange deliveries of products in accordance with construction progress schedules. Allow time for inspection prior to installation.
2. Coordinate deliveries to avoid conflict with Work and conditions at site; limitations on storage space; availability of personnel and handling equipment; and Owner's use of premises.
3. Deliver products in undamaged, dry condition, in original unopened containers or packaging with identifying labels intact and legible.
4. Clearly mark partial deliveries of component parts of equipment to identify equipment and contents, to permit easy accumulation of parts, and to facilitate assembly.
5. Immediately upon delivery, inspect shipment to assure:
   a. Product complies with requirement of Contract Documents and reviewed

submittals.
b. Quantities are correct.
c. Accessories and installation hardware are correct.
d. Containers and packages are intact and labels legible.
e. Products are protected and undamaged.

C. Product Handling
1. Provide equipment and personnel to handle products, by methods to prevent soiling and damage.
2. Provide additional protection during handling to prevent marring and otherwise damaging products, packaging, and surrounding surfaces.
3. Handle product by methods to avoid bending or overstressing. Lift large and heavy components only at designated lift points.

3.2 STORAGE AND PROTECTION

A. General
1. Store products immediately upon delivery in accordance with manufacturer's instructions, with seals and labels intact. Protect until installed.
2. Arrange storage in a manner to provide access for maintenance of stored items and for inspection.
3. Stored materials must not conflict with work conditions. On-site storage methods and locations are subject to Owner's approval.

B. Enclosed Storage
1. Store products subject to damage by the elements in substantial weathertight enclosures.
2. Maintain temperature and humidity within ranges stated in manufacturer's instructions.
3. Provide humidity control and ventilation for sensitive products as required by manufacturer's instructions.
4. Store unpacked and loose products on shelves, in bins, or in neat groups of like items.

C. Exterior Storage
1. Provide substantial platforms, blocking, or skids, to support fabricated products above ground; slope to provide drainage. Protect products form soiling and staining.
2. Products subject to discoloration or deterioration from exposure to the elements, cover with impervious sheet material. Provide ventilation to avoid condensation.
3. Store loose granular materials on clean, solid surfaces such as pavement, or on rigid sheet materials, to prevent mixing with foreign matter.
4. Provide surface drainage to prevent erosion and ponding of water.
5. Prevent mixing of refuse or chemically injurious materials or liquids.

D. Maintenance of Storage
1. Periodically inspect stored products on a scheduled basis.
2. Verify that storage facilities comply with manufacturer's product storage requirements.
3. Verify that manufacturer-required environmental conditions are maintained continually.
4. Verify that surfaces of products exposed to the elements are not adversely affected and that any weathering of finishes is acceptable under requirements of Contract Documents.

E. Maintenance of Equipment Storage
   1. For mechanical and electrical equipment in long-term storage, provide manufacturer's service instructions to accompany each item, with notice of enclosed instructions shown on exterior of package.
   2. Service equipment on a regularly scheduled basis, maintaining a log of services; submit as a Record Document.

F. Storage of Owner's Salvaged Furnishings and Equipment
   Contractor shall provide temporary storage facilities for items to be salvaged and re-installed.

END OF SECTION 01 66 00

01 73 00
EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:

1. Construction layout.
2. Field engineering.
3. Installation.
4. Cutting and patching.
5. Coordination of Owner's portion of the Work.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.
9. Correction of the Work.

B. Related Requirements:

1. Section 01 11 00 "Summary of Work" for limits on use of Project site.
2. Section 01 33 00 "Submittal Procedures" for submitting surveys.
3. Section 01 77 00 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Project Engineer-accepted deviations from indicated lines and levels, and final cleaning.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

B. Certified Surveys: Submit two copies signed by professional engineer.

C. Certificates: Submit certificate signed by professional engineer, certifying that location and elevation of improvements comply with requirements.

1.5 CLOSEOUT SUBMITTALS

A. Final Property Survey: Submit digital copies showing the Work performed and record survey data.

1.6 QUALITY ASSURANCE

A. Professional Engineer Qualifications: Refer to Section 014000 "Quality Requirements."

B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.

2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with requirements specified in other Sections.

1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.

C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Engineer promptly.

B. Engage a professional engineer experienced in laying out the Work, using the following accepted surveying practices:

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

C. Final Property Survey: Engage a professional engineer to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by professional engineer, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces, unless otherwise indicated on Drawings.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.

F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.

G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located

and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.6 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of Work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

F. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.

5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

G. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

    a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

H. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 COORDINATION OF OWNER'S PORTION OF THE WORK

A. Site Access: Provide access to Project site for Owner's construction personnel.

1. Provide temporary facilities required for Owner-furnished, Contractor-installed products.
2. Refer to Section 01 10 00 "Summary of Work" for other requirements for Owner-furnished, Contractor-installed products.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.

1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.8 PROGRESS CLEANING

A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, in accordance with regulations.

    a. Use containers intended for holding waste materials of type to be stored.

B. Project site free of waste materials and debris.

C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces in accordance with written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 74 00 "Cleaning and Waste Management".

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

C. Comply with manufacturer's written instructions for temperature and relative humidity.

3.10 CORRECTION OF THE WORK

A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.

C. Restore permanent facilities used during construction to their specified condition.

D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01 73 00

01 73 29
CUTTING AND PATCHING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work included: This Section establishes general requirements pertaining to cutting, fitting, and patching of Work required to:
   1. Make the several parts fit properly.
   2. Remove and/or uncover existing finishes or structures to provide for installation or inspection of new work.
   3. Patch existing finishes and structures in connection with new work.
   4. Remove and replace work not conforming to requirements of Contract Documents.
   5. Remove and replace defective work.

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

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in necessary crafts and who are completely familiar with specified requirements and methods needed for proper performance of the work of this Section.

1.3 SUBMITTALS

A. Request for Architect's consent:
   1. Prior to cutting that affects structural safety, submit written request to Architect for permission to proceed with cutting.
   2. Should conditions of Work or schedule indicate required change of materials or methods for cutting and patching, notify Architect and secure the Architect's written permission.

B. Notice to Architect: Submit written notice to Architect designating time Work will be uncovered, to provide for Architect's observation.

1.4 PAYMENT OF COSTS

A. Perform cutting and patching needed to comply with the Contract Documents at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. For replacement of items removed, use materials complying with pertinent Sections of these Specifications. If not identified in other sections of these specifications, provide material to match adjacent construction.

PART 3 - EXECUTION

3.1 CUTTING AND PATCHING

A. General
   1. Where cutting of any structural member is required and such cutting is not indicated or specified, first obtain Architect's written acceptance for each location. Also obtain written approval from local building officials, if required by local building code.
   2. Contractor shall locate and arrange for cutting of openings and chases through walls, floors, and ceilings in advance of need. Avoid unnecessary or excessive cutting. Where cutting of finished surface is required, make cuts neatly along true lines to avoid need for patching. Where possible, make holes and other cuts so they will be concealed by finished work and where they will be least conspicuous. Work in place damaged or defaced by cutting shall be restored to original conditions so such damage or defacement is undetectable upon completion.
   3. Do not cut and patch structural work in a manner resulting in reduction of load carrying capacity or load/deflection ratio. Do not cut and patch operational elements and safety related components in a manner resulting in decreased operational life, increased maintenance, or decreased safety. Do not cut and patch work which is exposed on the exterior or exposed in occupied spaces of the building, in a manner resulting in reduction of visual qualities or resulting in substantial evidence of cut and patch work, both as judged solely by the Architect. Remove and replace work judged by the Architect to be cut and patched in a visually unsatisfactory or otherwise objectionable manner.
   4. Where physical cutting action is required, cut work with sawing and grinding tools, not with hammering and chopping tools. Core drill openings through concrete work.
   5. Patch with seams which are durable and as invisible as possible. Comply with specified tolerances for the work.
   6. Restore exposed finishes of patched areas; and, where necessary extend finish restoration onto retained work adjoining, in a manner which will eliminate evidence of patching.
   7. Where patch occurs in a smooth painted surface, extend final paint coat over entire unbroken surface containing patch, after patched area has received prime and base coats.

B. Materials: Except as otherwise indicated or approved by the Architect, provide materials for cutting and patching which will result in equal or better work than work being cut and patched; in terms of performance characteristics and including visual effect where applicable. Use materials identical with original materials where feasible and where recognized that satisfactory results can be produced thereby.

C. Scope of Cutting and Patching Work: The Contractor shall perform all cutting and patching required and necessary to accomplish the construction of all improvements described in the Contract Documents, at no additional cost to the Owner.

3.2 TEMPORARY SUPPORT AND PROTECTION

A. Provide adequate temporary support for work to be cut, to prevent failure. Do not endanger other work. Provide adequate protection of other work during cutting and patching, to prevent damage; and provide protection of the work from adverse weather exposure.

3.3 SURFACE CONDITIONS

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

B. Discrepancies:

1. If uncovered conditions are not as anticipated, immediately notify Architect and secure needed directions.
2. Do not proceed until unsatisfactory conditions are corrected.

END OF SECTION 01 73 29

SECTION 01 74 19
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Salvaging nonhazardous demolition and construction waste.
2. Recycling nonhazardous demolition and construction waste.
3. Disposing of nonhazardous demolition and construction waste.

1.2 WASTE MANAGEMENT REQUIREMENTS

City requires that this project comply with the requirements set forth in the International Green Construction Code (IgCC) with amendments as identified in the current Building, Fire, and related codes of Baltimore City.

B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.

C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.

D. Contractor shall develop; 1) Construction Material and Waste Management Plan, 2) Building Site Waste Management Plan.

E. Methods of trash/waste disposal that are not acceptable are:
1. Burning on site
2. Burying on site
3. Dumping on other property
4. Illegal disposal of any kind

F. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements including but not limited to Federal, State and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.3 DEFINITIONS

Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.

C. Construction Materials and Waste: As defined by IgCC, construction materials and waste shall include all materials delivered to the site and intended for installation prior to the issuance of the certificate of occupancy, including related packaging.

D. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

E. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

F. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

G. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

H. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 PERFORMANCE REQUIREMENTS

A. General: Achieve end-of-Project rates for salvage/recycling of 15 percent by weight of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials.

ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within **7** days of date established for the Notice to Proceed.

1.6 INFORMATIONAL SUBMITTALS

Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Include the following information:

1. Material category.
2. Generation point of waste.
3. Total quantity of waste in tons.
4. Quantity of waste salvaged, both estimated and actual in tons.
5. Quantity of waste recycled, both estimated and actual in tons.
6. Total quantity of waste recovered (salvaged plus recycled) in tons.
7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

QUALITY ASSURANCE

Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

Waste Management Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:

Review and discuss waste management plan including responsibilities of waste management coordinator.

2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

1.8 WASTE MANAGEMENT PLAN

General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan. Plan shall comply with PHFA requirements.

B. Waste Identification: Indicate anticipated types and quantities of demolition, site-clearing, and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.

Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.

4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

1. Comply with operation, termination, and removal requirements in Section 01 50 00 "Temporary Facilities and Controls."

Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.

1. Distribute waste management plan to everyone concerned within three days of submittal return.
2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
2. Comply with Section 01 50 00 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

SALVAGING DEMOLITION WASTE

A. Salvaged Items for Engineer 's Use: Salvage items for Engineer 's use and handle as follows:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until delivery to Engineer.

4. Transport items to Engineer 's storage area designated by Engineer.
5. Protect items from damage during transport and storage.

RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Engineer.

C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

    a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste from Engineer 's property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE – Inclusion of material types in this list do not necessarily indicate the presence of said material on the site.

Concrete: Remove reinforcement and other metals from concrete and sort with other metals.

Pulverize concrete to maximum 4-inch size.
Crush concrete and screen to comply with requirements in Section 31 20 00 "Earth Moving" for use as satisfactory soil for fill or subbase.

B. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.

Clean and stack undamaged, whole masonry units on wood pallets.

C. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.

D. Metals: Separate metals by type.

1. Structural Steel: Stack members according to size, type of member, and length.
2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

E. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.

F. Conduit: Reduce conduit to straight lengths and store by type and size.

3.5 RECYCLING CONSTRUCTION WASTE

Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

DISPOSAL OF WASTE

General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

Burning: Do not burn waste materials.

C. Burning: Burning of waste materials is permitted only at designated areas on Engineer 's property, provided required permits are obtained. Provide full-time monitoring for burning materials until fires are extinguished.

Disposal: Remove waste materials and dispose of at designated spoil areas on Engineer 's property.

E. Disposal: Remove waste materials from Engineer 's property and legally dispose of them.

END OF SECTION 01 74 19

SECTION 01 77 00
CLOSEOUT PROCEDURES

GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

Substantial Completion procedures.

2. Final completion procedures.
3. Warranties.
4. Final cleaning.
5. Repair of the Work.

1.2 DEFINITIONS

A. Contractor's List of Incomplete Items: Contractor prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's Inspection, to determine if the Work is substantially complete.

1.3 ACTION SUBMITTALS

A. Product Data: For cleaning agents.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

A. Additional requirements from the Standard Specifications (see "Special Provisions" section) in which "Substantial Completion" is referred to as "Conditional Acceptance" will apply.

B. Contractor's List of Incomplete Items: Prepare and submit a *List of Incomplete Items* (to be completed and corrected) A.K.A. *Contractor's punch list*), indicating the value of each item on the list and reasons why the Work is incomplete.

C. Submittals Prior to Substantial Completion: Complete the following a minimum of 14 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Engineer unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Engineer. Label with manufacturer's name and model number where applicable.

Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Engineer's signature for receipt of submittals.

5. Submit test records.

Submit changeover information related to Engineer 's occupancy, use, operation, and maintenance.

D. Procedures Prior to Substantial Completion: Complete the following a minimum of 14 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Engineer of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Engineer. Advise Engineer's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Engineer's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
6. Advise Engineer of changeover in heat and other utilities.
7. Participate with Engineer in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements, including touchup painting.

10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
11. Provide proof of scheduling initial Use and Occupancy inspection.

Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 14 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Engineer, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.

1.7 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:

Submit a final Application for Payment according to Section 01 29 00 "Payment Procedures."

2. Certified List of Incomplete Items: Submit certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.

Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS (CONTRACTOR'S PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding to indoor spaces.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

a. Project name.
b. Date.
c. Name of Engineer.
d. Name of Contractor.
e. Page number.

4. Submit Contractor's List of Incomplete Items in Excel spreadsheet digital format. The list of spaces will correspond with Tabs in Excel. Each item shall include the CSI division association for cross-reference by trade.

5. The absence of items on the punch list and/or failure of engineer to identify items not included on the list shall in no way relieve contractor from completing the Work in the Documents.

SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Engineer for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Engineer 's rights under warranty.

Partial Occupancy: Submit properly executed warranties within 21 days of completion of designated portions of the Work that are completed and occupied or used by Engineer during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (215-by-280-mm) paper.

2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

EXECUTION

3.1 FINAL CLEANING

General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.

b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Sweep concrete floors broom clean in unoccupied spaces.
i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
k. Remove labels that are not permanent.

Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.

p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
q. Leave Project clean and ready for occupancy.

Pest Control: Comply with pest control requirements in Section 01 50 00 "Temporary Facilities and Controls." Prepare written report.

D. Construction Waste Disposal: Comply with waste disposal requirements in Section 01 74 19 "Construction Waste Management and Disposal."

REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, etc.
2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.

    a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.

3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 01 77 00

SECTION 01 78 23
OPERATION AND MAINTENANCE DATA

GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory manuals.
2. Systems and equipment operation manuals.
3. Systems and equipment maintenance manuals.
4. Product maintenance manuals.

1.2 DEFINITIONS

System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.3 CLOSEOUT SUBMITTALS

A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Engineer will comment on whether content of operations and maintenance submittals are acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operations and maintenance manuals in the following format:

PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Engineer.

a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
b. Enable inserted reviewer comments on draft submittals.

2. Operations manual: Provide 3. Include a complete operation and maintenance directory. For printed version enclose title pages and directories in clear plastic sleeves.

Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Engineer and Commissioning Authority will review and comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Engineer will return copy with comments.

1. Correct or revise each manual to comply with Engineer's comments. Submit copies of each corrected manual within 14 days of receipt of Engineer's comments and prior to commencing demonstration and training.

1.4 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Engineer.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager.
7. Name and contact information for Engineer.
8. Name and contact information for Commissioning Authority.
9. Names and contact information for major consultants to the Engineer that designed the systems contained in the manuals.
10. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

PART 2 - PRODUCTS

2.1 EMERGENCY MANUALS

Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Engineer's operating personnel for types of emergencies indicated.

B. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Water leak.
4. Power failure.
5. Water outage.
6. System, subsystem, or equipment failure.

D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Engineer 's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

E. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

2.2 SYSTEMS AND EQUIPMENT OPERATION MANUALS

Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.

B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.

5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed and identify color coding where required for identification.

2.3 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds, as described below.

C. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

    a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

H. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

2.4 PRODUCT MAINTENANCE MANUALS

Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

C. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format,

identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

D. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

Do not use original project record documents as part of operation and maintenance manuals.

2. Comply with requirements of newly prepared record Drawings in Section 01 78 39 "Project Record Documents."

E. Comply with Section 01 77 00 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 01 78 23

01 78 36
WARRANTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Preparation and submittal of warranties.

B. Schedule of submittals.

1.2 FORM OF SUBMITTALS

A. Bind in commercial quality 8-1/2-inch by 11-inch, three-ring "D" type ring binders, with hardback, cleanable plastic covers; 3-inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings and provide table of contents in each binder.

B. Label cover of each binder with typed or machine printed title WARRANTIES with title of Project, Project number, name, address, and telephone number of Contractor; and name of responsible principal.

C. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual; with each item identified with the number and title of the Specification Section in which specified, and the name of Product or Work item.

D. Separate each warranty with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List sub-contractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

1.3 PREPARATION OF SUBMITTALS

A. General: Verify with other specifications Sections for required warranties.

B. Obtain warranties, executed in duplicate by responsible subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of Work. Except for items placed into service with Owner's permission, leave date for beginning of warranty time blank until the Date of Substantial Completion is accepted by the Architect and Owner.

C. Verify that documents are in proper form, contain full information, and are notarized.

D. Co-execute submittals, when required. Provide originals for each warranty. Photostatic copies are not acceptable.

E. Retain warranties until time specified for submittal.

1.4 TIME OF SUBMITTALS

A. Warranties for completed and accepted work shall be dated the same date as the Certificate of Substantial Completion.

B. For items of Work where acceptance is delayed beyond the Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the

beginning of the warranty period.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

END OF SECTION 01 78 36

SECTION 01 78 39
PROJECT RECORD DOCUMENTS

GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.
4. Miscellaneous Record Submittals.

1.2 CLOSEOUT SUBMITTALS

Record Drawings: Comply with the following:

Number of Copies: Submit 1 set of marked-up record prints.

2. Number of Copies: Submit copies of record Drawings as follows:

a. Initial Submittal:

Submit 1 paper-copy set of marked-up record prints.

2) Submit PDF electronic files of scanned record prints and file prints.
3) Submit record digital data files and 1 set of plots.
4) Engineer will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

Final Submittal:

1) Submit 1 paper-copy set of marked-up record prints.
2) Submit PDF electronic files of scanned record prints.
3) Include each drawing, whether or not changes and additional information were recorded.

B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

Reports: Submit into Construction Management Platform (*RDMS*) written report biweekly indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS and SPECIFICATIONS

Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, as well as Specifications Book, incorporating new and revised drawings and specifications as modifications are issued.

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

    a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    b. Accurately record information in an acceptable drawing technique.
    c. Record data as soon as possible after obtaining it.
    d. Record and check the markup before enclosing concealed installations.
    e. Cross-reference record prints to corresponding archive photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

    a. Dimensional changes to Drawings.
    b. Revisions to details shown on Drawings.
    c. Depths of foundations.
    d. Locations and depths of underground utilities.
    e. Revisions to routing of piping and conduits.
    f. Revisions to electrical circuitry.
    g. Actual equipment locations.
    h. Duct size and routing.
    i. Locations of concealed internal utilities.

Changes made by Change Order or Construction Change Directive.

    k. Changes made following Engineer's written orders.
    l. Details not on the original Contract Drawings.
    m. Field records for variable and concealed conditions.
    n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings, Shop Drawings, and Specifications completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record sets (including Specifications) with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.

5. Mark important additional information that was either shown schematically or omitted from original Drawings, including Specifications.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.

2.2 RECORD PRODUCT DATA

Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.

Note related Change Orders, record Specifications, and record Drawings where applicable.

B. Format: Submit record Product Data as annotated PDF electronic file.

1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

MISCELLANEOUS RECORD SUBMITTALS

Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file.

1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Engineer's reference during normal working hours.

END OF SECTION 01 78 39

02 20 01
CONSTRUCTION STAKEOUT

PART 1 GENERAL

1.1 DESCRIPTION

A. This work shall consist of furnishing, placing and maintaining construction layout stakes as specified in the Contract Documents or as directed by the Engineer.

B. Where limits of clearing are not shown in the Contract Documents, the limit of clearing will be the top of cut, toe of slope or limit of ditch excavation.

PART 2 PRODUCTS

2.1 MATERIALS

A. The material for flagging the clearing limits shall be a 3 in. international orange vinyl material with "CLEARING LIMIT" printed on it with 2 in. letters.

B. Grade Stakes shall be timber.

PART 3 EXECUTION

3.1 Line and Grade

A. The Contractor will be responsible for all utility and structure stakeout. Control points were set at the site.

3.2 Equipment and Personnel

A. The Contractor shall use competent personnel and state of the art equipment for all engineering work required to set and maintain the elevations and dimensions as specified in the Contract Documents.

3.3 Control Markers

A. The Contractor shall be responsible for preserving the baseline line and bench marks. When the baseline and bench marks are disturbed or destroyed, they shall be replaced by the Contractor at no additional cost to the Owner.

3.4 Control Stakes

A. The Contractor shall furnish, set and preserve stakes at each station along the utility. Additional stakes as needed for horizontal and vertical controls necessary for the correct layout of the work shall be set by the Contractor.

3.5 Layout

A. For structures as specified in 3.1, the Contractor shall proceed with the layout work. From these field layouts, the Contractor shall check the proposed span lengths by electronic distance measurement or chaining. When chaining is used, the measurements shall be compensated for temperature, sag, and horizontal alignment. The Contractor shall also check the location of the structure to affirm its correct location with relation to existing structures, utilities, and existing conditions that are to remain in their original positions. If any discrepancies are found, the Contractor shall notify the Engineer at once in writing, otherwise, it will be assumed that all planned dimensions, grades and field measurements are correct. All lines established on the ground shall be preserved or referenced, marked, and kept available at all times.

3.6 Subgrade, Subbase and Base Controls

A. The Contractor shall furnish for subgrade, subbase and base courses, a string line and grade with fixed controls having a maximum longitudinal and transverse spacing of 25 ft.

3.7 Flagging

A. In areas where trees are not to be disturbed, the Contractor shall individually flag those trees in a line along the clearing limits that are not to be moved or destroyed. If the clearing flagging has been destroyed and the Engineer determines that its use is still required, the Contractor shall reflag the areas.

B. If the Contractor does not replace destroyed flagging within 48 hours after notification by the Engineer that replacement flagging is needed, the Engineer may proceed to have the area reflagged. The cost of the reflagging by the Engineer will be charged to the Contractor and deducted from any monies due under the Contract.

C. At the completion of construction, the Contractor shall remove all flagging.

END OF SECTION 02 20 01

02 41 13.14
MINOR SELECTIVE SITE DEMOLITION

PART 1 GENERAL

1.1 DESCRIPTION

A. This work shall consist of removing all or part of existing concrete, concrete block, brick or stone structures (headwalls, toe walls, etc.), including concrete piles as specified in the Contract Documents or all such masonry as may interfere with new work or as directed by the Engineer.

PART 2 PRODUCTS

2.1 MATERIALS

NOT APPLICABLE.

PART 3 EXECUTION

3.1 Removal

A. All removal shall be to an elevation of at least 1 ft below sub grade or existing ground, unless otherwise specified in the Contract Documents or as directed by the Engineer. Blasting will not be permitted without the written approval of the Engineer.

B. Piles, grillages, or cribbing under removed masonry shall be cut off and removed to the above limits unless they will not affect the design of new work, in which event, they may be left in place as directed by the Engineer.

3.2 USE OF REMOVED MASONRY

A. Masonry material may be broken and used in the embankment work. The broken material will be considered as rock provided that individual pieces do not exceed 24 inches in any dimension. Larger size rocks may be wasted with the approval of the Engineer.

B. All materials having salvage value shall be incorporated in the work, or stored within the limits of the project as indicated on the Contract Document or as directed by the Engineer.

C. Materials determined to be unsuitable by the Engineer shall be disposed of as excess or unsuitable material at no additional cost to the Owner.

3.3 Protection of Retained Masonry

A. Retained sections that are damaged due to the Contractor's operations as determined by the Engineer shall be repaired or replaced in a manner acceptable to the Engineer at the sole expense of the Contractor. Connecting edges and surfaces shall be cut to lines specified in the Contract Documents or as directed by the Engineer.

END OF SECTION 02 41 13.14

02 41 18
MINOR DEMOLITION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Removal of designated building equipment and fixtures.

B. Removal of designated construction.

C. Disposal of materials.

D. Identification of utilities.

1.2 SUBMITTALS FOR REVIEW

A. Shop Drawings: Indicate demolition and removal sequence and location of salvageable items as well as; location and construction of temporary work.

1.3 SUBMITTALS FOR CLOSEOUT

A. Project Record Documents: Accurately record actual locations of capped utilities, and subsurface obstructions.

1.4 REGULATORY REQUIREMENTS

A. Conform to applicable code for demolition work, dust control, and products requiring electrical disconnection and re-connection.

B. Obtain required permits from authorities.

C. Do not close or obstruct egress width to any building or site exit.

D. Do not disable or disrupt building fire or life safety systems without 3 days prior written notice to Owner.

E. Conform to procedures applicable when hazardous or contaminated materials are discovered.

1.5 SCHEDULING

A. Schedule Work to coincide with new construction.

1.6 PROJECT CONDITIONS

A. Conduct demolition to minimize interference with occupied building areas.

B. Cease operations immediately if structure appears to be in danger and notify Architect. Do not resume operations until directed.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION

A. Provide, erect, and maintain temporary barriers at locations indicated.

B. Erect and maintain weatherproof closures for exterior openings.

C. Erect and maintain temporary partitions to prevent spread of dust, odors, and noise to permit continued occupancy.

D. Protect existing materials which are not to be demolished.

E. Prevent movement of structure; provide bracing and shoring.

F. Notify affected utility companies before starting work and comply with their requirements.

G. Mark location and termination of utilities.

H. Provide appropriate temporary signage including signage for exit or building egress.

3.2 DEMOLITION

A. Disconnect, cap, and identify designated utilities within demolition areas.

B. Demolish in an orderly and careful manner. Protect existing supporting structural members.

C. Remove demolished materials from site except where specifically noted otherwise. Do not burn or bury materials on site.

D. Remove materials as Work progresses. Upon completion of Work, leave areas in clean condition.

E. Remove temporary Work.

END OF SECTION 02 41 18

03 30 00
CAST IN PLACE CONCRETE

PART 1 GENERAL

1.1 DESCRIPTION

A. This work shall consist of constructing concrete structures or portions of structures including the furnishing, transporting, mixing, placing, curing, and finishing of the portland cement concrete and protecting the structures as specified in the Contract Documents or as directed by the Engineer.

PART 2 PRODUCTS

2.1 MATERIALS

A. Curing Materials: Curing materials shall be burlap cloth, sheet materials, liquid membrane forming compounds, or cotton mats.

1. Burlap cloth shall be made from jute or kenaf and conform to M 182, Class 1, 2, or 3.
2. Sheet material shall conform to M 171 with the following exceptions:

    a. White Opaque Burlap Polyethylene Sheeting. Tensile strength and elongation requirements are waived. The sheeting shall have a finished product weight of not less than 10 oz/yd^2.
    b. White Opaque Polyethylene Backed Nonwoven Fabric. The material shall conform to a. (above), with the thickness requirement waived. The finished product weight shall be a minimum of 5 oz/yd^2.
    c. White Opaque Polyethylene Film. Tensile strength and elongation requirements are waived.

3. Liquid membrane forming compounds shall conform to M 148. Field control testing of the white pigmented curing compounds shall be on the basis of weight per gallon. The samples shall not deviate more than ± 0.3 lb/gal from the original source sample.
4. Cotton mats shall consist of a filling material of cotton bats or bats covered with unsized cloth and tufted or stitched to maintain the shape and stability of the unit under job conditions of handling.

    a. The covering shall be either cotton cloth, burlap or jute having the following properties:

        1) Cotton cloth covering shall weigh not less than 6.0 oz/yd^2 and shall have an average of not less than 32 threads/inch of warp and not less than 28 threads/inch of filling. The raw material used in the manufacture of the cotton cloth shall be raw cotton, cotton comber waste, cotton card strip waste, or combinations thereof.

2) Burlap or jute covering for cotton mats shall weigh not less than 6.4 oz/yd^2 and shall have not less than of 8 threads/inch of warp and not less than 8 threads/inch of filling. It shall be the grade known commercially as "firsts" and shall be free from avoidable imperfections in manufacture and from defects or blemishes affecting the serviceability.

b. The filling material for the mats shall be a cotton bat, or bats made of raw cotton, cotton waste, cotton linters, or combinations thereof, and shall weigh not less than 12 oz/yd^2.

B. Form Release Compound

1. Form release compounds shall effectively prevent the bond of the concrete to the forms. The form release compounds shall not cause discoloration of the concrete or adversely affect the quality or rate of hardening at the interface of the forms.
2. The flash point of the form release compound shall be a minimum of 100° F when tested as specified in T 73.

C. Coarse and Fine Aggregate. The grading requirements for coarse aggregate and fine aggregate are shown in Table A. The physical properties for coarse aggregate and fine aggregate are shown in Table B.

D. Cement. Portland cement shall conform to M 85, with the fineness and the time of setting determined in conformance with T 153 and T 131, respectively. Blended hydraulic cement shall conform to M 240, Type I (PM) or a Type IP containing 15 to 25 percent pozzolan by weight of cement. Maximum loss on ignition shall be 3.0 percent and ground iron blast furnace slag shall not be used for blending. The requirement for a manufacturer's written statement of the chemical composition is waived.

TABLE A – AGGREGATE GRADING REQUIREMENTS TEST METHOD T27															
MATERIAL		SIEVE SIZE													
		1-1/2"	1"	3/ 4"	1/ 2"	3/8"	No.4	No.8	No.10	No.16	No.30	No.40	No.50	No.100	No.200
COARSE AGGREGATE - PORTLAND CEMENT CONCRETE	57 and UNDERDRAIN (a)	100	95–100	—	25–60	—	0–10	0–5	—	—	—	—	—	—	—
	67	—	100	90–100	—	20–55	0–10	0–5	—	—	—	—	—	—	—
	7	—	—	100	90–100	40–70	0–15	0–5	—	—	—	—	—	—	—
FINE AGGREGATE — PORTLAND CEMENT CONCRETE, UNDERDRAIN, and PNEUMATIC MORTAR (b)		—	—	—	—	100	95–100	—	—	45–85	—	—	5–30	0–10	—
COARSE AGGREGATE — LIGHTWEIGHT PORTLAND CEMENT CONCRETE		—	100	90–100	—	10–50	0–15	—	—	—	—	—	—	—	—
FINE AGGREGATE — LIGHTWEIGHT PORTLAND CEMENT CONCRETE (b)		—	—	—	—	100	85–100	—	—	40–80	—	—	10–35	5–25	—
FINE AGGREGATE/SAND MORTAR and EPOXIES (b)		—	—	—	—	—	100	95–100	—	—	—	—	—	0–25	0–10
MINERAL FILLER		—	—	—	—	—	—	—	—	—	100	—	95–100	—	70–100
CRUSHED GLASS (c)		—	—	100	—	—	0–55	—	—	45–85	—	—	—	0–10	—

(a) When this material is used for drainage applications, recycled concrete shall not be used.
(b) Fine aggregate includes natural or manufactured sand.
(c) Crushed glass shall not contain more than one percent contaminants by weight.

TABLE B – AGGREGATE PHYSICAL PROPERTY REQUIREMENTS											
MATERIAL TYPE I	SPECIFICATION	TEST METHOD									
		T90	T 104	T 112	T 113	T 112 & T 113	T 11	T 113	D 4791 (a)	T 96	T 21
		PI	SODIUM SULFATE SOUNDNESS	CLAY LUMPS & FRIABLE PARTICLES	CHERT, LESS THAN 2.40 Sp Gr	SUM OF CLAY LUMPS, FRIABLE PARTICLES & CHERT	MATERIAL FINER THAN No. 200 SIEVE	COAL & LIGNITE	FLAT & ELONGATED	LOS ANGELES ABRASION	ORGANIC IMPURITIES
		max	% max	% max	% max	% max	% max	% max	% max	% max	max
COARSE AGGREGATE — PCC (a)	M 80 CLASS A	—	12	2.0	3.0	3.0	1.0(e)	0.5	12	50	—
FINE AGGREGATE — PCC (a)(b)	M 6 CLASS B	—	10	3.0	—	—	4.0(f)	1.0	—	—	3.0
COARSE AGGREGATE — LIGHTWEIGHT PCC	M 195	—	—	2.0	—	—	—	—	12	—	—
FINE AGGREGATE — LIGHTWEIGHT PCC (c)	M 195	—	—	2.0	—	—	—	—	—	—	3.0
FINE AGGREGATE/SAND MORTAR & EPOXIES	M 45	—	10	1.0	—	—	—	0.5	—	—	3.0
MINERAL FILLER (d)	M 17	NP	—	—	—	—	—	—	—	—	—
CRUSHED GLASS	M 80	—	12	—	—	—	—	—	—	45	—

(a) Coarse and fine aggregate for PCC shall be tested for alkali silica reactivity (ASR) as specified in MSMT 212.
(b) In areas exposed to traffic manufactured sand shall have a minimum ultimate polish value of 8, based on the parent rock.
(c) Fine aggregate conforming to M 6 may be used if the lightweight concrete does not exceed the maximum unit weight specified in the Contract Documents.
(d) Fly ash shall have a maximum of 12 percent loss on ignition.
(e) 1.5 if material passing No. 200 sieve is dust of fracture, free of clay or shale.
(f) 5.0 for concrete not subject to surface abrasion.

TABLE C - PORTLAND CEMENT CONCRETE MIXTURES									
MIX NO.	28 DAY SPECIFIED COMPRESSIVE STRENGTH psi	STANDARD DEVIATION psi	CRITICAL VALUE psi	MIN CEMENT FACTOR lb/yd^3	COARSE AGGREGATE SIZE M 43	MAX WATER/ CEMENT RATIO by wt	SLUMP RANGE inch	TOTAL AIR CONTENT %	CONCRETE TEMPERATURE °F
1	2500	375	2430	455	57, 67	0.55	2 – 5	5 – 8	70 ± 20
2	3000	450	3010	530	57, 67	0.50	2 – 5	5 – 8	70 ± 20
3	3500	525	3600	580	57, 67	0.50	2 – 5	5 – 8	70 ± 20
4	3500	525	3600	615	57, 67	0.55	4 – 8	N/A	70 ± 20
5	3500	525	3600	580	7	0.50	2 – 5	5 – 8	70 ± 20
6	4500	675	4770	615	57, 67	0.45	2 – 5	5 – 8	65 ± 15
7	4200	630	4420	580	57	0.50	1-1/2 - 3 2-1/2 max if slip-formed	5 – 8	70 ± 20
8	4000	600	4180	750	7	0.42	1 – 3	5 – 8	65 ± 15

Note 1: When concrete is exposed to water exceeding 15000 ppm sodium chloride content, Type II cement shall be used. In lieu of a Type II cement, a Type I cement may be used in combined form with an amount of up to 50 percent replacement with ground iron blast furnace slag, or an amount of up to 25 percent replacement with Class F fly ash. The Contractor shall submit to the Engineer the proposed mix proportions and satisfactory test results in conformance with C 1012 showing a sulfate resistance expansion not exceeding 0.10 percent at 180 days.

Note 2: The temperature of Mix No. 6 when used for other than superstructure work as defined in TC-1.02 shall be 70° ± 20° F

Note 3: When synthetic fibers are used, the slump shall not exceed 5 inches.

Note 4: Nonchloride Type C admixtures may be used when approved by the Engineer.

Note 5: If a high range water reducing admixture Type F or Type G is used, the slump requirement shall be 4 to 8 inches.

Note 6: Type A or D admixture shall be added to bridge, box culvert, and retaining wall concrete.

E. Concrete Admixtures. Concrete admixtures shall not contribute more than 200 ppm of chlorides based on the cement content when tested as specified in Maryland Standard Methods of Testing (MSMT) 610. Only prequalified admixtures shall be used. A pozzolan and Type I (PM) or Type IP cement shall not be used in the same mix. Since the strength gains are delayed with these materials, a longer period of time may be required for curing and form removal.

1. Air Entraining Admixtures. Air entraining admixtures shall conform to M 154.
2. Chemical Admixtures. Chemical admixtures shall conform to M 194, Type A, D, or nonchloride C.
3. High Range Water Reducing Admixtures. High range water reducing admixtures shall be liquid and shall conform to M 194, except that the water content shall be a maximum of 85 percent of that of the control, and the durability factor shall be a minimum of 90. Type F shall be used for early strength and shall produce a minimum compressive strength in 12 hours of 180 percent of that of the control. Type G shall be used when early strength is not specified. The manufacturer shall furnish certification as specified in TC-1.02. The certification shall include curves indicating the fluid ounces of admixture per 100 lb of cement as related to water reduction and strength gain for 12 hours when used with a minimum cement factor of 700 lb.
4. Pozzolans. The Contractor may request the use of pozzolans to control alkali silica reactivity or for other reasons. When a pozzolan is used, the minimum cement factor and water/cement ratio shall be determined on the basis of the combined weight of cement and pozzolan. See the following Table D for percentage of fly ash, ground iron blast furnace slag, and microsilica.
    a. Fly Ash. Fly ash shall conform to M 295, pozzolan Class C or F, except that the maximum permissible moisture content shall be 1.0 percent, and when used in concrete Mix Nos. 3 and 6 the loss on ignition shall not exceed 3.0 percent.
    b. Ground Iron Blast Furnace Slag. Ground iron blast furnace slag shall conform to M 302, Grade 100 or 120.
    c. Microsilica. Microsilica shall conform to C 1240, except that the oversize requirement is waived.
5. Ground Iron Blast Furnace Slag. The Contractor may request to substitute a maximum of 50 percent of the weight of cement with ground iron blast furnace slag. When ground iron blast furnace slag is used, the minimum cement factor and water/cement ratio will be determined on the basis of the combined weight of the cement and ground iron blast furnace slag. Ground iron blast furnace slag shall conform to M 302, Grade 100 or 120.
6. Synthetic Fibers. When synthetic fibers are specified in the Contract Documents, the fibers shall be 1/2 to 1-1/2 inch long and conform to C 1116, Type III. The manufacturer shall furnish certification as specified in TC-1.02. The quantity of fibers used and their point of introduction into the mix shall conform to the fiber manufacturer's recommendations.

F. Water. Water shall conform to the pH requirements of T 26, Method B and shall be clear. If questionable quality is suspected, the water shall conform to the limits of the comparison tests with distilled water as specified in T 26. The chloride concentration of water used in mixing and curing of portland cement concrete shall be determined in conformance with D 512 and shall not exceed the following limits:

1. Bridge Superstructure and Prestressed Concrete	500 ppm
2. Latex Modified Concrete	50 ppm
3. Other Concrete and Water Used in Curing	1000 ppm

G. Concrete Mixes

1. Portland cement concrete shall conform to the applicable portions of 03 30 43 and the following:
2. Prior to the start of construction, the Contractor shall submit to the Engineer the source and proportions of materials to be used for each concrete mix.
3. The concrete, with the exception of water and chemical admixtures, shall be proportioned by weight. Water and chemical admixtures may be proportioned by volume or weight. The mix shall be uniform and workable.
4. The concrete mixes shall conform to the aforementioned Table C.
5. Coarse and fine aggregate tested for alkali silica reactivity (ASR) having an expansion up to 0.10 percent may be used without restriction. Those having an expansion greater than or equal to 0.35 percent shall not be used. Aggregates having an expansion greater than 0.10 but less than 0.35 percent shall be considered reactive and shall only be used when one of the following options is employed:

TABLE D

OPTION	ALKALI CONTENT OF CEMENT % max	REPLACE CEMENT WITH		SPECIFICATION
		MATERIAL	% BY WEIGHT	
1	1.50	Class F Fly Ash	15 – 25	M 295
2	1.50	Ground Iron Blast Furnace Slag	25 – 50	M 302 Grade 100 or 120
3	1.50	Microsilica	5 – 7	C 1240
4	—	Blended Cement (a)	100	M 240
5	0.60 (b)	Low Alkali Cement	100	M 85

(a) Pozzolan content of 15 – 25 percent by weight of cement
(b) For mixes (Mix 6 Modified, 12 Hour Patch Mix) used for portland cement concrete pavement repairs; the maximum allowable percentage of alkalis in portland cement shall be 0.70.

6. When reactive aggregate is used, the Contractor shall designate which option will be used to control the formation of the ASR gel. If an option other than option 5 in Table D above is chosen, the Contractor shall conduct tests as specified in Maryland standard Methods of Tests (MSMT) 212 using the reactive aggregate and the proposed cementitious material. For approval, the expansion test results shall not be greater than 0.10 percent. When more than one reactive aggregate is used in a concrete mix, each shall be tested individually and the maximum amount of pozzolan required to reduce the expansion of all the aggregates to less than or equal to 0.10 percent shall be used. The Contractor shall submit to the Engineer the aggregate

source, test results, and the percent and type of replacement cement. The Engineer may withhold source approval pending verification testing.

7. A trial batch will be prepared to certify that each mix conforms to the requirements as specified in the following paragraph 10 and 11. Approval will be given when the test results conform to the minimum required average strength.
8. The Contractor shall make arrangements with the Engineer, at least two weeks in advance, to have an authorized representative present during the batching and testing. Each trial batch shall consist of at least 3 yd^3 of concrete. All materials, equipment, and labor required to produce the trial batches and conduct the required tests shall be supplied at no additional cost to the Owner.
9. The requirement for a trial batch may be waived by the Engineer when past performance records show that the required average strength requirement has been met.
10. Design Required Average Strength. The required average strength (fcr') shall be the larger of:

$$fcr' = fc' + (1.34 \times S) \text{ or}$$
$$fcr' = fc' + (2.33 \times S) - 500$$

where:

fc' = the 28 day specified compressive strength.
S = the standard deviation as specified in the following tables.
A test is defined as the average strength of two companion cylinders.

11. Standard Deviation.

    a. When past performance records are available, a standard deviation shall be established from documented performance records of the producer consisting of a minimum of 15, consecutive 28 day compressive strength tests obtained within the last 12 months. The standard deviation shall be established as the product of the calculated standard deviation and multiplier.

NUMBER OF TESTS	MULTIPLIER FOR STANDARD DEVIATION
15	1.16
20	1.08
25	1.03
30 or more	1.00

Interpolate for intermediate number of tests.

    b. When past performance records are not available, the required average strength shall conform to the following:

SPECIFIED COMPRESSIVE STRENGTH fc', psi	REQUIRED AVERAGE COMPRESSIVE STRENGTH fcr', psi
Less than 3000	fc' + 750
3000 – 4000	fc' + 1000

4001– 5000	$fc' + 1200$
over 5000	fc' + 1400

12. Standard of Control. The average of all sets of three consecutive strength tests shall equal or exceed the critical value as specified in paragraph 10 and 11 which shall be computed using the following formula:

$$\text{Critical Value} = fc' + (1.14 \times S) - 500$$

13. Failure to conform to these criteria shall be cause for immediate investigation and remedial action up to and including suspension of production. A design standard deviation equal to 15 percent of the specified strength shall be used for calculation until a minimum of 15 test results are obtained.
14. The actual average strength and standard deviation shall be computed upon the availability of 28 day strength data comprising a minimum of 15 tests. Should this determination indicate an excessive margin of safety, the concrete mix may be modified to produce lower average strength as approved by the Engineer. If these calculations indicate a coefficient of variation greater than 15, the quality of the concrete and testing will be evaluated.
15. Testing. Sampling shall conform to T 141. Testing shall be performed as follows:

TEST	METHOD	MINIMUM TEST FREQUENCY
Slump	T 119	1 per 50 yd^3 (or fraction thereof)
Air Content	T 152 T 196	1 per 50 yd^3 (or fraction thereof)
Compression	T 23	1 per 50 yd^3 (or fraction thereof)
Compression Mix No. 7 Only	T 23	3 per Day

Note 1: Compressive strength tests are defined as the average of two companion cylinders.
Note 2: A second test will be made if the first slump or air content test fails. Acceptance or rejection will be based on the results of the second test.
Note 3: When constructing plain and reinforced concrete pavements, the testing frequency for slump and air content shall be 1 per 100 yd^3 or fraction thereof.

16. Concrete will be acceptable if both of the following requirements are met:
    a. The average of all sets of three consecutive strength tests equal or exceed the specified design strength.
    b. No individual strength test (average of two companion cylinders) falls below the specified design strength by more than 500 psi.

17. A price adjustment will be based on the contract unit price per cubic yard of concrete. If the unit is a lump sum item, the price per cubic yard for the concrete will be determined by dividing the cubic yards into the contract lump sum price.

    a. Test results more than 500 psi below the specified design strength: Failing strength tests will be considered individually with a price adjustment being applied on the percentage basis as shown below.

    (Price per yd^3) X (quantity of yd^3 represented by the failing concrete strength) X (percent of failure).

    Example:

    \$400.00 per yd^3 X 50 yd^3 X [1-(3600/ 4500 psi)] = \$4,000.00

    1) No payment will be allowed when the test results fall below 50 percent of the specified design strength for structural concrete or 40 percent for incidental concrete.
    2) The Engineer will determine when the strength of the concrete represented by the failing tests is sufficient to remain in place or whether it must be removed and replaced with Specification concrete.

    b. Test results 500 psi or less below the specified design strength: Strength failures 500 psi or less than the specified design strength will be averaged with the next two consecutive tests. If those two tests include a failure greater than 500 psi, those tests will be evaluated as per previous paragraph "a" and replaced with the next consecutive test. If the resulting average falls below the specified design strength, a price adjustment will be applied in conformance with the table below. Any failure will only be included in one grouping.

STRENGTH BELOW THE SPECIFIED (avg of 3 tests) DESIGN LEVEL, psi MIX NO. 1 THRU MIX NO. 7	ADJUSTMENT FACTOR
1 – 100	0.005
101 – 200	0.01
201 – 300	0.02
301 – 400	0.04
401 – 500	0.08

Adjustment price equals (price per yd^3) X (quantity of yd^3 represented by the failing cylinders) X (the adjustment factor).

Example:

\$400.00 per yd^3 X 50 yd^3 X 0.01 = \$200.00

H. Grout: Mortar used for grouting anchor bolts, pipe, handrail posts, and miscellaneous items shall be composed in conformance with one of the following:

1. One part portland cement or blended hydraulic cement and one part mortar sand by dry loose volume.

2. Prepared bag mixes consisting of portland cement or blended hydraulic cement and mortar sand. The prepared mixes shall produce a mortar conforming to the strength requirements specified in the Contract Documents.
3. Nonshrink grout shall be used when specified. The grout shall have a minimum compressive strength of 5000 psi in seven days when tested as specified in T 106, except that the cube molds shall remain intact with a top firmly attached throughout the curing period. The nonshrink grout shall have a minimum expansion of 0.0 percent after seven days when tested as specified in T 160.
4. Epoxy grout shall consist of sand and epoxy mixed by volume in conformance with the manufacturer's recommendations. The grout shall be capable of developing a minimum compressive strength of 6500 psi in 72 hours when tested as specified in Maryland Standard Methods of Tests (MSMT) 501.
5. The natural or manufactured sand for epoxy grout shall conform to the following:

TABLE E - AGGREGATE GRADING REQUIREMENTS TEST METHOD T 27									
MATERIAL	SIEVE SIZE								
	No. 4	No. 8	No. 10	No. 16	No. 30	No. 40	No. 50	No. 100	No. 200
FINE AGGREGATE/SAND MORTAR and EPOXIES	100	95–100	—	—	—	—	—	0–25	0–10

6. An epoxy or polyester anchoring system may be used when approved by the Engineer in conformance with the manufacturer's recommendations. Strength values shall be as specified in the Contract Documents.

I. Linseed Oil: Linseed oil shall consist of a 50-50 mixture (by volume) of boiled linseed oil conforming to Federal Specification TT-L-190 and kerosene conforming to D 3699.

J. Drains, Downspouts, Weep holes and Pipes: The drains, downspouts, weep holes and pipes shall conform to the following Table F. The manufacturer shall furnish certification for all pipes, which verifies that the material and work complies with the applicable specifications and includes the actual test results to confirm the statement. The contents of the certification shall be on the Contractor's/vendor's/manufacturer's letterhead or approved document and shall be duly signed by a company officer.

TABLE F		
MATERIAL	SPECIFICATION	REMARKS
Corrugated Polyethylene Pipe	M 294	12 inch to 48 inch diameter
Corrugated Polyethylene Drainage Pipe	M 252	Perforated underdrain and underdrain outlet pipe.
Polyvinyl Chloride (PVC)	M 304	12 inch to 48 inch diameter

Profile Wall Pipe		
Polyvinyl Chloride (PVC) Pipe	AASHTO Bridge Section 18 PVC Ribbed Pipe	—
	M 278 (a)	Underdrain outlet pipe
	M 278 (a)	Perforated underdrain
Concrete Drain Tile	M 178	—

(a) Perforations shall conform to the requirements of F 758.

K. Reinforcement: Unless otherwise specified, reinforcement bars and reinforcement bars used as anchoring devices, shall be deformed bars conforming to A 615, Grade 60. Deformed bars shall be epoxy coated when specified in the Contract Documents.

1. The epoxy protective coatings shall be a one coat, heat curable, thermosetting powdered coating that is electrostatically applied on metal surfaces as specified in the Contract Documents. Unless otherwise specified in the Contract Documents, the color for structural steel shall match federal standards. For reinforcement steel the color shall be a bright color to contrast with the normal color of reinforcement steel and rust (e.g., orange, red, green, yellow, etc., and not brown or any color in the rust family). If reinforcement steel is coated before fabrication, all hairline cracks and minor damage on fabrication bends shall be patched, even if there is no bond loss.
2. Epoxy coatings shall conform to D 3963.
3. Material used for the touch up system shall be a two part epoxy system designated and color matched for patching the epoxy coating used.
4. Patching material shall be available through the manufacturer of the epoxy powder. The patching material shall be fully cured one hour after application at 35° F ambient.
5. The manufacturer shall furnish certification as specified previously.

L. Cast Iron Scuppers: Iron castings shall conform to A 48, Class 30B.

M. Anchor Bolts: Bolts, nuts and washers for general use shall conform to A 307, and shall be galvanized as specified in A 153. Anchor bolts shall be galvanized and shall conform to A 709, Grade 36.

N. Steel Forms Which Remain In Place: Steel bridge deck forms and deck form supports which remain in place shall be fabricated from steel conforming to A 653, Designation SS, Grades 33 through 80, Coating Designation G 165. The minimum thickness of uncoated steel shall be 0.0359 inches.

O. Joint Sealer:

1. Joint sealer and crack filler shall conform to D 3405 as modified by Maryland Standard Methods of Testing (MSMT) 404. The manufacturer shall furnish certification, which verifies that the material and work complies with the applicable specifications and includes the actual test results to confirm the statement. The contents of the certification shall be on the Contractor's/vendor's/manufacturer's letterhead or approved document and shall be duly signed by a company officer.

2. Manufacturer's recommendations regarding heating and pouring temperatures will be used when testing these materials. If a range of temperatures is recommended, the midpoint will be used as the pour point.
3. Silicone joint sealer and crack filler shall be low modulus, one component compound, which may or may not, require a primer for bonding to concrete. If a primer is required, it shall be as recommended by the sealant manufacturer and shall be placed on the joint faces following the insertion of the backup material.
4. Silicone material, when tested at 73° ± 3° F and 45 to 55 percent relative humidity, shall conform to the following:

TEST PROPERTY	TEST METHOD	SPECIFICATION LIMITS
SHORE A HARDNESS, AT 7 DAYS	D 2240	10-25
Tensile Strength at 150 % Elongation, psi max	D 412 Die C	45
Elongation, % min	D 412 Die C	700
Adhesion in Peel, lb/inch min	Federal Spec TT-S-00230	20
Flow, 0.01 inch max	T 187	0.3
Tack-Free Time, minutes	D 2377	20-75

5. Each container of silicone sealer and crack filler shall have a minimum shelf life of six months. Material more than six months old shall be retested.

P. Preformed Joint Fillers: Preformed joint fillers shall conform to M 153. The bituminous fiber type shall conform to M 213, with the bitumen content determined using T 164. The weathering test shall be deleted for either type of material.

Q. Preformed joint inserts: Preformed inserts shall conform to M 220.

R. Preformed Elastomeric Joint Seals:

1. The manufacturer shall furnish certification, which verifies that the material and work complies with the applicable specifications and includes the actual test results to confirm the statement. The contents of the certification shall be on the Contractor's/vendor's/manufacturer's letterhead or approved document and shall be duly signed by a company officer.
2. Roadway seals for concrete pavement shall conform to M 220.
3. Bridge seals shall conform to M 297.
4. The minimum depth of all seals measured at the contact surface shall be at least 90 percent of the minimum uncompressed width of the seal.
5. The lubricant adhesive shall be compatible with the preformed joint seals and concrete. The Engineer will determine if consistency is suitable at the time of installation.
6. The manufacturer shall furnish certification showing that lubricant adhesive conforms to the following:

TEST AND METHOD	SPECIFICATION LIMITS
Viscosity, D 1084, Method B, CP min	25000
Film Strength, D 412, psi min	2000
Elongation, D 412, % min	250

7. No lubricant adhesive shall be used after nine months from the date of manufacture. Each container shall be plainly marked with the manufacturer's name or trademark, lot number, and date of manufacture.

S. Water Stops and Flashing:

1. Water stops shall be made of rubber or polyvinyl chloride (PVC).
2. The water stop shall be of the shape and dimensions specified in the Contract Documents. The cross section shall be uniform along its length and transversely symmetrical so that the thickness at any given distance from either edge of the water stop shall be uniform.
3. The water stop shall conform to the following:

TEST AND METHOD	SPECIFICATION LIMITS
Tensile Strength, D 412, psi min	2000
Elongation @ Break, D 412, % min	300
Hardness, Rubber, Type A durometer, D 2240	55 ± 5
Hardness, PVC, Type A durometer, D 2240	75 ± 5

4. The Contractor shall furnish a test sample for each lot or shipment of water stop. The manufacturer shall furnish certification as specified in the previous paragraph.
5. Sheet metal for flashing shall be of a material and gauge as specified in the Contract Documents.
6. Copper shall conform to the weight per square foot and gauge requirements of B 152.
7. Galvanized sheets shall conform to A 653, Coating Designation G 90.

T. Fusion Bonded Epoxy

1. The epoxy protective coatings shall be a one coat, heat curable, thermosetting powdered coating that is electrostatically applied on metal surfaces as specified in the Contract Documents. Unless otherwise specified in the Contract Documents, the color for structural steel shall match federal standards. For reinforcement steel the color shall be a bright color to contrast with the normal color of reinforcement steel and rust (e.g., orange, red, green, yellow, etc., and not brown or any color in the rust family). If reinforcement steel is coated before fabrication, all hairline cracks and minor damage on fabrication bends shall be patched, even if there is no bond loss.
2. Epoxy coatings shall conform to D 3963.
3. Material used for the touch up system shall be a two-part epoxy system designated and color matched for patching the epoxy coating used.
4. Patching material shall be available through the manufacturer of the epoxy powder. The patching material shall be fully cured one hour after application at 35° F ambient.
5. The manufacturer shall furnish certification as specified.

6. Water shall conform to the pH requirements of T 26, Method B and shall be clear. If questionable quality is suspected, the water shall conform to the limits of the comparison tests with distilled water as specified in T 26. The chloride concentration of water used in mixing and curing of portland cement concrete shall be determined in conformance with D 512 and shall not exceed the following limits:

Bridge Superstructure and Prestressed Concrete	500	ppm
Latex Modified Concrete	50	ppm
Other Concrete and Water Used in Curing	1000	ppm

U. Epoxy Bonding Compound

1. Epoxy resin bonding material shall consist of a thermosetting epoxy resin and a hardener. The individual components of mixed epoxy shall not settle or skin and contain no volatile solvents, lumps, or foreign materials. The epoxy shall conform to C 881. Unless otherwise specified, epoxy adhesive used for bearing and expansion pads shall be nonsagging.
2. The manufacturer shall furnish certification of actual test results for each required property of the type, grade, and class of epoxy submitted, and shall accompany each sample.
3. The manufacturer shall supply actual bond test results for each batch submitted for use.

4. Admixtures:

   a. Calcium chloride or any other admixtures containing chloride salts shall not be used in the concrete placed on steel bridge deck forms which remain in place.

5. Requirements for Accessories:

   a. All accessories such as inserts and ties that will remain in completed superstructures within the top 5 inches of final deck slab concrete shall be either epoxy coated or made of material other than aluminum that will not rust. All accessories that will remain in parapets, sidewalks or any other portion of the structure designated to have epoxy coated reinforcement steel shall also conform to these requirements. Inserts are prohibited in the top half of slabs exposed to vehicular traffic unless specified in the Contract Documents.

6. Precast Reinforced Concrete Box Sections:

   a. Precast reinforced concrete box sections for culverts shall conform to M 259 or M 273 including concrete design strength. All details shall be as specified in the Contract Documents. Construction joints between the walls and the bottom and top slabs will be optional.

b. Certification from the manufacturer for each shipment of precast units is required. A copy of the certification shall be delivered to the Engineer, the Laboratory, and the Contractor with each shipment. One copy shall remain at the plant. The certification shall contain the name and address of the manufacturer, the type of structure, the identification number, the date of manufacture, the date of shipment, a statement indicating conformance with the Specifications, and the signature of the quality control manager. Noted on the unit shall be the station number and designation, the identification number, the name or trademark of the manufacturer, the date manufactured, and a stamp indicating conformance with the Specifications.

c. No precast unit shall be shipped unless it has been tested and is shown to be in full compliance with the Contract Documents.

d. The placement and consolidation of the required bedding under the unit shall be a minimum 6 inch of No. 57 aggregate unless otherwise directed by the Engineer.

7. Composition of Concrete Mixes for Slip Form

a. If the slip form method is used for constructing concrete parapets and concrete median barriers on bridges, the concrete shall conform to Mix No. 6 except that the slump shall be 1 inch maximum. The slump shall be measured at the placement point as the concrete is being charged into the slip form machine. The coarse aggregate shall be crushed stone conforming to M 43, size number 7, and shall not be less than 63 percent of the total aggregate in the mix. Other size coarse aggregate may be used provided the Engineer approves the slip form results.

PART 3 EXECUTION

3.1 GENERAL

A. Concrete shall be made either at the work site or away from the work site by an approved central mixing plant, or by approved truck mixing as specified in 03 30 43 (Production Plants).

3.2 EQUIPMENT

A. The Contractor shall use equipment of sufficient capacity to complete any unit or section of concrete between construction joints, as specified in the Contract Documents, in one continuous operation consistent with placement operations as approved by the Engineer. Hand mixing may be permitted with written approval of the Engineer for small volumes of concrete. However, its intended use is for small isolated areas where structural integrity is not critical and the volume does not exceed 1 yd^3.

3.3 FORMS

A. Design Criteria

1. Design Loads. Design loads shall conform to American Association of State Highway and Transportation (AASHTO) Standard Specifications for Highway Bridges, Temporary Works, and Loads. The lumber in the forms shall be assumed to weigh 50 lb/ft^3.
2. Design Stresses:

   a. Timber Design. Timber design for formwork shall conform to ACI Standard Recommended Practices for Concrete Formwork (ACI 347). Unit stresses stipulated in AASHTO for treated timber may be increased by 25 percent but shall not exceed the values listed below. Deflections for form members shall not exceed 1/270 of the span or 1/4 inch.

Compression Perpendicular to Grain	450	psi
Compression Parallel to Grain	1600	psi
Flexural Stress	1800	psi
Horizontal Shear Beams up to 6 inches deep	200	psi
Beams over 6 inches deep	150	psi
Axial Tension	1200	psi

3. Plywood. The strength of plywood without backing shall be calculated based on the grain of the face plies running parallel to its span. The plywood shall be installed in this manner.
4. Steel Members for Forms. Steel design for formwork shall conform to AASHTO Standard Specifications for Highway Bridges. For design where no dynamic loading is involved, the AISC Standard Manual of Steel Construction, Allowable Stress Design may be used as the accepted design code.
5. Steel Forms Which Remain in Place. The maximum deflection of steel deck forms that remain in place shall not exceed 1/180 of the span and not in excess of 1/2 inch.
   a. For steel deck forms that remain in place, camber shall not be used to compensate for deflection in excess of the above limits. The design spans of the form sheets shall be the clear distance between beam or girder flanges less 2 inches.

   b. For steel forms which remain in place, the unit working stress in the steel sheet and supporting members shall not be more than 0.725 of the specified minimum yield strength of the material furnished but not to exceed 36000 psi. Physical design properties shall be computed in conformance with the American Iron and Steel Institute Specification for Design of Cold Formed Steel Structural Members.

B. Working Drawing Approval. Detail, form, falsework and centering plans and design loads shall be submitted to the Engineer for approval except as specified otherwise in the Contract Documents. Working drawings for forms shall include all members proposed for use as well as form ties and bracing. Details for form ties shall not be submitted separately but shall be incorporated in the general working drawings submittal. The rate of placing concrete shall be noted on the working drawings. Approval of the working drawings will not relieve the Contractor of responsibility in connection with them. The provisions of 05 12 00 also apply when working drawings are submitted for falsework and centering.

C. Forms at Construction Joints and Corners. Ties or bolts shall be provided 3 to 6 inches from each side of concrete construction joints for tightening the forms against the hardened adjacent concrete prior to placing fresh concrete. At joints where forms have been removed and reconstructed, the form surface shall extend over the concrete already in place; and the forms shall be drawn tightly against the previously placed concrete prior to placing the fresh concrete. Forms shall be filleted at all sharp corners, except when otherwise specified in the Contract Documents and shall be given a bevel or draft in the case of all projections. All exposed corners of concrete shall be chamfered with 3/4 inch X 3/4 inch milled chamfer strips, except on unexposed footings or where specified in the Contract Documents.

D. Form Scaffolds and Platforms. Form scaffolds and platforms shall be built along the outside of bridge deck fascias during construction of forms for bridge decks. They shall be designed and constructed as an integral part of the form supports. Separate design calculations shall be furnished with the working drawing submission. Approval of the working drawings will not relieve the Contractor of responsibility in connection with them.

E. Forms for Unexposed Surfaces. All sheathing, studs and bracing shall be of sound material. Studs and wales shall be straight and true and surfaced on two edges to a uniform width. The inside face of the forms shall be of sufficiently smooth construction that the resulting concrete surfaces shall be accurately formed.

F. Forms for Exposed Surfaces. Unless otherwise specified in the Contract Documents, steel forms which remain in place shall be used between stringers to support the bridge deck concrete, except in panels where a longitudinal deck construction joint is located between stringers. Forms to be used on the structure for widening and rehabilitation shall provide that the exposed finished concrete surfaces shall match the existing structure.

1. Lined Forms for Exposed Surfaces. Contact surfaces of lined forms for surfaces exposed to weather or view shall be approved composition board, sanded plywood or metal. All studs shall be surfaced two edges to a uniform width and shall be of a grade of lumber that is solid, straight and free of defects that could impair its strength. The backing for form lining shall be constructed using a grade of form lumber that is solid, straight and free of defects that could impair its strength, but need not be of the quality used for contact forms for unexposed surfaces.
   All sheathing for form backing shall be surfaced two sides to a uniform minimum of the thickness of at least the dimension approved on the working drawings. Form sheathing shall be built solidly, securely nailed to studs and placed to prevent any bulging of the lining.

2. Unlined Forms for Exposed Surfaces. Unlined forms in contact with surfaces exposed to weather or view shall be constructed of five ply sanded plywood of the thickness specified in the Contract Documents. Plywood shall be manufactured especially for concrete formwork using waterproof glue. All studs and wales shall be surfaced two edges to a uniform width.
   Full size sheets of plywood shall be used except where smaller pieces cover an entire area. All joints shall be backed solidly to prevent leakage and the edges of abutting sheets shall be nailed to the same stud or blocking with sixpenny nails not more than 8 inches apart. Where rustication occurs, horizontal joints in the plywood shall be constructed behind a rustication strip. Otherwise, horizontal joints shall be placed at the same respective elevations in all portions of the structure. Where vertical rustication occurs, vertical joints in the lining shall be constructed behind a rustication strip. Otherwise, vertical joints shall be kept to a minimum and shall be butted tightly

together and sealed with a crack filler specified in the Contract Documents, as the plywood is nailed in place.

G. Steel Forms Which Remain in Place.

1. Installation. The surface of the steel forms in contact with concrete shall be smooth and free of surface irregularities. Working drawings for steel forms which remain in place shall specify the grade of steel, the physical and sectional properties for all permanent steel bridge deck form sheets and a clear indication of locations where the forms are supported by steel beam flanges subject to tensile stresses.
Form supports shall not be welded to flanges of steel that are not considered weldable or to portions of flanges that are subject to tensile stresses.
Welding and welds shall conform to the provisions of the latest American Welding Society (AWS) Bridge Welding Code pertaining to fillet welds.
Unless otherwise specified in the Contract Documents, steel forms which remain in place shall be used between stringers to support bridge deck concrete, except in panels where a longitudinal deck construction joint is located between stringers.

2. Procedure Check and Inspection. The Contractor shall remove at least one section of the forms at a location and time selected by the Engineer from each span of each bridge in the Contract. If the bridge has a longitudinal joint, a form on each side of the joint shall be removed from each span. This should be done as soon after placing the concrete as practical to provide visual evidence that the concrete mix and the Contractor's procedures are obtaining the desired results. An additional section shall be removed if the Engineer determines that there have been any changes in the concrete mix or in the Contractor's procedures warranting additional inspection.
At locations where sections of the forms are removed, the Contractor will not be required to replace the forms, but the adjacent metal forms and supports shall be repaired to present a neat appearance and ensure their satisfactory retention. As soon as the form is removed, the concrete surfaces will be examined for cavities, honeycombing, and other defects. If irregularities are found and the Engineer determines that these irregularities do not justify rejection of the work, the concrete shall be repaired as directed by the Engineer. The concrete shall be given an ordinary surface finish in conformance with the following paragraph 3.8 A. If the concrete where the form is removed is unsatisfactory, additional forms, as necessary, shall be removed to inspect and repair the slab. The Contractor's method of construction shall be modified as required to obtain satisfactory concrete in the slab. All unsatisfactory concrete shall be removed and replaced or repaired as directed by the Engineer at no additional cost to the Owner.
The Contractor shall provide all facilities as are reasonably required for the safe and convenient conduct of the Engineer's inspection procedures.

H. Steel Forms Which Do Not Remain in Place. The surface of the steel forms in contact with the concrete shall be smooth and free of bolts, bolt heads, nuts, rivet heads, welding seams and surface irregularities. Forms that produce unacceptable concrete surfaces will be rejected and shall not be reused.

1. For Round Columns and Piers. Steel forms for round columns and piers shall have minimum number of horizontal joints and shall be column height. The minimum thickness of these steel forms shall be 10 gauge.
2. For Pier Caps and Crash Walls. Prefabricated girder type steel forms may be used for forming pier caps or crash walls. Each element of these forms, including side, bottom

and end shall be in one piece where practical. Splices shall be arranged to provide a symmetrical pattern where forms are spliced.

3. For Reinforced Concrete Box Culverts and Rigid Frames. Steel forms or forms constructed of wood or composition wood panel sheathing set in metal frames may be used. The minimum thickness of steel forms for box culverts and rigid frames shall be 10 gauge.

I. Fiber Column Forms. Fiber column forms shall only be used for round columns, and shall conform to these Specifications. The forms shall produce columns truly round and straight and shall be protected from dampness before concrete is placed. Fiber forms shall not be spliced.

J. Release Agents. All forms shall be treated with form release compound immediately before placing concrete.

K. Temporary Supports. Temporary supports used for centering and falsework shall be built on good firm foundations. Unless otherwise provided, they shall be founded to bear upon strata at or below the frost line unless rock is available, or piling shall be driven for support where required. The strength and bracing of the temporary supports shall ensure that the completed structure will have the shape shown on the Contract Documents. The Contractor shall employ jacks or hardwood wedges in connection with the temporary supports in order to take up settlement either before or during placing of concrete. Temporary supports shall be set to give the structural camber specified on the Contract Documents, plus allowance for shrinkage and settlement. If during the construction any weakness, settlement or distortion develops, the work shall be stopped and any masonry affected thereby removed and the temporary structures strengthened before work is resumed. Centering shall be constructed to permit its gradual, uniform lowering.

L. Defective Forms. Removal or modification of steel forms which remain in place shall be performed using a device approved by the Engineer. Burning is prohibited.

M. Form Ties. Only form ties approved by the Engineer shall be used. Ties shall leave no metal closer than 2 inches from the surface. They shall not be fitted with lugs, cones, washers or other devices which act as spreaders within the form or for any purpose that leaves a hole larger than 7/8 inch diameter. When prefabricated steel girder forms are used, tapered ties up to 1-1/2 inch maximum diameter shall be used. Ties shall be clean and free of rust. When ties are removed, the holes shall be pressure grouted with a nonshrink mortar mixed to match the color and texture of the concrete.

N. Portions of ties to be removed from the concrete shall be coated with a clear lubricant or other approved material to facilitate removal. Care shall be exercised during removal of form ties to avoid spalling the concrete on the exposed surface. Cutting back from the face is prohibited.

O. Form Support Brackets or Devices. Devices attached to previously placed concrete may be used, provided all parts are acceptable to the Engineer. No metal part of an insert, threader or anchor that remains in place in the concrete shall be within 2-1/2 inches of the surface. The concrete supporting the brackets or other devices shall be cured and shall have attained a minimum compressive strength of 3000 psi before the brackets or other devices are attached. All voids left in the concrete after brackets or other devices have been removed, shall be no greater than 2 inches diameter and shall be completely filled with mortar and the surface finished as specified in the following paragraph 3.8 A.

P. Form Removal. For the purpose of determining the time when falsework and forms may be removed, backfill placed, and when loads may be applied to structures, an adequate number of concrete test specimens shall be made in addition to those required to check the quality of the concrete being produced. All forms for concrete work shall be removed and disposed of by the Contractor after formwork requirements have been conformed to, except those that are specified to remain in place.

Q. Methods of form removal likely to cause overstressing of the concrete shall not be used. Forms and their support shall not be removed without the approval of the Engineer. Supports shall be removed in a manner that permits the concrete to uniformly and gradually take the stresses due to its own weight.

R. Year Built Marking. The year of completion shall be cast into each structure, as determined by the Engineer. Forms or molds for casting the year built numerals in the structure shall be supplied by the Contractor. The year built numerals shall be the size specified in the Contract Documents.

3.4 ANCHOR BOLT PLACEMENT

A. No anchor bolts shall be cast in the concrete. The Contractor shall create a template to locate the anchor bolt holes. This template shall be used to shift the reinforcement prior to placing the concrete to eliminate conflicts between the reinforcement and the anchor bolt holes.

B. Anchor bolts shall be set in round holes drilled or cast in the concrete. Bolts shall be accurately positioned by using templates set to correct location and alignment to ensure proper span lengths, and tops of bolts shall be carefully set to proper elevation. Unless otherwise noted, bolts shall be installed plumb or normal to the finished bearing surface of the masonry.

C. Bolts set in holes drilled or cast into the concrete shall have the portion below the bridge seat swedged. The drilled or cast holes shall have a diameter at least 1 inch larger than the bolt diameter.

D. Anchor bolts, nuts, and washers shall not be painted.

E. After anchor bolts are finally and correctly positioned, the holes shall be completely filled with grout. Grouting of anchor bolts is not permitted until all structural steel is set in its final position. After the masonry plates or shoes are set, the space between the bolts and the round holes through fixed plates or shoes shall be filled with the same material. Slotted holes in expansion devices shall remain unfilled unless otherwise specified in the Contract Documents.

F. The Contractor shall maintain a minimum air temperature of 40° F around the mortar surface for a period of three days unless otherwise recommended by the manufacturer.

G. When mortar filling is used for bolts inserted in holes drilled or cast in the concrete, the holes shall first be checked for depth by inserting and withdrawing the bolts. They shall then be partially filled with mortar into which the bolts shall be forced by uniform pressure or light blows from a hammer (flogging and running is prohibited) so that excess mortar is pushed out at the top of the hole. The excess mortar shall be removed.

H. Bolts shall be set to project approximately 1/2 inch above the nut and shall be threaded to approximately 1/2 inch below the nut in their final position.

I. Rockers or expansion plates with slotted holes shall be set with the proper tilt or offset as determined by the temperature prevailing at the time and so that they will be in their midway position at 68° F or as specified in the Contract Documents.

3.5 CONCRETING

A. Before placing concrete, forms shall be cleaned. Struts, stays and braces serving temporarily to hold the forms in correct shape and alignment shall not be buried in the concrete. If faces of completed or proposed excavated footing areas are disturbed prior to concreting, the footings shall be extended at no additional cost to the Owner to bear on undisturbed faces acceptable to the Engineer.

B. All concrete except tremie concrete shall be placed in the dry.

1. Foundations. The Contractor shall be responsible for any reinforcement fabricated prior to approval of foundations. If bearing material varies more than assumed in design, footing may be lowered, raised, deepened, subfoundation placed, piles used or a combination of these methods used to best obtain bearing as directed by the Engineer. If planned footings are changed vertically, reinforcement steel shall be revised as required. Subfoundation concrete for bridges, retaining walls and wing walls of box culverts or rigid frames shall be constructed using plain Concrete Mix No. 1 (no reinforcement). The Concrete Mix No. 1 need not be vibrated, and the usual curing and cold weather requirements may be reduced to three days. Selected backfill using number 57 aggregate may be used for subfoundation for box culvert barrels, headwalls and miscellaneous structures.
2. Concrete Placement. Concrete shall be placed to avoid segregation of the material and the displacement of the reinforcement. The use of troughs, chutes and pipes for conveying concrete more than 15 ft from the mixer to the forms will be permitted only when acceptable to the Engineer. Open troughs and chutes shall be metal or metal lined. Where segregation occurs due to steep slopes, chutes shall be equipped with baffles.

   Where placing operations would involve dropping the concrete more than 5 ft, it shall be deposited through a tube made of sheet metal, canvas or other approved material. Aluminum hoppers or tubes are prohibited. Lower ends shall be kept as close as possible to the newly placed concrete and not more than 3 ft above the concrete. All tubes shall have a minimum diameter of 6 inches unless otherwise directed by the Engineer. After initial set of the concrete, the form shall not be disturbed, and no strain shall be placed on the projecting ends of the reinforcement. Concrete shall be placed in horizontal layers not more than 12 inches high except as provided herein. When less than the complete area of a layer is placed in one operation, it shall be terminated in a vertical bulkhead. Each layer shall be placed and vibrated before the preceding layer has taken initial set to prevent injury to the concrete and avoid separation of joints between the layers. Concrete in columns and walls shall be placed in one continuous operation unless otherwise directed. The concrete shall set at least 12 hours before the caps are placed.

   Where walls, piers, columns, struts and posts have horizontal construction joints, succeeding lifts shall not be placed until the lower placement has set for 12 hours. Prior to subsequent placement, all accumulations of mortar splashed upon the

reinforcement shall be cleaned. Care shall be exercised not to injure or break the concrete seal bond near and at the surface of the concrete while cleaning the reinforcement steel.

3. Grade Controls for Bridge Deck Slabs. Bridge deck slabs supported by new stringers shall be placed in conformance with the specified line and grade. The Contractor shall take all necessary precautions, including a check on all new bridge seat elevations as the last order of work before setting stringers. Any adjustments resulting from this check shall be completed before additional work is started. After the structural steel is set, a final check of elevations of all the steel stringers at points corresponding to those specified in the Contract Documents for dead load deflection and finished roadway elevations shall be made. Computations shall be made by the Contractor, reviewed by the Engineer, and controls set at proper elevations to produce finished tops of concrete bridge decks that will be true as to planned line and grade of the roadway surface.
    a. Grade control for bridge deck slab replacements shall conform to the 02 41 16.33.

4. Superstructure Placement Restrictions. The superstructure shall not be erected until the substructure forms have been sufficiently stripped to determine the character of the concrete in the entire substructure, unless otherwise permitted by the Engineer. In all spans, the concrete bridge deck slabs outside of the stringers shall be cast using plywood forms.
    a. Unless otherwise specified in the Contract Documents, concrete for deck slabs shall be pumped whenever the volume of concrete in the pour exceeds 50 yd^3.
    b. The Contractor shall place all superstructure concrete in conformance with the following schedule:

SUPERSTRUCTURE CONCRETE PLACEMENT SCHEDULE		
DATES	BEGIN CONCRETE PLACEMENT AFTER	FINISH BURLAP PLACEMENT BEFORE
May 15 - June 15	7:00 PM	11:00 AM
June 16 - Aug. 14	9:00 PM	7:00 AM
Aug. 15 - Sept. 15	7:00 PM	11:00 AM
Sept. 16 - May 14	No time restrictions	

    c. Superstructure concrete shall not be placed or worked in any manner when the temperature in an unshaded location at the placement site is above 80° F. Floodlighting shall be used when existing light is less than 20 average horizontal ft-c over the construction area.
    The Contractor shall submit a situation plan to the Engineer showing the locations and aiming of floodlights. After reviewing this plan, the Engineer will witness a test of the floodlighting system at the proposed construction area. The Contractor shall run the floodlighting test. The floodlighting system shall be capable of maintaining 20 ft-candles without producing a glare on traffic. Floodlighting systems will be approved by the Engineer. When portable

generators are used, an emergency backup system shall be available at all times on the job site.

5. Rate of Concreting for Bridge Deck Slabs. Provisions shall be made by the Contractor to ensure that the placement rate of concrete is 35 yd^3/hour minimum. Under special circumstances, the Engineer may give written approval to lower this requirement.

   a. The Contractor shall submit for the Engineer's approval written evidence of an adequate source of concrete, and placing and finishing equipment capable of conforming to the minimum rate of placement of 35 yd^3/hour per crew while providing the intended quality finish. This evidence shall be submitted at least one week prior to the proposed placement of the bridge deck slab.

   b. Concrete in slab spans shall be placed in one continuous operation and in one layer for each span, unless otherwise directed by the Engineer.

   c. Concrete shall not be mounded on concrete slab forms supported by beams, stringers, or girders. When placing, the concrete shall be distributed to a depth not exceeding the planned slab thickness plus 6 inches before spreading, consolidating and finishing.

   d. The placing sequence shall be in the numerical order specified in the Contract Documents and shall not be modified. A minimum of 40 hours shall lapse between the completion of one placement and the start of the next numbered placement.

6. Box Culverts. Box culverts shall be constructed by casting in place or using precast reinforced concrete box culvert sections. Whenever a particular method is indicated in the Contract Documents, the Contractor may elect to use the alternate method unless otherwise specified. However, all time constraints such as maintenance of traffic, curing, completion dates, etc., shall be met. If the Contractor elects to use precast reinforced concrete box sections, at least 15 ft of all box culvert ends and all footings, wing walls, headwalls and toe walls shall be cast in place. Additionally, the precast sections shall terminate a minimum of 1 ft from all footings and toe walls. All lifting devices shall be indicated on the working drawings and all lifting holes shall be filled with nonshrink grout after the precast units are in place. The precast reinforced concrete box sections shall be set tightly together and the joints shall be sealed in conformance with the manufacturer's recommendations. The bottom slabs of cast in place concrete box culverts shall be placed for their full depth in one mass or layer and permitted to set not less than 12 hours before any additional work is done. Single cell box culverts spanning in excess of 10 ft and multiple cell box culverts shall not have the top slabs placed until the concrete in the sidewalls has set for a minimum of 12 hours. Construction joints at the top of sidewalls may be omitted in some cases provided the top slabs are placed as follows:

   a. For single cell box culverts spanning 10 ft or less, the sidewall construction joint may be omitted and the top slab placed on the sidewalls, provided the concrete in the sidewalls is allowed to set for approximately two hours before starting to place the top slab.

   b. Regardless of size or number of cells, the Contractor may request in writing to place the top slab on the walls of box culverts in conformance with number

6 above. The written proposed plan, including rate and method of placement, and type and size of equipment, shall be submitted to the Engineer for approval. If the Contractor receives initial written approval, the first section of the structure shall serve as a demonstration to confirm that there is no excessive cracking or any other detriment, and that satisfactory results will be obtained. After receiving written final approval, the Contractor may continue placing the remainder of the box culvert. If at any time the Engineer decides that the results are no longer satisfactory, the Contractor shall revert to placing the concrete with the 12 hour delay as specified above at no additional cost to the Owner.

7. Forming Concrete Parapets and Median Barriers on Bridges. The Contractor may construct concrete parapets and median barriers on bridges by either the slip form method or conventional fixed form method. The slip form method is prohibited on bridges maintaining traffic, or on parapets when railing is specified. Contractors who elect to use the slip form method shall first demonstrate their ability to produce results acceptable to the Engineer. If a Contractor is unable to demonstrate that ability or fails to maintain acceptable results during production, the slip form operation shall be stopped, the unacceptable work shall be removed and the construction methods shall be modified. If construction modifications do not produce acceptable results, the Contractor shall use the fixed form method. No additional compensation will be permitted, and no increase will be allowed in any Contract price nor will any revisions be made to the amount of time to complete the Contract as a result of any required removals, modifications or changes in the method of placing parapets or barriers. The Contractor shall notify the Engineer in writing of the proposed method of constructing the parapets and median barriers prior to beginning superstructure work. If slip forming is to be considered, then the following shall apply:

   a.The Contractor shall submit to the Engineer evidence of being capable of producing high quality slip formwork. Prior to beginning any slip form construction, the Contractor shall submit a detailed work plan. The plan shall include the type of equipment, materials and procedures to be used, any subcontractors involved in the construction, key personnel who will be performing the work (names, training, experience, etc.), as well as detailed information on how the Contractor proposes to satisfactorily complete the work.

   b. When possible the work plan shall include reference to at least three other similar projects completed in the State of Maryland or surrounding states using the slip forming method for parapet or median barrier construction. As far as practical, these similar projects shall have been built using the same equipment, personnel, material, and procedures proposed for the project. The Engineer may elect to visit these completed projects to evaluate the acceptability of the finished product.
   If the Engineer determines that the Contractor has satisfactorily slip formed parapets or median barriers at the locations submitted in the Contractor's work plan, the requirements of the off bridge test site specified below may be waived and the first 50 ft of slip forming on the bridge will be considered the test section for the structure. This test section shall be completed and approved prior to placing the remaining portions of parapet or bridge median barrier.

   c.The work plan shall be approved in writing prior to beginning any slip forming operation.

d. Any proposed revisions or deviations to the approved work plan submitted by the Contractor shall be approved by the Engineer in writing prior to making the change.

e. If the Contractor does not conform to number 7 above, an off bridge test section shall be completed and accepted prior to placing any portion of the parapet or bridge median barrier. The Contractor shall place the appropriate test section of parapet or median barrier using the same equipment, sensor line, support spacing, material, personnel and procedures as described in the work plan. This test section shall match the structure's horizontal curve as much as practical, be a minimum of 50 ft long, and be placed at a location selected by the Contractor near the bridge site.

f. The off bridge test section shall be placed with vertical irregularities varying upward and downward at least 3/4 inch. The Contractor shall then prove that the method of slip forming can compensate for this deviation and provide a top of parapet or median barrier that is true to the proposed line and grade and not necessarily parallel to top of bridge deck. This will necessitate that the equipment provide for variations in height of vertical face of parapet where it intersects the top of deck slab.
The sensor line shall be positioned, supported, and spaced in the same manner in the testing operation as will be used on the bridge decks with no stakes, holes, etc., used to support it. Sensor support spacing shall be as recommended by the slip form machine manufacturer and as necessary to maintain the planned line and grade. The rate of slip forming on the test section shall be the same as that proposed for the bridge. Joints shall be saw cut in the test section at the same approximate spacing and in the same manner as proposed for the finished bridge.

g. The Engineer will evaluate the procedure, material, equipment and appearance of the test section. The Contractor shall take three test cores from the test section at locations directed by the Engineer to determine the concrete quality. Honeycombing, sags, tears or other evidence of poor quality concrete will be cause for rejection of the test section. If the test section is rejected, the Contractor may place additional test sections until approved by the Engineer or may elect to use the fixed form method.

h. The accepted test section shall remain in place until all parapets or median barriers on the bridges are complete. The slip formed parapets and median barriers on the bridges will be compared to the approved test section to ensure that similar acceptable structures are being achieved on the bridges. Following completion and acceptance of all bridge parapets and median barriers, the Contractor shall remove and dispose of the off bridge test section.

i. The entire testing procedure, including removing and disposing of test units, regardless of whether the procedure is approved or rejected, shall be done at no additional cost to the Owner.

j. When dual bridges are separated by a joint, the two parapets that make up the median barrier shall be constructed in separate operations. Constructing both sections of median barrier simultaneously is prohibited. The first median parapet section shall be allowed to cure for a minimum of 40 hours prior to constructing the second section of median parapet.

k. Additional reinforcement steel shall be placed to provide bracing for the reinforcement in the parapet to prevent displacement when subjected to the pressure developed in the slip form machine's extruding process. A detail will be included in the Contract Documents. The alignment and rigidity of the reinforcement steel will be strictly enforced by the Engineer to ensure that the minimum clearances shown on the Contract Documents for concrete cover are maintained.
The Contractor shall ensure that a continuous supply of concrete is available at the bridge site during slip forming operations, and that an uninterrupted flow of concrete is provided to the slip form machine. Once the slip form machine is set in motion, it shall keep advancing until it reaches the proposed stopping point. The Contractor shall organize and schedule the operations in a manner that the next concrete truck will be able to move into position at the slip form machine as soon as the previous truck pulls away without interrupting the machine's uniform advancement. Under no circumstances will the Contractor be allowed to operate the slip forming in a manner which requires a concrete truck to be removed from the bridge before another truck can move into place.
Vehicular traffic, except for the slip form machine and its concrete supply trucks, is prohibited on the bridge while slip forming operations are in progress.

l. When the slip form machine is set up and the sensor wire is placed, a dry run of the equipment shall be made in the presence of the Engineer to ensure that the parapet or median barrier will envelop preset obstacles that are to be embedded or meet with flush surfaces such as pull boxes, expansion joint plates, etc.

m. The concrete consistency shall maintain the shape of the structure without support after the extrusion. The surface shall be free of surface pits larger than 3/16 inch diameter. The concrete shall require no further finishing, other than light brushing with water only. Finishing with brush applications of grout is prohibited.

n. If a tear occurs at the top of the parapet or median barrier during the slip forming operation, it shall be repaired immediately. The repair shall be made in a workmanlike manner in conformance with good concrete practices acceptable to the Engineer. The repair shall blend into the barrier to the extent that the naked eye cannot distinguish any difference in the wall face or top.

o. The rate at which the slip form machine is advanced is crucial to the quality of the finished parapet or median barrier. The Contractor shall ensure that the rate of advancement conforms to the equipment manufacturer's recommended value. The advancement of the slip forming machine on the bridges shall be the same rate as used on the approved test section. A higher or lower rate is prohibited.

p. The shape of the finished parapet or median barrier shall conform to the dimensions shown on the Contract Documents. The vertical face at the bottom of the concrete safety shaped parapets or median barriers is 3 inches high, and will be unacceptable if this vertical face exceeds 3-1/2 inches. The finished parapet or median barrier shall show no deviation from the proposed grade and alignment in excess of 1/4 inch/10 ft.

q. Joints shall be saw cut in the finished parapet or median barrier using a diamond blade. Cuts shall be 1/8 inch wide and 2 inches deep and shall be made

in the top, outside and inside faces, stopping 3 inches above the top of deck slab in both faces except where it is impossible for the outside portion of the final placement of back to back median parapets. Joints shall be spaced as shown on the Contract Documents. Reinforcement steel in the parapets and median barriers shall be terminated at the joint locations. The deck shall be marked to ensure that the saw cuts are made at these locations and do not conflict with the reinforcing steel pattern. The trapezoidal shaped control joints on the outside of parapets will not be required if slip forming is used. Slip form placements shall only be terminated at a parapet control joint. The joints shall be saw cut as soon as possible after initial concrete set and after the concrete has set sufficiently to preclude raveling during the sawing. The sawing shall be completed the same day the concrete is extruded and before any shrinkage cracking has occurred. Concrete shall not be left overnight without saw cutting the joints.

r. When portions of the bridges are in super elevation with varying rates of slope, the Contractor shall produce the exact configuration of parapets and median barriers as shown on the Contract Documents, i.e., level top surface, wall normal to deck surface, etc.

8. Temperature Controls. Concrete temperatures shall be as specified in aforementioned Table A. Concrete below these temperatures shall be heated by one of the following methods:

a. When the method of heated mixing water is used, the water shall not be above 170° F when introduced into the mix.

b. When the method of heated aggregates is used, aggregates containing frozen lumps shall be independently heated and no materials containing frozen lumps, ice, or snow shall be permitted to enter the mixer. Aggregates may be heated by steam coils or other dry heat but not by discharging live steam or hot water into them. Heating by means of a flamethrower or any direct flame is prohibited.

c. When the ambient air temperature is below 40° F, the temperature of the air in contact with the reinforcement shall be raised to 40° F prior to placing concrete. When the ambient air temperature is above 70° F and the reinforcement is exposed to the direct rays of the sun, the reinforcement shall be cooled to 70° F or less by means of a water spray prior to placing concrete. When the ambient air temperature is above 70° F and the steel forms that remain in place are exposed to the direct rays of the sun, the forms shall be cooled by means of water spray prior to placing concrete.

d. When abnormal wind or storms are forecast locally by the National Weather Service, superstructure concrete shall not be placed during the period covered by the forecast.

9. Pumping. Equipment shall be suitable and adequate in capacity for the work and will be acceptable to the Engineer. The equipment shall be arranged so that no vibrations result which might damage freshly placed concrete. No parts of the pump or discharge line shall be made of aluminum.

10. Use of Conveyors. Concrete may be moved from the mixer to its final position by use of conveyors. Conveyors shall be in sections and concrete shall be deposited from one conveyor belt onto the next through a hopper. The maximum rise on any individual section of the conveyor is 30 degrees from the horizontal. The maximum belt travel speed shall be 900 ft/minute for concrete slumps less than 2 inches. This speed shall be decreased for slumps exceeding 2 inches. Conveyors used for placement of decks shall be supported by main load carrying members. Polyethylene or other material acceptable to the Engineer shall be placed under the conveyor line to contain any spillage from the belts onto the deck.

3.6 Depositing Concrete Under Water

A. Concrete shall not be deposited in water or exposed to the action of water before setting, unless specified in the Contract Documents or approved by the Engineer in writing. Concrete deposited under water shall be placed by means of a tremie pipe. The tremie pipe shall not be less than 10 inches diameter and shall be equipped with a watertight plug.

B. The bottom of the pipe shall be equipped with a baffle or deflector plate. The number and location of pipes will be dependent on the size of the pour. After tremie concrete has been placed, it shall not be disturbed nor shall successive layers be placed on top until the previously placed concrete has developed the necessary strength as determined by the Engineer. Concrete shall not be deposited in water where the temperature is less than 35° F. When concrete is deposited in water 36° to 45° F, the concrete shall be heated and placed at a temperature of 60° to 80° F. Pumping of water is prohibited while concrete is being placed. The consistency of the concrete shall be carefully regulated to prevent segregation. Tremie concrete which projects more than 6 inches above the top of the as-planned tremie concrete shall be cut down at no additional cost to the Owner until no portion is more than 6 inches above the as-planned elevation.

1. Cofferdams. Where cofferdams are used, separate forms shall be constructed within the cofferdams except where footing concrete is to be placed against a base of undisturbed material and where the cofferdam is to remain in place and act as the concrete form. The water level in the space between form and cofferdam shall be kept below the bottom elevation of concrete for at least 12 hours.
2. Concrete Seals. When feasible, concrete seals for parts of structures under water shall be placed continuously from start to finish so as to avoid horizontal construction joints. The surface of the concrete shall be kept as nearly horizontal as practicable at all times to ensure thorough bonding. In these cases, each succeeding layer of the seal shall be placed before the preceding layer has taken its initial set. The slump of tremie concrete shall be maintained between 4 and 8 inches and maintained as close to 4 inches as possible. After dewatering and prior to placing any succeeding layers of concrete, the top of the foundation seal (tremie concrete) shall be thoroughly cleaned.
3. Concrete Exposed to Saline Water. Saline water shall not come in direct contact with the concrete until it has been permitted to harden as required in the following table:

CONCRETE IN SALINE WATER	
SALINE CONTENT OF WATER BY WEIGHT	SALINE WATER SHALL NOT

IN PARTS PER THOUSAND	CONTACT CONCRETE UNTIL FOLLOWING MINIMUM TIME IN DAYS HAS ELAPSED AFTER INITIAL SET*
0 to 10	0
10+ to 15	7
15+ to 20	14
20+ to 25	21
Over 25	30
* The Engineer may approve a waiver in writing.	

Unless otherwise specified, the concrete shall be wet cured for at least seven days while being maintained at a temperature of 50° F or above.

3.7 CONSOLIDATION

A. All concrete except concrete deposited under water shall be consolidated by means of internal vibrators unless otherwise directed by the Engineer. These provisions shall also apply to precast members or units.

B. Vibration shall be applied at points uniformly spaced and not further apart than twice the radius over which the vibration is visibly effective.

1. Internal Vibration. Internal vibrators shall be of a type and design approved by the Engineer. The intensity of application shall visibly affect a mass of concrete of 1 inch slump over a radius of at least 18 inches and have frequency of vibration not less than 4500 impulses per minute.
2. External Vibration. External vibrators shall be of a type and design approved by the Engineer. External vibration shall be used as directed by the Engineer for the following sections: very thin, very heavily reinforced, numerous inserts, or where form surfaces are sharply inclined or battered. Filler concrete for steel grid floors shall be consolidated using external vibrators to the steel grid.

3.8 FINISHING CONCRETE SURFACES

A. Concrete faces shall be finished with one of the following types. All concrete work shall have an ordinary surface finish as described below unless otherwise specified.

1. Ordinary Surface. Immediately following the removal of forms, all fins and irregular projections shall be removed from all surfaces except from those that are not to be exposed or not to be waterproofed. On all surfaces, broken corners or edges and any cavities shall be thoroughly cleaned and, after having been kept moist, shall be carefully pointed and trued with a mortar of cement and fine aggregate mixed in the proportions used in the grade of the concrete being finished. Any excess mortar at the surface of the concrete shall be removed. The mortar patches shall be cured as specified in the following paragraph. Construction and expansion joints in the completed work shall be carefully tooled and cleaned. Joint filler shall be exposed for its full length with clean and true edges. Resulting surfaces shall be true and uniform.

Surfaces that cannot be repaired in a manner acceptable to the Engineer shall be completed as special surface finishes.

2. Special Surface. Fins and projections shall be removed. The surface of the concrete shall then be saturated with water and kept wet for a minimum of two hours. A grout mix of the same proportions as the concrete shall be thoroughly rubbed onto the surface by section using burlap pads or cork floats completely filling all voids, pits, and irregularities. After this grout has dried sufficiently, the excess shall be wiped off with dry, clean burlap. The surface shall then be cured as specified in the following paragraph except that only colorless liquid curing compound shall be used in this method. The exterior faces of cast-in-place superstructures and end posts for bridges over highways and all interior faces of cast-in-place parapets, bridge median barriers, and end posts shall receive this type of finish. This finish shall not be applied to members that have been constructed by the slip form method.
3. Horizontal Surfaces. All upper horizontal surfaces such as the tops of parapets, copings, and bridge seats shall be finished by placing an excess of concrete material in the forms and striking off even with a wood template. Tops of handrail (posts and caps), headwalls, parapets, wing walls, and barriers shall be steel troweled to a smooth, dense surface.
   The bridge seat bearing areas of the substructure masonry shall be finished to the elevations shown on the Contract Documents. The Contractor shall check the elevation of each bearing area prior to finishing to ensure conformance. Each area shall be checked for level in all directions using a spirit level and adjustments made prior to the setting of the concrete. The area shall be steel troweled to a dense flat surface. Bearing areas that are not flat after final finishing shall be ground to achieve an acceptable surface.
   Bearing areas will be rejected whenever the elevation is below that of the surrounding masonry.
4. Bridge Deck Slabs. Concrete for bridge decks shall be transversely screeded with a power operated cylinder or roller finishing machine approved by the Engineer. The finishing machine and all transverse construction joints shall be set parallel to the nearest support lines (the abutment or pier) on all bridge deck slabs. When the skew angle changes at supports, the screed angle shall be adjusted accordingly as the finishing machine progresses across the deck slab. The concrete shall be placed so that the front edge of the newly placed concrete is as nearly as possible parallel to the skew of the finishing machine. The concrete shall also be placed uniformly ahead of the finishing machine, and shall not be more than 6 inches above the top elevation of the finished deck slab nor more than 10 ft ahead of the finishing machine.
   Under no circumstances shall the finishing machine span a length greater than the manufacturer's recommendation. The Contractor may combine machines or use two machines of which both may use a common rail and any additional rail. The proposed method and the location and anchorage of accessories that will remain in the completed superstructures as a result of this requirement shall be subject to the approval of the Engineer and conform to 2.1 section V 5.
   After the concrete has been struck off, the surface shall be checked with a 10 ft straightedge operated in a position parallel to the center line of the structure by means of long handles.
   This straightedge shall progress longitudinally in overlapping 5 ft increments and transversely in 2 ft increments to locate any irregularities in the surface. The width of the working face shall not be greater than 2 inches and the straightedge shall be as light weight as possible to avoid distortion of the slab surface.
   The concrete surface shall be finished with a full width strip of burlap mechanically or manually dragged across the surface.

5. Slab Grooving. Grooving shall be performed on all bridge decks including slab bridges, and box culverts built to grade. The grooving operation shall start after the bridge deck slab has been cured in conformance with the following paragraph 3.11 and attained a minimum compressive strength specified in the following paragraph 3.16. The bridge deck shall be grooved perpendicular to the center line.
   The grooves shall be cut using a mechanical saw device that leaves grooves 1/8 inch wide, 3/16 inches ± 1/16 inch deep, and variably spaced from 5/8 inches to 7/8 inches apart. The grooves shall extend across the slab to within 1 ft of the gutter lines. The transverse grooving shall not cut across armored joints or any joint in which an existing joint seal may be damaged, but shall stay clear by 2 inches ± 1 inch on each side. On joints skewed 70 degrees or less, one pass shall be made parallel to the armored joint unless otherwise directed by the Engineer. The residue resulting from grooving operations shall be removed from all surfaces in a manner acceptable to the Engineer. All surfaces shall be left in a washed and clean condition.
6. Deck Slab Tolerances. Slab thickness shall not be reduced. Any slabs that are found to have deficient thickness may be rejected. The surface shall not deviate in a transverse or longitudinal direction more than 1/8 inch/10 ft from a straight line. For vertical curves the deviation (from the curve specified) shall not exceed 1/8 inch/10 ft in a longitudinal direction. The corrective work shall be done prior to grooving at no additional cost to the Owner.
7. Sidewalks and Safety Curbs. The concrete shall be struck off with an approved screed to the elevation and slope specified in the Contract Documents. It shall be wood floated to give a uniformly gritty surface free from depressions or high spots. The joints shall then be edged with the appropriate edging tool. Curbs shall be stripped and finished as soon as possible.
8. Culvert Slabs. The tops of culvert slabs when they are the roadway riding surface shall be finished in conformance with above. Invert slabs and the tops of culvert slabs when they are not part of the roadway, or when they are to be overlaid with hot mix asphalt shall be screeded either by hand or machine and have a float finish. The allowable surface tolerance shall be within 1/4 inch of the grade specified in the Contract Documents. Inverts of culverts having a span less than 10 ft need not be straightedged.

3.9 CURING

A. These requirements shall apply to curing of all concrete surfaces except bridge deck slabs or top surfaces of culverts with integral wearing surfaces. Curing for bridge deck slabs and top surfaces of culverts with integral wearing surfaces shall be as specified in the following paragraph 3.11.

B. Curing shall start as soon as the concrete has set sufficiently.

C. The requirement for keeping the surfaces wet shall be met even in areas where there is no ready water supply.

   1. Culvert invert slabs and all footings shall be cured for five days using the method specified in the following paragraph 3.10 A thru 3.10D.
   2. Vertical surfaces shall be cured in the forms for seven (7) days. However, the forms may be removed after 24 hours for structural elements 6 ft or less in height, or after 48 hours for structural elements greater than 6 ft high, with the following provisions.

The surface shall be cured as specified in the following paragraph 3.10D for the remainder of the seven (7) day curing period. The forms shall not be removed when cold weather protection is required. Forms, falsework, centering, etc., carrying loads shall remain in place for a minimum of seven (7) days and until the concrete has attained a compressive strength of 3000 psi. Internal bulkheads used for forming construction joints, etc. may be removed after the concrete has been in place for 24 hours if it is necessary to do so to continue the work without interruption. When a higher strength concrete than specified is used, forms, falsework, centering, etc., carrying loads shall remain in place for three and a half days and until the concrete has attained a compressive strength of 3000 psi.

Fiber column forms may be removed at times specified above, but no later than 10 days after placing concrete.

When parapets or median barriers on structures are formed by the slip form method, curing shall begin as specified in the following paragraph 3.10F using a fugitive dye liquid membrane-forming compound immediately after the concrete is finished. Immediately after each joint is saw cut, the concrete surfaces shall be cured for the remainder of the seven (7) days of cure as specified in the following paragraph 3.10D.

3. Tops of end walls, end support walls, headwalls, etc., shall be cured for three (3) days with burlap or cotton mats as specified in the following paragraphs 3.10B or 3.10D, respectively.

11. Horizontal surfaces shall be cured for seven (7) days as specified in 3.10B thru 3.10E.

3.10 CURING METHODS

A. Flooding. Units of structures that will be below water in the completed structure, i.e., bottom slabs of culverts, footings, struts, etc., may be gradually flooded when approved by the Engineer after the concrete is 12 hours old, provided the curing water conforms to the aforementioned 2.1 F. The temperature of this water shall be maintained at 35° F or above for the specified curing time.

B. Burlap. Two layers of burlap shall be used. Successive strips of burlap shall be overlapped a minimum of 6 inches. The second burlap layer shall be placed not less than 45 degrees to the first layer, or in lieu of this, the 6 inch overlap of the second layer may be placed midway between the first layer. This material shall be thoroughly saturated by immersion in curing water for at least 24 hours prior to placement and shall be kept saturated throughout the time specified for curing.

C. White Opaque Polyethylene Backed Nonwoven Fabric. One layer of white opaque polyethylene backed fabric shall be used. Successive strips shall be overlapped a minimum of 6 inches. This material shall be thoroughly saturated by immersion in curing water for at least 24 hours prior to placement and shall be kept saturated throughout the time specified for curing.

D. Cotton Mats. One layer of cotton mat material shall be used and shall be kept thoroughly saturated with curing water prior to placement and throughout the time specified for curing. The material shall be kept in tight contact with the concrete.

E. White Opaque Burlap Polyethylene or White Opaque Polyethylene Film. The white opaque burlap polyethylene sheeting shall be placed on no less than one layer of wet burlap with the burlap side of the sheeting facing down. White opaque polyethylene film, if used, shall be

placed on no less than two layers of wet burlap. Only one layer of cotton mats is required in any usage. These materials may only be used atop the wet burlap or cotton mats on unobstructed flat and reasonably level surfaces.

a. Adjacent mats or sheets shall be lapped no less than 1 ft. The ends shall be brought down around the sides of the concrete being cured and securely fastened to make an airtight seal.
b. The white opaque burlap polyethylene sheeting or the white opaque polyethylene film shall remain in place for the same length of time as required for burlap or cotton mats. These protective coverings need not be wetted down, however, the covered burlap or cotton mats shall be kept wet for the time interval specified.

F. Liquid Membrane. Liquid membrane forming compound shall be applied in conformance with manufacturer's recommendation or as directed by the Engineer. The material shall be applied by sprayers and shall be thoroughly agitated before and during use.

3.11 BRIDGE DECK SLABS

A. Bridge deck slabs and culvert top slabs with integral wearing surfaces, including sidewalks, shall be cured as follows:

B. The Contractor shall have misting equipment available. Prior to placement of any concrete, operation of the misting equipment shall be verified by the Engineer to ensure that the equipment and procedure are capable of misting the entire placement area without damaging the fresh concrete. This shall be done at the location of proposed use each day that a deck placement is to be made. Ample spare parts, water, fuel, etc. shall be readily available. A backup tested unit shall also be available.

C. The Contractor shall cover the finished concrete with wet burlap as specified in the previous paragraph 3.10B. The concrete covering shall progress immediately after the concrete has been finished but no portion of the concrete shall remain uncovered for more than 45 minutes after placement. Mist spraying shall be used when directed by the Engineer, and when the concrete is not covered with wet burlap within 30 minutes after placement. Once misting is started, it shall continue until wet burlap is completely in place.

D. Use of the mist spray shall not relieve the Contractor of the responsibility for covering the concrete within the 45 minutes after placement.

E. After the concrete is covered with wet burlap, it shall be cured in conformance with the previous paragraph 3.10B for the remainder of the seven (7) day period. The two layers of burlap shall be kept continuously and uniformly saturated throughout the curing period. White opaque burlap polyethylene sheeting and white opaque polyethylene film or clear polyethylene film shall not be placed over wet burlap except when approved by the Engineer in writing for cold weather protection. A sufficient quantity of soaker hoses shall be used to conform to these requirements. The Contractor shall take immediate action to remedy improper saturation of any area throughout the entire curing period.

F. The Contractor shall provide a sufficient number of experienced personnel and necessary equipment to ensure proper placement, protection and curing of the concrete in conformance with these Specifications.

G. The Contractor shall also provide temporary troughs, dams, etc., necessary to prohibit the runoff water from reaching any traveled roadway, shoulder or sidewalk. The proposed methods of controlling runoff water in these areas shall be submitted to the Engineer for approval before use. The plan shall include locations of all troughs and dams, as well as the proposed methods of attaching them to any portions of the structure. There shall be no welding or drilling holes in any portion of a permanent member of the structure.

H. After the procedure is underway, it shall be evaluated, and any areas not functioning in a manner acceptable to the Engineer shall be modified by the Contractor to satisfy the requirements for retaining and directing the flow of water.

I. In rehabilitation construction, where the full use of temporary troughs, dams, etc., is not practical, modifications to the provisions for controlling the runoff water shall be made by the Contractor and approved by the Engineer.

3.12 CONSTRUCTION JOINTS

A. Construction joints shall be kept to a minimum and will be permitted only where specified in the Contract Documents, or authorized by the Engineer in writing.

B. The surface of the hardened concrete shall be cleaned and kept moistened until the additional concrete is placed. The top surface of concrete shall be leveled using a grade strip, unless otherwise specified. At chamfers the top surface of the concrete shall be steel troweled adjacent to the chamfer using the top surface for the chamfer strip as a guide.

C. Where a featheredge might be produced at a construction joint, as in the sloped top surface of a wing wall, an inset form shall be used to produce a block in addition to the preceding placement. The inset form shall produce a 6 inch minimum edge thickness of concrete in the succeeding placement.

D. The Contractor shall place an epoxy bonding compound on the surface areas of existing concrete (concrete that existed prior to the beginning of the Contract) which will be in contact with new concrete. Epoxy bonding compound shall also be applied to the entire face of all bridge deck slab construction joints. The surfaces to be coated shall be clean, sound, and dry and bonding compound shall be mixed and applied in conformance with the manufacturer's recommendations.

3.13 LINSEED OIL PROTECTIVE COATING

A. Linseed oil protective coating shall be applied to the integral concrete bridge deck slabs, box culvert wearing surfaces and sidewalks on bridges and box culverts when the pertinent linseed oil protective coating item appears in the Contract Documents.

B. Permanent paint or tape lane markings required on the structures shall be placed prior to the application of the linseed oil protective coating. The concrete surfaces to be treated shall also be cured, dried and thoroughly cleaned of all dust, dirt, and deleterious material prior to placing the first linseed oil protective coating.

C. If the concrete is wet, it shall be allowed to dry for one to two days at a minimum temperature of 60° F. If the concrete surfaces are extremely dry, the Contractor shall either wet the concrete thoroughly and allow it to dry for one or two days or apply a third protective coating at the same rate per gallon as the second coat, as directed by the Engineer. The ambient temperature at the time of application shall be 50° F minimum. Following the second application, the ambient temperature shall be 40° F minimum. Two coats shall be applied on all top surfaces that are not grooved. The first coat shall be applied at a rate of 40 yd^2/gal. The second coat shall be applied at a rate of 67 yd^2/gal. On bridge decks and top slabs of box culverts that are grooved, the first coat shall be applied at a rate of 25 yd^2/gal. The second coat shall be applied at a rate of 45 yd^2/gal. The second coat shall not be applied until the first coat is dry. If additional coats are required, there shall be a minimum of 24 hours between them. The drying time may be increased as the ambient temperature falls below 70° F.

3.14 COLD WEATHER PROTECTION

A. Concrete shall be protected and heated after it has been placed when the air temperature in the shade and away from artificial heat drops to 40° F or lower at the time of placing or at any time within the number of days specified herein. Protection and heating shall be as follows:

1. Ordinary concrete shall be protected and kept continuously at a temperature not less than 50° F for at least seven (7) days following placement.
2. In no case shall concrete be heated to more than 100° F. At the end of the heating period, the concrete surfaces shall be cooled to the temperature of the outside air by slowly reducing the artificial heat at a uniform rate until the temperature of the outside air is reached within a 24 hour period.
   The Contractor shall have tarpaulins, insulating devices, and other suitable materials at the site to enclose or protect all portions of the concrete requiring protection. Materials shall be installed as close as possible before placing the concrete, and it shall be installed as rapidly as possible to keep exposure to cold weather to a minimum. Where heating is required, the spaces to be heated shall be completely enclosed and the temperature kept at required levels by the use of heaters approved by the Engineer.
   The Contractor shall provide a sufficient number of maximum/ minimum recording thermometers to record temperatures in each concrete placement undergoing cold weather protection.
   The curing period for all structure concrete requiring cold weather protection shall conform to the cold weather protection period except when the normal curing period is longer.

3.15 UNDERPINNING OLD FOUNDATIONS

A. If underpinning is required, the Contractor shall perform the required work as directed by the Engineer. The operation shall consist of the restoring or lowering of the old foundations with concrete. The concrete shall be Mix No. 6. Excavation and the underpinning operations shall be done in part section, so as not to remove more than 10 percent of the supporting area under the old foundation at one time. The concrete shall have a maximum slump of 1-1/2 inches. When directed by the Engineer, underpinning shall be installed by hand, pneumatic, or pumping processes. The usual curing and cold weather requirements will be deleted for the

underpinning with other provisions for curing and protection improvised on the job as may be directed.

3.16 LOADS ON CONCRETE STRUCTURES

A. The erection of structural steel or concrete superstructures on concrete substructures shall not start until the Contractor has completed curing, removed forms, and substructure concrete has reached a minimum compressive strength of 3000 psi.

B. Loads shall not be applied to any new portion of bridge deck or box culvert built to grade until the final section of that unit of the deck has completed its specified curing period. Vehicles, including the Contractor's, and heavy equipment are not permitted on any new portion of bridge deck or box culvert built to grade until the concrete cylinder breaks for the final section of that unit of the deck has attained a minimum compressive strength of 4500 psi. However, loads such as stored materials, lightweight equipment, concrete safety parapets, sidewalks, median curbs, etc., may be placed upon the concrete slab via cranes or other lifting devices when the concrete in the final section of that unit of the deck has attained a minimum compressive strength of 3000 psi.

C. Backfill shall not be placed on any new portion of box culverts not built to grade until the final section of that unit of the slab has completed its specified curing period and the concrete in that section has attained a minimum compressive strength of 3000 psi.

3.17 PREVENTION AND REMOVAL OF STAINS ON CONCRETE

A. The Contractor shall prevent rust from structural steel, staining by asphalt materials or any other substance from discoloring any portion of the concrete. The Contractor shall use construction procedures that prevent staining of any of the concrete. Where unpainted structural steel has been specified, the Contractor shall protect the pier caps, columns and abutments with a wrapping of reinforced polyethylene or similar material which shall be left in place to prevent staining until after the structure has been completed. If any portion of the concrete is stained, the stains shall be removed and concrete restored to its original color without damage to the concrete. The work shall be done as directed by the Engineer at no additional cost to the Owner. Chemical solvents shall not be used to remove stains unless approved by the Engineer.

3.18 SAFETY HAZARDS

A. The Contractor shall be responsible for gas detection in and ventilation of confined spaces.

B. When procedures require workers to enter confined spaces such as steel or concrete box section type superstructures, particularly when the interior is closed off at both ends, the Contractor shall be cognizant of the potential health hazards.

C. The Contractor shall adhere to all applicable Maryland Occupational, Safety and Health (MOSH) regulations. The Contractor shall have approved detecting devices available and shall conduct tests for oxygen content and presence of gases, such as combustible gas, carbon

dioxide, methane, carbon monoxide, and hydrogen sulfide whenever any fabrication, erection or inspection operations are to be performed within the confined spaces. The Contractor shall apply mechanical ventilation continuously to the confined space during occupancy to maintain the proper oxygen content and shall conduct air tests periodically during the occupancy.

D. Defective work exposed upon removal of the forms shall be entirely removed or repaired within 24 hours, as directed by the Engineer.

1. Edges of material remaining in place shall be cut perpendicular to the finished surface to the full depth of the material removed, but not less than 1 inch. If the removal of defective concrete affects the structural requirements, the member also shall be removed and replaced as directed by the Engineer.
2. Defective areas shall be cleaned.
3. Defective areas shall be coated with an epoxy bonding compound.
4. Defective areas shall be patched with concrete mortar or epoxy. The color, contour, and texture of surrounding concrete shall be matched as close as possible.

END OF SECTION 03 30 00

03 40 00
PRECAST CONCRETE

PART 1 GENERAL

1.1 DESCRIPTION

A. Section includes requirements for providing precast concrete structures, manholes, valve vaults, and other specified miscellaneous structures.

1.2 REQUIREMENTS FOR MANUFACTURERS AND SUPPLIERS BEFORE DELIVERY

A. Testing and Inspection.
   1. Engineer may inspect and test all precast structures, fittings, lining and joint material after delivery to site or at factory.
   2. Manufacturer or Supplier: Furnish materials for tests and labor to assist Engineer with tests.
   3. Engineer may continually perform plant certification and process inspections.
   4. Concrete design mix for precast manhole sections by manufacturer showing sieve analysis for aggregates, suppliers of materials, and thirty 28-day compressive strength test results performed within 1 year of submittal.
   5. Notify Engineer following Section 01 45 00.

B. Factory or Site Inspected Material: See Section 01 45 00.

C. Storage and Handling.
   1. Manufacturer or Supplier:
      a. Store reinforcing steel off ground in well drained area to prevent deformation.
      b. Aggregates and sand: Store on concrete slab and handle to maintain separation and to prevent infiltration of deleterious materials.
      c. Completed structures: Store off ground using wood blocks, pallets, or other appropriate means to give ample space between rows and individual pieces, and with enough clearance above and below to allow full view of walls and joint ends for inspection purposes.
      d. Joint ends: Keep clean and off ground.
   2. Manufacturer's Batching Plant, Casting Equipment, and Curing Facilities: Complete, operating properly, and of proper size and range.
   3. Manufacturer's Records: Show evidence of continual maintenance and quality control over casting forms and joint forming rings.

D. Shipment Identification: Before inspection of precast structures for an order, manufacturer or supplier shall furnish to Engineer:
   1. Owner's Contract Number.
   2. Contractor's name.
   3. Section sizes.
   4. Footage or number of pieces required to fill order.
   5. Evidence that concrete has cured to minimum 80 percent of design strength.

E. Ship only Owner approved precast concrete structures to Contract site.

F. Repairs: Follow manufacturer's procedures filed with Engineer.

G. Manufacturer or Supplier: Follow standard cold weather concreting practices of ACI 306R "Cold Weather Concreting."
   1. Engineer may make special requirements to ensure quality.

1.3 SUBMITTALS

A. Submit following Section 01 33 00.
   1. Shop Drawings: Show complete details, pertinent calculations, design loads, materials, strengths, sizes, and thicknesses, joint and connection design and details for precast structures.
      a. Reinforcing steel following ACI 315, including bar lists and bending diagrams, placement drawings, and special details.
      b. Location, types, and details of joints.
      c. Sequence of pours.
      d. Calculations showing concrete strength to be attained at proposed time of removal of formwork, falsework, and centering.
   2. Waivers.
      a. Shop drawing submittal waived when:
         1) Municipal Standard Details allow use of precast structures.
         2) Approved design drawings and calculations for precast structures are on file with Engineer.
      b. To obtain waiver submit letter citing:
         1) Owner's Contract Number.
         2) Precast structure manufacturer.
         3) Approved design drawing number.
      c. Installation Methods for Precast Sections when manufacturer's recommended methods are on file with Engineer.
      d. If Municipal Standard Details or specifications change, new submittals will be required.
   3. Coating manufacturer's catalog data for lining interior surfaces of precast concrete manholes, including recommendations for surface preparation, application, curing, handling, and repair procedures for coated manhole sections.

B. Submit following Section 01 45 00.
1. Certificate of Compliance:
      e. Precast Manhole Manufacturer or Supplier: Flexible connector assembly, including seals and metallic or non-metallic mechanical devices used therein.
      f. Manhole lining material meets physical property requirements of lining manufacturer and passes in-plant tests, as recommended by lining manufacturer.
      g. Engineer may require manufacturer or supplier to furnish test results substantiating certificate of compliance, or in case of failure, may elect to witness testing to his or her satisfaction.
2. Certified Test Reports:
      a. Aggregates, cement, admixtures, and steel reinforcement used in production of vaults, manhole sections, and grade rings following ASTM.
      b. Initial reports with above referenced concrete design mixes.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Suitability of Precast Structures for Transport to Contract Site: When concrete has cured to minimum of 80 percent of design strength.

B. Storage.

1. Store off ground on wood blocks, pallets, or other appropriate means away from brush, and in area accessible for inspection.
2. Do not place excavated or other material over or against stored precast structures.

C. Handling of Precast Structures and Appurtenances: Unload and handle with crane, backhoe, or equipment of adequate capacity, equipped with appropriate slings and lifting devices to protect material from damage.

D. Repair or Replacement.
1. When Engineer deems repairable: Repair as directed by Engineer.
2. When Engineer deems not repairable: Remove and replace as directed by Engineer before initiating work.
3. Repair or replacement of defective or damaged material and equipment will be at no cost to Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Reinforced Concrete Materials: Follow Section 03 30 00, and modification herein, except slump requirement shall not apply to manholes.

B. Precast Concrete Manholes: ASTM C478 except:

1. Compressive Design Strength of Concrete:
   a. Minimum 5000 psi using Type II cement.
   b. Minimum compression cylinder test of 4000 psi at time of shipment.
2. Configurations: Follow Drawings and municipal Standard Details.
3. Joints: ASTM C443.
4. Sizes: Furnish in lengths of 1 foot minimum, except do not use more than one, 1 foot section in each manhole.
5. Appurtenances.
   a. Steps: Manufactured and of style specified in City of Baltimore DPW Specifications, 2006 Section 33 49 00
   b. Bolt inserts: Follow municipal Standard Details.
      1) Embed one of following minimum of 3 inches, to accommodate 3/4 inch diameter bolts.
         a) Heckman Building Products Corporation, No. 444 Star Threaded Inserts.
         b) Pennsylvania Insert Corporation, the Liberator.
         c) Atlantic Concrete Products Co., Bolt Slot Insert System.
         d) Strut Service Company inserts.
      2) Provide with plugs for transport to Contract site.
6. Flexible Gasket Connectors: ASTM C923.
   a. Stainless steel, Type 304 may be used when not in contact with sewage or sewage gas.
   b. Identification: Permanent markings of date and production runs.
   c. Approved manufacturers for connectors connecting with diameter dimension of ductile iron pipes, polyvinyl chloride (PVC) ASTM D3034, and PVC ASTM F679 to sewer manholes:

1) A-LOK Products Inc., A-LOK or A-LOK X-CEL.
2) Chardon Rubber Company, Lock Joint Flexible Manhole Sleeve.
3) Hail Mary Rubber Co., Star Seal.
4) Press Seal Gasket Corporation, Press Boot, PSX Series, Econoseal, CAST-A-SEAL® 12-08 Cast In Boot, or equal.
5) NPC Incorporated, KOR-N-SEAL I Toggle Korband with Series 106 or 406 rubber boot.
6) International Precast Supply, Cobra Style, Toggle Style, and Adjustment Style.

d. Approved manufacturers for connectors for inserting pressure sewer piping through manhole walls:
1) A-LOK Products, Inc., Z-LOK.
2) Press Seal Gasket Corporation, 8QRS-PSX Positive Seal System.
3) Or equal.

e. Approved connector manufacturers for closed profile PVC pipe for ASTM F1803 Pipe "Manhole Pipe":
1) Press Seal Gasket Corporation.
2) A-LOK X-CEL.
3) Or Equal.

f. For connectors for profile PVC pipe for ASTM F794, use special adapter meeting profile dimensions approved by the pipe manufacturer.

g. Approved connector manufacturers for PVC pipe with AWWA C900/C905:
1) Pipe on slopes greater than 10 percent but no greater than 20 percent:
a) Atlantic Concrete Products Z-LOK.
b) Press-Seal Gasket Corporation.

Pipe Size Diameter	Manufacturer's Gasket Designation Manhole	Opening
4 inch	8QRS	8 inch
6 inch	12Y	12 inch
8 inch	12M	12 inch
10 inch	16Y	16 inch
12 inch	16M	16 inch

2) Pipe on slopes greater than 20 percent but no greater than 35 percent:
a) Atlantic Concrete Products Z-LOK.
b) Or equal.

h. Other pipe connectors: Recommended by pipe manufacturer and approved by Contract Manager.

7. Precast Channels/Benches:
a. Compressive design strength of concrete:
1) Minimum 28 day compressive strength of 4000 psi using Type II cement.
2) Compressive strength of 3200 psi at time of shipment.

b. Construction and finish:
1) Furnish access for jointing pipes to flexible manhole connectors.
2) Once channel/bench has been poured and initial concrete set has taken place, add no additional concrete to modify shape or repair defects.
3) Top surface of bench: Brush or light broom finish.
4) Channels: Troweled smooth surface.

c. Sizes:
   1) Lining: Minimum following municipal Standard Details.
   2) Slopes.
      a) Bench: Slope toward channel with maximum 1 inch vertical drop for each foot horizontal.
      b) Channels: Slope smoothly and uniformly from incoming pipes to outlet pipe.
   3) Width and height.

      a) Match inside diameters of incoming and outgoing pipes and blend channel to smooth contour.
      b) Deviations to channel width above spring line of pipe and at flexible connectors: Permitted for this purpose with Contract Manager's approval.

8. Manhole Identification: Clearly marked on inside near top where applicable.
   a. ASTM Specification designation.
   b. Manhole setting number (bases only) and Project number.
   c. Date of manufacture.
   d. Production control number for tracking manufacture phases of item and name or trademark of manufacturer.
   e. Manhole sections with flexible connectors:
      1) Marked above connector openings with type and size, and type of pipe for which connector is designed.
      2) Engraved or stenciled markings with waterproof paint or ink in minimum 1 inch high letters.
   f. Lined manholes: Stenciled with waterproof paint or ink markings as noted herein that cannot be easily removed from lining or epoxy coated surfaces.
9. Precast Manhole Sections.
   a. Approved Manufacturers:
      1) Americast, Martinsburg, WV plant only.
      2) Atlantic Concrete Products Company, Cockeysville, MD plant only.
      3) Hanson Concrete Products, Jessup, MD plant only.
      4) Frederick Precast Concrete, Inc., for 48 inch through 72 inch manholes.
      5) Contractors Precast Corporation, Davidsonville, MD plant only.
10. Lined Manholes: Concrete Protective Liner or Epoxy Resin Mortar.
   a. Concrete Protective Liner.
      1) Cover interior surfaces except at penetrations and channels.
      2) After installation, seal penetrations and other non-lined interior concrete surfaces following manufacturer's recommendation.
      3) Approved manufacturers:
         a) Dura Plate 100 PVC liner, A-LOK Products, Incorporated, Tullytown, Pennsylvania.
         b) T-Lok PVC liner, Ameron Protective Linings.
         c) AGRU Sure-Grip HDPE liner, Americast AgruAmerica.
   b. Epoxy Resin Mortar.
      1) Coat interior concrete surfaces, except channels, with .125 inch thick cementitious corrosion and abrasion resistant epoxy resin mortar.
      2) Approved supplier and product:
         a) Nitomortar EL, FOSROC Incorporated.
         b) Or equal.
11. Precast Concrete Grade Rings: ASTM C478, except:

a. Compressive Design Strength of Concrete: Minimum 5000 psi using Type II cement.
b. Configurations: Follow municipal Standard Details.
c. Rings: Drilled with holes 1-1/2 to 2-inch diameter to accommodate frame anchor bolts.
    1) Grade rings with cracks or fractures passing through height of ring and any continuous crack extending for length of 3 inches or more will be rejected.
    2) Rings with damaged edges which will prevent making satisfactory joint will be rejected.
    3) Planes of ring surfaces: Within limits of plus or minus 1/4 inch of horizontal and vertical, except for sloped adjusting grade ring to be within 1/4 inch of Standard Detail.
    4) Protection:
        a) On lined manholes: Follow manufacturer's recommendations.
d. Approved manufacturers:
    1) Atlantic Concrete Products Company.
    2) Americast.
    3) Contractors Precast Corporation.
    4) Hanson Concrete Products
    5) Dal-Col Products, Inc.
    6) Prism Precast Products, Inc.
    7) Frederick Precast Concrete, Inc.

C. Precast Concrete Vaults: ASTM C858.
1. Configurations: Follow Drawings.
2. Identification: Clearly mark inside of each precast concrete vault section.
    a. ASTM Designation.
    b. Vault size.
    c. Date of manufacture.
    d. Project station location and Project number.
    e. Name or trademark of manufacturer.
    f. Mark slabs on top and bottom surfaces.
3. Design Mixes:
    a. 5000 psi at 28 days using Type II cement.
    b. Mix proportion: ACI 318.
1. Approved Manufacturers:
    a. C. Miller, Spring City, PA plant only.
    b. Smith Midland Corp., Midland, VA plant only.
    c. Rotondo Precast Products, Inc., Fredericksburg, VA plant only.

D. Miscellaneous Materials.
1. Granular Bedding: ASTM C33 coarse aggregate size number 4.
2. Weepholes: Service weight cast iron covered with non-erodible filter on earth side.

2.2 SOURCE QUALITY CONTROL
A. Test Equipment: Instruments, gages, and other testing and measuring equipment of proper range, type, and accuracy to verify conformance with specification requirements.
1. Ensure equipment is calibrated and certified at annual intervals.
2. Calibrate against measurement standards with known relationship to existing national standards.

3. Calibrate and certify gages on equipment to which they belong, and keep them on equipment following certification.
4. Do not use instruments, gages, testing, and measuring equipment found to be out of calibration or adjustment until applicable requirements have been met.
5. Calibration by agency regularly engaged in this type of activity.

B. Precast Manhole Testing.
1. Joint and Barrel Testing: ASTM C443.
   a. Plant vacuum testing: ASTM C1244.
2. Pipe to Manhole Connection Testing: Flexible gasket connectors following ASTM C923, except modified herein.
   a. During every 90 day period, test at least 1 connector.
   b. Perform hydrostatic testing of connectors following ASTM C923.
      1) If manufacturer chooses to perform vacuum test following ASTM C1244, test connector with pipe in straight alignment, 7 degrees minimum axially deflected alignment, and loaded in shear following ASTM C923.
      2) Use test pipe of same size, class, design and type as pipe to be provided under Project.
      3) Measure pressure at horizontal centerline of connector using calibrated pressure gage, minimum 4-1/2 inch diameter, calibrated from 0 to 30 psi with 1/2 pound subdivisions.
      4) Manufacturer may use standpipe calibrated in 1/2 foot increments with permanent markings instead of calibrated pressure gage.
         a) Use standpipe high enough to develop specified water pressure and equipped with overflow line adjusted to height for developing specified pressure.
         b) Ensure that continuous stream of water flows from overflow line during test and is visible from test site.
   c. Hydrostatic test at or above 40 degrees F and in environment free from effects of wind, inclement weather, and conditions that would interfere with conducting tests and observing their results.
      1) Adjust test medium and specimens to, and maintain at, 40 degrees F or above prior to commencing and for duration of test.
      2) Faulty performance or failure of test equipment during test phase will necessitate rerunning phase using properly performing test equipment.
   d. Retesting: If connector fails to meet requirements herein and in referenced ASTM document, Contract Manager will randomly select and test 2 additional connectors of same diameter and from bases originally manufactured on same day as failed connector.
      1) If either of 2 additional connectors fails, Contract Manager will reject all bases manufactured that day with connectors of same size as those tested, as well as bases with other connector sizes mixed with original size tested.
      2) Perform retest of next day's production until compliance with requirements is proven.
   e. Repairs.
      1) Failure of seal between connector and manhole wall due to occasional imperfections in manufacture or accidental injury during test may be repaired using methods recommended by manufacturer, and will be acceptable if Contract Manager finds repairs are sound, properly finished, and cured.

2) Demonstrate to Contract Manager that repairs will result in seal conforming to requirements of this specification.

f. Post test failures: If previously tested and complying connectors resubjected to prescribed hydrostatic or vacuum pressure during testing of other sizes fail, and/or seal between them and manhole wall fails watertightness or vacuum tightness requirements, Contract Manager will reject base.
   1) Contract Manager will randomly select and test 2 additional bases fitted with same size connectors originally manufactured on same date as failed base.
   2) If previously tested connector sizes fail retest, all bases with same size connectors manufactured on that date will be rejected.
   3) Perform retest of next day's production until compliance with requirements is proven.
   4) Perform retest of connectors that fail to meet requirements herein and in referenced ASTM document as specified in above.
   5) During retesting of flexible connectors on manhole parts or joints between manhole parts, leakage of water as described in this section in any area constitutes failure requiring retest.
   6) Leakage consisting of a small run adjacent to lifting inserts on manhole sections shall not be cause for rejection.

C. Acceptance Procedure for Concrete Strength of Precast Manhole Sections: Procedure applies to acceptance and approval of precast manhole bases, riser and cone sections, flat top slabs, and grade rings.
   1. Concrete Design Mix Approval: Based on submittal specified above herein.
      a. Baltimore Ctiy approval issued every 3 years, provided design mix materials and sources are not changed and in-plant concrete testing of manhole sections continues to be accepted without rejection of more than 2 days' production in a row.
      b. Compressive strength test: ACI 301 and ACI 318.

D. Vaults and Other Precast Concrete Structures.
   1. Determination of concrete compressive strength: From compressive tests made on concrete cylinders.
   2. Unless otherwise specified, retain independent testing facility approved by Contract Manager for molding, capping, and testing concrete cylinders following appropriate ASTM requirements or, at Contract Manager's option, make cylinders and use own equipment to test.
      a. Furnish test results to Contract Manager.
      b. Contract Manager may require core samples of finished products.
      c. When requested by Contract Manager, furnish compressive test specimens for testing in addition to requirements above, and continue to monitor quality of concrete.
   3. Notify Contract Manager at least 10 working days prior to pouring any structure.
   4. The Owner may perform random or full inspections of manufacture of boxes, vaults, and precast structures to inspect:
      a. Steel placement and size.
      b. Overall fabrication.
      c. Workmanship.
      d. Other general or specific aspects of production and specification compliance.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Execution: Follow Sections 03 30 00, 33 31 00, City of Baltimore DPW Specifications, 2006, 33 11 13, and supplemented herein.

1. Provide granular bedding following Drawings.
2. Provide weepholes on base of impervious material following Drawings.
3. Provide bituminous membrane waterproofing following Drawings.

3.2 FIELD QUALITY ASSURANCE

A. Perform field testing of precast concrete structures required under other sections of these specifications.

END OF SECTION 03 40 00

04 21 13
BRICK MASONRY

PART 1 GENERAL

1.1 DESCRIPTION

A. This work shall consist of brick laid in full beds of mortar and built to the shapes and dimensions and at the locations specified in the Contract Documents or as directed by the Engineer.

PART 2 PRODUCTS

2.1 MATERIALS

A. Curing Compound: Liquid membrane forming compounds shall conform to M 148. Field control testing of the white pigmented curing compounds shall be on the basis of weight per gallon. The samples shall not deviate more than ± 0.3 lb/gal from the original source sample.

B. Brick:

1. Sewer brick shall have a standard size of 2-1/4 X 3-3/4 X 8 inches and conform to M 91, Grade SS.
2. Manhole brick shall conform to M 91, Grade MS.
3. Building brick shall conform to M 114, Grade SW.
4. Hollow load bearing concrete masonry block shall conform to C 90, Grade N, Type I, normal weight.
5. Solid concrete masonry block shall conform to C 145, Grade S, Types I and II, except units exposed to weather shall be Grade N, Types I or II.

C. Mortar used for masonry shall be composed in conformance with one of the following:
1. One part portland or blended cement and three parts mortar sand by dry loose volume and hydrated lime not to exceed 20 percent of the cement by weight.
2. One part masonry cement and three parts mortar sand by dry loose volume.
3. Prepared bag mixes consisting of masonry cement and mortar sand. The prepared mixes shall produce a minimum compressive strength of 500 psi in seven (7) days when tested using the applicable procedures specified in C 91.
4. Materials for mortar shall conform to the following:
   a. Mortar Sand shall conform to SHA Specification 901.01.
   b. Portland Cement: Portland cement shall conform to M 85, with the fineness and the time of setting determined in conformance with T 131 and T 153, respectively.
   c. Blended Cement: Blended hydraulic cement shall conform to M 240, Type I (PM) or a Type IP containing 15 to 25 percent pozzolan by weight of cement. Maximum loss on ignition shall be 3.0 percent and ground iron blast furnace slag shall not be used for blending. The requirement for a manufacturer's written statement of the chemical composition is waived.

d. Masonry Cement: Masonry cement shall conform to C 91, except the water retention and staining tests are waived.

e. Water: Water shall conform to the pH requirements of T 26, Method B and shall be clear. If questionable quality is suspected, the water shall conform to the limits of the comparison tests with distilled water as specified in T 26. The chloride concentration of water used in mixing and curing of portland cement concrete shall be determined in conformance with D 512 and shall not exceed 1000 ppm limit.

f. Lime:

Hydrated lime shall conform to the chemical requirements of C 206, Type N when used in finishing or C 207, Type N when used for masonry.

Hydrated lime for soil stabilization shall have a minimum combined calcium oxide and magnesium oxide content of 65 percent when tested as specified in C 25 and shall conform to the following gradation:

SIEVE SIZE	PERCENT RETAINED max
3/8 inch	0
No. 30	3
No. 200	25

Quicklime shall have a combined calcium oxide and magnesium oxide content of 75 percent minimum and a gradation of 100 percent passing the 3/8 inch sieve when tested as specified in C 25.

D. Fusion Bonded Epoxy Powdered Coatings:

1. The epoxy protective coatings shall be a one coat, heat curable, thermosetting powdered coating that is electrostatically applied on metal surfaces as specified in the Contract Documents. Unless otherwise specified in the Contract Documents, the color for structural steel shall match federal standards. For reinforcement steel the color shall be a bright color to contrast with the normal color of reinforcement steel and rust (e.g., orange, red, green, yellow, etc., and not brown or any color in the rust family). If reinforcement steel is coated before fabrication, all hairline cracks and minor damage on fabrication bends shall be patched, even if there is no bond loss. The epoxy coating material shall be selected from the prequalified materials list from the Engineer.
2. Epoxy coatings shall conform to D 3963.
3. Material used for the touch up system shall be a two-part epoxy system designated and color matched for patching the epoxy coating used. Patching material shall be available through the manufacturer of the epoxy powder. The patching material shall be fully cured one hour after application at 35° F ambient.
4. The manufacturer shall furnish certification, which verifies that the material and work complies with the applicable specifications and includes the actual test results to confirm the statement. The contents of the certification shall be on the Contractor's/vendor's/manufacturer's letterhead or approved document and shall be duly signed by a company officer.

E. Water: Water shall be as per aforementioned paragraph 2.1 C e.

F. Dove Tail Anchors shall be as specified in the Contract Documents.

2.2 Sample Panel

A. When specified in the Contract Documents, a sample panel measuring a minimum of 24 X 24 inches shall be prepared and delivered to the construction site. The panel shall be typical of the brickwork to be used on the project. The City's approval of the panel shall be received before beginning the brickwork on the project. The sample panel shall remain on the project site and all subsequent brickwork shall be equal in appearance to this approved panel.

PART 3 EXECUTION

3.1 CONSTRUCTION

A. Unless otherwise specified, all brick masonry shall be laid in level courses with faces plumb, square and true to the dimensions specified. All exposed surfaces shall be smooth. Brick masonry for parapets and end posts shall be laid parallel to the roadway or barrier.

B. Brick facing shall be constructed as specified in the Contract Documents.

C. Masonry Work for Utility Structures:

1. Use sewer brick whenever brick construction is exposed to flow; otherwise, use manhole brick or solid concrete block. Lay sewer brick on edge so that the 2 ¼ by 8-inch side is exposed to flow.

   Lay manhole brick so that every sixth brick course is a header course.

   Lay the first course of concrete masonry units in a full bed of mortar for the full width of the unit. Lay succeeding courses with broken joints. Form bed-joints by applying the mortar to the entire top surface of the inner and outer face shells. Form head joints by applying the mortar for a width of about 1 inch to the ends of the adjoining units laid previously. The mortar for the joints shall be smooth, not furrowed, and shall be of such thickness that it will be forced out of the joints as the units are being placed in position. Where anchors, bolts, and ties occur within the cells of the units, fill such cells with mortar or grout as the work progresses. Use concrete brick for bonding walls, working out the coursing, topping out walls under sloping slabs, distributing concentrated, backing brick headers, and elsewhere as required.

2. Where practicable, lay each course with a line. For courses curved or in nonparallel planes, use bonded and keyed brick construction. Joint thickness shall not be less than ¼ inch nor more than ½ inch. For courses curved or in non-parallel planes, make the thickest part of the joint as thin as practicable.

   Rack or tooth uncompleted brick and block construction and parge non-exposed surfaces with ½ inch of mortar. Tool concave in a manner that will compact and press mortar against units all joints except where work will be parged.

3.2 Bond

A. Unless otherwise specified, brick masonry shall be laid in running bond. Adjoining courses shall be laid to break joints by half brick as nearly as practical.

3.3 Bricklaying

A. All brick shall be sprayed with water to dampen the surface prior to laying. Only fresh plastic mortar shall be used, and it shall be soft and workable when placed on the wall. A layer of mortar shall be spread on the beds and not more than a shallow furrow which can be readily closed by the laying of the brick shall be made in it. All bed and head joints shall be filled solid with mortar. End joints of stretchers and side or cross joints of headers shall be fully buttered with mortar and a shoved joint made so that mortar is squeezed out at the top of the joint. No brick shall be jarred or moved after it has been fully bedded in the mortar. Bricks loosened after the mortar has taken its set shall be removed, cleaned, and re-laid with fresh mortar. No broken or chipped brick shall be used in the face. Spalls or bats are not permitted except where necessary to shape around irregular openings or edges. Full bricks shall be placed at ends or corners where possible and the bats used in the interior of the course. In making closures, bricks shorter than the width of a whole brick shall not be used. Whole brick shall be used as headers.

3.4 Joints

A. All joints shall be slushed with mortar at every course, but slushing alone will not be considered adequate for making an acceptable joint. Exterior faces shall be laid up in advance of backing. Exterior faces in contact with the earth shall be back plastered or parged with two coats of mortar each not less than 3/8 inches thick before the backing is laid up. The first coat shall be cross-scratched; the second coat shall be troweled smooth, beveled at the top, and covered out at the edge of the footing. Extend parging not more than 4 inches above grade, unless indicated otherwise, and keep damp for at least three days. Prior to parging, all joints on the back of face courses shall be cut flush. Joints shall be 1/4 to 1/2 inches wide. Whatever width is adopted shall be maintained uniformly throughout the work.

3.5 Pointing

A. All exterior head and bed joints shall be tooled with a round tool, slightly larger than the joint, pressed tight against the still plastic mortar so as to provide a concave finish. When nails or line pins are used, the holes shall be immediately plugged with mortar and pointed as soon as the nail or pin is removed.

3.6 Cleaning

A. Upon completion of the work, all exterior surfaces shall be cleaned by scrubbing and washing down with water, or if necessary, cleaning shall be done with a 5 percent solution of muriatic acid, which shall then be rinsed off with liberal quantities of clean fresh water.

3.7 Curing

A. After the work has been laid up and pointed, the exposed surfaces of brick masonry shall be cured by one of the following methods:

1. Brick shall be covered with two layers of burlap and kept wet for three (3) days.
2. A nonasphalt colorless liquid curing compound shall be applied by means of an approved hand or motor driven spray operated at a pressure between 40 and 60 psi. The liquid compound shall be uniformly applied at a rate of 27 yd^2/gal. The material shall be applied so that the exposed surface is completely coated and sealed in one application. At points where the work shows evidence of insufficient coating, additional material shall be added as directed by the Engineer.

3.8 Cold Weather Protection

A. Brick masonry work and pointing are not permitted when there is frost in the brick or when the air temperature is below 50° F, unless the Contractor provides suitable housing, covering and tarpaulins, and heating devices necessary to keep the atmosphere surrounding the masonry at a minimum temperature of 50° F for the curing period.

3.9 Backfill

A. Brick masonry shall not be backfilled before seven (7) days after completion of the section.

END OF SECTION 04 21 13

04 40 00
STONE MASONRY REPAIRS

PART 1---GENERAL

1.1 SUMMARY

A. This Section includes procedures for removing and replacing deteriorated stone masonry. It should be used in conjunction with Section 04 40 40 "Repointing Stone Masonry".

B. The Contractor shall furnish all materials, labor, equipment, tools, etc., required for the repair, renovation, and replacement of stone masonry as indicated on the Drawings, specified herein, and determined by field survey.

C. The Contractor, in conjunction with the Architect, shall determine the extent of cracked or deteriorated stone masonry to be rehabilitated and/or repaired. A summary of the work to be performed shall be submitted to the Architect for review, and such summary shall be approved by the Architect prior to commencement of the Work.

D. Stone masonry repairs include the following:

1. Stone Amphitheater

2. Stone Retaining Walls

1.2 REFERENCES

A. American Society for Testing and Materials

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Engage an installer having skilled craftsmen or individuals with extensive experience who have successfully completed stone installations similar in material, design, and extent to that indicated for Project.

1.4 MEASUREMENT AND PAYMENT

A. Measurement and payment for stone masonry repairs will be by the unit price method.

B. Measurement:

1. Stone masonry will be measured by the square foot or square yard for each thickness of wall.

2. Mortar, grout, anchors and miscellaneous accessories will not be measured separately, such items are considered incidental to and included with the stone masonry work.

C. Payment: Stone masonry repairs will be paid for at the indicated Contract unit prices for the computed quantities as determined by the measurement method specified in Division 1.

1.5 PROJECT/SITE CONDITIONS

A. Environmental Requirements:

1. Weather: Do not proceed with patching or replacement under adverse weather conditions, or when temperatures are below or above manufacturer's recommended limitations for installation; Proceed with the work only when forecasted weather conditions are favorable for proper cure.

2. Wet Weather: Do not apply or mix mortar on outside surfaces with standing water or outside during rain.

3. Cold Weather, winter construction is not allowed without consent of Regional Architect; Winter construction is defined as any time when surface temperature of masonry is below 40 degrees (F) or air temperature is predicted to be below 40 degrees (F) within 48 hours; Heat mortar materials to above 40 degrees (F) if necessary.

4. Hot Weather: The surface temperature of the work, not the ambient temperature, should not be higher than 100 degrees(F); Mortar mixing should be done only in the shade; Cover mortar in hot weather to reduce evaporation; Pointing work should be done in the shade; Work around the building during the day so that the fresh work will be shielded from direct sunlight to reduce evaporation rate.

PART 2---PRODUCTS

2.1 MATERIALS

A. Salvaged Stone: Approved, sound, crack free, clean stone without face chips larger than 1/2 inch, salvaged from removed face stone work.

B. Replacement Stone: Upon approval of Architect, provide natural building stone of type (classification) and with color, and surface texture to match existing stone on building. Match existing stones in size and shape.

C. Naturally colored binder such as (PFA) low sulphate pozzolanic fly ash

D. Mortar and Grout Materials:

1. Portland Cement: ASTM C150, Type I.

a. For stonework and other masonry indicated, provide non-staining white cement complying with staining requirement of ASTM C91 for not more than 0.03% water soluble alkali.

2. Hydrated Lime: ASTM C207, Type S.

3. Aggregate for Mortar: ASTM C144, unless otherwise indicated.

a. Colored Mortar Aggregate: Natural or manufactured sand selected to produce mortar color indicated.

4. Water: Clean, free of oils, acids, alkalis and organic matter.

5. Aggregate for Grout: ASTM C404.

E. Manufactured and raw materials accessory to the primary products.

1. Supports, fasteners, installation accessories, and anchors: Stainless steel only for use with granite. Brass, bronze, or stainless steel for use with limestone and other masonry.

2. Flashings or barriers: Sheet copper or as detailed.

2.2 EQUIPMENT

A. Trowels: range in length from 10-12 inches

B. Chisels: Joint chisels or a standard mason's chisel with a 1-1/2 in. blade and a long narrow handle

C. Hammers:

1. 5# stone dressing hammer

2. 2# striking hammer

3. "No-Bounce" hammer

4. Full size and one half size brick hammers

D. Joint Tools:

1. 3/8"-1/4" raised beaded tool

2. 3/8"-1/4" beaded striking tool

3. 1/2" raised beaded tool with offset handle

4. 1/2" flat joint iron

5. Pointing tool should be about 1/16" narrower than the joint being filled to achieve good compaction

E. Hawks: Plywood or steel hawk (mortar board)

F. Brushes:

1. Natural bristle brushes

2. Stiff bristle brushes (no wire)

G. Spray bottle

2.3 MIXES

A. Measurement and Mixing: Measure cementitious and aggregate material in a dry condition by volume or equivalent weight. Do not measure by shovel, use known measure. Mix materials in a clean mechanical batch mixer.

B. Consistently and accurately measure materials for each batch.

C. Mix for at least five minutes in a mechanical batch mixer or mortar box.

D. Mix trowel workable consistency for unit masonry setting and resetting.

1. Mixer Pointing Mortar: Thoroughly mix cementitious and aggregate materials together before adding any water. Then mix again adding only enough water to produce a damp, unworkable mix which will retain its form when pressed into a ball. Maintain mortar in this dampened condition for 1-to-2 hours. Add remaining water in small portions until mortar of desired consistency is reached. Use mortar within 30 minutes of final mixing; do not retemper or use partially hardened material.

E. Mix firm dry consistency for repointing.

F. Discard mortar not used within two hours after mixing; do not retemper at mixer.

G. Dispose of waste mortar and cleaning water in approved manner; do not contaminate the site, adjoining property, or waste to sewers.

H. Do not use admixtures of any kind in mortar, unless otherwise indicated.

I. Mortar Proportions:

1. Pointing Mortar for Stone: One part white portland cement, 1 part lime, 6 parts colored mortar aggregate.

2. Rebuilding Mortar: Comply with ASTM C270, proportion Specification, Type N, unless otherwise indicated with cementitious material content limited to portland cement-lime.

3. Grout: ASTM C476.

PART 3---EXECUTION

3.1 PREPARATION

A. Surface Preparation: Where fresh masonry joins existing work, clean the exposed surface of the set masonry by removing loose stone and mortar and wet lightly to obtain the best possible bond with the new work.

3.2 ERECTION/INSTALLATION/APPLICATION

A. Carefully remove by hand, as indicated, any stone which has deteriorated, shifted, or is damaged beyond repair.

1. Carefully cut out perimeter joints of stone by hand using a hammer and chisel.

2. Break down the rest of the damaged stone with vertical saw cuts and break it up with a hammer and chisel.

B. Carefully clean out the cavity to receive the stone. Remove mortar, loose particles and other debris from in preparation for resetting.

C. Thoroughly wet the cavity with water; Dampen the new or salvaged stone with water.

D. Spread a 1/2 inch thick mortar bed into the open cavity; the new mortar should consist of coarse

sand and grit to match the original mortar. Butter vertical joints for full width before setting and set unit(s) in full bed of mortar, unless otherwise indicated.

E. Repair and/or replace removed stone with salvaged stone, where possible, or with new stone to match existing, including size. Set the stone in the cavity.

F. Fill the joints with a grout of lime and low sulphate pozzolanic fly ash (PFA) or lime and HTI powder.

G. Tool joints after setting to match joints of surrounding stone.

H. Repoint new mortar joint to comply with requirements for repointing existing masonry, except rake out joints before mortar sets.

3.3 ADJUSTING/CLEANING

A. Wipe all excess mortar as the work progresses. Dry brush at the end of each day's work. After mortar is thoroughly set and cured, clean new masonry surfaces, walls, sills, overhangs, etc., of all loose mortar, and dirt and point up all nail holes, cracks, etc., after which wash down all masonry walls, leaving them clean and neat.

END OF SECTION 04 40 00

04 40 40
REPOINTING STONE MASONRY

PART 1---GENERAL

1.1 SUMMARY

A. This Section includes provisions for repointing stone masonry using lime mortar.

B. Repointing is the process of removing deteriorated mortar from a masonry joint and replacing old mortar with new, sound mortar.

1.2 SUBMITTALS

A. Manufacturers' literature describing packaged items.

B. Source and screen analysis of bulk aggregate.

C. Mortar sample: Submit, for verification and approval, a sample of each type of mortar used, in form of 6" long by 1/2" wide sample strips of mortar set in aluminum or plastic channels.

1. Provide record of mortar mix, composition and field procedures to be followed.

1.3 QUALITY ASSURANCE

A. Mock-ups: Raking and Repointing Sample Work:

1. Test/Sample Area:

a. Initially perform sample joint raking and repointing on each of a 100 sq. ft. test of stone, brick, and terra cotta areas as approved by Architect.

b. Demonstrate proficiency with joint raking tools and ability to not damage masonry units with either hand or power tools.

c. Mix and cure test batch of repointing mortar and place in joints; repeat test mix until mortar color is approved. Test mortar should be matched, dried and approved before placing in joints.

d. Demonstrate workmanship of repointing procedures and joint finishing.

e. Gain written approval from Architect for test area before proceeding with remaining work.

2. Joint Raking Method: Rake joints by hand only using special joint cleaning chisels and hammer.

3. Repointing Method: Repoint joints by hand only using approved pointing trowels. No bagging or caulking gun pointing methods are allowed.

1.04 PROJECT/SITE CONDITIONS

A. Environmental Conditions: Perform repointing only when the temperature is between 40 degrees Fahrenheit and 80 degrees Fahrenheit. If the temperature is below 40 degrees, the mortar sets too slowly, and there is a good chance of freezing before it fully sets. If the temperature is above 80 degrees, the mortar will set too quickly, and there is a strong chance of excessive loss of water prior to adequate setting.

B. Storage and Protection: Lime and cement must be protected from rainwater and ground moisture, as water vapor in the air can begin the setting process. Other materials also should be protected from contamination.

PART 2---PRODUCTS

2.1 MORTAR MATERIALS

A. Lime: Should conform to ASTM C207, Type S, high plasticity, Hydrated Lime for Masonry Purposes.

1. Lime which meets this standard will "work" well, resists drying during curing, and is sufficiently strong for the purpose of repointing.

2. Lime expands as it hydrates, making high lime mortars more resistant to crack formation.

B. Cement: Should conform to ASTM C150, Type I, White. It should not have more than 0.60% alkali nor more than 0.15% water soluble alkali. Use gray Portland cement ONLY if a dark mortar is to be matched.

1. Cement meeting this standard should increase the workability of the mortar, accelerate the setting time and slightly increase the strength of the mortar.

2. The low alkali content will prevent efflorescence.

C. Sand: Free of impurities and conforming to ASTM C144.

1. Sand color, size, and texture should match the original as closely as possible. Provide a sample of the sand for comparison to the original, and have it approved by the RHPO before beginning repointing work.

2. When possible, use bar sand or beach sand rather than crushed sand for the repointing mortar

D. Clean, potable water

2.2 EQUIPMENT

A. Surface temperature thermometer - can be either mechanical or digital electronic

B. Wooden mortar boxes

C. Hoe

D. Mesh screen

E. Trowels: range in length from 10-12 inches

F. Chisels:

1. Joint chisels or a standard mason's chisel with a 1-1/2 in. blade and a long narrow handle
2. Floor chisels

G. Hammers:

1. 5# stone dressing hammer
2. 2# striking hammer
3. "No-Bounce" hammer
4. Full size and one half size brick hammers

H. Joint Tools: Available from good hardware stores, building material suppliers or mail-order catalogues (The Stanley Gold-blatt Tool Co., Marshalltown Trowel Co.)

1. 3/8"-1/4" raised beaded tool
2. 3/8"-1/4" beaded striking tool
3. 1/2" raised beaded tool with offset handle
4. 1/2" flat joint iron
5. Pointing tool should be about 1/16" narrower than the joint being filled to achieve good compaction

I. Hawks: Plywood or steel hawk (mortar board)

J. Brushes:

1. Natural bristle brushes
2. Stiff bristle brushes (no wire)

K. Spray bottle

2.3 MORTAR MIXES

A. Have the existing mortar completely analyzed to insure that the repointing mortar will not be less permeable/harder than the masonry units or the original mortar.

B. Measure all ingredients by cubic volume using a pre-established uniform measure, such as a small bucket, rather than a less uniform measure such as a shovel.

C. For historic masonry set in lime mortar:

1. 1 part portland cement
2. 3 parts lime

3. 8-12 parts sand (To match existing mortar as closely as possible.)

4. The exact mix required will relate to the grain size and sharpness of the sand and will vary depending on the supply.

D. For historic masonry set in standard mortar (ASTM C270 Type "O"):

1. 1 part portland cement

2. 2 parts lime or lime putty

3. 6 to 9 parts sand and stone dust (To match existing mortar as closely as possible.)

E. For Limestone (ASTM C270 Type "N"):

1. 1 part portland cement

2. 1 parts lime

3. 4-6 parts aggregate

4. Enough water to form a workable consistency

F. For Granite (ASTM C270 Type "S"):

1. 2 parts portland cement

2. 1 part lime

3. 7-9 parts aggregate

4. Enough water to form a workable consistency

G. For deteriorated granite or granite walls indicating movement, use ASTM C270 Type "N" as listed above for limestone.

H. Mix a final "job-size" batch once the correct sand color, cement content, etc. have been determined through small tests to ensure the on-site mixing conditions will result in the same final product.

PART 3---EXECUTION

3.1 EXAMINATION

A. Examine all existing exterior mortar joints for deterioration and damage. Typical exterior damage due to mortar deterioration includes open joints, efflorescence, spalling and loosened masonry units.

3.2 MORTAR MIXING

B. Mix Hydrated Lime:

1. Add dry bagged hydrated lime to water. Stir and hoe the mass to form a thick cream.

2. Allow to stand at least 24 hours before use.

C. Prepare Roughage Premix (for later use):

1. Accurately proportion the sand and lime using measuring boxes constructed to contain the exact volume of each ingredient required to make on batch.

2. Mix sand and lime thoroughly for about ten minutes. Store in plastic-lined drums and seal until required.

3. When required for use, add and mix the correct portion of gauging cement as specified and use immediately.

D. Add cements to lime and aggregate mixes immediately before the use of the mortar.

1. Perform all batching with wooden boxes or plastic pails of known volume to ensure standardization and conformity of measurement. Shovel measurement of materials is not permitted.

2. Use box sizes that are sufficient for producing a batch size equal to one mixer load.

3. Mix dry ingredients thoroughly before adding any water (approximately five minutes).

E. Add a small amount of water so that the mortar is just wet enough to hang on a trowel. Record the amount of water added so that it may be used as a guide for future batches.

F. Mix mortars at least 10 minutes before using to improve workability and ensure thorough mixing.

1. Automatic mixers should have rubber blades. Clean mixing boards and mixing machines thoroughly after each use.

2. Repointing mortars may sit 1-2 hours after initial mixing and then may be remixed to a workable consistency. This is done to reduce shrinkage.

3. Test the mix by holding a trowel with mortar on it upside down and shaking it once.

a. If the mortar falls off without shaking, it has too much sand.

b. If more than one shake is required, the mortar is too sticky or "plastic" and the lime content must be decreased.

G. Use repointing mortar within approximately 1-2 hours of final mixing. Retemper the mortar as necessary to maintain workability.

1. Re-tempering is permitted to maintain workability. Remixing is not permitted. Add water at the mortar-board using a spray bottle to replace only water lost through evaporation.

2. Use all mortar within two hours of gauging; throw out left over mortar; do not re-temper or remix mortars after this time has elapsed.

3.3 PREPARATION

A. Preparing the Joints:

1. Clean area of loose dirt and debris using a stiff bristle brush and remove all extraneous fastenings and devices.

2. Install necessary protection of adjacent building materials, property and persons from joint cleaning work and dirt.

3. Control dust and dirt from raking work; dampen area being worked; and use curtains to limit spread of dust from joint raking and cutting operations.

B. Joint Cutting and Raking:

1. Cut and rake old mortar from existing joints by hand using a hammer and chisel. Power chisels and power saws should not be used.

2. Place the chisel in the center of the joint and pound it with a striking hammer or "No-Bounce" hammer until the mortar disintegrates.

3. Rake out the loose material to a depth of about 1 inch and never to a depth less than their width. Leave a clean, square face at the back of the joint to provide optimum contact with the new mortar.

4. While raking out joints, remove all metal fittings such as nails, brackets and clips on both horizontal and vertical surfaces.

5. Carefully clean out the prepared face with a soft or stiff bristle brush, or blow the joints clean with low-pressure compressed air (40-60 psi).

6. Thoroughly flush out joint with clean, clear water.

3.3 ERECTION, INSTALLATION, APPLICATION

A. Filling Joints:

1. Dampen masonry surfaces and joints to control suction and evaporation before placing repointing mortars.

2. Using a pointing tool, push the mortar into the joint from a board and iron with the maximum possible pressure; The mortar should be applied in layers, each to a maximum thickness of 3/8".

3. Thoroughly compact each layer of mortar and allow to set until thumb-print hard before applying the next layer of mortar.

4. Fill the joints so that they are slightly recessed from the masonry face. Avoid leaving a joint which is visually wider than the actual historical appearance.

5. Continuously keep all excess and spilled mortar brushed off the faces of masonry units, ledges and other surfaces before it sets or stains the work.

B. Joint Finishing:

1. Begin when mortar attains "thumb print" hardness.

2. Tool the joint to match the old mortar.

3. To produce a roughened texture, lightly spray the mortar with water after the initial set, stipple the mortar with a stiff bristle brush or dab the mortar with coarse sacking.

4. Protect finished work from direct sun and rain until the face has dried and hardened.

3.4 ADJUSTING/CLEANING

A. Cleaning Up:

1. Use masking and drop cloths to prevent mortar stains on adjacent work and ledges.

2. Keep work areas clean and free from mortar drips, spills and residue of waste mortars or wash-off.

3. Clean off excess mortar as work proceeds using masonry brushes before mortar sets.

4. Wash completed repointing work when finished mortar joints are set with clean water and masonry brushes, scrubbing only as required to clean mortar stains off masonry without scouring the units and joint faces.

5. Do not use acid or detergent cleaning agent to aid mortar removal and clean-up without written approval from Architect.

B. Curing:

1. Schedule work only when moderate weather is forecast.

2. Protect completed work from adverse weather, heavy rainfall, freezing, and drying by direct sunlight and winds until cured.

3. Sprinkle or mist repointed work as required to achieve cure in mortar joints for a minimum of 72 hours after completion.

4. Lime Mortar: Cures by drying and crystallization, not by hydration; and can be washed out of joints if not protected before it cures.

C. Final Cleaning:

1. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter using stiff nylon or bristle brushes and clean water spray applied at low pressure. Use of metal scrapers or brushes is not permitted. Use of acid or alkali cleaning agents is not permitted.

END OF SECTION 04 40 40

06 10 00
ROUGH CARPENTRY

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section includes:

1. Furnishing and installing rough carpentry, including rough hardware.
2. Rough carpentry consists of wood construction, both temporary and permanent that is not exposed to view in completed building. Rough carpentry work includes proper installation of grounds, wood or metal, nailing strips, blocking, etc., necessary or required to produce an adequate and substantial base for support of finishes, material, fittings and equipment.
3. Rough carpentry includes carpentry work not specified as part of other sections and which is generally not exposed, except as otherwise indicated. Types of work in this section include rough carpentry for:
   a. Wood framing
   b. Wood grounds, nailers, blocking and sleepers
   c. Plywood Sheathing

1.2 REFERENCES

A. Lumber Standards: Comply with PS 20 and with applicable rules of the respective grading and inspecting agencies for species and products indicated.

1. American Wood Preservers Bureau Standards
2. Western Wood Products Association Use Manual
3. American Plywood Association (APA) Design/Construction Guide

B. Plywood Product Standards: Comply with PS 1 (ANSI A 199.1) or, for products not manufactured under PS 1 provisions, with applicable APA Performance Standard for type of panel indicated.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's specifications and installation instructions for materials listed below:

1. Plywood
2. Metal connectors

B. Material Certificates: Where dimensional lumber is provided to comply with minimum allowable unit stresses, submit listing of species and grade selected for each use, and submit evidence of compliance with specified requirements. Compliance may be in the form of a signed copy of applicable portion of lumber producer's grading rules showing design values for selected species and grade. Design values shall be as approved by the Board of Review of the American Lumber Standards Committee.

C. Wood Treatment Data:

1. Submit treatment manufacturer's instructions for proper use of each type of treated material.

2. Pressure Treatment: For each type specified, include certification by treating plant stating chemicals and process used, net amount of preservative retained and conformance with applicable standards.
3. Water-Borne Preservatives: For each type include statement that moisture content of treated materials was reduced to a maximum of 15% prior to shipment to the project site.
4. Fire Retardant Treatment: Include certification by treating plant that treatment material complies with governing ordinances and that treatment will not bleed through finished surfaces.

1.4 PRODUCT HANDLING

A. Protection:
1. Deliver material to job site and store, in safe area, out of way of traffic and shored up off ground surface.
2. Identify framing lumber by grades, and store each grade separately from other grades.
3. Protect metals with adequate waterproof outer wrapping.
4. Use extreme care in off loading of lumber to prevent damage, splitting, and breaking of materials.
5. Delivery and Storage: Keep materials dry at all times. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber and plywood, and provide air circulation within stacks. Do not store materials directly on the ground.

1.5 JOB CONDITIONS

Coordination: Fit carpentry work to other work; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds and similar supports to allow proper attachment of other work.

PART 2 - PRODUCTS

2.1 LUMBER: GENERAL

A. Factory-mark each piece of lumber with type, grade, mill and grading agency, except omit marking from surfaces to be exposed with transparent finish or without finish.

B. Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20, for moisture content specified for each use.

C. Provide dressed lumber, S4S, unless otherwise indicated.

D. Provide kiln-dried lumber 15% maximum moisture content at time of dressing.

2.2 FRAMING LUMBER

A. Floor Joist, Roof Joist and Rafter Framing:
Provide No. 2 grade, Hem fir, Douglas Fir or SPF.

2.3 MISCELLANEOUS LUMBER

A. Provide Construction Grade light framing size lumber of any species for support or attachment of other work including cant strips, bucks, nails, blocking, furring, grounds, stripping and similar members. Provide kiln-dried lumber with 15% maximum moisture content.

2.4 PLYWOOD

A. Trademark: Identify each plywood panel with appropriate APA trademark.

B. Wall Sheathing:
Provide APA rated sheathing as indicated on the drawings and as follows:
1. Exposure Durability Classification:
   a. Exterior

C. Plywood Backing Panels: For mounting electrical or telephone equipment, provide fire-retardant treated plywood panels with grade designation, APA C-D PLUGGED INT with exterior glue, in thickness indicated, or, if not otherwise indicated, not less than 3/4".

2.5 MISCELLANEOUS MATERIALS

A. Fasteners and Anchorages:
1. Provide size, type, material and finish as indicated and as recommended by applicable standards, complying with applicable Federal Specifications for nails, staples, screws, bolts, nuts, washers and anchoring devices. Provide metal hangers and framing anchors of the size and type recommended by the manufacturer for each use including recommending nails.
2. Where rough carpentry work is exposed to the weather, in ground contact, or in area of high relative humidity, provide fasteners and anchorages made of stainless steel.

B. Rough Hardware
1. Steel Items:
   a. Comply with ASTM A7 or ASTM A36.
   b. Use stainless steel at exterior locations.
2. Machine bolts: Comply with ASTM A307.
3. Lag bolts: Comply with Fed Spec FF-B-561.
4. Nails:
   a. Use common except as otherwise noted.
   b. Comply with Fed Spec FF-N-1.
   c. Use stainless steel at exterior locations.
5. Plywood Sheathing Screws: Wafer head screw designed for attachment of plywood to light gauge metal supports, #10 zinc plate screw with #3 self-drilling point; length appropriate for engaging thread in metal substrate.

C. Joist hangers: Simpson, Teco, or equal as approved by Architect.

D. Building Paper: Asphalt saturated felt, non-perforated, ASTM 226.

E. Weather Resistive Barrier:
1. Provide DuPont™ Tyvek® CommercialWrap®: A flash spun bonded olefin, non-woven, non-perforated secondary weather resistant barrier.
2. Sealing Tape/Fasteners for Weather Barrier:
   a. DuPont™ Tyvek ® Tape, DuPont Weatherization Systems.
   b. For steel frame construction: DuPont™ Tyvek® Wrap Cap Screws, DuPont Weatherization Systems. 1 5/8" rust resistant screws with 2" diameter plastic cap

c. For wood frame construction: DuPont™ Tyvek® Wrap Caps, DuPont Weatherization Systems. Nails with large heads or plastic washers.
d. Caulks or Sealants: polyurethane or elastomeric sealants
Available Products:
i. OSI® Quad Pro-Series®, solvent release butyl rubber sealant
ii. DAP® Dynaflex 230™
iii. Other products as approved and recommended by air barrier/weather resistant barrier manufacturer.

3. Flashing of Weather Barrier:
a. Dupont StraightFlash for heads and jambs of rectangular windows
b. Dupont FlexWrap for sills and other irregular shaped junctures.

2.6 WOOD TREATMENT

A. Treatment Chemical Manufacturer's: Producer of chemical treatment products shall be recognized for production of wood preservation and fire retardant treatments. Specified products are based upon those manufactured by Wolman Arch Treatment Technologies, Inc. Alternative products from Treated Wood, Inc. will be acceptable subject to manufacturer's requirements for retention rate and proprietary chemical composition to meet AWPA use categories listed.

B. Treatment Applicator: The preservation treatment and fire retardant treatment application plants shall be licensed and approved by the treatment chemical manufacturer.

C. Preservative Treatment:
1. Where lumber or plywood is indicated as preservative treated ('PT'), or is specified herein to be treated, comply with applicable requirements of AWPA Standards as follows:
a. Standard P5, Waterborne Preservatives.
b. Standard E13, Standard Method of Testing to Determine Water Repellents in Pressure Treated Lumber.
c. Standard M4, Care of Preservative – Treated Wood Products.
d. Standard U1, Use Category system.
2. Preservative Treatment: Wolman E – Copper Azole; Arch Technologies Inc., dissolved (CA-C) Copper Azole.
3. Retention Rates
a. AWPA 'Use Category Designations' for above-grade uses; UC-1, UC-2, UC-3A and UC-3B; provide minimum retention of 0.06 lbs per cubic foot.
b. AWPA 'Use Category Designations' for ground contact; UC-4A; provide minimum retention of 0.15 lb per cubic foot.
4. Moisture Content: Dry lumber after treatment to 19% maximum moisture content.
5. Warranty: Provide manufacturer's written 40-year warranty.
6. Treated Material: Provide treated material that bears the Wolmanized trademark and the quality mark of an ALSC-recognized agency which maintains supervision, testing and inspection of the quality of the product. Quality marks shall be affixed to each piece and include the following:
a. Identification of the inspection agency.
b. Identification of the standard to which the material was treated.
c. Identification of the treating facility.
d. Identification of the preservative and retention.

e. Identification of the end use for which the product is suitable.

D. Fire Retardant Treatment:
1. Where fire retardant wood or plywood is specified otherwise indicated provide materials which comply with AWPA Standards for pressure impregnation with fire retardant chemicals, and which have a flame spread rating of not more than 25 when tested in accordance with UL Test 723 of ASTM E 84, and show no increase in flame spread and significant progressive combustion upon continuation of test for additional 20 minutes.
2. Where treated items are exposed to exterior or to high humidities or are to have a transparent finish in form of stain or sealer, provide materials which show no change in fire hazard classification when subjected to standard rain test (UL 790 of ASTM B 2898)
3. Use fire retardant treatment which will not bleed through or adversely affect type of finish indicated and which does not require brush treatment of field made end cuts to maintain fire hazard classification.
4. Where transparent finish is indicated use type of treatment and species which permits milling of lumber after treatment without altering indicated fire hazard classification, as determined by fire testing.
5. Kiln-dry treated items to maximum moisture content of 19%
6. Provide UL label on each piece of fire retardant lumber of plywood.

2.7 OTHER MATERIALS
A. Contractor selects other materials, not specifically described but required for a complete and proper installation, subject to Architect's approval.

2.8 WOOD REPAIR PRODUCTS
A. Epoxy Repairs:
1. Two-part liquid epoxy for pouring, brushing or injecting: Abatron LiquidWood or approved equal.
2. Two-part putty epoxy for shaping and re-building: Abatron WoodEpox or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION
A. General:
1. Discard units of material with defects which might impair quality of work, and units which are too small to use in fabricating work with minimum joints or optimum joint arrangement.
2. Set carpentry work accurately to required levels and lines, with members plumb and true and accurately cut and fitted.
3. Securely attach carpentry work to substrate by anchoring and fastening as shown and as required by recognized standards. Countersink nail heads on exposed carpentry work and fill holes.
4. Use common wire nails, except as otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; predrill as required.

B. Wood Grounds, Nailers, Blocking, and Sleepers:
   1. Provide wherever shown and where required for screeding or attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.
   2. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise show. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.
   3. Provide solid wood blocking concealed within stud wall framing for all wall mounted toilet accessories, wall and ceiling mounted cabinets, and wall mounted shelving.
   4. Provide permanent grounds of dressed, preservative treated, key beveled lumber not less than 1-1/2" wide and of thickness required to bring face of ground to exact thickness of finish material involved. Remove temporary grounds when no longer required.

3.2 WOOD FRAMING

A. General:
   1. Provide framing members of sizes and on spacings shown, and frame openings as shown, or if not shown, comply with recommendations of "Manual for House Framing" of the National Forest Products Association. Do not splice structural members between supports.
   2. Anchor and nail as shown, and to comply with the "Recommended Nailing Schedule" of the "Manual for House Framing" and other recommendations of the National Forest Products Association.
   3. Firestop concealed spaces with wood blocking not less than 2" thick, if not blocked by other framing members. Provide blocking at each building store level and at ends of joist spans.

C. Joists, Beams and Header Framing:
   1. Provide framing of sizes and spacings shown. Install with crown edge up and support ends of each member with not less than 1-1/2" of bearing on wood or metal, or 3" on masonry. Attach to wood bearing members by metal connectors; frame to wood supporting members with wood ledgers as shown, or if not shown, with metal connectors. Fire cut members built into masonry (if any). Frame openings with headers and trimmers supported by metal joist hangers; double headers and trimmers where span of header exceeds 4'. Do not notch in middle third of joists; limit notches to 1/6 of joist depth, 1/3 at ends. Do not bore holes larger than 1/3 depth of joist or locate closer than 2" from top of bottom. Provide solid blocking (2" thick by depth of joist) at ends of joists unless nailed to header or brand member.
   2. Lap members framing from opposite sides of beams, girders or partitions not less than 4" or securely tie opposing members together. Provide solid blocking (2" thick by depth of joist) over supports.
   3. Anchor members paralleling masonry with 1/4" x 1-1/4" metal strap anchors spaced not more than 8' on center. Extend anchors at least 4" into masonry, turn up 4" and extend over and fasten to 3 joists.
   4. Under jamb studs at openings, provide solid blocking between joist.
   5. Under non-loading bearing partitions, provide double joists separated by solid blocking equal to depth of studs above.

6. Provide triple joists separated as above, under partitions receiving ceramic tile and similar heavy finishes or fixtures, unless otherwise shown.
7. Provide bridging between joists where nominal depth to thickness ratio exceeds 4, at intervals of 8'. Use bevel cut 1" x 4" or 2" x 3" wood bracing, double crossed and nailed both ends to joists, or use solid wood bridging 2" thick by depth of joist, end nailed to joist.

D. Rafter and Ceiling Joist Framing:
1. Ceiling Joists:
   a. Provide member size and spacing shown, and as previously specified for joist framing. Face nail to ends of parallel rafters.
   b. Where principal ceiling joists are at right angles to rafters, frame as indicated with additional short joists from wall plate to first joist; nail to ends of rafters and to top plate and nail to long joists or anchor with framing anchors or metal straps. Provide 1 x 8 or 2 x 4 stringers spaced 4' on center crosswise over principal ceiling joists.
2. Rafters:
   a. Provide member size and spacing shown. Notch to fit exterior wall plates and toe nail or use special metal framing anchors. Double rafters to form headers and trimmers at openings in roof framing, and support with metal hangers. Where rafters abutt at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.
   b. At valleys, provide valley rafter of size shown, or if not shown, provide rafter twice as thick as regular rafters and 2" deeper. Bevel ends of jack rafters for full bearing against valley rafter.
   c. At hips, provide hip rafters of size shown, or if not shown, provide of same thickness as regular rafters and 2" deeper. Bevel ends of jack rafters for full bearing against hip rafters.
   d. Provide collar beams as shown, or if not shown, provide 1" x 6" boards between every third pair of rafters. Locate below ridge member, one-third of distance to ceiling joists. Cut ends to fit slope and nail to rafters.
   e. Provide special framing as shown for eaves, overhangs, dormers and similar conditions, if any.

3.7 INSTALLATION OF PLYWOOD

A. General: Comply with applicable recommendations contained in Form No. E 304, "APA Design/Construction Guide - Residential and Commercial", for types of plywood products and applications indicated.

3.15 WOOD REPAIRS

A. Epoxy Repairs to Structural and Architectural In Situ Wood Members: Comply with manufacturer's written instructions for repair and re-building products, and the following:
1. Repair of Surficial Wood Deterioration: In conditions where wood components have checking, exhibit severe weathering, and/or other forms of surface decay that is less than ½" deep, or as Architect directs, apply 2-part liquid epoxy repair product by brush, or by pouring. Apply multiple coats of epoxy until there is a level surface. Sand, tool and shape wood component to original profile.
2. Stabilization of Infested, Decayed Wood: In conditions where wood components have decay due to infestation, water damage, or other means, where the decay is deeper than

½", but not more than 2", apply a 2-part liquid epoxy stabilization product by injection, pouring and brushing in multiple applications until the deteriorated area is thoroughly saturated. Drill 1/8" to 3/16" diameter holes into the deteriorated material at intervals required to inject and thoroughly saturate the deteriorated wood with epoxy. Sand, tool and shape wood component to original profile.

3. Rebuilding of Lost or Severely Decayed Wood: In conditions where wood components have decay deeper than 2", and/or lost material deeper than ½", the decayed wood material shall be removed down to sound wood, and a 2-part epoxy putty shall be used to re-build the wood to the original profile. For rebuilding deeper than 1" thick, use stainless steel studs, or screws fastened to existing sound wood, that are set to allow a minimum of ½" of epoxy cover over the head of the fastener. Sand, tool and shape epoxy putty repair to match the component original profile.

END OF SECTION 06 10 00

06 15 33
DECKING AND FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Plastic decking, facia boards, and plates.
2. Support framing for elevated decks.
3. Hardware and Connectors

B. Related Requirements:
1. Section 03 30 10 " Miscellaneous Cast-In-Place Concrete" for installing anchorage items cast in concrete footings.
2. Section 31 20 00 "Earth Moving" for excavation for installing concrete footings.

1.3 DEFINITIONS

A. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater but less than 5 inches nominal (114 mm actual) in least dimension.

B. Lumber grading agency: SPIB: The Southern Pine Inspection Bureau.

1.4 ACTION SUBMITTALS

A. Product Data: For preservative-treated wood products plastic decking and metal framing anchors.

1. For preservative-treated wood products. Include chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
2. For plastic decking and metal framing anchors. Include installation instructions.

B. Samples: For plastic decking, not less than 24 inches (600 mm) long, showing the range of variation to be expected in appearance of decking, including surface texture.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates:

1. For lumber specified, indicate species grade and grading agency.

2. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

B. Certificates of Inspection: Issued by lumber grading agency for exposed wood products not marked with grade stamp.

C. Evaluation Reports: For the following, from ICC-ES:

1. Preservative-treated wood products.
2. Plastic decking.
3. Expansion anchors.
4. Metal framing anchors.
5. Decking fasteners.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials under cover and protected from weather and contact with damp or wet surfaces. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

B. Handle and store plastic lumber to comply with manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 LUMBER, GENERAL

A. Comply with DOC PS 20 and with grading rules of lumber grading agencies certified by ALSC's Board of Review as applicable. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by ALSC's Board of Review.

1. Factory mark each item with grade stamp of grading agency.
2. For items that are exposed to view in the completed Work, mark grade stamp on end or back of each piece.
3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
4. Provide dressed lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content:

1. Dimension Lumber: 19 percent.

2.2 DIMENSION LUMBER FRAMING

A. Deck Framing: No. 2 grade, Southern pine; SPIB.

2.3 PRESERVATIVE TREATMENT

A. Pressure treat dimension lumber with waterborne preservative according to AWPA U1; Use Category UC4B for exterior construction not in contact with the ground, and Use Category UC4A for items in contact with the ground.

B. Preservative Chemicals: Acceptable to authorities having jurisdiction.

1. Do not use chemicals containing arsenic or chromium.

C. Use process for dimension lumber that includes water-repellent treatment.

D. After treatment, redry dimension lumber to 19 percent maximum moisture content.

E. Mark treated wood with treatment quality mark of an inspection agency approved by ALSC's Board of Review.

F. Application: Treat all wood unless otherwise indicated.

2.4 PLASTIC DECKING

A. Subject to compliance with requirements, provide:
1. Basis of Design Product: Envision Ridge Premium by Envision Composite Decking, 800-253-1401, www.envisionoutdoorliving.com. 53 Eby Chiques Road, P.O. Box 37, Mount Joy, PA 17552. Or approved equal.
2. Decking Size: 7/8 by 5-1/2 inch actual.
3. Configuration: Provide product with grooved edges designed for fastening with concealed decking fasteners.
   a. EverClip Hidden Fastener System by Envision
4. Surface Texture: Woodgrain.
5. Color: To be selected from manufacturer's full range. Provide samples.

2.5 PLASTIC FACIA BOARDS AND PLATES

A. Subject to compliance with requirements, provide:
1. Basis of Design Product: Envision Deck Skirting by Envision Composite Decking, 800-253-1401, www.envisionoutdoorliving.com. 53 Eby Chiques Road, P.O. Box 37, Mount Joy, PA 17552. Or approved equal.
2. Install per Manufacturer's specifications and compatible fasteners.
3. Size: 7/16 by 12 inch actual.
4. Surface Texture: Woodgrain
5. Color: To be selected from manufacturer's full range to match decking.

2.6 METAL FRAMING ANCHORS

A. A manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

1. Basis of Design Product: Simpson Strong-Tie Wood Construction Connectors. Or approved equal.

B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G185 (Z550) coating designation (Simpson Strong-Tie ZMAX Coating).

C. Cold Galvanizing Coating:
1. Basis of Design Product: ZRC Cold Galvanizing.

2.7 CONCEALED DECKING FASTENERS

A. Deck Clips: Black-oxide-coated, stainless steel clips designed to be fastened to deck framing with screws, and to secure decking material with teeth that also provide uniform spacing of decking material.
1. Basis of Design Product: EverClip Hidden Fastener System by Envision Composite Decking, 800-253-1401, www.envisionoutdoorliving.com. 53 Eby Chiques Road, P.O. Box 37, Mount Joy, PA 17552. Or approved equal.
a. Install per manufacturer's specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

3.3 INSTALLATION, GENERAL

A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit work to other construction; scribe and cope as needed for accurate fit.

B. Framing Standard: Comply with AF&PA WCD1 unless otherwise indicated.

C. Install plastic lumber to comply with manufacturer's written instructions.

D. Secure decking to framing with deck clips.

E. Install metal framing anchors to comply with manufacturer's written instructions.

F. Do not splice structural members between supports unless otherwise indicated.

G. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

H. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of members or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

I. Securely attach exterior rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. "Fastening Schedule" in ICC's International Building Code, unless noted otherwise on drawings.

J. Use screws unless otherwise indicated. Select fasteners of size that do not fully penetrate members where opposite side is exposed to view. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads unless otherwise indicated.

K. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced and with adjacent rows staggered.

3.4 INSTALLATION OF ELEVATED DECK JOIST FRAMING

A. General: Install joists with crown edge up and support ends of each member with not less than 1-1/2 inches (38 mm) of bearing on wood or metal. Attach deck joists where framed into wood supporting members by using metal joist hangers. Do not notch joists.

END OF SECTION 06 15 33

07 18 00
EXTERIOR STUCCO

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK
Types of work includes: Portland cement plastering.

1.2 QUALITY ASSURANCE
A. Allowable Tolerances: For flat surfaces, do not exceed 1/4" in 8'-0" for bow or warp of surface, and for plumb or level.

1.3 SUBMITTALS
A. Product Data:
Submit manufacturer's product specifications and installation instructions for each material, including other data as may be required to show compliance with these specifications.

1.4 PRODUCT HANDLING
Deliver, store and protect manufacturer materials to comply with referenced standards.

1.5 JOB CONDITIONS
A. Environmental Conditions:
1. Comply with referenced standards.
2. Protect contiguous work from soiling, spattering, moisture deterioration and other harmful effects which might result from plastering.

PART 2 – PRODUCTS

2.1 METAL LATHING AND ACCESSORY MATERIALS
A. General:
1. Metals and Finishes: Manufacturer's standard steel products unless indicated as zinc alloy or other metal. Where not otherwise indicated, provide manufacturer's standard galvanized finish on steel products except as follows:
2. Exterior Components: Hot-dip galvanized finish, ASTM A 525 G90 for 18 gage and lighter formed metal products, ASTM A 123 galvanized after fabrication for 15 gage and heavier products.
3. Exterior Exposed Plastering Accessories: Provide zinc alloy accessories for exterior work and work in "High Humidity" areas, except where fully concealed in plaster.
4. Wire Ties: Galvanized soft steel wire.

B. Metal Lathing Materials (MtLth):
General: Where not otherwise indicated, comply with MLSFA "Technical Bulletin 101" and ASTM C 841 for selection of metal lath for each application indicated.
1. Product Standards: Comply with FS QQ-L-101.
2. Backing: Where lath is indicated to have backing, and where backing is required for machine application of plaster, provide lath with factory-applied backing of moisture-resistant paper or polyethylene film.
3. Exterior Diamond Mesh Lath: 3.6lbs per.sq.yd., large mesh openings (approximately 1-3/8" X 3-1/8").

C. Metal Plastering Accessories and Reinforcement:
General: Coordinate depth of accessory with thickness of a number of coats of plaster to be applied.

1. Small-Nose Corner Beads: General purpose type with expanded or perforated flanges.
2. Small-Nose Corner Beads: Expanded type with 2-7/8" wide flanges.
3. Bull-Nose Corner Bead: Expanded flange type with 1" wide face, 3/4" radius.
4. Cornerite: Manufacturer's standard pre-formed interior corner reinforcement made from 2.5 lb. per. sq.yd. diamond mesh lath.
5. Square-Edged Casing Beads: Manufacturer's standard with expanded or short flange to suit application.
6. Two-Piece Control Joints: Manufacturer's standard roll-formed pair of casing beads with modified back flanges providing positive slip joint action and dust barrier, adjustable for joint width variation of 1/8" to 5/8".
7. Corner Reinforcement: Special stucco-type woven galvanized wire corner reinforcing strips.
8. Line Wire: 18 gage soft annealed steel wire.
9. Fasteners: Galvanized steel, of type and length suitable for adequate penetration of the substrate.

2.2 BONDING MATERIALS

A. Acid Etch Solution: Muriatic acid, mixed one part acid to 6-to-10 parts water.

B. Bonding Additive: Acrylic-based emulsion for bonding exterior and interior Portland cement plaster base coat to solid substrates.

2.3 MISCELLANEOUS MATERIALS

A. Asphalt Saturated Felt: ASTM D 226, 15-lb. type, non-perforated.

PART 3 – PRODUCTS

3.1 PREPARATION

A. Plastering:
1. Clean plaster bases and substrates to be plastered, removing loose materials, coatings and other substances which might impair the work.
2. Etch concrete and masonry surfaces indicated for direct plastering. Wet surface, scrub with acid etch solution, and rinse thoroughly; repeat if necessary for adequate plaster bond.
3. Apply dash-out on concrete surfaces indicated for direct Portland cement plastering, and moisture-cure for 2 days.

B. Metal Lathing:
1. Install metal lath to comply with referenced standards unless otherwise indicated.
2. Nail self-furring diamond mesh directly to masonry and concrete substrates where shown for direct plaster application.

C. Plastering Accessories:
1. Anchor each flange of accessories 8" o.c. to plaster base.
2. Miter or cope accessory corners, and install with tight joints accurately aligned.

3. Set accessories plumb, level and true to line, with a tolerance of 1/8" in 10'-0".
4. Install metal corner beads at external corners.
5. Install casing beads at terminations of plaster work, except where plaster is indicated to pass through other work and be concealed by lapping work, and except where special screens, bases or frames act as casing beads including interior metal door frames.
6. For exterior work, set casing beads 1/4" from abutting frames and other work (for application of sealant).
7. Where plaster abuts concrete, set casing bead 1/4" from concrete.
8. At "Control Joints" and "Expansion Joints" set pair of casing beads back to back, with metal strip behind anchored to only one side of joint. At "Expansion Joints" space beads 1/4" apart for interior work, 3/8" apart for exterior work.
9. Install prefabricated expansion joints of 2-piece design where shown as "Expansion Joint"; 1/4" joint width for interior work, 3/8" for exterior.

3.2 INSTALLATION OF PLASTER

A. Mechanically mix plaster materials at the project site; do not hand mix except where small amounts are needed, using less than one bag of plaster.

B. Sequence plaster installation properly with the installation and protection of other work, so that neither will be damaged by the installation of the other.

C. Plaster flush with metal frames and other built-in metal items or accessories which act as a plaster ground, unless otherwise shown. Where plaster is not terminated at metal by casing beads, cut base coat free from metal before plaster sets and groove finish coat at the junctures with metal.

D. Apply thickness and number of coats of plaster as indicated; or as required by referenced standards.

E. Provide 3-coat plaster installation except where shown as 2-coat work.

F. Limit 2-coat plaster installation to applications recommended by manufacturer and permitted by ANSI standards and governing regulations.

G. Concealed Plaster: Where plaster application will be concealed by wood paneling, above suspended ceilings and similar locations, finish coat may be omitted; where concealed behind cabinets and similar furnishings and equipment, apply finish coat; where used as a base for adhesive application of tile and similar finishes, omit finish-coat and coordinate thickness with overall dimensions as shown, and comply with tolerances specified.

H. Texture of Plaster Finishes: Except as otherwise indicated, apply finish-coat as follows:
   1. Exterior Portland Cement Plaster: Sand-float finish (SF-PCPls).

I. Cure Portland cement plaster by maintaining each coat in a moist condition for 2 days following application; keep enclosed and fog-spray (after initial set) as required to prevent dry-out.

3.3 CUTTING AND PATCHING

A. Cut, patch, point-up and repair plaster as necessary to accommodate other work and to restore crack, dents and imperfections. Repair or replace work to eliminate blister, buckles,

excessive crazing and check cracking, dry-outs, efflorescence, sweat-outs and similar defects, including areas of the work which do not comply with specified tolerances, and where bond to the substrate has failed.

B. Sand smooth-troweled finishes lightly to remove trowel marks and arises.

3.4 CLEANING AND PROTECTION

A. Remove temporary protection and enclosure of other work, Promptly remove plaster from door frames, windows, and other surfaces which are not to be plastered. Repair floors, walls and other surfaces which have been stained, marred or otherwise damaged during the plastering work. When plastering work is completed, remove unused materials, containers and equipment and clean floors of plaster debris.

B. Installer shall advise the Contractor of requirements for the protection of plaster from deterioration and damage during the remainder of the construction period.

END OF SECTION 07 18 00

07 60 00
FLASHING AND SHEET METAL

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. The extent of each type of flashing and sheet metal work is indicated on the drawings and by provisions of this section.

B. The types of work specified in this section include the following:
   1. Metal counter flashing; and base flashing
   2. Metal wall flashing and expansion joints
   3. Exposed metal trim
   4. Prefabricated Coping
   5. Miscellaneous sheet metal accessories

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product specifications, installation instructions and general recommendations for each specified sheet material and fabricated product.

B. Shop Drawings: Submit shop drawings showing layout, joining, profiles, and anchorages of fabricated work, including major counter flashings, trim/facia units, gutters, downspouts, scuppers and expansion joint systems; layouts at ¼" scale, details at 3" scale.

C. Samples: Submit two, 8" square samples of specified sheet materials to be exposed as finished surfaces.

1.3 QUALITY ASSURANCE

A. Job Conditions: Coordinate work of this section with interfacing and adjoining work for proper sequencing of each installation. Ensure best possible weather resistance and durability of the work and protect of materials and finishes.

PART 2 – PRODUCTS

2.1 FLASHING AND SHEET METAL MATERIALS

A. Aluminum: ASTM B 209, alloy 3003, temper H14, Kynar 500 finish; 0.40" except as otherwise indicated.

B. Lead Coated Copper: Provide gutter and downspouts with 16 ounce copper sheets factory coated with lead finish. Provide lead coating of minimum 0.06 pounds per square foot on exposed copper surfaces.

C. Zinc Coated Steel: Commercial quality with 0.20% copper, ASTM A 525 except ASTM A 527 for lock forming, G90 hot dip galvainized, mill phosphatized where indicated for painting; 0.0359" thick (20 gage) except as otherwise indicated.

D. Stainless Steel: AISI Type 302/304, ASTM A 167, 2D annealed finish, soft except where harder temper required for forming or performance; 0.015" thick (28 gage) except as otherwise indicated.

E. Aluminum: ASTM B 209, alloy 3003, temper H14, AA-C22A41 clear anodized finish; 0.032" thick (20 gage) except as otherwise indicated.

F. Copper: ASTM B370, cold rolled except where soft temper is required for forming; 16 ounce (0.0216" thick) except as otherwise indicated.

G. Extruded Aluminum: Manufacturer's standard extrusions of sizes and profiles indicated, 6063-T52, AA-CCA41 clear anodized finish; 0.08" minimum thickness for primary legs of extrusions.

H. Elastic Sheet Membrane:
Manufacturer's standard flexible, elastic, black, non-reinforced, flashing sheet of 50 to 65 mils thickness; 50-70 Shore A hardness (ASTM D2240); 1200 psi tensile strength (ASTM D412); 120 pounds per linear inch tear resistance (ASTM D624, Die C); ultimate elongation of 250% (ASTM D412): brittleness temperature of -30 degrees F (ASTM D746): resistance to ozone aging of no cracks for 10% elongated sample for 100 hours in 50 ppm ozone at 104 degrees F (ASTM D573); resistance to heat aging of maximum hardness increase of 15 points, elongation reduction of 40%, and tensile strength reduction of 30%, for 70 hours at 212 degrees F (ASTM D 573).
1. Provide neoprene synthetic rubber sheet.
2. provide butyl synthetic rubber sheet.
3. Provide EPDM synthetic rubber sheet.

2.2 FORMED UNITS

A. General Metal Fabrication: Shop fabricate work to the greatest extent possible. Comply with details shown, and with applicable requirements of SMACNA "Architectural Sheet Metal Manual" and other recognized industry practices. Fabricate for waterproof and weather resistant performance; with expansion provisions for running work, sufficient to permanently prevent leakage, damage or deterioration of the work. Form work to fit substrates. Comply with material manufacturer instructions and recommendations. Form exposed sheet metal work without excessive oil-canning, buckling and tool marks, true to line and levels as indicated, with exposed edges folded back to form hems.

B. Seams: Fabricate non-moving seams in sheet metal with flat-lock seams. For metal other than aluminum, tin edges to be seamed, form seams, and solder.

C. Expansion Provision: Where lapped or bayonet type expansion provisions in work cannot be used, or would not be sufficiently water/weatherproof, form expansion joints of intermeshing hooked flanges, not less than 1" deep, filled with mastic sealant (concealed within joints).

D. Sealant Joints: Where movable, non-expansion type joints are indicated or required for proper performance of work, form metal to provide for proper installation of elastomeric sealant, in compliance with industry standards.

E. Separation: Provide for separation of metal from non-compatible metal or corrosive substrates by coating concealed surfaces at locations of contact, with bituminous coating or other permanent separation as recommended by manufacturer/fabricator.

F. Aluminum Extrusion Units:

1. Fabricate extruded aluminum running units with formed or extruded aluminum joint covers, for installation behind main members.
2. Fabricate mitered and welded corner units.

G. Shop Finish, Rain Drainage: Provide manufacturer's standard baked on bronze acrylic ship finish on sheet metal rain drainage units (gutters, downspouts, and similar exposed units); 1.0 mil dry film thickness.

2.3 FABRICATED METAL ROOFING ACCESSORIES

A. Aluminum Coping
1. Manufacturer's standard sizes and profiles or as indicated on the drawings, Kynar 500 finish, 0.050 minimum thickness for primary legs of extrusions.
2. Provide prefabricated system including preformed coping, continuous (22) gauge inside cleat and continuous (22) gauge outside cleat, 8" concealed splice plates with factory applied, dual, non-curing, isocryl butyl sealant strips at each joint.
3. Material: (24) (22) ga. galv, (.050") (.063") aluminum.
4. Inside face (4 inches) (as indicated on drawings)
5. Outside face (6 inches) (12 inches) (as indicted on drawing)
6. Factory fabricated mitered corners, endcaps, endwall flashings, pilaster caps, and accessories.
7. Provide Perma-Tite Continuous Cleat Coping by Metal-Era Roof Edge Solutions.

B. Aluminum Roof Edge
1. Manufacturer's standard sized and profiles or as indicated on the drawings, Kynar 500 finish, 0.050 minimum thickness. Aluminum with 7" face dimension unless otherwise indicated.
2. Provide prefabricated system including pre-formed roof edge with continuous extruded aluminum anchor bar.
3. Fascia Height: (4 inches) (5-1/2 inches) (7 inches) (8-1/2 inches)
4. Material: (24) ga. galv steel, (.040") aluminum.
5. Provide Anchor-Tite Standard Fascia by Metal-Era Roof Edge Solutions.

C. Aluminum Gutters and Downspouts: ASTM B 2009, alloy 3003, temper 1114, .040" thick, Kynar 500 finish, except as otherwise indicated.

2.4 MISCELLANEOUS MATERIALS AND ACCESSORIES

A. Fasteners: Same metal as flashing/sheet metal or, other non-corrosive metal as recommended by sheet manufacturer. Match finish of exposed heads with material being fastened.

B. Metal Accessories: Provide sheet metal clips, straps, anchoring devices and similar accessory units as required for installation of work, matching or compatible with material being installed, non-corrosive, size and gage required for performance.

C. Reglet:
1. Concrete: Stainless Steel, type "304-0.020" Fry Reglet "CO" or equal.
2. Masonry: Stainless Steel, type "304-0.020" Fry Reglet "MA' or equal.
3. Surface Reglets: Stainless Steel, type "304-0.020" Fry Reglet 'SM' or equal.

PART 3 – EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. General: Except as otherwise indicated, comply with manufacturer's installation instructions and recommendations, and with SMACNA "Architectural Sheet Metal Manual". Anchor units of work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints and seams which will be permanently watertight and weatherproof.

B. Underlayment: Where stainless steel or aluminum is to be installed directly on cementitious or wood substrates, install a course of paper slip sheet and a course of polyethylene underlayment.

C. Installation:

1. Bed flanges of work in roofing sealant where required for waterproof performance.
2. Reglet
   a. Install reglet and counter flashing in accordance with approved shop drawings and manufacturer's product data to comply with specified performance requirements. Reglet and counter flashing components shall be true to line, without buckling, creasing, warp or bin in finished surfaces.
   b. Coordinate counter flashing at roof surfaces with roofing work to provide weather tight condition at roof terminations.
   c. Isolate dissimilar materials to prevent electrolysis. Separate bituminous coating.
   d. Secure reglets and counter flashing using continuous cleats, clips and fasteners in accordance with product data and as indicated.
3. Install counterflashing in reglets, either by snap-in seal arrangement, or by wedging in place for anchorage and filling reglet with mastic or elastomeric sealant, as indicated and depending on degree of sealant exposure.
4. Install elastic flashing without stretching. Install elastic flashing filler strips to provide for movement by forming loops of bellows in width of flashing. Locate filler strips to facilitate complete drainage of water from flashing. Seam flashing sheets with adhesive, and anchor edges in manner indicated.
5. Nail flanges of expansion joint units to curb nailers, at maximum spacing of 6". Complete seams at joints between units, to form a continuous waterproof system.
6. Solder all joints (except for expansion joints) by thoroughly cleaning metal surfaces, apply flux in accordance with manufacturer's instructions, solder joint using heat sources and methods as recommended by solder manufacturer and in accordance with SMACNA standards. Apply heat in a manner that draws solder effectively into the sheet metal joint. Clean dull, or weathered copper with muriatic acid prior to soldering. Clean surface thoroughly ensuring that all acid is washed off of the surface prior to the application of flux.

3.2 CLEANING AND PROTECTION

A. Clean exposed metal surfaces, removing substances which might cause corrosion of metal or deterioration of finishes.

B. Contractor shall protect sheet metal and flashing work during construction to ensure that work will not be damaged.

END OF SECTION 07 60 00

07 71 23
GUTTER AND DOWNSPOUT

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Prefabricated prefinished gutters and downspouts complete with concealed splice plates, anchors and fasteners. See drawings for location.

1.2 PERFORMANCE CRITERIA

A. Thermal Movement:

1. Completed gutter and downspout system shall be capable of withstanding expansion and contraction of components caused by changes in temperature without buckling, producing excess stress on structure, anchors or fasteners, or reducing performance ability.
2. Gutters shall be tapered and notched to provide a 1" telescoping lap joint. Gutter shall be pre-punched at 12" o.c. to provide thermal movement.

B. Uniform Wind Load Capacity:

1. Installed gutter and downspout system shall withstand positive and negative design wind loading pressures complying with BOCA, 1990. Test pressures for testing purposes shall be in accord with the principles of ASTM E330, Procedure A, adapted to testing of gutters and downspouts as follows:
   a. Accessories shall be production materials of same type and thickness proposed for use on project.
2. Capacities for gauge, span or loading other than those tested may be determined by interpolation of test results within the range of test data. Extrapolation for conditions outside test range are not acceptable.

1.3 SUBMITTALS

A. Shop Drawings: Indicate material types, sizes, shapes, thickness, finishes, fabrication details, anchors, connections and relation to adjacent work. Details and profiles shall be drawn at appropriate scale.

B. Product Data: Indicate product description, finishes and installation instructions, including interface with adjacent materials and surfaces. Furnish standard and custom color charts.

1.4 QUALITY ASSURANCE

A. General: Comply with the following standards as referenced in this Section.

1. Aluminum Association, Design System for Aluminum Finishes (AA).
2. American Architectural Manufacturers Association (AAMA), standards.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials off ground, under cover. Protect from damage and deterioration.

B. Handle materials to prevent damage to surfaces, edges and ends of sheet metal items. Remove damaged material from site and replace with new products.

1.6 WARRANTY

A. Warrant coping work to be free of defects in materials and workmanship, to resist blow-off and to be weathertight, due to conditions within stated design limits. Provide 20-year warranty based on independent certified testing for design and performance criteria of this Section beginning from Date of Substantial Completion.

B. Warrant fluoropolymer coating for 20 years, under normal atmospheric conditions, from peeling, checking or cracking (except for slight crazing as may occur on tightly roll-formed edges or brake bends at time of forming prepainted sheet), caulking in excess of numerical rating of 8 when measured in compliance with ASTM D659-86, or fading in excess of 5 N.B.S. beginning from Date of Substantial Completion.

PART 2 – PRODUCTS

2.1 FORMED ALUMINUM GUTTER AND DOWNSPOUTS

A. Products:
1. Pre-Engineered Gutter Systems, Industrial Series by Southern Aluminum Finishing Co.
2. Gutter Systems by Metal-Era Roof Edge Systems.

B. Characteristics:
1. Material: Smooth surfaced formed aluminum alloy, minimum 0.063 inch thick with front and back drip legs factory roll-formed. Press braking of drip edges is unacceptable.
2. Finish: Custom color, fluoropolymer coating.
3. Gutter Size: 6 inches minimum and as indicated on drawings.
4. Downspout Size: 4 inches by 5 inches rectangular.

C. Accessories:
1. Fasteners: Types as recommended by manufacturer. Do not use adhesive without mechanical fastening devices.
2. Prefabricated Sections: Factory-assembled, mitered corners, and welded joints to match gutter and downspout in design and finish.

2.2 FINISH

A. Fluoropolymer Coating: Two-coat, shop-applied, baked-on fluoropolymer coating system.
1. Coating Thickness: 1.0 mil dry film thickness consisting of minimum 0.20 mil primer and minimum 0.80 mil color coat.
2. Color: As selected by Architect from coating system's selection for custom color.

B. Manufacturer: Atochem North America, Inc., Kynar 500 resin or Ausimont U.S.A., Inc., Hylar 5000 resin (polyvinylidene fluoride, PVDF), formulated by a licensed manufacturer and applied by manufacturer's approved applicator to meet AAMA Publication 605.2-90.

PART 3 – EXECUTION

3.1 PREFABRICATED GUTTER AND DOWNSPOUT INSTALLATION

A. Install prefabricated gutter and downspout system in compliance with manufacturer's product data and printed installation instructions.

B. Make watertight fit, allowing for expansion and contraction.

C. Install support brackets at 30" O.C. to allow a maximum 1/8" per 40 foot slope. Attach brackets with16d coated nail.

D. Install manufacturer's standard elastomeric expansion joint assembly at 40'-0" intervals.

E. End/Caps Terminations: Install manufacturer's end caps at all end terminations.

F. Miter all corners, install manufacturer's welded miters at corners.

G. Install gutter from left to right (roofside) into support brackets. Lap each telescoping section a distance of 1" seal and rivet at 2" O.C.

END OF SECTION 07 71 23

08 16 13
FIBERGLASS DOORS

PART 1 - GENERAL

1.1 SUMMARY

This section includes the design and performance specifications for fiberglass reinforced polyester doors and aluminum frames.

1.2 QUALITY ASSURANCE

A. Qualifications: Provide door assemblies designed and fabricated to comply with requirements for system performance characteristics listed below:
   1. Thermal Transmittance: U-value of not more than 0.087 nominal BTU/per AAMA 1503.1

B. Manufacturer Qualifications: Shall have produced fiberglass reinforced polyester doors featuring non-welded tie-rod construction for a minimum of ten (10) years. Shall have completed projects of similar building type and size. Manufacturers failing to meet the above requirements will not be accepted.

C. Pre-Installation Conference: Prior to installation, a representative of the manufacturer shall meet with the installer to provide information to verify and reinforce a thorough and complete understanding of the entrance system.

1.3 SPECIAL PROJECT WARRANTY

A. Material and workmanship of doors and frames shall be guaranteed to be free of defects for ten (10) years from the date of installation.

B. The door manufacturer's liability shall be limited to the cost of repairing or replacing defective products to the satisfaction of the Owner.

C. Only authorized factory personnel shall make any field modifications to the manufacturer's hardware, other than that which the door was engineered to receive.

D. The hardware manufacturer will guarantee hardware provided and installed by the door manufacturer for their applicable time span with installation being as covered above. A written copy of the manufacturer's warranty shall be supplied to the Owner.

1.4 PERFORMANCE REQUIREMENTS

A. Structural: When door corner is tested for strength in accordance with Dual Moment Load Test, top door corner test section shall withstand load of 190 pounds on lever arm before reaching point of failure. Failure is rotation of lever arm in excess of 45 degrees.

1.5 SUBMITTALS

A. Product Data:
   1. Materials list of items proposed to be provided under this Section;
   2. Manufacturer's specifications and other data needed to prove compliance with specified requirements;
   3. Shop Drawings in sufficient detail to show fabrication, installation, anchorage, and interface of work of this Section with work of adjacent trades;

B. Samples: Samples of finishes.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER- FIBERGLASS DOORS

A. Manufacturer: Subject to compliance with requirements, provide products of the following: SL-17 with SpecLite3 as manufactured by Special-Lite, Inc., Decatur, Michigan.

2.2 MATERIALS AND ACCESSORIES

A. Aluminum Members: Alloy and temper as recommended by manufacturer for strength, corrosion resistance and application of required finish and control of color; ASTM B 221 for extrusions, ASTM B 209 for sheet/plate with aluminum wall thickness of 0.125".

B. Components: Furnish door and frame components from the same manufacturer. "Splitting" of door and frame components is not permitted.

C. Fasteners: Aluminum, non-magnetic stainless steel or other non-corrosive metal fasteners, guaranteed by the manufacturer to be compatible with the doors, frames, stops, panels, hardware, anchors and other items being fastened. For exposed fasteners (if any) provide Philips head screws with finish matching the item to be fastened.

2.3 FABRICATION

A. Sizes and Profiles: The required sizes for door and frame units, and profile requirements determined by field measurement. See drawing for door locations.

B. Coordination of Fabrication: Field measure before fabrication and show recorded measurements on final shop drawings.

C. Complete the cutting, fitting, forming, drilling and grinding of all metal work prior to assembly. Remove burrs from cut edges, and ease edges and corners to a radius of approximately 1/64".

D. No welding of doors or frames is acceptable.

E. Maintain continuity of line and accurate relation of planes and angles. Secure attachments and support at mechanical joints, with hairline fit at contacting members.

2.4 FIBERGLASS REINFORCED POLYESTER FLUSH DOORS

A. Materials and Construction.

1. Construct 1- 3/4" thick doors of 6063-T5 aluminum alloy rails and stiles minimum 2-5/16 " depth. Construct with mitered corners and provide joinery of 3/8" diameter full width tie rods through extruded splines top and bottom as standard. .125" tubular shaped stiles and rails reinforced to accept hardware as specified. Provide hex type aircraft nuts for joinery without welds, glues or other methods for securing internal door extrusions. Furnish integral reglets to accept face sheet to permit a flush appearance. Rail caps or other face sheet capture methods are not acceptable.
2. Extrude top and bottom rail legs for interlocking continuous rail rigidity weather bar. Lock face sheet material in place with extruded interlocking edges to be flush with aluminum rails and stiles.

3. Door face sheeting .120" thickness fiberglass reinforced polyester, SL-17 doors with an abuse resistant engineered surface of the standard colors: white, light gray, red, blue, green, beige, dark gray, dark bronze or black as selected.
4. Core of Door Assembly: Minimum five (5) pounds per cubic foot density poured-in-place polyurethane free of CFC. Minimum "R" value of 11. Meeting stiles on pairs of doors and bottom weather bars with nylon brush weather-stripping.
5. Manufacture doors with cutouts for vision lites, louvers or panels as scheduled. Factory furnish and install all glass, louvers and panels prior to shipment.
6. Pre-machine doors in accordance with templates from the specified hardware manufacturers and approved hardware schedule. Factory install hardware.

2.5 FIBERGLASS FRAMING SYSTEMS

A. Framing:
1. Size and Type: As indicated on the Drawings.
2. Materials: ¼" thick solid pultruded FRP profiles having no corrosive components or reinforcement.
3. Width: 2" face.
4. Depth: Contractor to field verify
5. Assembly: One piece chemically welded at factory
6. Door Stop: 5/8" x 2 ¼".
7. Corner Construction: Mitered with 4" x 4" x 3/8" pultruded FRP angle reinforcement with interlocking pultruded FRP brackets.
8. Reinforcing: ¼" pultruded FRP chemically welded at all hinge, strike and closer locations.
11. Anchors: Furnished with type as specified on drawings.
12. Fasteners for reinforcing: 18-8 Stainless Steel.

2.6 LOUVERS

A. Type: Pultruded FRP 1/8" thick materials. Fixed inverted "Y" shaped blades. Louver size as indicated on drawings. Finish shall match door.

B. Installation: Factory installed into standard vision lite kit. Exterior side of louver shall be free of fasteners.

C. Insect screen. Stainless Steel

2.7 FINISHES

A. All aluminum to be provided in anodized finishes complying with Aluminum Association standards AAM12C22A31.
1. Door face panels shall be embossed surface with Fluropon finish, factory applied in color Architect selects.

B. All exposed surfaces of aluminum door and framing members shall be free of scratches and other serious surface blemishes.

2.8 HARDWARE

A. General:
1. All doors and frames shall be machined using templates available from the manufacturer of specified hardware. Doors and frames shall be internally reinforced for specified surface hardware. All doors to be properly reinforced for hardware before core is foamed.

2. Doors are to be shipped with hardware installed except for door closer and holders, locksets and thresholds that may be field applied.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of Work. Do not proceed until unsatisfactory conditions are corrected.

B. Commencement of work shall signify acceptance of conditions and any subsequent adjustments shall be the responsibility of the Contractor.

C. Field inspection and measurement of doorframes and doors is the responsibility of the Contractor. Any problems in installing units shall be the responsibility of the Contractor, who shall bear all additional expense to meet full satisfaction of the Owner.

3.2 FIELD QUALITY CONTROL

A. Inspection: test door and frame for proper fit and smooth operation and confirm that no damage occurred during installation.

3.3 INSTALLATION

A. Install work of this Section in strict compliance with original design, approved Shop Drawings, pertinent requirements of governmental agencies having jurisdiction, and manufacturer's recommended installation procedures, anchoring all components firmly into position for long life.

B. Remove protective coating completely from exposed surfaces as soon as progress of Work will safely permit.

3.4 ADJUSTING AND CLEANING

A. Upon completion of installation, leave work areas and materials installed in a neat and clean condition.

B. Upon completion of installation, lubricate, test, and adjust doors to operate easily, free from warp, twist or distortion and fitting weather-tight for the entire perimeter.

3.5 PROTECTION

Secure area. Provide proper protection of completed entrance system from damage or physical abuse until final inspection and approval of owner.

END OF SECTION 08 16 13

08 31 00
ACCESS DOORS AND PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes: Panels installed in ceilings, floors and walls as required to provide access to items concealed behind finish surfaces.

B. The extent, location, and size of each type of access door required shall be determined by the final locations of all equipment and devices.

C. The Contractor shall provide access panels to all concealed equipment, mechanical devices, plumbing fittings, and any building component required to be accessed for maintenance or operational functions. Access panels shall be sufficient size to provide the necessary access.

1.2 QUALITY ASSURANCE

A. Fire Resistance Ratings:
   1. Wherever a fire resistance classification is required, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in Underwriters Laboratories, Inc.; "Classified Building Materials Index" for rating shown.
   2. Provide UL label on each fire-rated access door.

B. Size Variations: Obtain Architect's acceptance of manufacturer's standard size units which may vary slightly.

C. Coordination: Furnish inserts and anchoring devices which must be built into other work for installation of access doors.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical data and installation instructions for each type of access door assembly, including setting drawings, templates, instructions and directions for installation of anchorage devices.

B. Shop Drawings: Submit shop drawings for fabrication and installation of customized access doors and frames, including details of each frame type, elevations of door design types, anchorage and accessory items.

PART 2 - PRODUCTS

2.1 MATERIALS AND FABRICATION

A. General: Furnish each access door assembly manufactured as an integral unit, complete with all parts and ready for installation.

B. Steel Access Doors and Frames: Fabricate units of continuous welded steel construction using commercial quality, cold formed steel sheets, unless otherwise indicated. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of support shown.

2.3 ACCESS PANELS

A. Security

1. Material: 12-gauge steel frame with 12-gauge door panel.
2. Type: Standard access panel with exposed 1" flange perimeter for mounting in all types of wall surfaces.
3. Hinge: Concealed, continuous piano
4. Lock: flush key operated latch bolt
5. Size: smallest size practical to provide necessary access as approved by Architect
6. Finish: phosphate dipped and factory applied prime coated
7. Product: Style 'MT' flush standard panel as manufactured by Nystrom Building Products or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's instructions for installation of access doors.

B. Coordinate installation with work of other trades.

C. Set frames accurately in position securely attach to supports with face panels plumb or level in relation to adjacent finish surfaces.

D. Position units to provide convenient access to concealed work requiring access.

E. Provide UL or Warnock-Hersey label on all fire rated access panels. Install fire rated units in accordance with Code requirements, and to maintain fire rating assembly of wall and/or ceiling.

3.2 ADJUST AND CLEAN

Adjust hardware and panels after installation for proper operation. Remove and replace panels or frames which are warped, bowed or otherwise damaged.

END OF SECTION 08 31 00

08 70 00
HARDWARE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work included: All finishing hardware not factory installed, including miscellaneous items required for complete installation of specified items.

1.2 QUALITY ASSURANCE

A. Supplier of finish hardware must meet following conditions for Architect's approval:
   1. Be recognized distributor of one of approved lock manufacturers.
   2. Sufficiently experienced organization and trained hardware consultants to properly specify, detail, and service finishing hardware in satisfactory manner.
   3. At all times, stocks representative inventory of specified finishing hardware in order to take care of shortages and minor extras without delay.
   4. Available to General Contractor on jobsite within 48 hours' notice, until job is complete.

B. Guarantee: In addition to guarantee contained in General Conditions, guarantee all material free from defects for period of two (2) years after Substantial Completion. Material found to be defective shall be removed and replaced including labor at no expense to Owner.

1.3 SUBMITTALS

A. Completely detailed hardware schedule. Schedule shall include following information:
   1. Architect's Opening Number
   2. Location
   3. Size of Opening
   4. Manufacturer's Number
   5. Finish
   6. Keying
   7. UL Label, if applicable
   8. All other pertinent data

B. Do not proceed until Architect has reviewed hardware schedule and Owner has approved keying.
   1. Keying Schedule: Submit a separate detailed schedule indicating clearly how the Owner's final instructions on keying of locks has been fulfilled.

C. Deviation from or modification of items will be permitted only for special instances, caused by reason of construction characteristics and for purpose of providing proper operational function.

D. Prior to final acceptance, certify that hardware in place is same as that called for on final hardware schedule or on approved modification thereof.

E. Templates: Issue, free of charge, to all interested parties, hardware schedule and template drawings required for preparation of doors and frames. Do not issue until Architect has responded to final hardware submission.

F. Samples:

1. Prior to submittal of the final hardware schedule and prior to final ordering of builder's hardware, submit one sample of each type of exposed hardware unit, finished as required, and tagged with full description for coordination with schedule.
2. Samples will be returned to the supplier. Units which are acceptable and remain undamaged through submittal, review and field comparison procedures may, after final check of operation, be used in the work, within limitations of keying coordination requirements.

1.4 PRODUCT HANDLING AND STORAGE

A. Each item of hardware shall be substantially packed in approved manufacturer's container, complete with trimmings, bolts, and other fasteners required for application. Each package shall be clearly labeled with manufacturer's number, quantity included, and schedule identification number.

B. Deliver hardware in time to not delay project. Deliver, as directed, to jobsite.

C. Provide easily accessible open shelving for supplier's assembly and sorting of finish hardware. Keep under lock and key until final application of all hardware.

D. Provide secure lock-up for hardware delivered to the project, but not yet installed. Control and handling and installation of hardware items which are not immediately replaceable, so that the completion of the work will not be delayed by hardware losses, both before and after installation.

1.5 CODE CONFORMANCE

A. Finish hardware shall conform with all applicable codes and regulations, including requirements of:
1. ANSI 4.13.9
2. NFPA 80 - Fire Doors and Windows.
3. NFPA 101 - Life Safety Code.
4. Local and state building codes.
5. UL Labeled for Rated Doors.
6. DHI - Door and Hardware Institute.
7. SDI - Steel Door Institute.
8. AWI - Architectural Woodwork Institute.

1.6 FIRE-RATED OPENINGS

A. Where doors are indicated as labeled assemblies, provide only hardware that has been tested and listed by UL for the type, sizes and labels of doors and frames shown or otherwise required by local code, in compliance with American Insurance Association, Pamphlet No. 80 and NFPA, Standard No. 80, current editions. This requirement takes precedence over other requirements for such hardware specified.

1.7 JOB CONDITIONS

A. Coordination:
Coordinate hardware with other work. Tag each item or package separately, with identification related to the final hardware schedule, and include basic installation instructions in the package. Furnish hardware items of proper design for use on doors and frames of the thicknesses, profile, swing, security and similar requirements indicated, as necessary for proper installation and function. Deliver individually packaged hardware items at the proper times to the proper locations for installation.

B. Templates:
Furnish hardware templates to each fabricator of doors, frames and other work to be factory prepared for the installation of hardware. The Contractor shall check the shop drawings of such other work, to confirm that adequate provisions are made for the proper installation of hardware.

1.8 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:
1. Seven years for heavy duty cylindrical (bored) locks and latches.
2. Ten years for mortise locks
3. Five years for exit hardware.
4. Twenty five years for manual surface door closer bodies.
5. Five years for motorized electric latch retraction exit devices.
6. Two years for electromechanical door hardware.

PART 2 - PRODUCTS

2.1 FINISH HARDWARE

A. Manufacturer:
1. Products of finish hardware supplied shall be selected from manufacturers mentioned in this document.
2. Hardware specified herein shall be considered as standard of quality. Review and approval of other than specified products must be approved by Architect and Owner seven days prior to bid date in a written addendum.

2.2 MATERIALS AND FABRICATION

A. Hand of door: The drawings show the direction of slide, swing or hand of each door leaf. Furnish each item of hardware for proper installation and operation of the door movement as shown.

B. Manufacturer's Name Plate: Do not use manufacturer's products that have manufacturer's name or trade name displayed in a visible location, except in conjunction with required UL labels and as otherwise acceptable to the Architect.

C. Base Metals: Produce hardware units of the basic metal and forming method indicated, using the manufacturer's standard metal alloy, composition, temper and hardness, but in no case of lesser quality than specified for the applicable hardware units by FS FF-H-106, FS FF-G-111, FS FF-H-116 and FS FF-H-121. Do not furnish optional materials or forming methods for those indicated, except as otherwise specified.

D. Fasteners:
1. Manufacture hardware to conform to published templates, generally prepared for machine screw installation. Do not provide hardware which has been prepared for self-tapping sheet metal screw, except as specifically indicated.
2. Furnish screws for installation, with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed screws to match the hardware finish or, if exposed in surfaces of other work, to match the finish of such other work as closely as possible, including "prepared for paint" in surfaces to receive painted finish.
3. Provide concealed fasteners for hardware units which are exposed when the door is closed, except to the extent no standard units of the type specified are available with concealed fasteners. Do not use through bolts for installation where the bolt head or the nut on the opposite face is exposed in other work, except where it is not feasible to adequately reinforce the work.

E. Tools for Maintenance: Furnish a complete set of specialized tools as needed for Owner's continued adjustment, maintenance, and removal and replacement of builders hardware.

2.3 HINGES AND BUTTS

A. Template: Provide template produced units only.

B. Hinge Pins:
Except as otherwise indicated, provide hinge pins as follows:
1. Exterior Doors: Non-removable pins.
Tips: Flat button and matching plug, finished to match leaves, except where hospital tip indicated.

C. Exterior: All exterior hinges shall be heavy weight (.180 or .190 ga.) continuous hinges

D. Screws: Provide manufacturers' standard screws.

E. Quality: Provide products from the following list of manufacturers:
1. Hager
2. McKinney
3. Stanley

2.4 LOCK CYLINDERS AND KEYING

A. General:
1. Supplier shall meet with the Owner to finalize keying requirements and obtain final instructions in writing.

2. Comply with the Owner's instructions for master keying and, except as otherwise indicated, provide individual change key for each lock which is not designated to be keyed alike with a group of related locks.

B. Standard System:
1. Existing System: Provide keying system integrated with the Owner's existing key system, with a new masterkey for the project.
2. Equip locks with manufacturer's standard 6-pin tumbler cylinders.
3. Equip locks with manufacturer' special 6-pin tumbler cylinder, with construction master key feature, which permits voiding of construction keys without cylinder removal.
4. Equip locks with cylinders for interchangeable core pin tumbler inserts. Furnish only temporary inserts for the construction period and remove these when directed.

C. Metals: Construct lock cylinder parts from brass, bronze, stainless steel or nickel silver.

D. Keys:
1. Provide keys of nickel silver only.
2. Provide 3 change keys for each lock; 5 master keys for each master system; and 5 grandmaster keys for each grandmaster system.
3. Provide a key control system including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by the system manufacturer, with the capacity for 150% of the number of locks required for the project.

E. All cylinders shall be 7-pin, interchangeable core by Best Lock Corporation and keyed into the existing factory registered Grand Masterkey System with a restricted keyway.

F. Cylinder and core to be supplied by the same manufacturer.
1. Permanent cylinders, temporary brass cores and permanent cores shall be supplied and installed by the contractor. All doors shall have temporary brass cores to allow securing of all areas as needed during construction.
2. Permanent cores will be shipped to owner for installation by contractor. Installation is to be scheduled one week prior to substantial completion.

G. Compatibility: It is the finish hardware supplier's responsibility to assure compatibility between the locksets and cylinders when components of different manufacturers are used. Correct collars and cams must be provided and work properly.

H. Finish: All cylinders shall be US3.

I. Key cylinders at lock manufacturers' factory and factory install cylinders in the locksets.

J. Permanently emboss both sides of all key bows with manufacturers name, key biting number and keyset symbol.

K. Key Management: Key control shall be provided by supplying a complete key storage and management system. Each key shall be fully cut, indexed, tagged and installed on cabinet hooks by the key cabinet supplier and shipped with the locks. Key cabinet provided shall be wall mounted (by contractor) type with capacity plus 50%. Provide 3-way cross index system

referencing the 1) permanent room number; 2) key symbol; 3) biting number set up by key control manufacturer and place keys on markers and hooks in the cabinet as determined by the final key schedule. Identify each key. Provide a red tag for each key and mark this tag "DO NOT REMOVE". Attach to one (each differently numbered) key and place it first in the key cabinet. Using white tags place the remaining 4 like keys on the same hook. Provide 4 copies of chart showing hook number, key number, the location or room the key opens and the key cut. One chart to be a permanent part of the key cabinet. Turn over the other 3 to owner's locksmith. Provide and install hinged-panel wall mount type cabinet. Provide key cabinet by MMF Industries.

L. Deliver permanent keys to the Owner's representative and locksmith upon acceptance of the building. At this time the contractor will replace the construction system and core with permanent keys and cores in the presence of the owner. All keys and locks shall be tested and approved by the owner before acceptance.

2.5 LOCKS AND LATCHES

A. Locks: All locks shall be heavy duty key-in-levers, U/L labeled for use on fire doors up to and including 3 hours. Levers shall be cast with 3 1/8" diameter cold forged roses. Lever locksets shall have independent lever return springs and free wheeling lever handles when unit is locked. Also provide tru-bolts and mounting plate for chassis stability. Lockset series must have availability to accept 6 pin standard cylinder assemblies and be prepared to accept 7 pin Best interchangeable cores. Furnish Corbin/Russwin CL3600, CL3500 x Newport Design NZD x US3 as indicated in HW sets or Yale BAU-5400-LN Series x US3.

B. Strikes:
1. Provide manufacturer's standard wrought box strike for each latch or lock bolt, with curved lip extended to protect frame, finished to match hardware set.
2. Provide standard strike plates for interior doors of residential units where wood door frames are used.
3. Provide dust proof strikes for foot bolts, except where special threshold construction provides non-recessed strike for bolt.
4. Provide roller type strikes.

C. Lock Throw:
1. Provide 5/8" minimum throw of latch and deadbolt used on pairs of doors. Comply with UL requirements for throw of bolts and latch bolts on rated fire openings.
2. Provide 1/2" minimum throw on other latch and deadlock bolts.

D. Flush Bolts Heads: Minimum of 1/2" diameter rods of brass, bronze or stainless steel, with minimum 12" long rod.

E. Exit Device Dogging: Except on fire rated doors, wherever closers are provided on doors equipped with exit devices, equip the units with keyed dogging device to hold the push bar down and the latch bolt in the open position.

2.6 PUSH/PULL PLATES

A. Push plates: Push plates shall be .050 thickness stainless steel with 4 beveled edges. Plates shall be 3 1/2" x 15" and be cut for cylinder or thumbturn as needed.
1. Ives 8200 x 4BE
2. Rockwood 70B x 4BE

3. Lindstrom 100 x 4BE

B. Pull plates: Pull plates shall be .050 thickness satin brass with 4 beveled edges. Plates shall be 3 1/2" x 15" and be cut for cylinder or thumbturn as needed. Pull shall be 3/4" rod at 8" centers.

2.7 SURFACE CLOSERS

A. Type: All surface closers shall be full rack and pinion type with cast aluminum alloy or cast iron shell. Closers shall be full metal cover type and shall project no more than 2 1/4" from the mounting surface. Closers shall be non-handed and be provided with non-gumming and non-freezing hydraulic fluid. Closers shall have two non-critical valves, hex-key adjusted to independently regulate closing and latch speed. Closers shall also have multi-size spring power adjustment to permit setting of power from size 2 thru 6.

B. Access-Free Manual Closers: Where manual closers are indicated for doors provide adjustable units complying with ANSI A 117.1 provisions for door opening force and delayed action closing.

C. All closers are to be supplied and installed with sex, nuts and bolts.

2.8 PROTECTIVE PLATES

A. Kick: All kick plates shall be 10" by 2" less than door width. Plates shall be .050 US3 and beveled on three sides. All plates shall be prepared for and furnished with stainless steel sheet metal screws.

2.9 THRESHOLDS

A. Supply thresholds as indicated in the drawings or in the hardware sets. All thresholds shall conform to state and local handicap codes. Supply from the following list of manufacturers:
   1. Ultra
   2. National Guard Products.
   3. Pemko.
   4. Rixson.

2.10 WEATHERSTRIPPING AND GASKETING

A. All exterior openings shall be gasketed with UL labeled and listed Ultra WS108 or equal. Apply gasketing to head jamb, hinge jamb, lock jamb and astragal. For other applications, refer to drawings and hardware sets.

2.11 FINISHES

A. US26D except closers. Satin Chrome

2.12 DOOR TAGS

A. All doors to receive brass door I.D. tags indicating door number scheduled on plans. On typical floors, use corresponding floor number. Mount on hinge side stile edge of door. Stamped characters on 1-1/4 inch round brass tags number 1538W136 by McMaster - Carr supply company.

PART 3 - EXECUTION

3.1 HARDWARE INSTALLATION

A. General: Prior to installing any hardware the supplier will meet with the owner, manufacturers representatives and the installer to review installers qualifications, installation, templates, tools, etc. Installer must have ten years minimum experience commercial/ institutional hardware installing. Install each hardware item in compliance with manufacturers instructions and recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces which are later to be painted or finished in another way, install each item completely and then remove and store in a secure place during the finish application. After completion of the finishes, reinstall each item. Do not install surface mounted items until finishes have been completed in the substrate. Protect hardware from damage until Final Acceptance.

B. Hardware mounting heights shall comply with DHI "Recommended Locations for Builders Hardware" as scheduled below: Except as specifically indicated or required to comply with governing regulations and except as may be otherwise specified by the architect.
   1. Center of doorknobs: 38" above finished floor.
   2. Center of cylinder deadlocks: 48" above finished floor.
   3. Center of panic bars: Per manufacturer's instructions.
   4. Center of push plates: 45" above finished floor.
   5. Upper edge of top hinge: 5" below door head
   6. Lower edge of bottom hinge: 10" above finished floor.
   7. Center hinge: Midway between top and bottom hinge.

C. Adjust and check each operating item of hardware and each door, to ensure proper operation of functions of every unit. Lubricate moving parts with type lubrication recommended by manufacturer (graphite-type if no other recommended). Replace units which cannot be adjusted and lubricate to operate freely and smoothly as intended for the application made. All installation tools furnished with hardware shall be turned over to owner at completion of project.

D. Thresholds shall be full width of openings, notch at stops and center mullions, if required, and set in full bed of butyl rubber or polyisobutylene mastic sealant in accordance with manufacturer's instructions such as to prevent seepage of water or vapor.

E. Installation by other trades: All electric equipment is to be coordinated with responsible trade, with proper wire and wiring furnished and connections made under that section.

F. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance of occupancy, make a final check and adjustment of all hardware items in such space or area. Clean and relubricate operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment. Replace all defective, damaged, missing or stolen hardware.

G. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

H. Drill and countersink units which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

I. Clean adjacent surfaces soiled by hardware installation.

3.2 FASTENERS

A. Fasteners shall be suitable size, quantity and of the same material and finishes of hardware, unless otherwise specified to secure hardware on proper position. All fasteners exposed to weather shall be nonferrous or corrosion resisting steel.

1. Machine screws and tapcon shields shall be furnished for attaching hardware to concrete, stone or masonry.
2. Machine or sheet metal screws shall be furnished for attaching hardware to metal.
3. Self-tapping screws shall be furnished for attaching kickplates to mineral core doors.
4. Full thread screws shall be furnished for attaching butt hinges to wood core doors.
5. Sex bolts shall be provided for attaching surface type closers or closer arm to wood doors.
6. Use only machine screw expansion shields when fastening into masonry. Do not use plastic anchors.
7. Where tamperproof screws are specified, provide special security type torx screws with tamperproof center pin.

3.3 MATERIALS AND WORKMANSHIP

A. Provide all hardware, unless otherwise specified, of the best grade, entirely free of imperfections in manufacture and finish, and guaranteed by the manufacturer to satisfactorily perform the various functions required of it for a long life under normal usage. Metal finishes will be as specified.

B. Continued Maintenance: Approximately six months after the acceptance of hardware in each area, the installer, accompanied by the representative of the latch and lock manufacturer, shall return to the project and re-adjust every item of hardware to restore proper function of doors and hardware. Instruct owner's personnel in proper adjustment and maintenance of hardware and hardware finishes.

C. Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures. Replace hardware items which have deteriorated or failed due to faulty design, materials or installation of hardware units. Prepare a written report of current and predictable problems in the performance of the hardware. Provide owner manufacturers manuals for all hardware.

3.4 COORDINATION

A. The hardware supplier shall consult the project drawing and details and otherwise familiarize himself with work to the end that all items of hardware furnished shall conform to units to which it is applied. He shall coordinate the hardware with other conflicting trades such as millwork metal doors and frames, etc.

B. Immediately after the award of the hardware purchase order, it shall be the duty of the hardware supplier to request approved shop drawings from such trades with which the hardware must be coordinated.

C. After checking approved shop drawings, hardware supplier shall supply promptly such template information, template drawings, approved hardware schedules, etc., as may be required to facilitate the progress of the job.

D. Prior to owner's acceptance of the building, the hardware supplier shall walk the job to assure all hardware is properly installed and adjusted according to manufacturer's installation instructions.

3.5 ADJUST AND CLEAN

A. General

1. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made.
2. Instruct Owner's personnel in proper adjustment and maintenance of hardware and hardware finishes, during the final adjustment of hardware.

3.6 HARDWARE DATA

A. Following hardware descriptions correspond to hardware sets on the drawings. Equip doors leading to dangerous areas such as switch rooms, mechanical rooms, and electrical closets with knobs that have been knurled.

1. Continuous Geared Hinge: Full mortise geared hinges certified to ANSI 156.26, Grade 1, UL approved to 90 minutes, fabricated from 6063-T6 aluminum, US 28 clear anodized finish. Ives Model XY or equal, continuous hinge full height of door.
2. Manual Door Closers: Heavy duty, Grade 1, UL listed for fire doors, 30-year warranty, incorporating ADA reduced force requirements, meets 'Buy America Act' compliant, LCN 4040X series, 'HEDA' parallel arm, and metal cover with powder coat finish.
3. Full Mortise Latchsets and Locksets:
   a. Storeroom Function: Schlage Model L9080
   b. Deadbolt: Schlage L Series Grade 1 Mortise Deadbolt
4. Door Accessories:
   a. Threshold: Pemko extruded aluminum ½" tall, depth equal to full depth of door jamb, latching panic threshold.
   b. Weather Strip Set: (Head and Jambs) Pemko Model 296-S standard extruded aluminum with silicone insert mill aluminum finish.

END OF SECTION 08 70 00

08 90 00
LOUVERS AND VENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section includes: Metal louvers and vents.

B. Related work: Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

C. Description of Work:
1. The extent of louvers and vents is indicated on the drawings, including indications of sizes and locations.
2. Types of louvers and vents include the following: Extruded aluminum louvers

1.2 QUALITY ASSURANCE

A. Performance Requirements:
1. Where louvers are indicated to comply with specific performance requirements, provide units whose performance ratings have been determined in compliance with Air Movement and Control Association (AMCA) Standard 500.
2. Comply with SMACNA "Architectural Sheet Metal Manual" recommendations for fabrication, construction details and installation procedures, except as otherwise indicated.

B. Field Measurements: Verify size, location, and placement of louver units prior to fabrication, wherever possible.

C. Shop Assembly: Coordinate field measurements and shop drawings with fabrication and shop assembly to minimize field adjustments, splicing, mechanical joints and field assembly of units. Pre-assemble units in shop to greatest extent possible and disassemble as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's specifications; certified test data, where applicable; and installation instructions for required products, including finishes.
1. Materials list of items proposed to be provided under this Section;
2. Manufacturer's specifications and other data needed to prove compliance with specified requirements;
3. Shop Drawings in sufficient detail to show fabrication, installation, anchorage, and interface of work of adjacent trades;
4. Color chart for standard colors;
5. Manufacturer's recommended installation procedures which, when approved by Architect, will become basis for accepting or rejecting actual installation procedures used on Work.

B. Shop Drawings: Submit shop drawings for fabrication and erection of louver units and accessories. Include plans, elevations and details of sections and connections to adjoining work. Indicate materials, finishes, fasteners, joinery and other information to determine compliance with specified requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, provide products of one of the following:
Airline Products
Airolite Co.
Ruskin Manufacturing Co.

2.2 MATERIALS

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T52.

B. Fastenings: Use same material as items fastened, unless otherwise indicated. Fasteners for exterior applications may be stainless steel or aluminum. Provide types, gages and lengths to suit unit installation conditions. Use Phillips flat head machine screws for exposed fasteners, unless otherwise indicated.

C. Anchors and Inserts: Use stainless steel anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Furnish inserts, as required, to be set into concrete or masonry work.

2.3 FABRICATION, GENERAL

A. Provide louvers and accessories of design, materials, sizes, depth, arrangement, and metal thicknesses indicated, or if not indicated, as required for optimum performance with respect to airflow; water penetration; air leakage, where applicable (for adjustable units, if any); strength; durability; and uniform appearance.

B. Fabricate frames including integral sills to suit adjacent construction with tolerances for installation, including application of sealants in joints between louvers and adjoining work.

C. Include supports, anchorages, and accessories required for complete assembly.

D. Provide sill extensions and loose sills made of same material as louvers, where indicated, or required for drainage to exterior and to prevent water penetrating to interior.

E. Join frame members to one another and to stationary louver blades by welding. Maintain equal blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

2.4 STATIONARY EXTRUDED ALUMINUM WALL LOUVERS

A. Horizontal Drainable Blade Louvers:

1. Units designed to collect and drain water to exterior at sill by means of gutters in front edges of blades, and channels in jambs and mullions. Furnish units with extrusions not less than 0.081" thick, 4" depth, unless otherwise indicated, complying with the following performance requirements.

2. Free Area: Not less than 54% for a 48" x 48" size.
3. Static Pressure Loss: Not more than 0.15" of water gage at an airflow of 1050 fpm free area velocity in intake direction.
4. Water Penetration: Not more than 0.01 ounce per square foot of free area at an airflow of 873 fpm free area velocity.
5. Vertical Supports: Hidden vertical supports to allow continuous line appearance up to 120 inches (3,048 mm).
6. Sill: Steeply angled integral sill eliminating areas of standing or trapped moisture where mold or mildew may thrive and effect indoor air quality.
7. Assembly: Factory assemble louver components. All welded construction.

B. Manufacturer: Provide Ruskin model ELF375DX or approved equal, with 37.5 degree blade angle mounted 5" on center, nominal.

2.5 ACCESSORIES

A. Installation Hardware: Aluminum angles for securing louver assembly on the interior rough opening framing.

2.6 LOUVER SCREENS

A. General:
1. Provide removable screens for exterior louvers.
2. Provide rewireable frames consisting of formed or extruded metal with a driven spline or insert for securing screen mesh.
3. Locate screens on inside face of louvers, unless otherwise indicated. Secure screens to louver frames with machine screws, spaced at each corner and at 12" on center between.

B. Insect Screens: 18" x 16" mesh, 0.011" aluminum wire.

2.7 METAL FINISHES

A. General:
1. Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations, except as otherwise indicated. Apply finishes in factory after products are assembled. Protect finishes on exposed surfaces with protective covering, prior to shipment. Remove scratches and blemishes from exposed surfaces which will be visible after completing finishing process.
2. Provide colors as selected by the Architect from the manufacturer's standard colors.

B. Aluminum High Performance Coating: Fluoropolymer Coating: Inhibitive thermo cured primer, 0.2 mil minimum dry film thickness, and thermo-cured fluoropolymer coating containing "Kynar 500" resin, 1.0 mil minimum dry film thickness.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Examine areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

3.3 INSTALLATION

A. Coordinate as required with other trades to assure proper and adequate provision in work of those trades for interface with work of this Section.

B. Install work of this Section in strict accordance with approved Shop Drawings and recommendations of manufacturers as approved by Architect, anchoring all components firmly into position in true alignment within tolerance of one in 1000 vertically and horizontally.

C. Locate and place louver units plumb, level and in proper alignment with adjacent work.

D. Use concealed anchorages wherever possible. Provide stainless steel washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

E. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers, as indicated.

F. Repair finishes damaged by cutting, welding, soldering, and grinding operations require for fitting and jointing. Restore finishes so there is no evidence of corrective work. Return items which cannot be refinished in field to shop, make required alterations, and refinish entire unit, or provide new units, at Contractor's option.

END OF SECTION 08 90 00

09 67 00
METHYL-METHACRYLATE BASED SELF-LEVELING FLOORING SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES
Methyl Methacrylate based self-leveling flooring system with a decorative flake broadcast.

1.2 REFERENCE STANDARDS
A. NACE No. 6/SSPC-SP 13 - Surface Preparation of Concrete

B. ACI 308 – Standard Practice for Curing Concrete

C. ACI 302.1R-80 - Guide for Concrete Floor and Slab Construction

D. American Society for Testing and Materials (ASTM)

1.3 SUBMITTALS
A. Prior to commencing work, submit manufacturer's technical information and installation details to describe materials to be used. The same manufacturer shall supply all polymer underlayments wall and floor finishes.

B. Submit manufacturer's certificate of compliance that materials meet specification requirements.

C. Before beginning work, samples of the flooring system shall be provided for architect's approval.

1.4 QUALITY ASSURANCE
A. Manufacturer Qualifications: Manufacturer must show a minimum 10 year history of manufacturing MMA products for the specified application. Manufacturer must show a minimum of 10 projects of equal size and magnitude as this project.

B. Applicator Qualifications:
1. Each approved applicator shall have been trained by the Manufacturer in all phases of surface preparation and application of the specified flooring system(s). Approved applicator must possess proper surface preparation equipment as recommended by manufacturer.
2. Each approved applicator shall have five years' experience of installing the specified flooring system and submit a list of five projects/references as a prequalification requirement. At least one of the five projects/references must be of equal size, quantity, and magnitude to this project as a prequalification requirement.

1.6 DELIVERY AND STORAGE
A. Material shall be delivered to project site in manufacturer's original unopened containers bearing manufacturer's name, product and color.

B. Materials shall be stored indoors, protected from damage, moisture, direct sunlight and temperatures below 50 degrees F or above 80 degrees F.

1.7 PROJECT CONDITIONS

A. Evaluate the substrate condition, including moisture content and extent of substrate leveling and repairs required, if any.

B. Bond Testing: Surface preparation efforts shall be evaluated by conducting Bond Tests at the site prior to application of the flooring system(s).

C. Coordinate flooring work with other trades to ensure adequate illumination, ventilation, and dust free environment during application and curing of flooring.

D. Comply with material manufacturer's recommended temperature limitations for flooring application.

E. Pre-Job Meeting: Architect requires a Pre-Job Meeting with representatives of Owner, Contractor/Applicator, and Material Manufacturer in attendance. The agenda shall include a review and clarification of this specification, application procedures, quality control, inspection and acceptance criteria, and production schedules. Applicator is not authorized to proceed until this meeting is held or waived by Owner.

1.8 WARRANTY

Contractor shall furnish a written warranty covering both material and workmanship for a period of five (5) years from date of installation.

PART 2 – PRODUCTS

2.1 FLOORING SYSTEM

A. Basis of Design:

MasterTop 1851 SRS CF floor topping system as manufactured by the BASF Corporation, comprised of 1/8" thick MASTERTOP SRS 61BC Self-Leveling with appropriate Primer and Topcoat, or approved equal.

The topping system shall cure and be available to normal traffic in no more than 60 minutes at 68° F. after application of last coat. It shall have a maximum water absorption value of 0.04 weight percent in accordance with ASTM D570.It shall be chemically resistant to a wide range of acids, alkalis, salts, fats, oils, and other chemicals.

BASF Corporation
889 Valley Park Drive
Shakopee, MN 55379
Customer Service: 800- 433-9517
Technical Service: 800-243-6739
Direct Phone: 952-496-6000
Internet: www.master-builders-solutions.basf.us

2.2 MATERIALS

A. MasterTop 1851 SRS CF Methyl Methacrylate (MMA) Acrylic Resin System:
   1. Saturating Primer/Sealer Coat: MasterTop SRS 41P
   2. Coving: MasterTop SRS 61BC Self-Leveling with appropriate filler
   3. Patching/Sloping: MasterTop 1817 SRS PC Polymer Concrete
   4. Topping: MASTERTOP SRS 61BC Self-Leveling, consisting of MasterTop SRS 61BC Self-Leveling resin and MasterTop SRS 100SL with Colored Flake broadcast.
   5. Topcoat: MasterTop SRS 71TC Colorless Topcoat Resin
   6. Pigment: Color to compliment Colored Flake.

7. MasterTop Colored Flake for broadcasting: Colors to be chosen by Architect from manufacturer's full range of colors.

2.3 PRODUCT PERFORMANCE CRITERIA

A. Primer/Sealer

1.	Percentage Reactive Resin:	100%
	Percentage Solids	100%
2.	Water Absorption, Wt. % (ASTM D570):	less than 0.6
3.	Tensile Strength, psi (ASTM D638)	3550
4.	Tensile Modulus, psi X 10 to the 5th (ASTM D638):	2.1
5.	Coefficient of Thermal Expansion, in./in./deg. F (ASTM D696):	.000035
6.	Electrical Resistivity (ASTM D257):	
	Volume Resistance, ohm-cm:	10^{15}
	Surface Resistance, ohm:	10^{12}
7.	Water Vapor Transmission (DIN 53122), g/cm-hr-mm Hg X 10^{-9}:	1.4

B. Polymer Concrete

1.	Percentage of reactive resin	100%
2.	Water Absorption, Wt. % (ASTM D570):	0.02
3.	Tensile Strength, psi (ASTM D638)	1200
4.	Tensile Modulus, psi X 10 to the 5th (ASTM D638):	1.2
5.	Coefficient of Thermal Expansion, in./in./deg. F (ASTM D696) psi $x10^{-6}$:	18
6.	Compressive Strength, psi (ASTM C39)	7,000
	(ASTM C109)	9,200

C. Self-Leveling Topping

1.	Percentage of reactive resin:	100%
	Percentage of solids:	100%
2.	Water Absorption, Wt. % (ASTM D570):	0.04
3.	Compressive Strength, psi (ASTM C109):	6,000-8,000
	(ASTM D695):	6,000
4.	Tensile Strength, psi (ASTM D638):	1,050
5.	Tensile Modulus, psi (ASTM D638):	720,000

6.	Flexural Strength, psi (ASTM D790):	3,500
7.	Coefficient of Thermal Expansion, in./in./deg. F (ASTM D696):	.000019
8.	Electrical Resistivity, (ASTM D257) Volume Resistance, ohm-cm:	10^{14}

D. Colorless Topcoat Resin

1.	Percentage Reactive Resin:	100%
	Percentage Solids:	100%
2.	Water Absorption, Wt. % (ASTM D570):	0.04
3.	Tensile Strength, psi (ASTM D638):	3555
4.	Tensile Modulus, psi (ASTM D638):	210,000
5.	Coefficient of Thermal Expansion (ASTM D696)	.000035 in./in. Deg. F
6.	Electrical Resistivity (ASTM D257):	
	Volume Resistance, ohm-cm:	10^{15}
	Surface Resistance, ohm:	10^{12}
7.	Water Vapor Transmission (DIN 53122) g/cm-hr-mm Hg X 10^{-9}:	1.43
8.	Chemical Resistance, ASTM D543: Effect of weak acids: none Effect of strong acids: slight Effect of alkalis: none Effect of salt solutions: none Effect of oil, grease: none Effect of sunlight (UV radiation): none	

2.4 PRODUCT INSTALLATION AND APPLICATION CRITERIA

A. All material systems:
   1. Pot Life at 68° F.: 10-15 minutes
   2. Cure Time at 68° F.: 60 minutes
   3. Recoat Time at 68° F.: 60-90 minutes

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Concrete must have a curing period of 28 days minimum at 70° F. The surface must be clean and dry, physically sound and free of contamination. Surfaces must be free of holes, voids or defects. Cracks and abrupt changes in surface profile must be corrected. Fins and projections must be removed. All curing compounds and sealers must be removed.

B. Verify that moisture content is within range acceptable to flooring manufacturer, using calcium chloride test kit in accordance with ASTM F-1869.

C. Contractor must report, in writing, surfaces left in improper condition by other trades. Application will constitute acceptance of surfaces by the applicator.

3.2 PREWORK INSPECTION

A. Examine all surfaces to be coated with MMA material systems and report to the General Contractor and Architect any conditions that will adversely affect the appearance or performance of these coating systems and that cannot be put into acceptable condition by the preparatory work.

B. Do not proceed with application until the surface is in a condition that meets manufacturer's requirements.

3.3 PREPARATION

A. Surface Preparation – General

1. Concrete substrate must be clean and dry. Dislodge dirt, mortar spatter, paint overspray, and other dry surface accumulations and contamination by scraping, brushing, sweeping, vacuuming, and/or compressed air blow-down.
2. Surfaces that are heavily contaminated shall be cleaned with the appropriate degreaser, detergent, or other appropriate cleaner/surfactant followed by thoroughly rinsing with fresh water to remove the accumulation prior to mechanical cleaning efforts. Mechanical cleaning will not remove such deposits, but only drive them deeper.
3. Concrete shall have a moisture emission rate of no more than 5 lbs. per 1000 sq. ft. per 24-hour period as determined by proper Calcium Chloride Testing.

B. Bond Testing

1. The applicator shall evaluate all surface preparation by conducting bond tests at strategic locations.
2. Mix six (6) ounces of the primer to be used in the application with #10-#12 mesh, dry quartz sand until an easily trowelable mixture is obtained. Add 10% by volume SRS 100HD and mix well. Apply palm-sized patties 1/8" to 1/4" thick.
3. After one (1) hour at (68° F.), patties must be cured tack-free and cooled to ambient temperature of concrete. Remove patties with hammer and chisel and examine fracture/delamination plane. Concrete with fractured aggregate must be attached to the entire underside of the patty.
4. If only laitance or a small amount of concrete is attached or if interface between patty and substrate is tacky, further substrate preparation is required.
5. If further surface preparation is required, bond tests shall be conducted again when this has been completed.
6. If no amount or kind of surface preparation produces satisfactory bond tests, the applicator shall report that to the General Contractor, Architect, and Manufacturer.

C. Mechanical Surface Preparation and Cleaning

1. The flooring system requires a CSP 4-5 in accordance with ICRI--CSP Surface Preparation Standards. All accessible concrete floor surfaces shall be mechanically blast cleaned using a mobile steelshot, dust recycling machine such as BLASTRAC, as manufactured by Wheelabrator Corp., or approved equivalent. All surface and embedded accumulations of paint, toppings, hardened concrete layers, laitance, power trowel finishes, and other similar surface characteristics shall be completely removed leaving a bare concrete surface having a profile similar to 40 grit sandpaper and exposing the upper fascia of concrete aggregate.
2. Floor areas inaccessible to the mobile blast cleaning machines shall be mechanically

abraded to the same degree of cleanliness, soundness, and profile using vertical disc scarifiers, starwheel scarifiers, needle guns, scabblers, or other suitably effective equipment.

3. After blasting, traces or accumulations of spent abrasive, laitance, removed toppings, and other debris shall be removed with brush or vacuum.
4. Conduct Bond Tests to check adequacy of surface preparation.
5. Application of the respective specified material system(s) must be completed before any water or other contamination of the surface occurs.

3.4 INSTALLATION

A. General:
The finished floor coating system shall be uniform in color, texture, and appearance. All edges that terminate at walls, floor discontinuities, and other embedded items shall be sharp, uniform, and cosmetically acceptable with no thick or ragged edge. The Contractor shall work out an acceptable masking technique to ensure the acceptable finish of all edges.

B. Application of the flooring system generally consists of the following:
1. Applying the primer/sealer,
2. Applying coving,
3. Performing patching and sloping with manufacturer's approved system,
4. Re-priming patched areas
5. Applying the topping, broadcasting the Colored Flake,
6. Applying the topcoat,

Time for curing (45 - 60 minutes) shall be allowed between each coat.

C. Open only the containers of component materials to be use in each specific application as needed. Refer to Manufacturer's data sheets for pot-life/temperature relationship to determine size of batches to mix and mix ratios for each respective coat of the system.

D. Measure, add, and mix the initiator into the respective resin components in the proportions recommended by the material manufacturer. Pot life is short, so mix only as much material at a time as can be easily and efficiently applied.

3.5 PRIME COAT

A. Measure, add, and mix the MasterTop SRS 103IN, and initiator (MasterTop SRS 100HD) into the respective resin components in the proportions recommended by the material manufacturer.

B. Pour the mixture batches onto the floor surface and use a 9" or 18" wide, 1/2" - 3/4" thick-napped, solvent-resistant paint roller to roll out the material at a rate of 100 sq. ft./ gal. to form a uniform, continuous film, ensuring that all crevices, cracks, other surface discontinuities have been saturated and coated. Use a paint brush to reach areas inaccessible to the roller. Work quickly and deliberately; the pot life is short (10 -15 minutes). Do not leave any "puddles"; roll out any such accumulations.

C. Allow the primer/sealer coat to cure.

D. If any of the concrete has absorbed all of the primer or if the concrete still has a dry look, re-prime these areas before applying bodycoat or topcoat.

3.6 COVING

A. Surface Preparation
   1. If concrete walls are to be painted prior to installation of cove base, the bottom portion of the walls shall remain un-coated to the height of the cove base to insure a proper bond to the concrete wall.
   2. If walls are constructed of a non-compatible material or if a coating exists, a backer board of ½" cement board cut to the desired height of the cove base shall be installed. The top of the backer board should be cut at a 45° angle to create a "beveled" edge. Backer board shall be fastened using a high grade construction adhesive as well as counter sunk screws or concrete masonry anchors.

B. System Description
   1. Cove base shall be installed according to manufacturer's recommendations and shall be one of two systems:
      a. MasterTop 1815 SRS CB or MasterTop 1815 SRS RG cove base consisting of "spooned in" radius and brush on body coat.
      b. Trowel-On Cove Base consisting of a trowel applied radius/base mix with a termination strip installed at the top of the base.

   2. Cove base will receive a broadcast and top coat consistent with flooring system.

3.7 PATCHING/SLOPING

A. Measure, add, and mix the MasterTop 1817 SRS PC (MasterTop SRS 17RS Part A resin and MasterTop SRS 17RS Part B powder Component), and necessary aggregate in the proportions recommended by the material manufacturer.

B. Use mixture to repair any damaged concrete, or to slope any areas as needed.

C. Once cured, material must be re-primed before topping system is applied.

3.8 TOPPING

A. Size the batches, and mix according to manufacturer's instructions. The entire batch should be poured and spread at once, i.e., do not let material set in pail.

B. Spread the topping material with a gauge rake set to a depth of 1/8". Lightly trowel to a uniform thickness of 1/8" as necessary.

C. Immediately after application, roll with a porcupine roller available from the manufacturer to release any trapped air from the topping.

D. Broadcast colored flake into the fresh material before it begins to cure. It is important that the flake "rains" down, and not be thrown into, the surface.

E. Allow the topping to cure.

F. Remove excess Flake by sweeping and vacuuming

3.9 TOPCOAT

A. Apply with clean rollers at a rate of 90 - 100 sq. ft./gal. in the same way as the Primer/Sealer material.

B. Allow topcoat to cure.

3.10 SECOND TOPCOAT

A. Apply with clean rollers at a rate of 100 - 125 sq. ft./gal. in the same way as the Primer/Sealer was applied.

B. Allow topcoat to cure.

3.11 FIELD QUALITY CONTROL/INSPECTION

A. Applicator shall request acceptance of surface preparation from the General Contractor before application of the prime/seal coat.

B. Applicator shall request acceptance of the prime/seal coat from the General Contractor before application of subsequent specified materials.

C. All work not acceptable to the Architect, General Contractor, or Owner must be corrected before consideration of final acceptance.

3.12 CLEANING

A. Applicator shall remove any material spatters and other material that is not where it should be. Remove masking and covers taking care not to contaminate surrounding area.

B. Applicator shall repair any damage that should arise from either the application or clean-up effort.

3.13 COATING SCHEDULE

A. Primer shall be MasterTop SRS 41P. Application rate shall be approx.100 sq.ft. per gallon (approx. 12 mils).

B. Coving shall be MASTERTOP SRS 61BC Self-Leveling with appropriate filler installed per manufacturers recommendations

C. Patching/Sloping material shall be MasterTop 1817 SRS PC

D. Body coat shall be MASTERTOP SRS 61BC Self-Leveling applied with a gauge rake set at 1/8" for a rate of 40 sq. ft. per batch. Colored Flake to be broadcast into the uncured topping. Broadcast the Colored Flake at the rate of .15 pounds per sq. ft.

E. Clear topcoat shall be MASTERTOP SRS 71TC; apply at the rate of 90 - 100 sq. ft. per gallon for the first coat and 100 - 125 sq. ft. per gallon for the second application.

3.14 MANUFACTURERS RECOMMENDATIONS

A. For more specific information concerning maintaining Methyl Methacrylate floors please consult the manufacturer at the above location.

END OF SECTION 09 67 00

09 91 00
PAINTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Painting and finishing exterior and interior exposed surfaces of items provided under other Sections that are not factory-finish coated.

B. Related Work in other Sections: Priming or priming and finishing of certain surfaces may be specified to be factory performed or installer performed under other Sections.

C. Work not included:
1. Unless otherwise indicated, painting is not required on surfaces in concealed areas and inaccessible areas such as furred spaces, foundation spaces, utility tunnels, pipe spaces, and duct shafts.
2. Metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze, and similar finished materials will not require painting under this Section except if specified.
3. Do not paint moving parts or operating units, mechanical or electrical parts such as valve operators, linkages, sensing devices, and motor shafts, unless otherwise indicated.
4. Do not paint over required labels or equipment identification, performance rating, name, or nomenclature plates.
5. Do not paint concrete that has been sandblasted.

D. Definitions: "Paint," as used herein, means coating systems materials including primers, emulsions, epoxy, enamels, sealers, fillers, and other applied materials whether used as prime, intermediate, or finish coats.

1.2 QUALITY ASSURANCE

A. Paint coordination:
1. Provide finish coats compatible with prime coats actually used.
2. Review other Sections of these Specifications as required, verifying prime coats to be used and assuring compatibility of total coating system for various substrata.
3. Upon request, furnish information on characteristics of specific finish materials to assure that compatible prime coats are used.
4. Provide barrier coats over non-compatible primers or remove primer and reprime as required.
5. Notify Architect in writing of anticipated problems in using specified coating systems over prime coatings supplied under other Sections.

1.3 SUBMITTALS

A. Product data:
1. Submit materials list of items to be provided under this Section if substitutions are proposed. If specified products are used, submittal is not required. Key material list to Articles of this Section.
2. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
3. Color and finish selection kits.

1.4 JOB CONDITIONS

A. Do not apply solvent-thinned paints when temperature of surfaces to be painted and surrounding air temperatures are below 45 degrees F, unless manufacturer's printed instructions permit otherwise as approved by Architect.

B. Weather conditions:
   1. Do not apply paint in snow, rain, fog, or mist; when relative humidity exceeds 85%; to damp or wet surfaces, unless manufacturers' printed instructions permit otherwise as approved by Architect.
   2. Applications may be continued during inclement weather only within temperature limits paint manufacturer specifies as suitable for use during application and drying periods.

PART 2 - PRODUCTS

2.1 COLORS AND FINISHES

A. General:
   1. Paint colors, surface treatments, and finishes, are indicated in schedules of the contract documents.
   2. Use representative colors when preparing samples for review.
   3. Final acceptance of colors will be from samples applied on the job.

B. Color Pigments:
   1. Pure, non-fading, applicable types to suit substrates and service indicated.
   2. Paint shall contain no lead.

C. Paint Coordination: Provide finish coats which are compatible with prime paints used. Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates. Upon request from other trades, furnish information on characteristics of finish materials proposed for use, to ensure compatible prime coats are used. Provide barrier coats over incompatible primers or remove and reprime as required. Notify the Architect in writing of any anticipated problems using specified coating systems with substrates primed by others.

2.2 MATERIAL QUALITY

A. Provide best quality grade of various types of coatings as regularly manufactured by acceptable paint materials manufacturers. Materials not displaying manufacturer's identification as a standard, best-grade product will not acceptable.

B. Proprietary names used to designate colors or materials are not intended to imply that products of named manufacturers are required to exclusion of equivalent products of other manufacturers.

C. Federal Specifications establish minimum acceptable quality for paint materials. Provide written certification from paint manufacturer that materials provided meet or exceed these minimums.

D. Manufacturer's products which comply with coating qualitative requirements of applicable Federal Specifications, yet differ in quantitative requirements, may be considered for use when acceptable to the Architect. Furnish material data and manufacturer's certificate of performance to the Architect for any proposed substitutions.

E. Provide undercoat paint produced by the same manufacturer as the finish coats. Use only

thinners approved by the paint manufacturer and use only within recommended limits.

F. Insofar as practicable, use undercoat, finish coat, and thinner material as parts of unified system of paint finish.

2.3 COLOR SCHEDULES

A. Architect will prepare color schedule for guidance in painting.

2.4 APPLICATION EQUIPMENT

A. For application of approved paint, use only such equipment recommended for application of particular paint by manufacturer and as approved by Architect.

B. Prior to use of application equipment, verify that proposed equipment is actually compatible with material to be applied and that integrity of finish will not be jeopardized by use of proposed equipment.

2.5 OTHER MATERIALS

A. Contractor selects other materials, not specifically described but required for complete and proper installation, subject to Architect's approval.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Examine areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 MATERIALS PREPARATION

A. General:

1. Mix and prepare paint materials in strict accordance with manufacturer's recommendations as approved by Architect.
2. When materials are not in use, store in tightly covered containers.
3. Maintain containers used in storage, mixing, and application of paint in clean condition, free from foreign materials and residue.

B. Stirring:

1. Stir materials before application, producing mixture of uniform density.
2. Do not stir into material any film that forms on surface, but remove film and, if necessary, strain material before using.

3.3 SURFACE PREPARATION

A. Manufactured items: Follow printed instructions of manufacturer of item being finished.

B. General:

1. Prepare and clean in strict accordance with paint manufacturer's recommendations as approved by Architect.
2. Remove removable items that are in place and not scheduled to receive paint finish, or provide surface applied protection prior to surface preparation and painting operations.
3. Following completion of painting in each space or area, reinstall removed items by using workmen skilled in necessary trades.
4. Clean each surface to be painted prior to applying paint or surface treatment.
5. Remove oil and grease with clean cloths and cleaning solvent of low toxicity and flash

point in excess of 200 degrees F, prior to start of mechanical cleaning.

6. Schedule cleaning and painting so that dust and other containments from cleaning process will not fall onto wet, newly painted surfaces.

D. Preparation of wood surfaces:
   1. Clean wood surfaces until free from dirt, oil, and other foreign substance.
   2. Smooth finished wood surfaces exposed to view, using proper sandpaper. Where required, use varying degrees of coarseness in sandpaper to produce uniformly smooth and unmarred wood surface.
   3. Unless Architect specifically approves, do not proceed with painting of wood surfaces until moisture content of wood is 12% or less as measured by moisture meter approved by Architect.

3.4 PAINT APPLICATION

A. General:
   1. Provide masking and protection of existing finishes and improvements from the paint application processes.
   2. Touch-up damaged shop-applied prime coats, and touch-up bare area prior to applying finish coats.
   3. Slightly vary color of succeeding coats. Do not apply additional coats until completed coat has been inspected and approved coats of paint will be considered in determining number of coats applied.
   4. Sand and dust between coats to remove defects visible to unaided eye from distance of five feet.
   5. On removable panels and hinged panels, paint back sides to match exposed sides.
   6. Comply with printed instructions of manufacturer of factory-manufactured items.
   7. **Roller application is acceptable only on gypsum wall board or plaster wall and ceiling surfaces. All woodwork and other surfaces are to be brushed or sprayed only.**

B. Drying:
   1. Allow sufficient drying time between coats, modifying period as material manufacturer recommends, to suit adverse weather conditions.
   2. Consider oil-base and oleo-resinous solvent-type paint as dry for recoating when point feels firm, does not deform or feel sticky under moderate thumb pressure, and applying another coat of paint does not cause undercoat to lift or lose adhesion.

C. Brush applications:
   1. Brush out and work brush coats onto surface in even film.
   2. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, and other surface imperfections are not acceptable.

D. Spray application:
   1. Where spray application is used, apply each coat to provide hiding equivalent of brush coats.
   2. Do not double back with spray equipment to build up film thickness of two coats in one pass.

E. Miscellaneous surfaces and procedures:
   1. Exposed mechanical items:
      a. Finish electric panels, access doors, conduits, pipes, ducts, grilles, registers, vents,

and items of similar nature to match adjacent wall and ceiling surfaces, or as directed.

3.5 COMPLETION AND CLEANING

A. Non-painted surfaces, including glass, are to be scraped clean of excess paint and putty applied as part of Work of this Contract.

B. Window sashes that operated before painting are to be operable at conclusion of Work.

3.6 PRODUCT AND SURFACE SCHEDULE

Provide following paint finishes as manufactured by the Sherwin Williams Paint company or approved equals. Substitutions submitted for approval shall include a comparison of the specified product with the substitute product.

Ptd 'A': Stucco
Primer: S-W Loxon Conrete & Masonry Primer Sealer
Finish: (2) coats of S-W A-100 Exterior Latex Low Sheen, A12 Series

Ptd 'B': Wood Base and Trim: semi-gloss finish
Primer: S-W PrepRite "ProBlock" primer sealer
Finish: (2) coats of S-W ProMar 200 Zero VOC Latex, Semi-Gloss, B31-2600 Series

Ptd 'C': Plywood ceiling: eggshell finish
Primer: S-W PrepRite "ProBlock" primer sealer
Finish: (2) coats of S-W ProMar 200 Zero VOC Latex, Eg-Shel, B20-2600 Series

Ptd 'D': Graffiti Control Product
Finish: (2) coats of SW Invisi-Shield Anti-Graffiti Clear

Ptd 'E': Steel lintels, metal roof panels, gloss finish
Primer: S-W Pro-Industrial Pro-Cryl Universal Primer, B66-310 Series
Finish: (2) coats of SW Pro Industrial Acrylic Gloss Coating, B66-660 Series

END OF SECTION 09 91 00

10 14 00
SIGNAGE

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. This work shall consist of all services related to the coordination, fabrication, delivery and installation of all exterior signs as detailed in the Contract Drawings and otherwise determined necessary in accordance with these Specifications. Locations of specialty signs are shown on the drawings.

1.2 QUALITY ASSURANCE

A. Uniformity: For each sign form and graphic image process indicated, furnish products of a single manufacturer. If conditions require products to be produced by separate manufacturers, the products shall be approved for use together. Components shall be manufactured and installed in accordance with guarantees.

B. Code Compliance: All signage shall comply with the ADA Accessibility Guidelines for Buildings and Facilities, 28 CFR Part 36.

C. Qualifications of Fabricator/Installer

1. Sign system fabricator and installer shall have as a minimum 2 years regularly engaged in the fabrication and installation of sign projects of the same caliber as represented in this manual and have three (3) references for completing projects of similar scope and size.
2. The Contractor will schedule only skilled and experienced sign system fabricators and installers for fabrication and installation of sign system.
3. Pre- Approved Sign Manufacturers:

a. GableSigns, Inc.
7440 Fort Smallwood Rd. Baltimore, MD 21226
410-255-6400
www.gablesigns.com

b. Belsinger Sign Works, Inc. 1300 Bayard Street
Baltimore, MD. 21230
410-837-2700
www.belsinger.com

c. Triangle Sign & Service 11 Azar Court
Baltimore, MD. 21227
410-247-5300
www.trianglesign.com

1.3 SUBMITTALS

A. Product Data: Supply manufacturer's product data, fabrication/construction details related to materials, dimensions of individual components, profiles and finishes for each type of sign required. Provide manufacturer's recommendations for maintenance and cleaning requirements of sign surfaces.

B. Samples: Submit color and finish samples as applicable to all exterior signs. Samples shall be a minimum of 3"x 3" on same material of final sign component and be submitted to BCRP and the Architect for approval prior to fabrication.

C. Documentation showing signs by type and location with text and graphics for final approval. Incorporate final text/graphic edits returned with submittal comments as the final production copy.

D. Shop Drawings: The Contractor is required to submit the following items for approval prior to commencing with production:
   a. Product Data: Submit material descriptions, finishes and color charts for sign construction.
   b. Shop Drawings: Submit shop drawings indicating sign style, lettering, overall dimensions and quantities.
   c. Manufacturer's installation and sign material maintenance instructions.

E. Manufacturing specifications reflecting structural, and finish details with to-scale layouts, elevations, section and plan views.

F. Sample digital output of directory graphics as produced from artwork prepared by the Designer. Sample to reflect typical color, resolution and density of final production.

G. Provide setting drawing, templates, and directions for accurate installation.

H. Provide system requirements for placement and graphic configuration which reflect color contrast, finish and other components relevant to the most recent ADA accessibility guidelines.

I. Maintain general design concept as shown on the Drawings without altering profile.

J. Make necessary provisions in the design to accommodate all stresses, including wind bracing.

1.4 WARRANTY

A. All Product and workmanship shall be warranted against failure for a period of no less than two (2) years following substantial completion. The failure of independently warranted components used in the construction and/or installation of the sign - through their structure, appearance or function shall be covered under the Contractor's General Warranty.

PART 2- PRODUCTS

2.1 EXTERIOR ALUMINUM SIGNS

A. Materials:
   1. Aluminum:
      a. Aluminum Sheet: Provide aluminum sheet of alloy and temper recommended by the aluminum producer or finisher for the type of use

and finish indicated, and with not less than the strength and durability properties specified in ASTM B 209 for 5005-H15.

b. Aluminum Extrusions: Provide aluminum extrusions of alloy and temper recommended by the aluminum producer or finisher for the type of use and finish indicated, and with not less than the strength and durability properties specified in ASTM B 221 for 6063-T5.

c. Aluminum used for all exposed or concealed surfaces shall be a minimum thickness of 0.090" with a painted finish in strict accordance with manufacturer's specifications.

d. All aluminum shall be straight and true. There shall be no scratches, scars, creases or buckles.

2. Cast Acrylic Sheet:
   a. Provide cast (not extruded or continuous cast) methacrylate plastic sheet with a minimum flexural strength of 16,000 psi, ASTM D 790, minimum allowable continuous service temperature of 1800° F.
   b. Where indicated, provide colorless sheet with light transmittance of 95%, ASTM D 1003, in matte finish, first surface.
   c. Where indicated, provide colored opaque acrylic sheet as shown in the details.
   d. Finishes: All color finishes will be per the specifications.

3. Vinyl Film: Non-reflective vinyl film, 0.0035" minimum thickness, with pressure sensitive adhesive backing suitable for exterior as well as interior applications. Color is to be integral. Specified film to be provided by 3M Corporation. For color selection see detail sheets.

4. Digital Graphic: Provide 0.125" thick matte finished Digital High-Pressure Laminate (dHPL) with sanded back to facilitate bonding to aluminum signs panel.
   a. Digital graphic surface papers shall be encapsulated with melamine resins and pressed over 100% recycled post-consumer kraft paper core sheets impregnated with phenolic resin. These sheets shall then be bonded at pressures greater than 1000 pounds per square inch at temperatures approaching 300*F (149*C). Sheets are then trimmed, cut to shape.
   b. Bond to sign panel with adhesives and follow the techniques recommended by the adhesive manufacturer.
   c. The dHPL shall be warrantied against delamination, peeling, blistering, cracking, or fading for a period of ten (10) years from the date of purchase.
   d. The dHPL shall be provided by:
      a. iZone Imaging
         2526 Charter Oak Dr, Suite 100
         Temple, TX 76502
         888-464-9663
         www.izoneimaging.com Or approved equal.

5. Inks and Paints:
   a. All inks and paints required shall be a type made for the surface material on which it is applied and recommended by the manufacturer

of the ink or paint. Exact identification of all ink and paint shall be noted on the shop drawings, together with data describing the method of application, if other than "air" drying.

b. No ink or paint that will fade, discolor or delaminate as a result of proximity to light source or heat shall be used.

c. All inks and paints shall be evenly applied and without pinholes, scratches, orange peel texture, application marks, etc.

d. Prime coats or other surface pre-treatments, where recommended by the manufacturer for inks and paints, shall be included in the work as part of the finishing work at no extra cost to the owner.

e. Paint for shop coating and field touch-up of dissimilar metal connecting members, including anchors and clips, shall be alkali-resistant, bituminous paints.

f. Colors: See details for all color selections. When specified contractor is to match approved sample retained by the Engineer or Engineer's Representative.

g. Finishes: If requested, the Contractor is to submit a color match sample of the paint finish to the client for review and approval.

6. Fasteners:

a. Fasteners, anchors, and hardware shall meet all structural design requirements and be specified to the best commercial quality for the specific functional use. For all other fasteners refer to the following:

i. Hardware shall be non-corrosive type and shall be non-conductive and/or insulated when joining compatible materials.

ii. Vandal-resistant fasteners for permanent and changeable applications shall be used whenever possible.

b. All liquid adhesives and adhesive tapes required for plastic, glass, and metal shall be a type recommended for the particular usage by the manufacturer and guaranteed to meet the general and structural support criteria for weight and surface-to-surface bonding.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Delivery, storage, and handling

1. Coordinate the on-site storage of all materials with the Engineer. It is the responsibility of the Contractor to ensure that the storage of the material is secure and safe.
2. Protect materials/products stored on site from damage and soiling.
3. Store materials in an enclosed and dry area and within protective packaging to prevent damage.

B. Exterior Signs:

1. All panels are to be fabricated to form smooth, even, level surfaces.
2. Surface finishes are to be resistant to non-corrosive, cleaning and other solutions typically used for maintenance.

C. Typography:

1. System copy graphics will be supplied in the style, weight, size, extension and placement as required for compliance with federal regulations, Title III of the Americans with Disabilities Act, (ADA).

a. Letter forms shall be aligned to maintain a base line parallel to the sign format. Margins shall be established and specified.

b. Letter heights shall be indicated as "cap" letter height unless otherwise specified.

D. Symbols:
1. Directional arrows shall be indicated for each sign type and formatted to be consistent with typographic styling.
2. Regulatory and other symbols shall conform to the color, form, layout and content of Uniform Traffic, Control Devices, U.S. Department of Transportation.

E. Identification Graphics:
1. All graphics must be precisely reproduced, digitally.
2. Any variation from the artwork supplied is unacceptable.
3. Identity graphics/logos to be supplied directly to the Contractor by the Client.

E. Graphic Image Process:
1. Comply with specified requirements indicated for sizes, styles, spacing, content, positions, materials, finishes, and colors for lettering, numbers, symbols and other graphic devices.
2. Apply copy/graphics to prepared sign plane forming flush panel face by process indicated to produce precisely formed images free from rough edges.

F. Installation
1. Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's installation instructions.
2. When any manipulation of existing or planned architectural surfaces is required such as cutting, drilling, or filling, submit to the Engineer for approval a written plan for procedure before beginning work. Procedural outlines shall include rough and finished opening dimensions and any safety measures required for completion.
3. Set anchor bolts and other embedded items required for installation of signs using templates, setting drawing diagrams, instructions, and directions provided by suppliers of items to be attached.
4. Install signs level, plumb and at height indicated, with sign surfaces free from distortion or other defects in appearance.

G. Cleaning and Protection
1. At completion of the installation, clean soiled sign surfaces in accordance with the manufacturer's instructions.
2. Protect installed sign units from damage until acceptance by the Owner.

3.2 INSTALLATION FOLLOW-UP

A. Touch-up all scratches and other surface damage to powder coated finishes on metal posts, rails, and components.

B. Remove all installer-made markings, except the Finished Grade Marker, Manufacturer Identity Label, and Warning Label.

3.2 SIGN SCHEDULE

A. The sign schedule refers to location codes, sign type, text, and sign placement. Refer to the Engineer's final approved sign schedule and drawings for construction.

END OF SECTION 10 14 00

22 13 53
FACILITY SEPTIC SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

F. Drawings and general provisions of the Contract, and other Division 01 Special Provisions, apply to this Special Provision

G. Related Sections: The following sections in this document contain requirements that relate to this section:

1. Special Provision 33 31 00 "Sanitary Sewerage Utilities."
2. Special Provision 31 23 33 "Trenching and Backfilling."
3. City of Baltimore DPW Specifications, 2006, 03 40 00 "Precast Concrete"

1.2 DESCRIPTION

A. The work to be performed under this section includes all material, labor, tools, equipment, and services necessary for and incidental to the construction of a on-site sanitary disposal system. as shown on the Drawings and specified herein.

B. The work shall include, but is not limited to:

1. Installation of a concrete septic tank, distribution box, septic field, and all necessary piping.
2. All necessary excavation, backfilling; sheeting and shoring; dewatering; testing; and all incidentals necessary to complete the work

1.3 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 01 Specification Sections.

3. Product data for pipe and fittings, and valves..
4. Shop drawings
5. Structures: Septic tank showing dimensions, reinforcing steel, wall sleeves, manhole steps, and piping layout. Also, dosing tank access covers.
6. Final Certification: Upon completion of the project and before final acceptance, the Contractor shall deliver to the Engineer a statement signed by the principal officer of the contracting firm stating that the installation and related piping installation is satisfactory and in complete accordance with the contract plans, specifications, and the manufacturer's prescribed procedures and has been found to be tight and in compliance with all State and local codes covering such installations.

1.5 QUALITY ASSURANCE

A. Regulations, Code Requirements, and Permits
All work shall be accomplished in accordance with the laws, ordinances, and codes of the State of Maryland and any other local, county, or state governing body having jurisdiction.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall coordinate the delivery and receipt of equipment and materials at the project site so that installation is made in proper sequence and with a minimum loss of time.

F. Equipment and materials shall be stored in a secure temporarily fenced-in area designated by the Engineer.

G. From the commencement of the work until its completion and acceptance by the Owner, the Contractor shall be solely responsible for the storage and care of all equipment and materials and all injury or damage to the same, from whatever cause, shall be repaired by him at his own expense, before the final estimate is made. He shall provide suitable means of protection for all materials intended to be used in the work in progress, as well as for completed work.

1.7 JOB CONDITIONS

A. Visit to Site: All Contractors submitting proposals shall first examine the site of the work and all conditions thereon. The Contractor's attention is directed to the General Provisions.

PART 2 - PRODUCTS

1.2 MATERIALS

A. Solid Pipe

1. General

a. Polyvinyl chloride (PVC) pressure pipe shall be manufactured from PVC compounds meeting the requirements of ASTM D 1784, Class 12454B. Pipe joints shall be as specified herein and elsewhere in the Contract Documents for various locations within piping systems.

b. Solvent-cemented pipe joints shall meet the materials and workmanship requirements of ASTM D 2672. Primer shall meet the materials requirements of ASTM F 656. Solvent cement shall meet the materials requirements of ASTM D 2564.

c. Rubber gaskets for gasketed joints shall meet the materials requirements of ASTM D 477. Gaskets and lubricants shall be made from materials that are compatible with the pipe material and will not support bacterial growth.

B. Concrete Tank:

1. A 1,500-gallon (minimum capacity) dosing tank in accordance with ASTM C1227.
2. The dosing tank be in conformance with 03 40 00- Precast Concrete and shall consist of a precast reinforced concrete tank constructed to the dimensions shown on the plans.
3. Openings through wall for inlet and outlet pipes shall be constructed as detailed on the plans. The tank shall be capable of supporting a HS-20 vehicle load. Dosing tank access shall as detailed on the plans. Installation shall be in accordance with manufacturer's instructions.
4. Mechanical Type Link Seals: For all wall penetrations, provide mechanical type link seals where indicated on the plans. Provide seal material of EPDM with stainless steel nuts and bolts.

C. Drain Field:
1. Polyvinyl chloride (PVC) pipe, ASTM D 2729, perforated
2. Clean stone, gravel, slag, or similar material acceptable to Administrative Authority , varying in size from 3/4" to 2-1/2".
3. Untreated building paper, straw, hay, pine needles, or geotextile similar porous material to prevent closure of voids with earth backfill..

D. Nuts, bolts, screws, etc. shall be Type 304 stainless steel.

E. Metal detection tape shall be a printed polyethylene tape with a metallic core. The tape shall be furnished with an appropriate message imprinted on a colored background warning of buried sewer or electric line.

PART 3 - EXECUTION

1.2 SITE PREPARATION

A. Site preparation shall be done in accordance with 31 11 00 for Clearing and Grubbing.

1.3 EARTHWORK

A. All earthwork required shall be done in accordance with 31 23 33 Trenching and Backfilling.

1.4 INSTALLATION

A. General:

1. The Contractor shall furnish all materials, perform all excavation and backfill, construct all necessary joints and connections, construct all appurtenances, dispose of all surplus excavation and discard materials as may be necessary to complete the dosing tank station. all materials and equipment shall be installed complete in a first class manner and in accordance with modern methods and practice. Any material or equipment installed which does not present an orderly and reasonably neat or workmanlike appearance shall be removed and replaced when directed by the Engineer. The removal and replacement of this work shall be done at the Contractor's expense.

2. Removal of Water: The Contractor shall at all times during construction provide proper and satisfactory means and devices for the removal of all water entering the excavated area, and he shall remove all such water as fast as it may collect to avoid interference with the prosecution of the work of the proper placing of pipe, masonry, or other materials.
3. Delivery, Handling, and Storage of Materials: Inspect materials delivered to site for damage. Unload materials with minimum handling and store on site in enclosures or under protective covering. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris. Handle pipe, fittings, valves, and other accessories in such manner as to ensure delivery to the trench in sound undamaged condition. Take special care to avoid injury to coatings and linings on pipe and fittings; make satisfactory repairs if coatings or linings are damaged. Carry pipe to the trench; do not drag it.

B. Excavation:

1. The Contractor shall excavate, protect, and backfill all excavation that may be necessary for completing the work under the contract. Sheeting, shoring, and hand excavation shall be done as may be necessary for the protection of the work and for the safety of personnel in accordance with local, State, and Federal regulations including OSHA.
2. All sheeting in excavations shall be withdrawn as the backfilling is being done. The Contractor shall cut off any sheeting left in place. at least 18 inches below finished grade and shall remove the material cut off without compensation therefore.
3. All excavations must be kept free of water below the subgrade of the work while work is in progress. This may be accomplished by ordinary pumping methods, use of underdrains, or by well points, whichever will produce the required results.

C. FIELD QUALITY CONTROL

1. Testing:

a. General: All testing must be done in the presence of a representative of the Owner' representative and local and State inspectors having authority. Notice of applying such tests shall be given a minimum of three (3) days in advance. Contractor shall provide temporary power, if required, by means by standby generator or other approved methods. If any imperfections or leaks are detected by the tests, they shall be corrected by repair or replacement of defective materials as directed by the Engineer and then retested.

d. Septic tank Water Tightness Test:

1) Test the dosing tank for leakage as follows:

(a.) Fill structure with water and watch for any drop for 24 hours.
(b.) Refill as necessary and watch for any drop in 60 minutes.

D. Placement of Pipe:

1. Solvent-Cemented Polyvinyl Chloride (PVC) Pipe Joints: Solvent-cemented polyvinyl chloride (PVC) pipe joints shall be assembled only by personnel knowledgeable and experienced in properly making solvent type joints in accordance with the solvent cement manufacturer's recommendations, as specified in ASTM D 2855, and as detailed herein.
   a. Ends shall be cut square with the pipe axis using a fine-tooth hand or power saw. Pipe cutters not specifically designed for cutting plastic pipe or that raise a burr or ridge at the cut end of the pipe shall not be used. Cut ends shall be chamfered and deburred prior to joint assembly.
   b. Surfaces to be joined shall be cleaned and free of dirt, moisture, oil and other foreign material. Cleaning shall be accomplished by wiping with a clean dry cloth, a chemical cleaner, or mechanical means. The surface temperature of the mating surfaces shall not exceed 110 F at the time of assembly. Pipe and fittings shall be shaded from direct exposure to the sun prior to assembling the joints if required.
   c. The inside socket surfaces and the male end of the pipe shall be softened by application of one or more coats of primer. After the surfaces have been softened, and while still wet with primer, cement shall be applied to both surfaces in a uniform and even manner, taking care to keep excess cement out of the socket. Immediately after applying the last coat of cement to the pipe, and while both the inside socket surface and the outside surface of the male end of the pipe are soft and wet with solvent cement, forcefully bottom the male end of the pipe in the socket. Turn the pipe or fitting one-quarter turn during assembly to distribute the cement evenly. Hold the joints firmly together until the cement has received its initial set.
   d. Handle newly assembled joints carefully until the cement has gone through the set period. Set time shall be in accordance with the manufacturer's recommendations or the following, whichever is longer:

Minimum Time	Ambient Temperature
30 minutes	60 to 100 F
1 hour	40 to 60 F
2 hours	20 to 40 F
4 hours	0 to 20 F

   Pressure testing shall not be conducted until at least 24 hours after solvent cement joints have been assembled.
   e. After the set period, the pipe shall be carefully placed in the trench

2. Place according to manufacturer's literature and 31 23 33 Trenching and Backfilling.

B. Septic Tank:
   1. General: Install as indicated, and in accordance with manufacturer's installation instructions
   2. Excavate in accordance with 31 23 33 Trenching and Backfilling for work of this Section. Hand trim excavation for accurate placement of tank to elevations indicated.

3. Place bedding material level in one continuous layer not exceeding 6 inches compacted depth, compact to 95 percent.
4. Backfill around sides of tank, tamped in place and compacted to 95 percent.
5. Maintain optimum moisture content of bedding material to attain required compaction density.
6. Install septic tank and related components on bedding.
7. Tests: Fill septic tank with water and let stand overnight. If water level recedes, locate and repair leaks, and retest

C. Seepage System:

1. Drainage Piping: Lay drainage piping solidly bedded in filtering material. Provide full bearing for each pipe section throughout its length, to true grades and alignment, and continuous slope in direction of flow.
   a. Lay perforated pipe with perforations down and joints tightly closed in accordance with pipe manufacturer's recommendations. Provide collars and couplings as required.
   b. After drainage lines have been installed, place additional filtering material around sides and top to compacted depth as indicated or, if not indicated, to compacted depth of 2" above top of pipe.
2. Testing Drainage Lines: Test and check lines before backfilling to assure free flow. Remove obstructions, replace damaged components, and retest system until satisfactory.
3. Filter Mat: Prior to back-filling, place filter mat over filter material.
4. Backfilling: Immediately backfill trench with excavated soil, mounding but not compacting soil above original grade. Do not permit construction equipment on backfilled trenches.

1.3 CLEANING

A. General: Clean all parts of the system before final acceptance.

END OF SECTION 22 13 53

22 42 70
COMPOSTING TOILET

PART 1 - GENERAL

1.1 DESCRIPTION
A. Section includes:
1. Furnishing and installing prefabricated composting toilet and building enclosure system.

1.2 SUBMITTALS
A. Product Data: Submit manufacturer's specifications and installation instructions for materials.

B. Shop Drawings: Submit shop drawings for specified product.

1.3 JOB CONDITIONS
Coordination: Coordinate location and installation with site work.

PART 2 - PRODUCTS

2.1 COMPOSTING TOILET
A. Provide prefabricated, Rockport M54W Double composting toilet by Clivus Multrum, or approved equal.

B. Prefabricated building to have the following characteristics:
1. Pad base to be minimum 130" wide with minimum 28" offset entrance pad.
2. Enclosure building to be minimum 130" wide, minimum 85" long, minimum 150" tall to center of roof.
3. Building interior to be constructed of insulated panels, expanded polystyrene core with fiberglass reinforced plastic over OSB interior finish.
4. Building exterior to be finished with 1" rough sawn pine board and batten.
5. Doors to be 36" x 80" 24-guage minimum cold rolled steel with zinc coating.
6. Roof to be structured insulated panels, 4" virgin expanded polystyrene faced with white fiberglass reinforced panels inside and OSB plywood outside topped with standing seam metal roofing material.
7. Floor to be expanded polystyrene core with 7/16 plywood with nonskid rubber coating.
8. Unit and all accessories must conform to the requirements for universal access of the American with Disabilities Act.

C. Ventilation:
1. DC 12-volt fan, maximum free air 100cfm with power input of 5 watts, pipe vented out of roof.

D. Toilets:
1. Waterless toilets constructed of impact resistant fiberglass with sanitary white finish. Seat and lid shall be made of heavy-duty plastic.

2. ADA grab bars and toilet tissue holder to be included.
3. Toilets to be ADA compliant.

E. Composter Base
1. Solid storage capacity of minimum 1,200 US gallons, liquid storage capacity of minimum 600 gallons.
2. Base length shall be minimum 80", max. 100", with height no more than 50".
3. Base shall be made of rotationally molded high density linear poly resin.

PART 3 - EXECUTION

3.1 INSTALLATION
A. General:
1. Unit must come pre-assembled.
2. Install unit level, and in accordance with manufacturer's installation instructions.

END OF SECTION 22 42 70

26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - **GENERAL**

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alcan Products Corporation; Alcan Cable Division.
2. American Insulated Wire Corp.; a Leviton Company.
3. General Cable Corporation.
4. Senator Wire & Cable Company.
5. Southwire Company.

C. Copper Conductors: Comply with NEMA WC 70.

D. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN.

E. Multiconductor Cable: Comply with NEMA WC 70 for armored cable, Type AC, metal-clad cable, Type MC with ground wire.

2.2 CONNECTORS AND SPLICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

C. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN-THWN, conductors in raceway.

B. Exposed Feeders: Type THHN-THWN, conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway. Underground feeder cable, Type UF may be used for site lighting.

E. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN, conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, conductors in raceway.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, conductors in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm of slack.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 0544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Perform tests and inspections and prepare test reports.

C. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, and conductors feeding the following critical equipment and services for compliance with requirements.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.

a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

D. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

E. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 26 05 19

26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Grounding systems and equipment.

B. Section includes grounding systems and equipment, plus the following special applications:

1. Overhead-line grounding.
2. Underground distribution grounding.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:

1. Test wells.
2. Ground rods.
3. Ground rings.

B. Qualification Data: For qualified testing agency and testing agency's field supervisor.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Instructions for periodic testing and inspection of grounding features at test wells, ground rings, grounding connections for separately derived systems based on NETA MTS & NFPA 70B.

a. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
b. Include recommended testing intervals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA and/or NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

C. Bare Grounding Conductor and Conductor Protector for Wood Poles:

1. No. 4 AWG minimum, soft-drawn copper.
2. Conductor Protector: Half-round PVC or wood molding; if wood, use pressure-treated fir, cypress, or cedar.

2.2 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad

B. Steel 3/4 inch by 10 feet (19 mm by 3 m) in diameter.

C. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.

1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches (1200 mm) long.
2. Backfill Material: Electrode manufacturers recommended material.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.

1. Bury at least 24 inches (600 mm) below grade.
2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.
3. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down to specified height above floor; connect to horizontal bus.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Flexible raceway runs.
6. Armored and metal-clad cable runs.

C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

3.4 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches (300 mm) deep, with cover.

1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

E. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

F. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.

G. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.

1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
2. Bury ground ring not less than 24 inches (600 mm) from building's foundation.

H. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70; use a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 4 AWG.

1. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation.
2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

3.5 LABELING

A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for instruction signs. The label or its text shall be green.

B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.

1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells and at individual ground rods. Make tests at ground rods before any conductors are connected.

a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
b. Perform tests by fall-of-potential method according to IEEE 81.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

E. Grounding system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.

H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - **GENERAL**

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.
2. Nonmetallic slotted support systems.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.
2. Steel slotted channel systems. Include Product Data for components.
3. Nonmetallic slotted channel systems. Include Product Data for components.
4. Equipment supports.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.8 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Allied Tube & Conduit.
    b. Cooper B-Line, Inc.; a division of Cooper Industries.
    c. ERICO International Corporation.
    d. GS Metals Corp.
    e. Thomas & Betts Corporation.
    f. Unistrut; Tyco International, Ltd.

3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
4. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4 requirements.
6. Channel Dimensions: Selected for applicable load criteria.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NEC.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69

7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

END OF SECTION 26 05 29

26 05 33
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid steel conduit.

C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Qualification Data: For professional engineer.

C. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.

D. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Allied Tube & Conduit; a Tyco International Ltd. Co.
3. Anamet Electrical, Inc.
4. Electri-Flex Company.
5. O-Z/Gedney; a brand of EGS Electrical Group.
6. Picoma Industries, a subsidiary of Mueller Water Products, Inc.
7. Republic Conduit.
8. Robroy Industries.
9. Southwire Company.
10. Thomas & Betts Corporation.
11. Western Tube and Conduit Corporation.
12. Wheatland Tube Company; a division of John Maneely Company.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. ARC: Comply with ANSI C80.5 and UL 6A.

E. IMC: Comply with ANSI C80.6 and UL 1242.

F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit or IMC.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch (1 mm), minimum.

G. EMT: Comply with ANSI C80.3 and UL 797.

H. FMC: Comply with UL 1; zinc-coated steel or aluminum.

I. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

J. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:

    a. Material: Steel or die cast.
    b. Type: Setscrew or compression.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

K. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Anamet Electrical, Inc.
3. Arnco Corporation.
4. CANTEX Inc.
5. CertainTeed Corp.
6. Condux International, Inc.
7. Electri-Flex Company.
8. Kraloy.
9. Lamson & Sessions; Carlon Electrical Products.
10. Niedax-Kleinhuis USA, Inc.
11. RACO; a Hubbell company.
12. Thomas & Betts Corporation.

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ENT: Comply with NEMA TC 13 and UL 1653.

D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

E. LFNC: Comply with UL 1660.

F. Rigid HDPE: Comply with UL 651A.

G. Continuous HDPE: Comply with UL 651B.

H. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.

I. RTRC: Comply with UL 1684A and NEMA TC 14.

J. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

K. Fittings for LFNC: Comply with UL 514B.

L. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

M. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

N. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

O. Finish: Manufacturer's standard enamel finish.

P. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

Q. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

R. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Adalet.
2. Cooper Technologies Company; Cooper Crouse-Hinds.
3. EGS/Appleton Electric.
4. Erickson Electrical Equipment Company.
5. Hoffman; a Pentair company.
6. Hubbell Incorporated; Killark Division.
7. Milbank Manufacturing Co.
8. Mono-Systems, Inc.
9. O-Z/Gedney; a brand of EGS Electrical Group.
10. RACO; a Hubbell Company.
11. Spring City Electrical Manufacturing Company.
12. Thomas & Betts Corporation.
13. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1 aluminum, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

I. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

J. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).

K. Gangable boxes are prohibited.

L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1, Type 3R or Type 4 with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic.
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

M. Cabinets:

1. NEMA 250, Type 1, Type 3R or Type 4 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.4 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete or fiberglass.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Armorcast Products Company.
b. Carson Industries LLC.

c. CDR Systems Corporation; Hubbell Power Systems.
d. NewBasis.
e. Nordic Fiberglass, Inc.
f. Oldcastle Precast, Inc.; Christy Concrete Products.
g. Synertech Moulded Products; a division of Oldcastle Precast, Inc.

3. Standard: Comply with SCTE 77.
4. Color of Frame and Cover: Gray.
5. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
6. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
7. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
8. Cover Legend: Molded lettering, "ELECTRIC.".
9. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
10. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.5 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC or IMC.
2. Concealed Conduit, Aboveground RNC, Type EPC-40-PVC or EMT.
3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried or concrete encased.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R or Type 4.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT, ENT or RNC.
2. Exposed, Not Subject to Severe Physical Damage: EMT or RNC identified for such use.
3. Exposed and Subject to Severe Physical Damage: GRC or IMC. Raceway locations include the following:
   a. Mechanical rooms.

4. Concealed in Ceilings and Interior Walls and Partitions: ENT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: GRC or IMC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

G. Install surface raceways only where indicated on Drawings.

H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C)

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches (300 mm)of enclosures to which attached.

I. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m)intervals.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Arrange raceways to keep a minimum of 2 inches (50 mm) of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from ENT to RNC, Type EPC-40-PVC, GRC or IMC before rising above floor.

J. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

Q. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

S. Surface Raceways:

1. Install surface raceway with a minimum 2-inch (50-mm)radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway

section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

T. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

U. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

V. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

W. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

    a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
    c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
    d. Attics: 135 deg F (75 deg C temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

X. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

Y. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to bottom of box unless otherwise indicated.

Z. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

AA. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

BB. Locate boxes so that cover or plate will not span different building finishes.

CC. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

DD. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

EE. Set metal floor boxes level and flush with finished floor surface.

FF. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.
    b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits but a minimum of 6 inches (150 mm) below grade. Align planks along centerline of conduit.

7. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

26 05 44
SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:

    a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
    b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Advance Products & Systems, Inc.
    b. CALPICO, Inc.
    c. Metraflex Company (The).
    d. Pipeline Seal and Insulator, Inc.
    e. Proco Products, Inc.

3. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
4. Pressure Plates: Stainless steel.
5. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
2. Sealant shall have VOC content in according to 40 CFR 59, Subpart D (EPA Method 24).
3. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.

2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 26 05 44

26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - **GENERAL**

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

D. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

F. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.

G. Write-On Tags: Polyester tag, 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.2 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.

D. Write-On Tags: Polyester tag, 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

E. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

F. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.3 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

F. Write-On Tags: Polyester tag, 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.4 FLOOR MARKING TAPE

A. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.5 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

C. Tag: Type I:

1. Pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Thickness: 4 mils (0.1 mm).
3. Weight: 18.5 lb/1000 sq. ft. (9.0 kg/100 sq. m).
4. 3-Inch (75-mm) Tensile According to ASTM D 882: 30 lbf (133.4 N), and 2500 psi (17.2 MPa).

D. Tag: Type II:

1. Multilayer laminate consisting of high-density polyethylene scrim coated with pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Thickness: 12 mils (0.3 mm).
3. Weight: 36.1 lb/1000 sq. ft. (17.6 kg/100 sq. m).
4. 3-Inch (75-mm) Tensile According to ASTM D 882: 400 lbf (1780 N), and 11,500 psi (79.2 MPa).

2.6 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal size, 7 by 10 inches (180 by 250 mm).

D. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal size, 10 by 14 inches (250 by 360 mm).

E. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

2.7 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).

C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

2.8 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

H. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.

3.2 IDENTIFICATION SCHEDULE

1. Wall surfaces directly external to raceways concealed within wall.

B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
   1. Power.

C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

   1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.

      a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
      b. Colors for 208/120-V Circuits:

         1) Phase A: Black.
         2) Phase B: Red.
         3) Phase C: Blue.

      c. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

E. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

   1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
   2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
   3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

F. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

   1. Limit use of underground-line warning tape to direct-buried cables.
   2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

G. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

H. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.

   1. Comply with 29 CFR 1910.145.
   2. Identify system voltage with black letters on an orange background.
   3. Apply to exterior of door, cover, or other access.

4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

    a. Power transfer switches.
    b. Controls with external control power connections.

I. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.

K. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

    a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.

    b. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

    a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.

END OF SECTION 26 05 53

26 09 23
LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Indoor occupancy sensors.

B. Related Requirements:

1. Section 26 2726 "Wiring Devices" for, wall-mounted occupancy sensors, and manual light switches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show installation details for occupancy sensors.

1. Interconnection diagrams showing field-installed wiring.
2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 OUTDOOR PHOTOELECTRIC SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Cooper Industries, Inc.
2. Intermatic, Inc.
3. Tyco Electronics; ALR Brand.

C. Description: Solid state, with DPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lux), with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
3. Time Delay: Fifteen second minimum, to prevent false operation.
4. Surge Protection: Metal-oxide varistor.
5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

D. Description: Solid state, with DPST dry contacts rated for 1800 VA, to operate connected load, complying with UL 773.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lux), with an adjustment for turn-on and turn-off levels within that range.
3. Time Delay: Thirty-second minimum, to prevent false operation.
4. Lightning Arrester: Air-gap type.
5. Mounting: Twist lock complying with NEMA C136.10, with base.
6. Hubbell Building Automation, Inc.
7. Leviton Mfg. Company Inc.
8. Lithonia Lighting; Acuity Lighting Group, Inc.
9. NSi Industries LLC; TORK Products.
10. Sensor Switch, Inc.
11. Tyco Electronics; ALR Brand.
12. Watt Stopper.

2.2 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Bryant Electric; a Hubbell company.
2. Cooper Industries, Inc.
3. Hubbell Building Automation, Inc.
4. Leviton Mfg. Company Inc.
5. Lightolier Controls.
6. Lithonia Lighting; Acuity Lighting Group, Inc.

7. Lutron Electronics Co., Inc.
8. NSi Industries LLC; TORK Products.
9. RAB Lighting.
10. Sensor Switch, Inc.
11. Square D; a brand of Schneider Electric.
12. Watt Stopper.

C. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application, and shall comply with California Title 24.
2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).
3. Switch Rating: Not less than 800-VA fluorescent at 120 V and 800-W incandescent.

D. Wall-Switch Sensor Tag M:

1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft. (84 sq. m).
2. Sensing Technology Dual technology - PIR and ultrasonic.
3. Switch Type: SP, field selectable automatic "on," or manual "on" automatic "off."
4. Voltage: Match the circuit voltage type.
5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc (108 to 1600 lux). The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
7. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
8. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

2.3 CONDUCTORS AND CABLES

A. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 CONTACTOR INSTALLATION

A. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.2 WIRING INSTALLATION

A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to evaluate lighting control devices and perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Lighting control devices will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 26 09 23

26 24 16
PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

A. SVR: Suppressed voltage rating.

B. TVSS: Transient voltage surge suppressor.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 ACTION SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

7. Include wiring diagrams for power, signal, and control wiring.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.
2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: Two spares for each panelboard.

1.9 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NEMA PB 1.

F. Comply with NFPA 70.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NECA 407.

1.11 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding minus 22 deg F (minus 30 deg C) to plus 104 deg F (plus 40 deg C).
b. Altitude: Not exceeding 6600 feet (2000 m).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Architect and owner no fewer than two weeks in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Owner's or Construction Manager's written permission.
3. Comply with NFPA 70E.

1.12 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.13 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Enclosures: Flush- and surface-mounted cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
6. Finishes:

a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
b. Back Boxes: Galvanized stee.
c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

7. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.

B. Incoming Mains Location Top and bottom.

C. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
4. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
5. Split Bus: Vertical buses divided into individual vertical sections.

D. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Tin-plated aluminum.
2. Main and Neutral Lugs: Mechanical type.
3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Locate at same end of bus as incoming lugs or main device.
6. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
7. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

G. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, listed and labeled for series-connected short-circuit rating by an NRTL.

H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

C. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

D. Mains: Circuit breaker or lugs only as indicated on the drawings.

E. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

F. Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
2. External Control-Power Source: 24-V control circuit.

G. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

H. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

C. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

a. Instantaneous trip.
b. Long- and short-time pickup levels.
c. Long- and short-time time adjustments.
d. Ground-fault pickup level, time delay, and I^2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    c. Application Listing: Appropriate for application; Type SWD for switching LED loads;
    d. Select first option in first subparagraph below for solid-state trip units; select second option for thermal-magnetic units. If selecting second option, also retain "Shunt Trip" Subparagraph below.
    e. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    f. Shunt Trip: 24-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
    g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
    h. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
    i. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.4 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to **NECA 407**.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and accessories according to NECA 407.

B. Equipment Mounting: Install panelboards on wall.

C. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

E. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

F. Install filler plates in unused spaces.

G. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.

H. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

I. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
c. Instruments and Equipment:

1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

F. Panelboards will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.

4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

END OF SECTION 26 24 16

26 27 26
WIRING DEVICES

PART 1 - **GENERAL**

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Weather-resistant receptacles.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. UTP: Unshielded twisted pair.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand (Pass & Seymour).

B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.

2.3 STRAIGHT-BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

1. Products: Subject to compliance with requirements provide one of the following:

a. Cooper; 5351 (single), CR5362 (duplex).
b. Hubbell; HBL5351 (single), HBL5352 (duplex).
c. Leviton; 5891 (single), 5352 (duplex).
d. Pass & Seymour; 5361 (single), 5362 (duplex).

2.4 GFCI RECEPTACLES

A. General Description:

1. Straight blade, non-feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Cooper; VGF20.
   b. Hubbell; GFR5352L.
   c. Pass & Seymour; 2095.
   d. Leviton; 7590.

2.5 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:

   1) Single Pole:

   2) Cooper; AH1221.
   3) Hubbell; HBL1221.
   4) Leviton; 1221-2.
   5) Pass & Seymour; CSB20AC1.

2.6 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces satin-finished, Type 302 stainless steel 0.04-inch- (1-mm-) thick,.
3. Material for Damp Locations Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

2.7 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System White unless otherwise indicated or required by NFPA 70 or device listing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

a. Cut back and pigtail, or replace all damaged conductors.
b. Straighten conductors that remain and remove corrosion and foreign matter.
c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.

4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up and on horizontally mounted receptacles to the left.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections :

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Wiring device will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 26 27 26

26 41 13
LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes lightning protection for structures.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For air terminals and mounting accessories.

1. Layout of the lightning protection system, along with details of the components to be used in the installation.
2. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Certified by UL, trained and approved for installation of units required for this Project.

B. System Certificate:

1. UL Master Label.
2. LPI System Certificate.
3. UL Master Label Recertification.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 780, "Definitions" Article.

PART 2 - PRODUCTS

2.1 LIGHTNING PROTECTION SYSTEM COMPONENTS

A. Comply with UL 96 and NFPA 780.

B. Roof-Mounted Air Terminals: NFPA 780, copper unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:

a. East Coast Lightning Equipment Inc.
b. ERICO International Corporation.
c. Harger.
d. Heary Bros. Lightning Protection Co. Inc.
e. Independent Protection Co.
f. Preferred Lightning Protection.
g. Robbins Lightning, Inc.
h. Thompson Lightning Protection, Inc.

3. Air Terminals More than 24 Inches Long: With brace attached to the terminal at not less than half the height of the terminal.
4. Single-Membrane, Roof-Mounted Air Terminals: Designed specifically for single-membrane roof system materials. Comply with requirements in roofing Sections.

C. Main and Bonding Conductors: Copper.

D. Ground Loop Conductor: The same size and type as the main conductor except tinned.

E. Ground Rods: **Copper-clad,;** 3/4 inch in diameter by 10 feet.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lightning protection components and systems according to UL 96A and NFPA 780.

B. Conceal the following conductors:

1. System conductors.
2. Down conductors.
3. Interior conductors.
4. Conductors within normal view of exterior locations at grade within 200 feet of building.

C. Cable Connections: Use crimped or bolted connections for all conductor splices and connections between conductors and other components. Use exothermic-welded connections in underground portions of the system.

D. Cable Connections: Use exothermic-welded connections for all conductor splices and connections between conductors and other components.

1. Exception: In single-ply membrane roofing, exothermic-welded connections may be used only below the roof level.

E. Air Terminals on Single-Ply Membrane Roofing: Comply with roofing membrane and adhesive manufacturer's written instructions.

F. Bond extremities of vertical metal bodies exceeding 60 feet in length to lightning protection components.

G. Ground Loop: Install ground-level, potential equalization conductor and extend around the perimeter of structure.

1. Bury ground ring not less than 24 inches from building foundation.
2. Bond ground terminals to the ground loop.
3. Bond grounded building systems to the ground loop conductor within 12 feet of grade level.

3.2 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.3 CORROSION PROTECTION

A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.

B. Use conductors with protective coatings where conditions cause deterioration or corrosion of conductors.

3.4 FIELD QUALITY CONTROL

A. Notify Architect at least 48 hours in advance of inspection before concealing lightning protection components.

B. UL Inspection: Meet requirements to obtain a UL Master Label for system.

C. LPI System Inspection: Meet requirements to obtain an LPI System Certificate.

END OF SECTION 26 41 13

26 51 00
INTERIOR/EXTERIOR LIGHTING

PART 1 - **GENERAL**

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior lighting fixtures, lamps, and ballasts.
2. Exterior Lighting
3. Lighting fixture supports.

B. Related Sections:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, photocell, and occupancy sensors

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. LED: Light Emitting Diode

D. Lumen: Measured output of lamp and luminaire, or both.

E. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Energy-efficiency data.
3. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.
4. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

a. Testing Agency Certified Data: For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by manufacturer.
b. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Shop Drawings: For nonstandard or custom lighting fixtures. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Installation instructions.

1.5 CLOSEOUT SUBMITTALS

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
2. Plastic Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.7 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910, complying with the IESNA Lighting Measurements Testing & Calculation Guides.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NFPA 70.

1.8 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

D. Diffusers and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.
b. UV stabilized.

2. Glass: Annealed crystal glass unless otherwise indicated.

E. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:

a. "USE ONLY" and include specific lamp type.

2.3 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

2.4 FIELD QUALITY CONTROL

A. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

2.5 STARTUP SERVICE

A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner.

END OF SECTION 26 51 00

31 10 00
CLEARING AND GRUBBING

PART 1 GENERAL

1.1 DESCRIPTION

A. This work shall consist of clearing and grubbing of the wooded areas within the limits specified in the Contract Documents.

1.2 Definitions.

A. Clearing. Clearing within the construction area includes removing and disposing of trees, brush, shrubs, vegetation, rotten wood, rubbish, fences and structures not specified in the Contract Documents for removal and disposal. Clearing outside the construction area is the removing and disposing of rubbish.

B. Grubbing. Grubbing is removing from the ground and disposing of all stumps, roots and stubs, brush and debris.

C. Limits. Limits of clearing and grubbing include the wooded construction area and all ditch areas and stream or channel change areas.

D. Disturbed Area. Any erodible material exposed by construction activities.

E. Stabilization. Providing vegetation or structural measures (seed, temporary or permanent mulch, soil stabilization matting, riprap, stone aggregate, and paving by asphalt or concrete) that will prevent erosion. The placement of one or more of these temporary or permanent stabilization measures as directed by the Engineer shall satisfy the requirements to proceed with the next grading unit or operation.

F. Stabilized. An area covered with erosion resistant material such as grass cover, seed and mulch, soil stabilization matting, riprap, stone aggregate, or paving by asphalt or concrete.

PART 2 PRODUCTS

2.1 MATERIALS

Not applicable.

PART 3 EXECUTION

3.1 Erosion and Sediment Control

A. A grading operation is defined as the Contractor's ability to provide adequate resources to perform the grading in a timely manner and provide and maintain the proper erosion and sediment control measures. The Engineer will be the final authority in this determination

3.2 Vegetation

A. The Engineer will designate and mark any trees, shrubbery and plants that are to remain in place, and the Contractor shall protect them from any damage. Branches of trees overhanging the roadway shall be cut and properly trimmed to maintain a vertical clearance of 16 ft. All trimming shall be done under the supervision of a tree expert employed by the Contractor and licensed by the State of Maryland, including trimming of trees by the Contractor for any other reason.

3.3 Fences

A. All fences within the Limits of Disturbance shall be removed and disposed of unless otherwise specified in the Contract Documents.

3.4 Grubbing.

A. Excavation Areas. Within areas to be excavated, all embedded stumps and roots shall be removed to a depth of not less than 3 ft below the subgrade or slope surfaces. All depressions made below the subgrade or slope surfaces by the removal of stumps shall be refilled with materials suitable for embankment and shall be compacted as specified in under item xx (Embankment)

B. Low Embankments. Areas where the total depth of the embankment is less than 3 ft shall be grubbed.

C. High Embankments. Areas where the embankment is 3 ft or more in depth, trees and stumps shall be cut off as close to the ground as is practical but shall not exceed 1 ft above the ground surface. Near the toe of embankment slopes, stumps or trees are prohibited within 1 ft of the slope surfaces.

3.5 Disposal.

A. Burning. Will not be permitted

B. Disposal Locations. Materials and debris that cannot be burned and perishable materials shall be removed from the limits of disturbance and disposed of by the Contractor. The Contractor shall make all necessary arrangements to obtain suitable disposal locations and shall furnish the Engineer with a copy of resulting agreements.

C. Wood Disposal. Disposal of wood to the general public shall be accomplished off the job site. Any plan for disposal in this manner shall be submitted to and approved by the Engineer prior to beginning the clearing and grubbing operation.

3.6 Destroying Trees Beyond Clearing Limits

A. The Contractor shall not damage nor destroy any trees that exist beyond the clearing limits specified.

B. The Contractor shall be responsible for all damage to trees located beyond the clearing limits due to the Contractor's operations. The Contractor shall restore, to the satisfaction of the Engineer, any trees that have been damaged or destroyed at no additional cost to the Owner.

C. Replacement trees shall be of the same species as those damaged or destroyed unless otherwise directed by the Engineer. The replacement size shall be the same as the damaged or destroyed trees when the trees measure less than 4 in. diameter at breast height (DBH). Damaged trees 4 in. DBH or greater shall be replaced with 2 in. caliper trees in conformance with the following:

SIZE OF DAMAGED OR DESTROYED TREES in. DBH	NUMBER OF 2 in. CALIPER REPLACEMENT TREES
4	5
6	8
8	10
10	13
12	15
16	20
20	25
24	36
32	48
40	80
60	135
80	200
120 or Greater	360

NOTE: DBH shall be measured at 4.5 ft above the ground.
Caliper shall be measured at 6 in. above the ground.

D. Replacement trees shall be planted within the limits of the project whenever possible, as determined by the Engineer. If not possible, a suitable location will be determined by the Engineer.

E. In case of failure on the part of the Contractor to restore or replace the damaged tree at the start of the next appropriate planting season, the Contractor will have 48 hours to begin corrective action, after notification by the Engineer. If the Contractor has not taken the corrective actions within the specified time, the Engineer may proceed with corrective measures. The cost of the corrective measures will be deducted from any monies due under the Contract.

END OF SECTION 31 11 00

31 14 13
TOPSOIL AND SUBSOIL

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work shall consist of salvaging topsoil and subsoil, placing salvaged topsoil and subsoil, and placing furnished topsoil and subsoil as specified in the Contract Documents or as directed by the Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS.

A. Salvaged Topsoil. Salvaged topsoil shall be that surface material to be salvaged from the project which has been classified as topsoil as specified in the Contract Documents.

B. Furnished Topsoil. Furnished topsoil shall be natural, friable surface soil uniform in color and texture and not supplied from the project. Topsoil shall be free from any parts of Johnsongrass, Canada Thistle, or Phragmites.
Topsoil shall have an organic content between 1.5 to 10.0 percent by weight when tested as specified in T 194. Furnished topsoil shall have a corrected pH value of not less than 6.0 nor more than 7.5.
Grading analysis shall be as follows:

SIEVE SIZE	MINIMUM PERCENT PASSING BY WEIGHT
2 in.	100
No. 4	90
No. 10	80

Topsoil shall be analyzed for sand, silt, and clay as specified in T 88.
Textural analysis shall be as follows:

SOIL PARTICLE SIZES mm	PERCENT PASSING BY WEIGHT
Sand (2.0 – 0.050)	20 – 75
Silt (0.050 – 0.002)	10 – 60
Clay (less than 0.002)	5 – 30

C. Salvaged Subsoil. Salvaged subsoil shall be material salvaged from the project that has been classified as subsoil as specified in the Contract Documents.

D. Furnished Subsoil. Furnished subsoil shall be natural, friable subsurface soil uniform in texture and not salvaged from the project. Subsoil shall be free from any parts of Johnsongrass, Canada Thistle, or Phragmites. The Contractor shall submit a source of supply for the material to the Engineer for approval, prior to use. Material shall conform to MSHA 916 with the following exceptions:

1. The use of recycled portland cement concrete or recycled HMA pavement is prohibited.
2. The corrected pH value shall be 5.0 to 7.5.
3. The organic matter content shall be 0.1 to 5.0 percent.

Grading analysis shall be as follows:

SIEVE SIZE	MINIMUM PERCENT PASSING BY WEIGHT
2 in.	100
No. 4	85
No. 10	60

Material shall be analyzed for sand, silt and clay as specified in T 88.
The textural analysis shall be as follows:

SOIL PARTICLE SIZES mm	PERCENT PASSING BY WEIGHT
Sand (2.0 – 0.050)	20 – 85
Silt (0.050 – 0.002)	10 – 60
Clay (less than 0.002)	5 – 40

E. Agricultural Limestone. Refer to MSHA 920.02

F. Miscellaneous Landscaping Items. Refer to MSHA 920.08.

PART 3 - EXECUTION

3.1 GENERAL

A. When soil or weather conditions are unsuitable, the Contractor shall cease topsoil and subsoil operations until directed by the Engineer to resume.

3.2 SALVAGING TOPSOIL AND SUBSOIL.

A. Evaluation. Topsoil and subsoil infested with any parts (seed, rhizomes, stolons, roots, etc.) of Johnsongrass, Canada Thistle, or Phragmites will be evaluated by the Engineer prior to the salvaging operations to determine the severity of the infestation. The evaluation will determine how the topsoil and subsoil are to be used and to establish a means of preventing the spread of these weeds.

B. Removal. Topsoil and subsoil shall be removed from selected areas specified in the Contract Documents or as directed by the Engineer. Prior to removing topsoil and subsoil, the Contractor shall mow or remove all vegetation over the areas where topsoil and subsoil are to be salvaged. Topsoil and subsoil shall be removed to the depth as directed by the Engineer. The topsoil and subsoil shall be transported and stockpiled in separate storage piles and kept separated from other materials.

C. Storage. Storage areas for topsoil and subsoil shall be constructed on well drained land, away from live streams, and in conformance with MSHA 308. Prior to placing piles, the Contractor shall install silt fence around the perimeter of the stockpile area and maintain the silt fence until vegetation is established. Topsoil and subsoil shall be kept in neat and separate piles separated from other excavated material. The piles shall be seeded with temporary seed immediately after final shaping of the pile. Temporary seeding shall conform to MSHA 704.

D. Excess topsoil and subsoil will become the property of the Owner and any removal will require written approval from the Engineer.

3.3 PLACING SALVAGED TOPSOIL AND SUBSOIL.

A. Evaluation. The Engineer will reevaluate salvaged topsoil and subsoil infested with any parts (seed, rhizomes, stolons, roots, etc.) of Johnsongrass, Canada Thistle, or Phragmites prior to placing, to establish a means of preventing the spread of these noxious weeds.

B. Surface Preparation. The Contractor shall completely prepare and finish the surface of all areas to be covered with topsoil and subsoil as specified in the Contract Documents. Immediately prior to being covered with topsoil, the prepared surface shall be in a loose condition and be free from stones or other foreign material 3 in. or greater. When topsoil is placed on a prepared surface material that blends with the topsoil or subsoil, the Contractor shall work the topsoil or subsoil into that material by means acceptable to the Engineer. When topsoil or subsoil will not blend with the prepared surface material, the Contractor shall roughen the surface to provide a bond for the topsoil or subsoil.

C. Loading and Hauling. Prior to the start of the hauling operations, all grass, weeds, brush, stumps, and other objectionable material shall be removed from the surface of stockpiles.

D. Placing and Spreading Topsoil. Topsoil shall be placed, spread, and maintained over the areas designated to the depth, that after settlement, the completed work shall be in conformance with the thickness, lines, grades, and elevations specified in the Contract Documents. Stones and other foreign material larger than 3 in. shall be removed and disposed of by the Contractor. Slopes 4:1 to 2:1 shall be tracked with cleated tract type equipment operating perpendicular to the slope.

E. Placing, Spreading, and Compacting Subsoil. Subsoil shall be placed, spread, and compacted in maximum layers of 8 in. to produce a uniform firm layer of subsoil. The

completed work shall be in conformance with the thickness, lines, grades, and elevations specified in the Contract Documents. Stones and other foreign material larger than 4 in. shall be removed and disposed by the Contractor. Slopes 4:1 to 2:1 shall be tracked with cleated tract type equipment operating perpendicular to the slope.

3.4 PLACING FURNISHED TOPSOIL AND SUBSOIL

A. Refer to 3.3 and the following:

B. Contractor Responsibility. The Contractor shall make all arrangements and assume all responsibility for consents, agreements, and payments with property owners involved in topsoil and subsoil operations.

C. Soil Test Reports. Limestone and soil amendments shall be added as specified in the soil test reports and MSHA 705.03.01(d) and 705.03.02(b).

D. Storage. If the material is stockpiled upon delivery for future use on the project, the stockpiling shall conform to 3.2C.

END OF SECTION 31 14 13

31 23 16
EXCAVATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work shall consist of the excavation and grading for buildings roadways and their appurtenances to the lines and grades specified in the Contract Documents. The Contractor shall use all suitable materials from excavation in the construction of embankments throughout the limits of the work as directed by the Engineer.

1.2 CLASSIFICATION

A. All excavation will be unclassified.

1.3 EXCAVATION

A. Excavation shall include the following:

1. Cut areas within the boundary faces of the proposed cross sections specified in the Contract Documents, including ditches within the cut sections, and excavation for entrances, approach roads, streets, intersections, gutters, ditches, berm ditches, and flumes.
2. Topsoil to be salvaged within the limits of excavation as specified in the Contract Documents or as directed by the Engineer.
3. The removal and disposal of existing pavement, sidewalks, curb and combination curb and gutter, when within the limits of any excavation.
4. The removal and disposal of below grade structures other than as specified "Removal and Disposal of Existing Buildings".

PART 2 - PRODUCTS

2.1 MATERIALS

PART 3 - EXECUTION

3.1 USE OF EXCAVATED MATERIALS

A. No excavated material shall be wasted without prior approval of the Engineer. Borrow shall not be used unless provisions have been made for utilizing all available suitable excavated material in embankments. Refer "Borrow Excavation"

B. Rights in and use of materials found on the project. The Contractor, with the approval of the Engineer may use on the project any excavated stone, gravel, sand or other material conforming to the requirements of the Contract Documents.

C. The Contractor shall not excavate nor remove any material which is not within the limits of excavation, as indicated by the slope and grade lines, without written authorization from the Engineer.

3.2 BROKEN PAVEMENT MATERIAL

A. Existing pavement, sidewalks, gutter, curb or combination curb and gutter materials from the excavation may not be used in embankments.

3.3 ROCK EXCAVATION.

A. Boulders and Rock

1. Boulders and rock from the excavation may be broken and used in embankment provided the materials conform to the following:
    a. Rock may be used in embankments, provided that individual pieces do not exceed of 24 in. in any dimension. Larger size rocks may be wasted with the approval of the Engineer.

B. Blasting

1. Blasting will not be allowed.

3.4 FROZEN MATERIAL

A. Frozen material is prohibited from being placed in embankments. It shall be stockpiled outside the construction limits and reserved for future use. Any material that is wasted shall be replaced. Rehandling of excavated material and replacement of wasted material shall be at no additional cost to the Owner.

3.5 SERRATED SLOPES

A. Serrated cut slopes are defined as slopes having continuously benched faces. Slopes that are to be serrated and the width and height of benches shall be as specified in the Contract Documents or as directed by the Engineer. The benches shall be constructed parallel to each other, and they shall be level, not graded to drain, and shall be constructed as the excavation progresses.

3.6 DRAINAGE

A. All drainage shall conform to Erosion and Sediment Control requirements. During construction of the roadway, the roadbed shall be maintained in a well drained condition at all times. Excavated material is prohibited from being deposited or left within 3 ft of the edge of the ditch or channel or be permitted to obstruct normal surface drainage into the ditch or channel. Ditches draining from cuts to embankments or otherwise shall be constructed to avoid damage to embankments by erosion. All drainage necessary to provide free and uninterrupted flow of the surface and underground water shall be installed before surfacing is placed. When stabilized side and outlet ditches provide the principal means for drainage, the cutting and stabilization of ditches for the disposition of surface water shall be the first work in the grading operation.

3.7 EXCAVATION BEYOND SPECIFIED LIMITS

A. The widening of cut or excavation sections beyond the limits on the Contract Documents is prohibited except by written authorization from the Engineer. When authorized by the Engineer the procurement of additional materials for embankments, unless otherwise specified under Borrow Excavation, shall conform to the following:

1. Finished Excavation. The widening of cuts or excavation sections shall be finished so that completed flat and slope areas shall be uniform in appearance. The slopes shall not be steeper than the cut slopes specified in the Contract Documents or as directed by the Engineer.
2. Excavation Limits.
    a. If the Engineer directs the Contractor to excavate beyond the limits on the plans, all material within the limits will be Unclassified Excavation.

b. If the Contractor, with approval of the Engineer, elects to obtain material by widening cuts beyond the limits of the plans and within the right-of-way or easement, the excavation of the materials will be Unclassified Excavation.

3. Borrow Excavation Beyond Specified Limits. If the Engineer directs the Contractor to excavate beyond the limits of the plans originally proposed after the Contractor has substantially completed the excavation in a cut section, all material removed beyond the limits of the plans will be classified as Borrow Excavation.

3.8 UNSUITABLE MATERIAL

A. Unstable or other unsuitable material encountered at or below the subgrade specified in the Contract Documents shall be removed to the extent directed by the Engineer and will be taken to be Unclassified Excavation. In rock areas the limit of measurement for excavation will be at the bottom of the pavement section. All voids created by the removal of unsuitable material, except when rock is encountered at subgrade, shall be backfilled to the lines and grades with the material specified in the Contract Documents.

B. Backfill material shall conform to the following:

1. All borrow excavation shall be a soil or soil aggregate mixture and shall conform to the "Borrow Excavation".

3.9 WIDENING EXCAVATION LIMITS

A. The area to be excavated for widening shall be limited to the extent that the excavated area can be backfilled within the same working day using the excavated material or common borrow to form a temporary wedge. The 4:1 or flatter fill slope shall be maintained. The material shall be compacted as directed by the Engineer and remain in place until placement of the graded aggregate base course.

END OF SECTION 31 23 16

31 23 23
EMBANKMENT AND SUBGRADE

PART 1 GENERAL

1.1 DESCRIPTION

A. This work shall consist of constructing the embankment and subgrade of suitable material obtained from structure, borrow, and other excavation included in the Contract. The material shall be placed, processed, and compacted to the lines and grades specified in the Contract Documents.

PART 2 PRODUCTS

2.1 MATERIALS

A. Soils and soil aggregate mixtures used in the construction of embankments shall conform to the common borrow requirements in 31 23 16 Borrow Excavation Part 2 unless otherwise specified in the Contract Documents.

B. Rock may be used in embankments, provided that individual pieces do not exceed 24 in. in any dimension. Larger size rocks may be wasted with the approval of the Engineer.

C. Frozen material is prohibited from being placed in embankments. It shall be stockpiled outside the construction limits and reserved for future use. Any material that is wasted shall be replaced. Rehandling of excavated material and replacement of wasted material shall be at no additional cost to the Owner. Any material that freezes after being placed in the embankment shall not be covered until it has thawed.

D. Embankment Adjacent to Structures. The Engineer may require the use of specially selected material adjacent to structures to ensure good compaction or to protect the structure from damage. Rock is prohibited. Embankment material at locations of pile supported foundations shall be a type that piles may be easily driven through the embankment.

PART 3 EXECUTION

3.1 Embankment Foundation.

A. Foundation Material. The Engineer will inspect the foundation prior to the construction of an embankment. Topsoil, root mat, or unsuitable material shall be removed to the depth directed by the Engineer.

3.2 Placing and Spreading

A. The material shall be placed in horizontal layers across the full width of the embankment. An adequate crown shall be maintained to provide drainage at all times. Side slopes shall be maintained at the specified slope throughout the progress of the work.

1. Embankment on Unstable Ground. When embankment is to be constructed on wet and unstable ground that will not support the weight of the construction equipment, the first layer of the fill may be constructed by depositing material in a layer no thicker than that required to support the equipment. Subsequent layers shall conform to the following paragraph.
2. Earth Embankment. Except as otherwise specified, no layer shall exceed 8 in. compacted depth.

3.3 Benching

A. When embankment is to be placed and compacted on hillsides or when new embankment is to be compacted against existing embankments, the slopes on which the embankment is to be placed shall be continuously benched where they are steeper than 4:1 when measured at right angles to the embankment. The benching operation shall be done as the embankment is brought up in layers. Benching shall be a minimum width of 5 ft. Each horizontal cut shall begin at the intersection of the original ground and the vertical sides of the previous cut. Material conforming to embankment requirements cut from the benches shall be compacted along with the new embankment material at no additional cost to the Owner.

3.4 Compaction

A. Immediately after spreading of each layer, the material shall be compacted with compaction equipment approved by the Engineer. Rolling shall be done in a longitudinal direction along the embankment, beginning at the outer edges and progressing towards the center. The travel paths of traffic and equipment shall be dispersed over the width of the embankment to aid in obtaining uniform compaction.

B. Material 1 ft below the top of subgrade shall be compacted to not less than 92 percent of the maximum dry density as specified in T 180. Material in the top 1 ft shall be compacted to not less than 97 percent of the maximum dry density. In place density shall be determined by the Maryland Standard Methods of Tests 350 or 352. When necessary, the layer shall be wetted or dried in order to compact the layer to the required density. The resultant moisture content of embankment material, when finally compacted to required density, shall be within two percentage points of optimum.

3.5 Stability of Embankments

A. The Contractor shall be responsible for the stability of all embankments in the Contract and shall remove and replace with acceptable material any embankment or portion thereof that has been constructed with unsuitable material. The Contractor shall remove and replace unstable material and remove and replace portions of the embankment that become unstable or displaced as the result of the Contractor's operations at no additional cost to the Owner.

3.6 Protection of Structures and Utilities During Construction

A. The Contractor shall be responsible for protecting all structures and utilities from any damage in the handling, processing, or compacting of embankment or backfill material. Particular care shall be exercised in the vicinity of arches, retaining walls, culverts and utility trenches to assure that no undue strain or movement is produced. In areas where rollers cannot be used, the embankment or backfill shall conform to MSHA 210.

3.7 Maintenance

During construction and after completion of the embankment and subgrade, the embankment and subgrade shall be maintained by the Contractor until finally accepted. Embankment and subgrade material that may be lost or displaced as a result of natural causes such as storms and cloudbursts, or as a result of unavoidable movement or settlement of the ground or foundation upon which the embankment and subgrade is constructed shall be replaced by the Contractor with acceptable material from excavation or borrow. The Contractor shall at all times maintain ditches and drains to provide adequate drainage. The travel paths of any traffic or construction equipment on the embankment and subgrade shall be held to a minimum to avoid the displacement of material or formation of ruts. When ruts 2 in. or more in depth are formed in the subgrade they shall be removed by reshaping.

END OF SECTION 31 23 23

31 23 23.10
TAMPED FILL

PART 1 GENERAL

1.1 DESCRIPTION

A. This work shall consist of compacting embankment and backfill materials by means of mechanical tampers or vibratory compactors. This method of compaction shall be used wherever materials cannot be adequately compacted by other methods approved by the Engineer.

PART 2 PRODUCTS

2.1 MATERIALS

Refer to City of Baltimore DPW Specifications, 2006, Section 31 23 16.12 Part 2.

PART 3 EXECUTION

A. After approval has been given by the Engineer, the areas shall be backfilled with materials approved by the Engineer. The material shall be placed in horizontal layers not to exceed 6 inches loose depth over the entire area to be tamped and uniformly compacted by means of mechanical tampers or vibratory compactors. The moisture and compaction requirements shall conform to City of Baltimore DPW Specifications, 2006, 31 24 13.10 Part 3.4.

B. When backfilling around abutments, retaining walls, culverts, utilities, or other structures, special care shall be taken to prevent any wedging action against the structure by the material being compacted. The existing slopes to be filled against shall be benched or stepped. The backfill shall be constructed in horizontal layers as described above and wide enough that there shall be a horizontal berm of thoroughly compacted material behind the structure at all times for a distance at least equal to the height of the structure remaining to be backfilled, except insofar as undisturbed material protrudes into this space. Tamping may be required over additional widths when the material cannot be adequately compacted by other methods. When structures are installed below subgrade in embankments, the tamped fill shall be placed to a depth of 1 ft over the top of the structure, while in excavation sections the tamped fill shall extend to the surface of the finished earthwork.

END OF SECTION 31 23 23.10

31 23 23.13
SELECTED BACKFILL

PART 1 GENERAL

1.1 DESCRIPTION

A. This work shall consist of placing selected backfill material as specified in the Contract Documents or as directed by the Engineer.

PART 2 PRODUCTS

2.1 MATERIALS

A. No. 57 Aggregate shall conform to 32 11 23.10 Part 2 (Aggregate Base Course).

B. Crusher Run Aggregate CR-6 shall conform to 32 11 23.10 Part 2 (Aggregate Base Course).

PART 3 EXECUTION

A. Unsuitable foundation material shall be replaced as directed by the Engineer. Refer to 31 23 23.10 (Tamped Fill) for compaction.

END OF SECTION 31 23 23.13

31 23 33
TRENCHING AND BACKFILLING

PART 1 GENERAL

1.1 DESCRIPTION

A. Section includes requirements for excavation, backfill, grading, and related items for pipeline construction.

1.2 DEFINITIONS

A. Trench Zones.

1. Pipe Embedment Zone: Area surrounding pipe in trench, consisting of Bedding Zone, Haunching Zone, and Initial Backfill Zone defined herein.
    a. Bedding Zone: Area from pipe bottom to firm subgrade, extending full width of trench and providing support for pipe shown in WSSC standard details.
    b. Haunching Zone: Area from pipe bottom up to as far as spring line and extending full width of trench shown in WSSC standard details.
    c. Initial Backfill Zone: Area from top of Haunching Zone up to as far as 1 foot above top of pipe and extending to full width of trench shown in WSSC standard details or specified herein.
2. Final Backfill Zone: Area from top of Pipe Embedment Zone to finished grade, extending full width of trench shown in WSSC standard details.
3. Additional Excavation: Excavation below trench bottom to remove unsuitable material such as rock, cobble, soft or organic soil, when Contract Manager determines that material is unsuitable to support pipe.

B. Backfill Material.

1. Trench Backfill: Native or Borrow Material placed in trench excavation and meeting specifications herein.
2. Borrow Material: Suitable material used for Trench Backfill provided from locations outside limits of trench excavation and meeting specification requirements herein.
3. Structural Fill: Compacted Trench Backfill meeting specification requirements herein, to minimize future settlement and provide support or bearing for structures to be constructed upon or within fill.

C. Pipe.

1. Rigid Pipe: Reinforced Concrete Pipe (RCP), Cast Iron Soil Pipe, Cast Iron Pipe, Prestressed Concrete Cylinder Pipe (PCCP), Asbestos Cement Pipe, Vitrified Clay Pipe, and Concrete Sewer Pipe.
    a. Pipes relying primarily on inherent strength to support external vertical load.
2. Flexible Pipe: Ductile Iron Pipe (DIP), Polyvinyl Chloride (PVC) Pipe, and Type K Copper Pipe, Steel Pipe, and High Density Polyethylene (HDPE) Pipe.
    a. Pipe deriving its supporting strength primarily from passive pressures induced as pipe flexes outward against material in Pipe Embedment Zone.

D. Controlled Blasting: Blasting method used to fracture and excavate rock to required limits for trench while minimizing overbreak and fracturing.

E. Paved Areas: Areas over which paving exists or is to be placed under this Project or areas designated on Drawings to receive future paving.

F. Wetland Areas: Non-tidal Wetlands and Non-tidal Wetlands Buffer Zones.

1.3 QUALITY ASSURANCE

A. Inspection and Testing.

1. Field Density Compaction Tests shall be in accordance with ASTM D1556, ASTM D2922, or ASTM D2937 at minimum rate of 1 test for each 200 feet of fill and at every structure and valve box in Type I areas.
   a. Test fill to minimum depth of 5.0 feet from the surface on sewer main and sewer service connections. Test fill on water main, water service connections, pressure sewer and pressure sewer service connections to minimum depth of 3.0 feet from surface or 1.5 feet above the top of the pipe, whichever is greater.
   b. When field-testing indicates differences in soil types, reference and/or verify test results using one-step field proctors or laboratory proctors following AASHTO T99.
   c. Re-excavate and recompact failed test areas, at 25 foot intervals, the entire trench depth and length until retests meet above referenced standards.
2. Placing Trench Backfill and earthwork is subject to continuous inspection by OWNER.
   a. Allow time for OWNER to perform tests after completion of each layer of fill in designated area.
   b. Provide safe access and equipment to cut out smooth-surfaced spot locations designated by Contract Manager for testing.
   c. OWNER may perform gradation and other tests on Trench Backfill.

B. Finished Grade Settlement Limitations.

1. Guarantee backfilled trench excavation areas designated on Drawings will not pond or settle in excess of following limitations.

Designations	Settlement Limitations	Locations
Type I	0.05 foot	Paved areas and public rights of way
Type II	with positive drainage	Unimproved areas
Type III	0.10 foot	Nonpaved improved areas
Type IV	0.00 foot	Wetlands or wetlands buffer

2. Remove and replace Trench Backfill which settles in excess of above limitations with suitable material
3. Remove and replace piping, structures, paving, landscaping, and other site improvements damaged by settlement or repair.

1.4 SUBMITTALS

A. Submit following Section 01 33 00.

1. Working drawings and data to show blasting design and monitoring, for information only.
   a. Submit request and obtain written permission from Contract Manager before using explosives.
2. Working drawings showing sheeting and shoring, and method of dewatering, for structure excavations deeper than 8 feet and larger than 400 square feet.
3. Samples of Borrow Material, except for Borrow Aggregate.
   a. Size: Minimum of 30 pounds in sturdy cloth or plastic bags.

b. In addition to sample identification required in Section 01 33 00, clearly label each sample showing type and material designation, intended use, name and address of supplier, and location where material is mined or manufactured.

B. Delivery of Borrow Material.
1. Submit prior notification of source, designation, quantity, and intended use for all Borrow Material.
2. Submit delivery tickets with each load of Borrow Material.
a. Name and location of supplier.
b. Type and amount of material delivered, including ASTM's and the Owner's material designations.

C. Submit following Section 01 45 00.
1. Certificate of Compliance: When recycled concrete is used, submit letter from governing jurisdiction approving its use.
2. Certified Test Reports: Borrow Aggregate.
a. In addition to requirements of Section 01 45 00, include information showing type and material designation, intended use, name and address of supplier, and location where material is mined or manufactured.

D. Flowable Fill: See MSHA 314.02.

E. Submit Soil's Compaction Reports as follows:
1. Certified by Professional Engineer registered in State of Maryland.
2. Field Density Compaction Test Results.
3. Owner Project Number.
4. Soils Technician's Name and Employer.
5. Owner's name and owner's Contractor.
6. Test Number.
7. Date of Test.
8. Location of Test (sewer and/or water station, lot number and street name).
9. Retest results of previous tests (and number), if required.
10. Depth of Test.
11. Dry Density.
12. Moisture Content.
13. Maximum Density/Optimum Moisture Curve Relationship Chart following ASTM D698.
14. Test Results.
15. One Step Proctor Determination (when taken).
16. Additional Comments.
17. Submit test results to the Contract Manager within 2 weeks of test.

PART 2 PRODUCTS

2.1 MATERIALS

A. Detectable Warning Tape.
1. Description.
a. Size: Six inch width, minimum 5 mils thickness.
b. Printing: Two lines, minimum 3/4 inch high lettering on each line, repeated continuously along length of tape at intervals no greater than 3 feet.
1) Water: CAUTION - WATER LINE BURIED BELOW
2) Sewer: CAUTION - SEWER LINE BURIED BELOW

3) Cathodic Protection: CAUTION – CATHODIC PROTECTION

c. Colors.

1) Tape: Blue for water. Green for sewer. Yellow for cathodic protection.

2) Lettering: Black.

2. Approved Manufacturers:

a. Lineguard, Inc, Type III Detectable Tape.

b. Pro-Line Safety Products, No. 5012 (Type A Double Safe).

c. Reef Industries, Terra Tape D.

d. Empire Level Manufacturing Corporation, Magnatec.

B. Trench Backfill.

1. General Trench Backfill Requirements.

a. Outside Wetland Areas: Free of organic or frozen material, waste metal products, unsightly debris, toxic material, or other deleterious materials and at moisture content permitting compaction to density specified.

b. Within Wetlands Areas: Previously excavated native material which can include organic matter, but free of frozen material, waste metal products, unsightly debris, toxic material, or other deleterious materials.

c. Material Excavated from Trench and Meeting These Requirements: Use when approved by Contract Manager; otherwise excavate, haul, and place Borrow Material.

2. General Borrow Material Requirements .

a. Outside Wetland Areas: Meet General Trench Backfill Requirements for Outside Wetland Areas, stated herein.

b. Within Wetland Areas: Soil material meeting requirements of ASTM D2488, material classification types SM, SC, ML, CL, OL and PT, which can include organic matter, but be free of frozen material, waste metal products, unsightly debris, toxic material, or other deleterious materials.

c. Acceptance of Borrow Material from any location outside limits of trench excavation, shall not be construed as approval of entire Borrow Material site, but only insofar as material continues to meet specified requirements, herein.

3. Borrow Aggregate.

a. Standard Sizes of Aggregate: ASTM C33, coarse aggregate.

b. Dry Concrete Sand: ASTM C33, fine aggregate.

c. Surge Stone: 3 inch to 7 inch stones.

d. Crushed stone, crusher run (CR-6), or bank run gravel.

1. Aggregate Test Requirements: Maximum Sodium Sulfate Soundness (ASTM C88): 12 percent. Maximum Los Angeles Abrasion (ASTM C131): 50 percent. Maximum Flat and Elongated (ASTM D4791) for crushed stone only: 15 percent.

2. Gradations: Conform to Table of Borrow Aggregate Gradations.

Borrow Aggregate Gradations

(Based on Table "901-A", January2001MSHAStandardSpecificationsfor Construction and Materials)

3.

Sieve Size	Percent Passing Each Sieve by Weight				
	[1]Bank Run Gravel Number 1	[2]Bank Run Gravel Number 2	[3]Crushed Stone Number 3		[4]Crusher Run Number 4 (CR-6)
			Design Value	Tolerance	Design Value
2-1/2 inch	100	100			
2 inch			100	-2	100
1-1/2 inch			95-100	□5	90-100
1 inch	85-100	90-100			
3/4 inch			70-92	□8	60-90
1/2 inch	60-100	60-100			
3/8 inch			50-70	□8	
Number 4			35-55	□8	30-60
Number 10	35-75	35-90			
Number 30			12-25	□5	
Number 40	20-50	20-55			
Number 200	0. 3-20	5-25	0-8	□3	0-15

[1]MSHA- Base Bank Run Gravel

[2]MSHA- Subbase Bank Run Gravel

[3]MSHA - Base Graded Aggregate

[4]MSHA – Crusher Run Aggregate

PART 3 EXECUTION

3.1 EXCAVATION

A. General: Excavate to lines and grades indicated on Drawings.
On-grade Slabs and Pavements: Sufficient to allow for fills, base, and waterproofing materials.

1. Planting Areas: Sufficient to allow for topsoil.
2. Formed Concrete: Sufficient to allow for convenient construction and removal of forms, and for application of waterproofing and curing materials.

B. Test Pit Excavation: Perform with caution and to prevent damage to facility.

Before pipe installation:

a. Dig test pits to determine size, type, and exact location of existing pipe to which proposed pipe will connect.
b. Excavate sufficient trench in advance and test pit all existing underground utilities or structures, whether shown on Drawings or visually identified in the field, to:
   1) Verify actual locations.
   2) Make reasonable changes in line and grade to resolve conflicts, with Contract Manager's approval.
c. Furnish Contract Manager location and elevation information when previously unknown or different underground utilities or structures are encountered.

2. Perform additional work made necessary because of failure to take above precautions.
3. See City of Baltimore DPW Specifications, 2006, Section 31 23 16.05 for additional information on test pits.

C. Material Storage and Disposal of Unsuitable Material.
1. Separate and protect excavated material which is suitable Trench Backfill from contamination by unsuitable excavated material or by other sources.
2. Stockpile suitable materials in location to avoid contamination and prevent erosion.
3. See City of Baltimore DPW Specifications, 2006, Section 01 11 00 for off-site disposal of excess excavated material and unsuitable material.
4. See City of Baltimore DPW Specifications, 2006, Section 31 14 13.24 for site clearing and storage of existing top soil.

D. Unauthorized Excavation: Where excavations are made below indicated elevations under slabs, footings, pipes, structures, or outside maximum trench pay widths, restore to proper elevations with materials specified herein at Contract Manager's direction.

E. Trench Excavation.
1. Excavate trenches to width and depth following WSSC Standard Details, Drawings, or specified herein.
   a. Sides of trenches within Pipe Embedment Zones: Practically plumb.
   b. Trench widths within Pipe Embedment Zone for Rigid Pipe shown on Drawings are maximum widths.
2. Remove rock, when encountered, to minimum depth of 6 inches below pipe barrel and pipe bell and structures.
   a. Excavate trench bottom to conform with shape and dimensions of proposed pipe or structure.
   b. Excavate bell holes in trench bottom to permit proper assembling of joints.
   c. Support pipe or structure uniformly and continuously, upon specified material.
3. Where material not meeting requirements of Trench Backfill and deemed unsuitable by Contract Manager is encountered either contiguous to or within proposed limits of excavation, Contract Manager may direct additional excavation and removal of unsuitable material.
   a. Depth and extent of additional excavation at Contract Managers determination.
4. Perform excavation in immediate vicinity of adjacent and crossing facilities by means that will not damage facility.
   a. Excavate within 1 foot of existing pipelines or conduits by hand.
   b. Repair or replace damage caused to existing facilities, pipelines, or conduits.

5. Unless otherwise authorized by Contract Manager, proceed with trench excavation no more than 75 feet in advance of placing of Trench backfill.
   a. Contract Manager may require backfilling and subsequent re-excavation on trenches left open in advance of pipe installation.
   b. Protect or enclose trenches left open overnight, or during periods when Contractor's personnel are not present and mark to prevent danger to public or others.
6. Excavate sides of trenches in improved public areas and adjacent to other utilities or structures practically plumb.
   a. When crossing under existing pipes or conduits, plumb sides of trench from 1 foot above top of existing pipes or conduits to bottom of trench.
   b. With Contract Manager's permission, sides of trenches in other areas may be sloped from 1 foot above top of pipe to finished grade.
7. Trench Sheeting, Shoring, and Bracing: Place so as not to interfere with construction work and be entirely independent of footings and structures.
   a. Method, design and adequacy of sheeting, shoring and bracing: Meet requirements of MOSH.
      1) Repair damage related or caused by excavation.
      2) Sheeting, shoring, and bracing: Before placement, use means acceptable to Contract Manager for its removal as backfill progresses.
   b. Sheet and shore as required to assure safe working conditions, maintain required excavation dimensions for proper construction, and to prevent accidents, cave-ins, and damage to adjacent structures, facilities, and surfaces.
      1) In excavations over 4 feet in depth, where the Owner personnel are required to enter, sheeting and shoring shall meet requirements of MOSH for Type "C" soil conditions.
   c. Remove sheeting, shoring, bracing and wood forms concurrently with backfilling operations, except in Pipe Embedment Zone and where sheeting is used as 1 side of form for concrete.
      1) Accomplish removal in manner that precludes settlement of backfill, cave-in of excavation sides, and prevents damage to adjacent surfaces.
      2) Promptly fill voids left or caused by removal.
      3) Compact contiguous areas concurrent with removal of trench sheeting.
   d. Follow WSSC Standard Details where sheeting is used for trench width between interior faces of sheeting.
   e. Sheeting may be left in place, provided that following are met:
      1) Positive verification that no voids exist between sheeting and trench wall.
      2) Upper wales and horizontal braces are removed or excavation is backfilled with sand.
      3) Existing voids are filled following Trench Backfill requirements.
      a) Sheeting left in place: Cut off minimum of 1-1/2 feet below finished grade or at Contract Manager's direction.
8. Trench Boxes or Mules: Use of trench boxes will be permitted in areas where excavation sidewalls are suitable and where sheeting, shoring, and bracing are not required to maintain excavation dimensions.
   a. Structural box design: To withstand pressures imposed thereon.
      1) Trench boxes and steel plates and their use: Meet requirements of MOSH.
   b. Location:

1) Do not extend trench box below top of Pipe Embedment Zone during or after placement of Pipe Embedment Zone material.
2) Remove steel plates used below trench box in Pipe Embedment Zone simultaneously with placement of Pipe Embedment Zone material and before its compaction.

c. Box size:
1) Height: Sufficient to assure safe working conditions.
2) Length: To accommodate size and lengths of pipe being installed.
3) Width: For trench opening not more than maximum permitted in WSSC standard details.

F. Rock Excavation.

1. When blasting, control fly rock and material to prevent injury or damage to persons or properties.
a. Use blasting mats in areas where overburden has been removed before blasting, or as required to control fly rock.
b. Equipment used for drilling holes shall have positive means of dust control and meet OSHA and other applicable regulations and agencies requirements in asbestos-bearing rock area.

2. Blasting unless otherwise directed by Contract Manager:
a. No closer than 10 feet to existing water, gas, sewer or conduit utilities unless such facilities have been completely exposed, definitely located, and then backfilled before blasting.
b. No closer than 2 feet from definitely located existing utilities, 10 inch or smaller diameter.
c. No closer than 5 feet from utilities larger than 10 inch diameter.

3. Use controlled blasting techniques.
a. Modify blasting round as necessary to achieve best obtainable results and to keep air blast over pressure, vibrations, and noise within limits herein specified.
1) Exercise care in drilling and blasting operations to minimize over break and blast damage of adjacent unexcavated ground.
2) Produce satisfactory excavated surface by determining proper relationships of burden, spacing, depth of charge, amount and type of explosive, hole size and delay pattern, and other necessary considerations to achieve required results.

4. Vibration and Air Blast Control.
a. Control operations to ensure:
1) Peak particle velocity will not exceed 2 inches per second measured adjacent to any structure in vicinity of blasting operations or following limits for concrete:

Inches Per Second	Age of Concrete
0.25	12 - 24 hours
0.5	24 - 48 hours
1.0	48 hours - 5 days
2.0	5 plus days

2) Impact or impulsive noise from blasting operations will not exceed 140 db peak sound pressure level measured at nearest structure or property line.

b. Peak particle velocity definition: Maximum of 3 velocity components of a vibration measured at any point in 3 mutually perpendicular directions by

Contract Manager approved seismograph, capable of producing permanent record and capable of internal dynamic calibration.

c. Furnish seismograph instruments, qualified personnel to operate instruments, interpret results for all blasting operations, and submit copy of results to Contract Manager.

d. Record air blast over pressure with peak impact recording instrument having linear frequency response, and submit copy of results to Contract Manager.

5. Repair or replace facilities damaged by blasting operations.

6. Replace rock which is not broken to meet backfill requirements with suitable Trench Backfill, as specified herein.

G. Dewatering and Drainage.

1. If water is encountered in excavation, install and maintain dewatering system of sufficient capacity to remove it during excavation, pipe placement, and backfill.

a. For structures:

1) Until concrete footings have been poured and cured,

2) Walls or other portions of structure are erected to grade,

3) Or until excavation has been backfilled.

b. Do not allow sediment-laden water to flow into watercourses, drainageways, or over land without first filtering it through approved desilting device. See Section 31 25 00.

2. Choose methods of dewatering excavations including, but not limited to, sump pumps, wellpoints, deep wells, drainage blankets, and tight sheeting.

a. Continuously inspect dewatering system to ensure it is functioning properly.

b. Ensure system does not disturb or degrade final subgrade for new pipe or structure and does not cause damage or settlement to adjacent surfaces or structures.

c. Modify system as required, and repair or restore damage or disturbance caused by system.

d. Install necessary temporary surface drainage and keep it operating, until permanent drainage or finish grading has been completed.

e. Do not allow damming or ponding of water in gutters or storm drains.

3. Remove dewatering devices upon completion of work.

3.2 BACKFILL OPERATIONS

A. Placing Trench Backfill.

1. Backfill trench excavations with soils material excavated therefrom, provided this material meets requirements of Trench Backfill herein and at Contract Manager's approval.

2. Do not place, spread, or compact frozen or thawing material or place specified materials upon frozen or thawing ground or during unfavorable weather conditions.

a. When work is interrupted by rain, do not resume backfill operations until field tests indicate moisture content and density of materials are within specified limits.

b. Rework and recompact after thawing compacted layers which have been frozen before next layer is placed.

3. Mix each lift before compaction to ensure uniform distribution of water content and distribute rocks of permissible sizes through material.

4. Place Trench Backfill and utilize compaction equipment that will not damage structures, pipe, and appurtenances.

a. Place and compact Trench Backfill around pipe and structures evenly to preclude unbalanced pressure.
b. Compaction with large rollers or heavy equipment will not be permitted within 5 feet of structures.
c. Repair damage done during backfill operations or replace at Contract Manager's direction.

5. Place Trench Backfill in uniform lifts of 8 inches maximum in uncompacted thickness, unless otherwise specified herein.
   a. Spread each layer uniformly and evenly.
   b. Perform compaction using compacting rollers, pneumatic or vibratory compactors.
6. When Borrow Material is utilized, place in uniform lifts of 8 inches maximum in uncompacted thickness.
   a. Backhoe buckets permitted for gravel compaction.
7. Backfill Structural Fill areas in uniform lifts of 8 inches maximum in uncompacted thickness and compact to not less than 95 percent of maximum dry density, following ASTM D698, at moisture content within 2 percent optimum for material.
8. Meet following conditions when flowable fill is used instead of Trench Backfill material when specified herein for Type I areas under existing paved areas and for circular precast or cast-in-place concrete manholes.
   a. Prevent floatation during placement of flowable fill.
   b. Install 12 inches minimum of Trench Backfill material around valves, valve boxes, and fire hydrants.
   c. Place flowable fill at maximum of 10 foot lifts.
      1) Cure flowable fill at least 4 hours before placing additional lift of flowable fill.
      2) Cure final lift at least 24 hours before placing additional compacted Trench Backfill material or paving.
   d. For circular precast or cast-in-place concrete manholes, when specified herein, place flowable fill equally around entire manhole from 1 foot above uppermost pipe entering manhole.
      1) Backfill trench with flowable fill from top of Pipe Embedment Zone to below pavement base course.
      2) Outside Type I areas backfill minimum 12 inches Trench Backfill material above flowable fill.

B. Placing Trench Backfill for Pipes.
   1. In new subdivision work where water and sewer service connections are to be placed in same trench at different times, backfill and compact above sewer service connection as specified up to proposed finished grade.
      a. When installing water service connection, re-excavate as required, install water pipe, backfill, and compact as specified.
   2. Detectable Warning Tape
      a. Use blue detectable warning tape for water mainline and water service connections.
      b. When water and sewer are installed in same trench use only blue detectable tape.
      c. Use green detectable warning tape for gravity sewer mainline, gravity sewer service connections, and pressure sewer piping for both grinder pump systems and force mains.

1) Detectable warning tape will not be required when both manholes in gravity sewer mainline reach are within limits of existing or proposed paved areas.

d. Place tape directly over centerline of pipe, between 18 to 30 inches below finished surface and with minimal number of splices.
   1) Overlap tape minimum 6 inches at splices and intersections.

3. On steep slopes, place trench erosion checks following Standard Details, at locations shown on Drawings or at Contract Manager's direction.
4. When pipelines cross under existing utilities, place and compact Trench Backfill around and between existing pipelines or conduits, using manual tampers to ensure proper compaction and to avoid damage to pipes or conduits.
   a. When indicated on Drawings, place and compact Borrow Aggregate to limits following Standard Detail.
   b. Flowable fill may be used instead of Borrow Aggregate specified herein.
5. When connecting to existing pipelines, backfill under and around excavated and undermined existing pipes with Trench Backfill compacted as structural fill:
   a. Backfill existing Rigid Pipe to pipe spring line with Borrow Aggregate ASTM C33, coarse aggregate size number 67, or same Borrow Aggregate as used at connecting or adjacent pipe.
   b. Backfill existing Flexible Pipe to 1 foot above top of pipe:
      1) DIP 24 inch and smaller and Type K Copper Pipe: Trench Backfill.
      2) DIP larger than 24 inch: Borrow Aggregate.
         a) Bank run gravel, gradation number 1,
         b) Or crushed stone, gradation number 3.
      3) PVC Gravity Sewer Pipe:
         a) Borrow aggregate, ASTM C33.
         b) Coarse aggregate, size number 67 or size number 8.
      4) PVC AWWA C900/905 PVC Pipe:
         c) Pipe with 10 feet or less cover:
         (1) Trench Backfill containing no rock or gravel larger than 3/4 inch.
         (2) Or Borrow Aggregate meeting ASTM C33, coarse aggregate size number 67 for Bedding Zone.
         d) Pipe with greater than 10 feet cover:
         (1) Borrow Aggregate meeting ASTM C33, coarse aggregate size number 67 for Bedding Zone.
6. Place and compact specified Trench Backfill in following Zones to width and depth following Standard Details and Drawings, unless otherwise specified.
   a. Additional excavation area below Pipe Embedment Zone: Place as Trench Backfill and compact as Structural Fill.
   b. Pipe Embedment Zone: Place and compact Trench Backfill as Structural Fill.
      1) DIP, 24 inch and smaller and PVC AWWA C900/905: If additional excavation below trench bottom is required to remove unsuitable material, install minimum 6 inches of compacted Trench Backfill between pipe and additional excavation material.
      2) PVC Pipe: Compact using manual tampers.
      3) All sizes of DIP with polyethylene encasement: Place Trench Backfill around pipe without damaging pipe coating and polyethylene encasement.
         a) Do not drop Trench Backfill directly on pipe; use deflecting boards or other temporary protection.
         b) Do not permit workers to walk on or place tools on pipe.

4) Sewer pipe connections to manholes or structures: Bentonite when required, following Section 33 31 00 Standard Details or Drawings.
5) Pipe Embedment Zone within Wetland Areas: Extend from trench bottom to 6 inches above pipe, full width of trench.
6) Pipe to have concrete encasement: Place concrete around pipe within Pipe Embedment Zone, to limits shown on Standard Details.

c. Final Backfill Zone: Place Trench Backfill and compact following these designation types.
1) In Type I areas under existing paved areas:
a) Compact to not less than following percents of maximum dry densities at moisture content within 2 percent of optimum for material, as determined by listed ASTM method.
(1) MSHA highways: 92 percent, except for top foot will be 95 percent following ASTM D1557.
(2) All other paved areas: 95 percent, except for top foot will be 100 percent following ASTM D698.
2) In Type I areas under future paved areas and within public rights of way: Compact to not less than 95 percent of maximum dry density following ASTM D698 at moisture content within range where density can be obtained based on moisture density curves taken on existing soil.
3) In Type II: Compact in layers to form thoroughly dense refill free of voids and to preclude settlement within limits specified herein.
4) In Type III areas: Place in 12 inch maximum lifts and compact to not less than 90 percent of maximum dry density, following ASTM D698, at moisture content within range where density can be obtained.
5) In Type IV areas: Place in 12 inch lifts.

C. Placing Trench Backfill for Structures.
1. Place and compact specified backfill material to width and depth following Standard Details, Drawings, and specified herein.
a. Additional excavation area, below Granular Bedding: Place and compact Trench Backfill as Structural Fill.
b. Granular Bedding, under structure: Place and compact specified herein.
c. Place and compact Trench Backfill as Structural Fill to top of structure or to finished grade, following Drawings or Standard Details.

D. Finished Grade.
2. Slope surface to drain, to provide positive drainage in Type I, II, and III areas.

3.3 RESTORATION
A. Restore and restabilize surface features and facilities damaged or destroyed during construction at least to condition existing before construction, following Section 32 01 29.60, and other applicable Specification Sections.

END OF SECTION 31 23 33

31 25 13
EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work shall consist of the application of erosion and sediment control measures throughout the life of the project to control erosion and to minimize the sedimentation in rivers, streams, lakes, reservoirs, bays, and coastal waters as specified in the Contract Documents or as directed by the Engineer.

B. Erosion and sediment control measures shall be applied to all disturbed areas. In addition, the Contractor shall identify all staging and stockpile areas and apply erosion and sediment control measures as approved by the Engineer and the Maryland Department of the Environment.

C. The Contractor shall assign an employee to the project to serve in the capacity of Erosion and Sediment Control Manager (ESCM).

1.2 STANDARDS AND SPECIFICATIONS

A. The erosion and sediment control measures and devices shall be constructed in conformance with the latest Maryland Standards and Specifications for Soil Erosion and Sediment Control published by the Maryland Department of the Environment, Water Management Administration and all revisions thereof including the additions and modifications specified herein or in the Contract Documents. The Contractor shall keep a copy of the latest Maryland Department of the Environment (MDE) Standards and Specifications for Soil Erosion and Sediment Control on the site at all times.

PART 2 - PRODUCTS

2.1 MATERIALS.

A. Riprap. Shall conform to MSHA 901.03

B. Stone for gabions. Shall conform to MSHA 901.05

C. Hot Mix Asphalt. Shall conform to MSHA 904

D. Pipe. Shall conform to MSHA 905

E. Gabion Wire. Shall conform to MSHA 906

F. Steel Plate. Steel for miscellaneous use shall conform to A 36 or A 709, Grade 36.

G. Welding Material. Welding materials shall conform to AASHTO AWS D1.5.

H. Fence Fabric for Super Silt Fence. Chain link fencing fabric shall be 2 in. mesh woven from coated No. 9 gauge wire. The ends shall have a knuckled selvage at the bottom and a barbed selvage at the top. The fabric shall conform to M 181. Type I fabric shall conform to Class C coating. The mesh shall be 42 in. in height.

I. Seed, Mulch, Fertilizer, Soil Conditioner, Soil Stabilization Matting, and Other Materials for seeding and soil stabilization shall conform to the follows:
   1. Seed. Refer to MSHA 920.06
   2. Mulch. Refer to MSHA 920.04
   3. FERTILIZER. Refer to MSHA 920.03
   4. Soil Stabilization Matting. Use type E unless otherwise shown on the plans. Refer to MSHA 920.05

J. Straw Bales. Straw bales for erosion and sediment control shall conform to the Contract Documents and shall be approximately 14 X 18 X 36 in.

K. Geotextile, Class as specified. Geotextile shall conform to the MSHA 921.092 to 3 in. Stone. Stone shall conform to M 43, No. 2.

L. 3/4 to 1-1/2 in. Stone. Stone shall conform to M 43, No. 4.

M. No. 57 Stone. Stone shall conform to M 43, No. 57.

N. Soil Stabilization Matting will replace Erosion Control Matting, and Geotextile Class SE will replace Filter Cloth and Geotextile Class C where they appear in the latest Maryland Standards and Specifications for Soil Erosion and Sediment Control.

PART 3 - EXECUTION

3.1 GENERAL

A. Refer to MSHA 402.03.01 for excavated material.

3.2 CONTRACTOR RESPONSIBILITIES

A. The Contractor shall construct all erosion and sediment control measures in conformance with 1.2. The Contractor shall have all control measures inspected and approved by the Engineer and Office of Resources and Environmental Protection (OREP) prior to beginning any other land disturbances. The Contractor shall ensure that all runoff from disturbed areas is directed to the sediment control measures. The Contractor shall not remove any erosion or sediment control measure without the approval of the Engineer and OREP.

3.3 EROSION AND SEDIMENT CONTROL PLAN (E & S PLAN) AND SEQUENCE OF CONSTRUCTION

A. The Contractor shall implement the E & S Plan and Sequence of Construction as approved by OREP. Minor adjustments to the sediment control locations may be made in the field with the approval of the Engineer and OREP. Major revisions, deletions, or substitutions to the E & S Plan will require a formal review and approval by the Engineer and OREP. Changes to the approved E & S Plan shall be submitted to the Engineer in writing at least 14 days prior to implementing the change. The Contractor shall obtain Engineer and OREP approval for changes to the E & S Plan or Sequence of Construction prior to implementing the change.

3.4 EROSION AND SEDIMENT CONTROL MANAGER (ESCM)

A. At least 10 days prior to beginning any work, the name and credentials of the ESCM shall be submitted to the Engineer for approval. Any substitutes for the ESCM will be subject to the approval of the Engineer. The substitution shall be timed to ensure that an ESCM is

assigned to the project at all times. The Engineer reserves the right to request a reassignment of the ESCM duties to another individual for any reason.

B. The ESCM shall be thoroughly experienced in all aspects of construction and have satisfactorily completed an Erosion and Sediment Control Training Program either conducted or authorized by OREP pursuant to the appropriate article published in the Annotated Code for the State of Maryland. The ESCM shall have primary responsibility and authority for the implementation of the approved erosion and sediment control plans, schedules and methods of operation for both on-site and off-site activities.

C. The ESCM's duties shall include:

1. Inspect the erosion and sediment controls on a daily basis to ensure that all controls are in place at all times and to develop a list of activities and schedules to ensure conformance with the Contract Documents.
2. Maintain a daily log of these inspections, including actions taken, and submit a written report to the Engineer at the end of the work day.
3. Conduct after storm inspections with the Engineer both during and beyond normal working hours/days and submit a written report to the Engineer.
4. Be assigned the authority by the Contractor to mobilize crews to make immediate repairs to the controls during working and nonworking hours.
5. When requested, accompany the Engineer on Quality Assurance Inspections and inspections made by the regulating agencies.
6. Coordinate with the Engineer to ensure that all corrections are made immediately and that the project is in compliance with the approved plan at all times.

3.5 SCHEDULE

A. Within 14 days after the Notice of Award, the Contractor shall submit for approval to the Engineer, an Erosion and Sediment Control Schedule to implement the E & S Plan. The schedule shall indicate the sequence of construction, implementation and maintenance of controls, temporary and permanent stabilization, and the various stages of soil disturbance. The schedule shall include the following:
1. Clearing and grubbing of areas necessary for installation of perimeter controls specified in the Contract Documents.
2. Construction of perimeter controls specified in the Contract Documents.
3. Remaining clearing and grubbing.
4. Roadway grading (including off-site work).
5. If applicable, utility installation and whether storm drains shall be used or blocked after construction.
6. Final grading, landscaping, and stabilization.
7. Removal of perimeter controls.

B. No work shall be started, on-site or off-site until the Erosion and Sediment Control schedules and methods of operation have been accepted by the Engineer.

3.6 PRECONSTRUCTION CONFERENCE

A. At the Preconstruction Conference, the Contractor shall present a general overview of how erosion and sediment control measures will be implemented on the project.

3.7 MEETINGS

A. At least seven working days prior to the start of work, the Engineer will initiate and conduct an Erosion and Sediment Control Field Meeting. The meeting shall be attended by the ESCM, and representatives of the Engineer.

B. In addition to the initial Erosion and Sediment Control Field Meeting, periodic in-field Erosion and Sediment Control Meetings will be held to review and evaluate the effectiveness of measures already installed, and to plan for the implementation of necessary controls proposed for succeeding areas of soil disturbance.

3.8 INITIAL CONTROLS

A. All perimeter controls such as silt fence, earth dikes/swales, check dams, traps, basins, etc., shall be installed prior to the clearing and grubbing operation.

B. If the Engineer determines that the clearing area has been disturbed and a potential for sediment runoff or erosion exists, the Engineer will direct the Contractor to install the controls at that time.

3.9 STABILIZATION REQUIREMENTS

A. Areas flatter than 3:1 and stockpile areas shall be permanently or temporarily stabilized as soon as possible, but not later than fourteen days after grubbing and grading activities have ceased in the area. Trap embankments and slopes, earth dikes, temporary swales, perimeter dike/swales, ditches, and slopes 3:1 or steeper shall be permanently or temporarily stabilized as soon as possible, but not later than seven days after grubbing and grading activities have ceased in the area. The seven and fourteen day requirements mean that the stabilization operation is complete within the applicable seven or fourteen day time frame.

B. When the excavation or embankment reaches the bottom of the subgrade, those areas in which paving will be placed are exempt from the stabilization requirements. Areas between temporary berms, except median areas, need not be stabilized during incremental stabilization. When permanently stabilized areas are disturbed by the Contractor's grading operation or other activities not specifically approved by the Engineer, the restabilization will be at no additional cost to the Owner. Stabilization requirements may be reduced to less than seven days for sensitive areas. Maintenance shall be performed as necessary to ensure continued stabilization.

C. All slopes shall be tracked within five days of establishment with cleated type equipment operating perpendicular to the slope.

3.10 MAINTENANCE

A. All erosion and sediment control devices shall be maintained during the construction season, the winter months, and other times when the project is shut down. Access shall be maintained to all erosion and sediment controls until the controls are removed. Lack of maintenance by the Contractor will be considered as noncompliance with the E & S Plan and grounds for a shutdown of the project.

B. Controls shall be inspected immediately following storm events. The Contractor shall repair controls when damaged and clean out controls as necessary as the first order of business after a storm event.

C. Any pumping activity, including dewatering sediment traps and basins, shall be directed through a dewatering device approved by OREP.

D. Perimeter controls shall be inspected daily, repairs shall be made immediately.

3.11 WASTE AREAS

A. Off-site waste areas require OREP approval. All other off-site waste areas shall be approved by the appropriate local authority. All waste areas and stockpile areas shall be protected by erosion and sediment control measures and stabilized within the seven or fourteen day stabilization requirement.

3.12 OREP INSPECTIONS

A. OREP will conduct frequent field inspections relative to erosion and sediment control compliance. If they determine that noncompliance with erosion and sediment control provisions are found, their representative will immediately notify the Engineer relative to corrective action. This corrective action may require a shutdown of construction activities until the noncompliance is satisfactorily corrected, and no claims against the Owner will be considered due to a shutdown of the grading operations or the entire project.

3.13 SIDE OR BERM DITCHES AND CULVERTS

A. As a first order of work, the Contractor shall construct the side ditches in fill areas and berm ditches in cuts including lining. These linings shall be protected from sediment deposits. Silt fence shall be placed along the banks of existing streams as shown in the Contract Documents prior to any culverts being placed. To avoid sedimentation during the construction of culverts, the streams shall be diverted around the location of the culvert until the proposed culvert and channel have been stabilized.

3.14 REMOVAL OF CONTROLS

A. No erosion and sediment control measures shall be removed until all previously disturbed areas are vegetated with a minimum 3 in. growth of grass, and the removal has been approved by the Engineer and OREP. The sediment controls shall be backfilled, graded, and stabilized as specified in the Contract Documents.

B. All control devices shall be removed, except where an attempt to remove a particular control may severely disturb an area that has been stabilized. When a sediment trap or stone outlet structure is placed at the bottom of a fill greater than 8 ft, the controls may be left in place as determined by the Engineer. Sediment traps left in place shall be stabilized by placing soil stabilization matting over a permanent seed mix.

3.15 EROSION AND SEDIMENT CONTROL ORIGINAL EXCAVATION

A. The Contractor shall excavate, construct embankments, grade, and backfill for sediment traps, sediment basins, and other sediment controls as specified in the Contract Documents, or as directed by the Engineer.

B. Excavation and embankments shall be to the dimensions for each sediment control as specified in the Contract Documents. Excavated material shall be stockpiled and used for backfill when the sediment controls are removed.

3.16 EROSION AND SEDIMENT CONTROL CLEANOUT EXCAVATION

A. The Contractor shall remove accumulated sediment from sediment controls or other areas during routine maintenance of sediment controls, or as directed by the Engineer.

B. Sediment traps shall be cleaned out as necessary to have a minimum of 50 percent of the wet storage capacity available at all times. Riprap outlet sediment traps shall have at least 75 percent of the wet storage capacity available at all times. Silt fence, super silt fence, stone outlet structures, stone check dams, and straw bales shall have sediment removed when it reaches 50 percent of the height of the control device.

C. Sediment removed from control devices shall be placed in an approved waste site either on or off the project. Material stored on-site may be reused once it is dried and it conforms to OREP requirements for embankment.

3.17 EARTH DIKE

A. Stabilization using sod is prohibited.

3.18 PIPE SLOPE DRAIN

A. Interceptor berms shall be constructed to direct flow into the flared end section when slope drains are placed on grade. The geotextile apron shall be keyed into a 4 X 4 in. trench.

3.19 TEMPORARY RISER MODIFICATION FOR SEDIMENT BASIN

A. See Item 3030 Temporary Riser Modification for Sediment Basin.

3.20 SILT FENCE

A. The geotextile shall be embedded a minimum of 8 in. vertically into the ground and extend a minimum of 22 in. above ground. The fence post shall be driven a minimum 16 in. into the ground and extend a minimum 26 in. above the ground.

B. Silt fence shall be removed and reset when and as directed by the Engineer. All of the requirements for the original placement of the silt fence shall be strictly adhered to when the fence is reset.

3.21 STABILIZED CONSTRUCTION ENTRANCE

A. Stabilized construction entrances shall be located as specified in the Contract Documents or as directed by the Engineer.

B. Rehabilitate stabilized construction entrance shall consist of periodic top dressing with additional aggregate, replacement of pipe, or other repairs to the entrance and sediment trapping devices as needed or as directed by the Engineer.

3.22 SUPER SILT FENCE

A. The construction requirements for the placement of the chain link fence shall be as specified in MSHA 607.03 with the following exceptions:
   1. Drive anchors shall be used when and as directed by the Engineer.
   2. The lower tension wire, brace and truss rods, post caps, 1 in. ground clearance, and concrete footings shall not be used.

B. Geotextile shall be embedded a minimum of 8 in. into the ground and extend a minimum of 33 in. above ground.

C. Super silt fence shall be removed and reset when and as directed by the Engineer. All of the requirements for the original placement of the super silt fence shall be strictly adhered to when the fence is reset.

3.23 TEMPORARY ASPHALT BERM

A. When a storm drain system outfall is directed to a sediment trap, or sediment basin, and the system is to be used for temporarily conveying sediment laden water, all storm drain inlets in nonsump areas shall have temporary asphalt berms constructed as directed by the Engineer at the time of base paving to direct gutter flow into the inlets to avoid surcharging and overflow of inlets in sump areas.

3.24 STONE FOR SEDIMENT CONTROL

A. The Contractor shall place No. 57 stone, 3/4 to 1-1/2 inch stone, 2 to 3 inch stone, 4 to 7 inch stone and riprap for sediment control as specified in the Contract Documents or as directed by the Engineer.

END OF SECTION 31 25 13

31 26 00
TEMPORARY ORANGE CONSTRUCTION FENCE

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work shall consist of furnishing and installing new or like new temporary orange mesh construction fence. The fence shall be used where specified in the Contract Documents or where directed by the Engineer. This fence is not a safety barrier.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Precast Concrete Blocks. Solid concrete masonry block shall conform to C 139.

B. Tie Wire, Tension Wires, Tension Wire Clips and Hardware. These items shall conform to M 181. The galvanized coating shall have a minimum weight of 1.2 oz/ft^2. These items, when used with aluminum coated steel fabric, shall be coated with aluminum at a minimum weight of 0.40 oz/ft^2. The tension wire used with polyvinyl chloride (PVC) coated steel fabric shall have the same coating thickness and color requirements as the fence fabric.

C. Orange Mesh Fencing shall be as approved by the Engineer.

D. Fence posts shall be 4 ft high round posts having a 1.90 in. outside diameter, or a 5-1/2 ft high, 2 in. steel U channel.

E. Samples of the fence fabric, fence posts, movable precast concrete blocks, tie wire, tension wires and other miscellaneous hardware shall be submitted to the Engineer prior to installing any fencing.

PART 3 - EXECUTION

A. Temporary orange construction fence shall be a minimum of 4 ft high with a maximum post spacing of 8 ft. When the fence is installed on a paved surface, a precast concrete block shall be used to support the round fence post. The concrete block shall have a round hole through the center of the block in which the round post shall be inserted. When the fence is installed in unpaved areas, steel U channel fence posts shall be driven 1-1/2 ft into the ground.

B. The fence fabric shall be attached to the posts using tie wire. Fabric shall be secured to the posts by wrapping a tie wire around the horizontal fence strands and the posts. A top tension wire shall be used to prevent sagging. When installed on paved surfaces, the Engineer will determine if a bottom tension wire is required. The Contractor may elect to install the construction fence in another manner if approved by Engineer.

C. Damaged Construction Fence. Damaged construction fence shall be repaired or replaced within four hours after the Contractor is notified. When the Engineer determines that the fence is no longer needed, the Contractor shall remove the fence, which shall become the property of the Contractor.

END OF SECTION 31 26 00

31 31 16
TERMITE CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Soil treatment for termite control.

1.2 DEFINITIONS

A. EPA: Environmental Protection Agency.

B. PCO: Pest control operator.

1.3 SUBMITTALS

A. Product Data: Treatments and application instructions, including EPA-Registered Label.

B. Product Certificates: Signed by manufacturers of termite control products certifying that treatments furnished comply with requirements.

C. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

D. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's record information, including the following as applicable:
1. Date and time of application.
2. Moisture content of soil before application.
3. Brand name and manufacturer of termiticide.
4. Quantity of undiluted termiticide used.
5. Dilutions, methods, volumes, and rates of application used.
6. Areas of application.
7. Water source for application.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications: A pest control operator who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment in jurisdiction where Project is located.

B. Regulatory Requirements: Formulate and apply termiticides, and label with a Federal registration number, to comply with EPA regulations and authorities having jurisdiction.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated.

Do not treat soil while precipitation is occurring. Comply with EPA-Registered Label requirements and requirements of authorities having jurisdiction.

1.6 COORDINATION

A. Coordinate soil treatment application with excavating, filling, and grading and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs, before construction.

1.7 WARRANTY

A. Special Warranty: Written warranty, signed by applicator and Contractor certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation:
   1. Warranty Period: Five years from date of Substantial Completion..

1.8 MAINTENANCE SERVICE

A. Continuing Service: Provide a proposal for continuing service, including monitoring, inspection, and retreatment for occurrences of termite activity, from applicator to Owner, in the form of a standard continuing service agreement, starting on the date of Substantial Completion. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 - PRODUCTS

2.1 SOIL TREATMENT

A. Termiticide: Provide an EPA-registered termiticide complying with requirements of authorities having jurisdiction, in a soluble or emulsible, concentrated formulation that dilutes with water or foaming agent, and formulated to prevent termite infestation. Use only soil treatment solutions that are not harmful to plants. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to the product's EPA-Registered Label.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of the soil, interfaces with earthwork, slab and foundation work, landscaping, and other conditions affecting performance of termite control. Proceed with application only after unsatisfactory conditions have been corrected

3.2 PREPARATION

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's written instructions for preparing substrate.

1. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil and around foundations.

B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended by termiticide manufacturer.

3.3 APPLICATION, GENERAL

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

3.4 APPLYING SOIL TREATMENT

A. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute the treatment evenly.

1. Masonry: Treat voids.
2. Penetrations: At expansion joints, control joints, and areas where slabs will be penetrated.

B. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.

C. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

D. Post warning signs in areas of application.

E. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

F. Post warning signs in areas of application.

G. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

END OF SECTION 31 31 16

CERTIFICATION OF DISPOSAL

The undersigned hereby attests that they have written agreements to dispose of debris from the _____ Project, _____ County, _____ and hereby certifies that all disposal of debris is in accordance with all Federal, State and local laws and regulations.

Approximate Quantity of Material Disposed: _____ Cu. Yds.

Type of Material Disposed: _____

_____

Location of Disposal Site: _____

_____

CONTRACTOR: _____

_____
President (Signature)

_____
(Typed/Printed Name)

_____
Treasurer (Signature)

_____
(Typed/Printed Name)

(CORPORATE SEAL)

Attest: _____
Secretary (Signature)

_____
(Typed/Printed Name)

32 01 29.60
PATCH EXISTING PAVEMENT AND RESET UTILITY SERVICES

PART 1 GENERAL

1.1 DESCRIPTION

A. The work performed in conjunction with the placement or repair of utility lines consists of trenching, shoring, sub-grade replacement, base course replacement, surface course replacement and pavement marking replacement for composite pavements, PCC pavements, flexible pavements, curb replacement, combination curb and gutter replacement, sidewalk replacement, the adjusting and resetting of all manhole frames, inlet frames and other utility service structures in accordance with these specifications, plans and/or standards.

PART 2 PRODUCTS

2.1 MATERIALS

A. Aggregates for Hot Mix Asphalt (HMA) – Refer to MSHA 901.01).

B. Performance Graded Asphalt Binders and Hot Mix Asphalt – Refer to MSHA 904.

C. Crusher Run Aggregate CR-6— Refer to MSHA 901.01 (Aggregate Base Course).

D. Graded Aggregate— Refer to 32 11 23 (Aggregate Base Course).

E. Flowable Backfill — Refer to MSHA 314.02 (Flowable Fill).

PART 3 EXECUTION

3.1 GENERAL

A. The existing pavement shall be removed with a minimum disturbance to the base material and the faces of the remaining pavement shall be plane without ragged edges. The use of equipment that could damage the existing pavement is prohibited. If any part of the existing pavement is damaged, it shall be repaired or replaced by the Contractor at no additional cost to the Owner. Repairs shall be made in only one lane at a time for each roadway.

3.2 EXISTING PAVEMENT

A. Each day the Contractor shall complete all repairs for which excavation has been completed or the excavation shall be covered with steel plates. Open excavated areas at the end of the workday are prohibited.

3.3 EMERGENCY FILLER

F. When the existing pavement is a flexible pavement, the Contractor shall have readily available sufficient cold patch material to completely fill the void of the repair area. This material shall be subject to the approval of the Engineer and shall be placed and compacted in the void when directed by the Engineer. At the beginning of the next day's work, this material shall be completely removed as directed by the Engineer.

3.4 MAINTENANCE OF TRAFFIC

A. Procedure for maintenance of traffic shall be approved by the Engineer before any existing pavement is removed.

3.5 STEEL PLATES

A. The Contractor shall have an ample supply of 12 ft X 14 ft X 1 inch thick steel plates available on the project to cover emergency filler or be placed over the patch area until the concrete has developed sufficient strength to carry traffic. The Contractor shall place the appropriate notification signs ("Steel Plates") if it uses steel plates at any point in the processes described herein. Further, the Contractor shall notify the Engineer before placing any steel plates in the Public Right-of-Way.

3.6 PATCH CONSTRUCTION

A. FLEXIBLE PAVEMENTS: Refer to plans for additional information on this patch construction. All material and specification references on the aforementioned detail will be superseded by this specification.

1. TRENCH EXCAVATION. The Contractor shall cut the pavement full depth along the trench outline by means of a power saw.
2. RESTORATION OF BASE COURSE

a. Restoration Cut: The Contractor shall cut the pavement parallel to the trench and wider than the trench on both sides of the excavation and across the ends in accordance with the aforementioned standard detail. The existing pavement materials that are removed shall be disposed of immediately by the Contractor.

b. Replacement of Base Course: The top six inches of the trench shall be filled with crusher run aggregate CR-6, compacted in accordance to MSHA 901.01 (Aggregate Base Course). The Contractor shall protect the aggregate base or subgrade after preparation. Note that if the Contractor chooses the flowable fill option, aggregate sub-base is not needed. Prior to placing the HMA, the exposed vertical surface of all adjacent pavements shall be thoroughly cleaned and all vertical surfaces shall be tack coated. The tack coat shall be uniformly applied to the surface at a rate of 0.01 to 0.05 gal/yd^2 as directed by the Engineer. The HMA mixture may be spread by shovel, rake or other method approved by the Engineer. Placing HMA on a frozen base is prohibited. Use Hot Mix Asphalt Superpave 19.0 mm for the base course PG64-22, Level 2 The maximum lift thickness shall be 3 inches and the minimum lift thickness shall be 2 inches. The temperature of the mixture shall be a minimum of 225° F at the time of placement. Apply a tack coat between each lift as described above. Manual operation will be permitted for placement of the HMA. Patch construction shall conform to the applicable portions of 32 01 19.59 (Asphalt Patches). Cores, control strip and pavement profile measurements are waived. Equipment, placement, compaction and quality control procedures shall be as approved by the Engineer. Where the Engineer determines the areas involved to be of narrow or irregular section where mechanical paving equipment is impractical, hand tamping will be permitted. Compaction tests on hot mix asphalt courses will be waived in these narrow or irregular areas. Where areas are of sufficient size to permit the use of mechanical paving equipment, use of such paving equipment and compaction tests shall be required.

3.7 SURFACE COURSE RESTORATION

a. EXISTING PAVING SURFACE MORE THAN 2 YEARS OLD
   1) If the existing wearing surface is more than 2 years old, then the surface course can be restricted to the limits of the full depth patch construction. The surface course shall be Hot Mix Asphalt Superpave 12.5 mm PG64-22, level 2, two inches thick.
   2) Whenever a utility cut is within 5 feet of another one, both cuts shall be encapsulated in a single patch by either milling away the intervening existing surface course to allow for a single surface course patch or by combing the two patches with a single full depth pavement patch.

3.8 CROSSWALKS AND SIDEWALKS

A. CROSSWALKS. If a utility cut intersects a crosswalk(s) of any material other than that of the surrounding roadway, the permanent restoration of the crosswalk(s) must be restored to its original condition with materials identical to those of the original crosswalk(s).

B. SIDEWALKS. If a sidewalk(s) is affected by a utility cut, the Contractor must restore it to its original condition with materials identical to those of the original sidewalk. All sidewalks shall be removed and replaced to the nearest existing expansion or contraction joint on either side of the utility cut.

3.9 PAVEMENT MARKING

A. If any pavement markings are affected by a utility cut, the Contractor shall replace them with temporary pavement markings within 48 hours. Immediately upon the completion of a permanent repair, the Contractor shall replace temporary pavement markings with permanent ones.

3.10 UTILITY ADJUSTMENTS

A. Utility adjustments shall be made to be flush with the proposed grade. The frames shall be adjusted to the new grade using brick masonry and mortar. Wood blocks or pegs will not be permitted. All reset frames shall be protected from traffic for a period of twenty-four (24) hours after the concrete is in place. No Hot Mix Asphalt shall be placed around the utility structures or in areas of pavement repairs until the concrete has set for a period of twenty-four (24) hours. The Contractor shall be held responsible for the new grade of the adjusted structures and any structures determined by the Engineer to be off grade shall be reset to the correct grade at the Contractor's expense.

3.11 FLOWABLE FILL

A. If flowable fill is used as backfill, a foot of sand compacted in accordance with MSHA 314.03, shall be placed over any utility before the trench is backfilled.

3.12 UNACCEPTABLE REPAIRS

A. Pavement repairs that have been damaged by traffic or other causes or are not in conformance with the Contract Documents shall be removed and replaced by the Contractor at no additional cost to the Owner.

END OF SECTION 32 01 29.60

32 11 23
AGGREGATE BASE COURSE

PART 1 GENERAL

1.1 DESCRIPTION

A. This work shall consist of constructing base courses using one of the following as specified in the Contract Documents or as directed by the Engineer:

1. Graded aggregate without a stabilizing agent.
2. Plant mixed graded aggregate with a portland cement stabilizing agent.
3. Bank run gravel.
4. Sand aggregate.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Graded Aggregate for Base Course — See MSHA 901.01

B. Bank Run Gravel for Base Course — See MSHA 901.01

C. Sand Aggregate Base Course

Coarse Aggregate	See MSHA 901.01, Size No. 57
Fine Aggregate	See MSHA 916.01.01

D. Portland Cement — See MSHA 902, Type I or IA

E. Emulsified Asphalt:

Emulsified asphalts shall conform to M 140 or M 208 with the following exceptions:

1. Cement mixing tests are waived.
2. Grade SS-1 viscosity shall be 50 to 400 seconds at 77 F.
3. Maximum of 3.0 percent by volume of oil distillate.
4. The sieve test requirement for field samples shall be a maximum of 0.4 percent.

F. Production Plant — See MSHA 915

G. Water

1. Water shall conform to the pH requirements of T 26, Method B and shall be clear. If questionable quality is suspected, the water shall conform to the limits of the comparison tests with distilled water as specified in T 26. The chloride concentration of water used in mixing and curing of portland cement concrete shall be determined in conformance with D 512 and shall not exceed 1000 ppm

G. Moisture and Dust Control Agents: — See MSHA 921.02

PART 3 EXECUTION

3.1 CONSTRUCTION

A. At least 30 days prior to the start of constructing the base course, the Contractor shall submit the proposed plants, equipment, and material sources to the Engineer for approval.

B. The Contractor shall protect the subgrade and base against damage from all causes. Any part of the subgrade or base that is damaged shall be repaired or replaced by the Contractor in a manner acceptable to the Engineer at no additional cost to the Owner.

C. Excavation for widening shall be limited to an area which can be backfilled the same working day using graded aggregate base course. The temporary graded aggregate base wedge shall be maintained with a 4:1 or flatter fill slope. The material shall be compacted as directed by the Engineer. The graded aggregate base wedge shall remain in place until placement of the hot mix asphalt base.

3.2 EQUIPMENT

A. All equipment, including the production plant and on-site equipment, shall be subject to approval by the Engineer. The plant shall be ready for inspection by the Engineer at least 48 hours prior to the start of construction operations.

3.3 WEATHER RESTRICTIONS

A. Temperature and Surface Conditions: Graded aggregate stabilized with portland cement shall be placed only when the ambient air and surface temperature is at least 40 F and rising. Graded aggregate, bank run gravel and sand aggregate base shall be placed only when the ambient air and surface temperature is at least 32 F and rising. Placing material on a frozen subgrade is prohibited.

B. Cold Weather Protection: The plant mixed graded aggregate stabilized base shall be protected from freezing during the seven day curing period.

C. Precipitation: Construction during precipitation is prohibited. When precipitation has occurred during the previous 24 hours, the Engineer will determine if the subgrade is sufficiently dry. Any material en route from the plant to the job site may be placed at the Contractor's risk

3.4 SUBGRADE PREPARATION

B. The approved subgrade set to final line and grade shall be completed at least 500 ft ahead of the base course or as directed by the Engineer before the base course construction begins. The foundation shall be constructed as specified in MSHA 204 and MSHA 208, the Contract Documents, and as approved by the Engineer. If traffic, including construction equipment, is allowed to use the subgrade foundation or preceding layer, it shall be distributed over the entire width of the course to aid in obtaining uniform and thorough compaction. If ruts are formed, they shall be removed by reshaping and recompacting the affected area as specified in MSHA 204.

3.5 STABILIZED GRADED AGGREGATE BASE MIX

A. The amount of portland cement shall be determined as specified in Maryland Standard Methods of Tests 321.

3.6 BANK RUN GRAVEL BASE MIX

C. The Contractor will be permitted to mix or blend materials using chemical additives approved by the Engineer.

3.7 SAND AGGREGATE BASE MIX

A. The mixture shall contain 35 to 40 percent coarse material as measured by dry weight of the total mix.

3.8 TRANSPORTATION

A. Mixed base materials shall be handled and transported in a manner that minimizes segregation and loss of moisture. All loads shall be covered in conformance with State laws unless hauling is off road and is approved by the Engineer. Dumping into piles, hauling over the completed base course, and stockpiling of material on the job site is prohibited unless approved by the Engineer.

3.9 SPREADING

A. The base material shall be uniformly spread without segregating the coarse and fine particles, in layers of approximately equal thickness, to provide the specified planned depth. Shoulders or berms not less than 2 ft wide shall be built up on each side of the base to the top elevation of each uncompacted layer unless the base is placed against concrete curbs or gutters.

3.9.1 GRADE OR FINISHED SURFACE CONTROL

A. The surface of the base material shall be shaped to the required lines, grades and cross section specified in the Contract Documents. Grades shall be set longitudinally and transversely with fixed controls having a maximum spacing of 25 ft. The surface material shall be compacted and smoothed over its full width using a smooth faced steel wheeled roller or, if rolling is not feasible, by mechanical tampers and vibratory compactors as approved by the Engineer. The finished grade shall not deviate more than 1/2 in. from the established grade.

3.10 COMPACTION

A. Immediately after placement, the base material shall be compacted to the required density. During compaction operations, the moisture content of the material shall be maintained within 2 percent of the materials optimum moisture. The optimum moisture content and maximum dry density shall be determined as follows:

1. Sand Aggregate Base and Bank Run Gravel Base: T 180
2. Graded Aggregate Base and Graded Stabilized Aggregate Base: Maryland Standard Method of Tests 321

B. Graded aggregate for base, bank run gravel base, and sand aggregate base shall be compacted to a minimum density of 97 percent of the maximum dry density. Graded stabilized aggregate base shall be compacted to a minimum dry density of 95 percent of the maximum dry density. In place density shall be measured as specified in Maryland Standard Method of Tests 350 or 352.

C. Compaction operations, except on superelevated curves, shall begin at the sides of the

course, overlap the shoulder or berm at least 1 ft and progress toward the center parallel to the center line of the roadway. Superelevated curve compaction shall begin at the low side of the superelevation and progress toward the high side. The compaction operation shall continue until all compaction marks are eliminated.

3.11 GRADED STABILIZED AGGREGATE BASE PROTECTION AND CURING

A. When graded stabilized aggregate base is used, the spreading, compacting and shaping shall be completed within three hours after the mixing water, cement and aggregate have come in contact. Any section not conforming to these requirements shall be reconstructed as directed by the Engineer at no additional cost to the Owner. The surface of the stabilized aggregate base course shall be maintained in a moist condition until the emulsified asphalt seal coat is applied. The emulsified asphalt shall be applied by distributing equipment as specified in MSHA 503.03.01 at the rate of 0.2 gal/yd^2. Ponding of the emulsified asphalt shall be avoided. If ponding occurs, the Contractor shall use a sand blotter or an equivalent method as approved by the Engineer.

B. The stabilized aggregate base course shall be allowed to cure for a period of seven days. During this period the base course shall be closed to all traffic. Any portion of the base course seal coat that is damaged shall be repaired at no additional cost to the Owner.

3.12 MOISTURE AND DUST CONTROL AGENTS

A. When specified in the Contract Documents or as directed by the Engineer, calcium or magnesium chloride shall be added at the plant or applied to the surface of the graded aggregate, bank run gravel, or sand aggregate base at the project site. Calcium chloride shall be applied at the rate of 1 lb/yd^2. Magnesium chloride shall be applied at the rate of 1 lb/yd^2 or as a solution at the rate of 1/2 gal/yd^2.

3.13 MAINTENANCE

A. During construction and after completion of the base course, the base shall be maintained by the Contractor until the surface course is placed. Unacceptable work that cannot be repaired shall be replaced for the full depth of the base at no additional cost to the Owner.

END OF SECTION 32 11 23

32 12 16
HOT MIX ASPHALT PAVEMENT

PART 1 GENERAL

1.1 DESCRIPTION

A. This work shall consist of constructing hot mix asphalt (HMA) pavement as specified in the Contract Documents.

PART 2 PRODUCTS

2.1 MATERIALS.

A. Performance Graded Asphalt Binders and Hot Mix Asphalt: MSHA 904.02

B. Tack Coat: MSHA 904.03

C. Hot Mix Asphalt (HMA): MSHA 904.04.

a. Aggregates. Aggregates shall conform to the following, and AASHTO MP2 with the exception that the aggregate retained on the 4.75 mm sieve shall be tested for flat and elongated particles in conformance with D 4791. When recycled asphalt pavement is used in an HMA mix as defined in Maryland Standard Method of Tests 412, it shall be considered an aggregate source.

Grading requirements are outlined in Tables A and B; physical properties in MSHA 901 B and MSHA 901 D. Force drying may be used in the preparation of samples for grading tests conducted in the field. Steel slag may be used.

b. Mix Design. The Contractor shall develop a Superpave mix design in conformance with AASHTO PP 28. HMA Superpave mixes shall conform to the specification for Superpave Volumetric Mix Design, AASHTO MP 2, and shall be designed for the Equivalent Single Axle Loading (ESAL) range specified in the Contract Documents.

The Contractor may elect to use crushed, recycled asphalt pavement (RAP) material or a maximum of 5 percent roofing shingles from manufacturing waste. The allowable percentage and its suitability for use shall be determined in conformance with Maryland Standard Method of Tests 412. When using 15 percent or less of RAP, binder viscosity adjustments are not required.

The use of RAP may be considered for applications where higher polish value aggregates are required. Approval for use will be on an individual project basis. Documentation of RAP stockpile quality and traceability shall be submitted to the Engineer for approval prior to use.

Crushed glass shall not be used in surface mixes. RAP and roofing shingles from manufacturing waste shall not be used in gap-graded mixes, surface mixes requiring high polish aggregate, or mixes requiring elastomer type polymer binder.

c. Mix Design Approval. Documents containing the data from the Contractor's laboratory study shall be submitted to the Engineer for tentative approval at least two weeks prior to paving operations using Engineer's approved AASHTO software, and shall include the following:

1) Mix designation.

2) Source and percentage of aggregate.
3) Source, percentage, and grade of performance graded asphalt binder.
4) Anticipated gradation and proportion of each component aggregate.
5) Combined cold feed grading, extracted grading, or ignited grading.
6) Plant where the HMA mix will be produced.
7) Plant target mixing temperature based on viscosity of 0.22 Pa·s.
8) Percent passing No. 200 sieve removed by dust collecting system.
9) Ratio of dust to binder material on effective asphalt.
10) Maximum specific gravity at the target binder content.
11) Mix design grading plotted on 0.45 power gradation chart.
12) Tensile strength ratio and worksheets.
13) The gyratory compaction curve for N_{max}.
14) The bulk specific gravity at N_{design} gyrations.
15) The air void content (percent Va) at $N_{initial}$, N_{design}, and N_{max} gyrations.
16) The voids in the mineral aggregate (percent VMA) and the voids filled with asphalt (percent VFA) at N_{design} gyrations (TP4).
17) The slope of the gyratory compaction curve.
18) All consensus and source properties.
    a) Coarse aggregate angularity.
    b) Flat and elongated.
    c) Sand equivalent.
    d) Uncompacted void content of fine aggregate.
    e) Bulk and apparent specific gravity of coarse and fine aggregate.
    f) Absorption of coarse and fine aggregate.

Mix designs submitted to the Engineer for approval shall be accompanied by a quantity of job mix formula aggregate and appropriate amount of required PG binder for ignition oven calibration.

If previous construction or performance experience has shown the proposed mix design to be unsatisfactory, the Engineer may require the Contractor to submit a more suitable design.

If the Contractor proposes to change the source of aggregate used in the mix, a revised mix design shall be submitted with the information required above and in 2.1 A 4 b. The conditions set forth above relative to initial submission shall apply. If a change in the Performance Grade binder source becomes necessary, a stripping test shall be conducted in conformance with Maryland Standard Method of Tests 410, prior to approval. The Engineer may require an antistripping additive test in conformance with D 4867 before giving the final approval.

Field Verification of Mix Design. After receiving the tentative approval for the mix design from the Engineer, the Contractor shall conduct a field verification of the mix at the beginning of production in each plant. Field verification shall be performed by the certified personnel as specified in Part 4. The verification samples shall be prepared as specified in PP28. The Contractor shall notify the Engineer at least two working days in advance of the scheduled verification.

Verification Evaluation.

1) Initial verification shall consist of four samples tested for the parameters listed in Maryland Standard Method of Tests 730, Table 3. These

samples shall be randomly drawn from the first day's production. If the first day of production is less than 1000 tons, the Contractor may choose to spread verification testing over the number of days needed to accumulate 1000 tons. The verification testing shall be completed on the day when production has reached the 1000 tons. The Contractor shall evaluate the verification tests results as specified in Maryland Standard Method of Tests 730. All tonnage up to and including the final day of verification will not be subject to a price adjustment if individual test data is within the allowable control limits specified in Table C.

2) If the mix produced by the plant conforms to the parameters listed in Maryland Standard Method of Tests 730, Table 3 with the Percent Within Specification Limit (PWSL) a minimum of 85, production may proceed without any changes. If the Contractor has submitted mixes with identical aggregate combinations and differing asphalt contents associated with changes in ESAL loads, verification will be limited to volumetric analysis at the Engineer's discretion.

3) If the mix produced by the plant does not conform to the parameters listed in Maryland Standard Method of Tests 730, Table 3 with PWSL a minimum of 85, then an adjustment to the asphalt content or gradation may be made to bring the mix design requirements within acceptable levels.

Permissible adjustment limitations between the approved Mix Design and Adjusted Mix Design are as follows:

TEST PROPERTY	PERMISSIBLE ADJUSTMENT % (*)
Larger than 1/2 in. (12.5 mm) sieve	± 5
1/2 in. (12.5 mm) thru No. 4 (4.75 mm) sieves	± 4
No. 8 (2.36 mm) thru No. 100 (1.50 µm) sieves	± 3
No. 200 (75 µm) sieve	± 1.0
Binder Content	± 0.20

*The permissible adjustment for all mixes shall establish a job mix formula having targets outside the restricted zone. Additionally, Superpave mixes shall be within control points.

When an adjustment is made to the mix design, a second verification shall be performed to ensure that the modified mix conforms to all design requirements. The time and tonnage limitations shall be as specified in 1) above. Material produced during this verification will be subject to a price adjustment if it does not conform to Specifications.

If the adjusted mix conforms to the PWSL, production may proceed. If the mix does not conform to these requirements, production for the mix shall be suspended and a new mix design shall be submitted to the Engineer for approval. The new mix shall be designed as specified in Maryland Standard Method of Tests 412 or AASHTO PP28.

4) Subsequent designs submitted due to nonconformance will be subjected to the price adjustment during the required field verifications. If the mix does not conform to 2) above during the initial verification, production for the mix shall be suspended until corrective action is taken as approved by the Engineer.

d. Antistripping Additives. HMA shall have a minimum Tensile Strength Ratio (TSR) of 0.85 when tested in conformance with D 4867. The freeze-thaw conditioning cycle is required. HMA mixes not conforming to the minimum TSR requirement shall include an antistripping additive.

When an antistripping additive is needed, the exact quantity shall be determined by the producer in conformance with D 4867 based on a minimum TSR of 0.85.

When a heat stable antistripping additive is used, the minimum dosage rate shall be 0.20 percent of the total weight of asphalt. The additive shall be introduced at the plant by line blending, metering, or otherwise measuring to ensure accurate proportioning and thorough mixing.

When hydrated lime is used, it shall be added in slurry form at the rate of 1.0 to 1.5 percent by weight of total aggregate. The hydrated lime shall conform to C 1097. Lime slurry shall be sprayed uniformly on the damp, cold aggregate on the feed belt prior to entry into the HMA plant dryer.

Plant control and acceptance of the mix shall be based on Maryland Standard Method of Tests 410 with respect to its stripping potential.

e. Plant Control. The following tolerances shall apply:

TABLE C – MIX TOLERANCES

PHYSICAL PROPERTY	TOLERANCE (b)
Passing No. 4 (4.75 mm) sieve and larger, %	± 7
Passing No. 8 (2.36 mm) thru No. 100 (150 μm) sieve, %	± 4
Passing No. 200 (75 μm) sieve, %	± 2
Asphalt content, %	± 0.4
Ratio of dust to binder material	0.6 to 1.6 (a)
Mix temperature leaving plant versus mix design temperature, F	± 25
Deviation of maximum specific gravity per lot versus design maximum specific gravity	± 0.030
Voids, total mix, (VTM), %	3.5 ± 1.2
Voids, total mix, 4.75mm mix (VTM), %	3 ± 2

Voids in mineral aggregate, (VMA), %	± 1.2 from design target
Voids filled asphalt (VFA), %	Within spec
Bulk specific gravity, G_{mb}, %	± 0.022
G_{mb} at N_{max}, %	+ 0.5

(a) Not applicable to 4.75 mm.
(b) For mixes other than Gap Graded HMA.

PWSL computations shall be performed for maximum specific gravity, voids in the total mix, voids in the mineral aggregate, and voids filled with asphalt. This computation shall be performed as specified in 4.3 using the moving average of the last three consecutive test values for each parameter. If the PWSL for the three test values fall below 85, corrective action shall be taken to bring the PWSL to at least 85. If the PWSL drops below 68, production shall be suspended until corrective action is taken as approved by the Engineer.

B. Crack Filler. Joint sealer and crack filler shall conform to D 3405 as modified by Maryland Standard Method of Tests 404. The manufacturer shall furnish certification. This certification shall be a document which verifies that the material and work complies with the applicable specifications and includes the actual test results to confirm the statement. The contents of the certification shall be on the Contractor's/vendor's/manufacturer's letterhead or approved document and shall be duly signed by a company officer. Manufacturer's recommendations regarding heating and pouring temperatures will be used when testing these materials. If a range of temperatures is recommended, the midpoint will be used as the pour point.

1. Silicone Joint Sealer And Crack Filler.
   a. Silicone joint sealer and crack filler shall be low modulus, one component compound which may or may not require a primer for bonding to concrete. If a primer is required, it shall be as recommended by the sealant manufacturer and shall be placed on the joint faces following the insertion of the backup material.
   b. Silicone material, when tested at 73 ± 3 F and 45 to 55 relative humidity, shall conform to the following:

TEST PROPERTY	TEST METHOD	SPECIFICATION LIMITS
Shore A Hardness, at 7 days	D 2240	10-25
Tensile Strength at 150 % Elongation, psi max	D 412 Die C	45
Elongation, % min	D 412 Die C	700
Adhesion in Peel, lb/in. min	Federal Spec TT-S-00230	20

Flow, 0.01 in. max	T 187	0.3
Tack-Free Time, minutes	D 2377	20-75

c. Each container of silicone sealer and crack filler shall have a minimum shelf life of six months. Material more than six months old shall be retested.

C. Production Plant shall be certified by MSHA in accordance with MSHA 915.

PART 3 - EXECUTION

3.1 GENERAL

A. Quality Control Plan. At least 30 days prior to the placement of any HMA pavement, the Contractor shall submit in writing a plant Quality Control Plan to the Engineer and a field Quality Control Plan to the Engineer for approval. The Quality Control Plans shall contain a statistically based procedure of random sampling and shall show how the Contractor proposes to control the equipment, materials, production and paving operations to ensure conformance with these Specifications. A master plant Quality Control Plan may be submitted for this prior approval. If a master plant quality control plan is submitted and approved, an addendum shall be submitted for each specific Contract.

The plan shall contain production plants, location of plants with respect to the project site, personnel qualifications, inspection and record keeping methods, and minimum frequencies of sampling and testing as specified in Maryland Standard Method of Tests 730, Table 3. The plan shall also detail when and how corrective action will be taken for unsatisfactory construction practices and deviations from the material Specifications. Additionally, the plan shall include a Quality Control Plan for the plant which addresses all elements necessary for quality control.

B. Plan Administrator and Certified Technicians . The Quality Control Plan shall designate a Plan Administrator. The Plan Administrator shall have full authority to institute any action necessary for the successful operation of the Plan. The Plan Administrator may supervise the Quality Control Plan on more than one project if that person can be in contact with the job site within one hour after being notified of a problem.

The Quality Control Plan shall also designate a Certified Plant Control Technician, Field Control Technician and Certified Materials Tester, if used, as specified in Maryland Standard Method of Tests 731.

C. Records. The Contractor shall maintain complete records of sampling, testing, actions taken to correct problems and quality control inspection results and shall make them available to the Engineer upon request. Copies of the reports shall be provided when requested by the Engineer.

Linear control charts shall be maintained by the Contractor. Control charts shall be maintained in the Quality Control laboratory in a manner satisfactory to the Engineer and shall be current. As a minimum, the control charts shall identify the mix design number, each test result and the upper and lower specification limits applicable to each test.

D. Acceptance. The Engineer will provide acceptance by:

1. Periodically observing tests performed by the producer.
2. Monitoring required control charts.
3. Directing the producer to take additional samples at any time and location.
4. Monitoring the Contractor's conformance with the Quality Control Plan.
5. Evaluating quality control sampling and testing by an independent assurance program.

A. The Contractor shall protect the pavement against damage from all causes. Any part of the pavement that is damaged shall be repaired or replaced by the Contractor at no additional cost to the Owner.

3.2 EQUIPMENT

All equipment, including the production plant and paving equipment, shall be subject to approval by the Engineer. The plant shall be ready for inspection by the Engineer at least 48 hours prior to the start of construction operations.

A. Hauling Units. Refer to 2.1 C 2 a 6. Due regard shall be given to the safety and convenience of the public while applying and maintaining the tack coat. Provisions shall be made to minimize hauling trucks from tracking tack coat onto the adjacent pavement.

B. Pavers. Pavers will be inspected and approved by the Engineer based upon the manufacturer's specification manual (copy to be provided by the Contractor). The paver shall be a self-contained, self-propelled unit capable of spreading the mixture true to line, grade and cross slope. The paver shall be equipped with a screed or strike off assembly that will produce a finished surface of the required smoothness and texture without tearing, shoving or gouging the mixture. The paver shall have automatic controls for transverse slope and grade. Controls shall be capable of sensing grade from an outside reference line or ski and sensing the transverse slope of the screed to maintain the required grade and transverse slope within plus or minus 0.1 of the required slope percentage.

Manual operation will be permitted in the construction of irregularly shaped and minor areas, or where directed by the Engineer.
Whenever a breakdown or malfunction of any automatic control occurs, the equipment may be operated manually for the remainder of the work day as directed by the Engineer.

Reference lines or other suitable markings to control the horizontal alignment shall be provided by the Contractor, subject to the approval of the Engineer.

C. Rollers. Rollers shall be self-propelled, reversible, and steel wheeled or pneumatic tired. Rollers may be vibratory or nonvibratory, and they may be operated in the vibratory mode as long as the Engineer determines that the roller is not cracking or damaging the aggregate in the mix. Rollers shall not be used in the vibratory mode on bridge decks. Pneumatic tire rollers shall have multiple tires of equal size with smooth tread. Wheels shall be arranged to oscillate in pairs, or they may be individually sprung. Tires shall be uniformly inflated at the operating pressure approved by the Engineer. The Contractor shall furnish the Engineer a manufacturer's table showing this data. The difference in tire pressure between any two tires shall not be greater than 5 psi. The Contractor shall provide a means for checking the tire pressure on the job at all times.

3.3 WEATHER RESTRICTIONS

A. HMA material shall only be placed on roadway surfaces when the ambient air and surface temperature is at least 40 F and rising for surface mixes and at least 32 F and rising for base mixes. The pavement surfaces shall be clean and dry and approved by the Engineer before HMA paving begins. Placing HMA material on a frozen graded aggregate base is prohibited. When weather conditions differ from these limits, material en route from the plant to the job site may be used at the Contractor's risk. If placement of the material is stopped by the Engineer, all material en route shall be wasted at no additional cost to the Owner.

3.4 FOUNDATION PREPARATION

A. Prior to placement of paving material, the foundation shall be constructed as specified in the Contract Documents and approved by the Engineer. When paving over existing pavement, all excess crack filling or patch material shall be removed and all spalls and potholes shall be cleaned, tack coated, filled and tamped with HMA before placement. Manholes, valve boxes, inlets, and other appurtenances within the area to be paved shall be adjusted to grade as directed by the Engineer.

3.5 TACK COAT

A. Prior to application of the tack coat, the surface shall be cleaned of all loose and foreign materials. The tack coat shall be uniformly applied to the surface by full circulation spray bars that are laterally and vertically adjustable and provide triple fanning and overlapping action so that the resulting coating shall be residual asphalt applied at a rate of 0.01 to 0.05 gal/yd^2 as directed by the Engineer.

3.6 HOT MIX ASPHALT PLACEMENT

A. HMA shall be placed by the paver. Delivery of the mixture by the hauling units and placement shall be continuous. The temperature of the mixture shall be a minimum of 225 F at the time of placement. Broadcasting of loose mixture over the new surface is prohibited.

3.7 COMPACTION

A. Immediately following placement of the HMA, the mixture shall be compacted by rolling to an in place density of 92.0 to 97.0 percent of the maximum density. In place compaction shall be completed before the mixture cools below 185 F, as determined by a probe type surface thermometer, supplied by the Contractor and approved by the Engineer. Price adjustment due to noncompliance with the required density will be as specified in 4.3. Probe type surface thermometer shall remain the property of the Contractor at the completion of the project.

B. Rolling shall consist of six separate operations in the following sequence:
   1. Transverse joint.
   2. Longitudinal joint.
   3. Edges.
   4. Initial breakdown rolling.
   5. Second or intermediate rolling.
   6. Finish rolling.

C. Steel wheel rollers shall be used for the first rolling of all joints and edges, the initial breakdown rolling, and the finish rolling.

D. Rollers shall start at the sides and proceed longitudinally toward the center of the pavement, except on superelevated curves. The rolling shall begin at the low side and progress toward the high side. Successive trips of the roller shall overlap by at least half the width of the roller, and alternate trips shall not end at the same point. When base widening is too narrow to permit the use of conventional rollers, a power driven trench roller shall be used. When the trench must be excavated wider than the proposed width of the widening, an earth berm or shoulder shall be formed against the loose HMA as soon as it is placed. The two materials shall be rolled and compacted simultaneously. Roller marks shall not be visible after rolling operations.

E. After rolling is completed, no traffic of any kind will be permitted on the pavement until the pavement has cooled to less than 140 F or as directed by the Engineer.

3.8 JOINTS

A. Both longitudinal and transverse joints in successive courses shall be staggered so that one is not above the other. Transverse joints shall be staggered by the length of the paver. Longitudinal joints shall be staggered a minimum of 6 in. and shall be arranged so that the longitudinal joint in the top course shall be within 6 in. of the line dividing the traffic lanes.

B. Joints shall be constructed to provide a continuous bond between the old and new surfaces.

C. Joints shall be coated with tack coat as directed by the Engineer. When placing a surface course, the edge of the existing pavement shall be cut back for its full depth at transverse joints to expose a fresh surface which shall be coated with tack coat material as directed by the Engineer. Before placing the mixture against curbs, gutters, headers, manholes, etc., all contact surfaces shall be coated with tack coat.

3.9 EDGE DROPOFF

A. Where HMA paving is being applied to highways carrying traffic, all pavement courses exceeding 2-1/2 in. in depth shall be matched with the abutting lane or shoulder on the same working day. Where pavement courses of 2-1/2 in. or less are placed, the Contractor shall have the option of paving the abutting lane or shoulder on alternate days. The abutting lane or shoulder shall be paved regardless of the depth of pavement course prior to weekends and temporary shutdowns. When uneven pavement joints exist, the Contractor shall provide advance warning traffic control devices in conformance with the Contract Documents.

3.10 TIE-IN

A. Where HMA paving is being applied to the traveled way carrying traffic, the Contractor shall construct a temporary tie-in a minimum of 4 ft in length for each 1 in. of pavement depth before traffic is allowed to cross the transverse joint.

B. The final tie-in shall include the removal of a transverse portion of the existing pavement to a depth so the design thickness of the final surface course is maintained. The length of the final tie-in shall be equal to the posted speed per 1 in. depth of the design thickness of the final course with a minimum length of 25 ft per 1 in. depth and a maximum length of 50 ft per 1 in. depth.

3.11 SAMPLING AND TESTING FOR DENSITY

A. Density testing shall be performed before allowing traffic or construction equipment on the in place material and before placement of the next layer.

1. Compaction for Quality Control. A lot shall not exceed 1000 tons. A sublot shall not exceed 200 tons. Five consecutive 200 ton sublots shall equal one lot. A lot may contain only one sublot that is less than 200 tons.

On any paving day when production does not end in a multiple of 1000 tons, the remaining fraction shall be considered another lot. A paving day shall begin with a new lot and sublots. Control strips shall be divided into five equal sublots.

On Contracts requiring less than 500 tons of HMA or when HMA is used in nontraffic areas or on bridge decks, acceptance will be determined by the use of a thin layer nuclear density gauge, when tested in conformance with the manufacturer's recommendations. When the HMA courses are compacted to 1 in. or less, a control strip shall be constructed on the first day of paving. Readings shall be taken with a thin layer nuclear density gauge to determine roller patterns and the number of coverages to obtain optimum density. Optimum density is defined as when the average density does not change by more than 1.0 percent between successive coverages of a 400 to 500 ft area. This optimum density shall be used to determine HMA acceptance after approval by the Engineer. Any lot average 2.0 percent or more below optimum
density shall require a new control strip be constructed and tested before paving continues.

The Contractor may use the core or the combined nuclear/core method of testing on Contracts requiring 500 tons or more.

The Contractor shall secure samples and perform tests as follows:

1) Core Method. When the core method is used, the Contractor shall take samples as specified in Maryland Standard Method of Tests 451, Method B, for each sublot of material placed. Core sample locations will be randomly determined by the Engineer in conformance with Maryland Standard Method of Tests 418.

Two core samples shall be taken from each sublot no later than the next day after compaction. The size diameter cores shall be 4 or 6 in. cores for 9.5 mm, 12.5 mm, and 19.0 mm mixes; and 6 in. cores for 25.0 mm and 37.5 mm mixes. These cores shall represent the day's production and shall be taken prior to placement of the next layer.

Core samples shall be tested in conformance with Maryland Standard Method of Tests 452. The specific gravity of the samples shall be expressed as a percentage of the maximum specific gravity determined for each lot of material. The in place density of each mixture in each lot shall be 92.0 to 97.0 percent. The two core results from each sublot shall be averaged and compliance will be determined on the basis of all sublots tested for each material. Results shall be made available by the Contractor no later than the following work day.

2) Nuclear/Core Method. The nuclear gauge shall be calibrated in conformance with Maryland Standard Method of Tests 417. A daily validation and standard count shall be performed as specified in the manufacturer's recommendations. A log of these validations and counts shall be with the gauge at all times.

Two one-minute special calibration nuclear tests shall be conducted on each sublot as specified in Maryland Standard Method of Tests 418 no later than the next work day after compaction. A special calibration nuclear test is defined as an average of a minimum of two special calibration readings taken at the same location after rotating the gauge 180 degrees. Two tests per sublot; a minimum of four readings (2 tests X 2 readings/test = 4) shall be taken. Likewise, a 1000 ton lot shall have a minimum of 20 readings (5 sublots X 2 tests/sublot X 2 readings/test = 20).

The results of the two nuclear tests in each sublot shall be averaged and conformance will be determined on the basis of all sublots tested for each material.

Three cores for each lot of material shall be sampled; one at each of three different nuclear test locations determined by the Engineer. The average of the three core results and the average of the three corresponding nuclear tests shall be within 3.0 lb/ft^3. When the difference between nuclear test results and core test results is greater than 3.0 lb/ft^3, the Contractor shall use the core method of testing. The Contractor may return to the nuclear/core method of testing when all calibration criteria are met. If the Contractor's nuclear test results again fail to conform to the 3.0 lb/ft^3 maximum requirement, the core method of density determination shall be used for the remainder of the project.

2. Acceptance Testing.

a. Core Method. Acceptance testing will be performed on a minimum of three cores per 6000 tons when the core method of control is used. If the specific gravity difference on each of the three cores is within 0.030, all the lots will be evaluated individually using the test results of quality control samples as specified in 4.3. If the difference is greater than 0.030, the Engineer will conduct tests on the remainder of the quality control samples since the last acceptance and all the lots will be evaluated individually using the Engineer's test results.

b. Nuclear/Core Method. When the nuclear/core method is used, the Engineer will witness the Contractor's testing and coring and will perform acceptance testing on three verification cores from any one lot since the last acceptance. If the density difference between the average of three verification cores and the average of three corresponding nuclear tests is within 3.0 lb/ft^3, all the lots will be evaluated individually using nuclear quality control test results as specified in 4.3.

If the difference is greater than 3.0 lb/ft^3, the Engineer will test the remainder of the verification cores since the last acceptance. All lots will be evaluated for the 3.0 lb/ft^3 difference. Lots not conforming to the 3.0 lb/ft^3 difference will be evaluated individually as specified in 4.3 using verification core test results. Lots conforming to the 3.0 lb/ft^3 difference will be evaluated individually.

3.12 CONTROL STRIP

A. The Contractor may opt to construct a control strip for guidance in determining roller patterns to achieve optimum density. When a control strip is constructed, it shall be placed on the first workday in which HMA is placed and shall be between 400 and 500 ft in length. Based on the Contractor's evaluation of the initial control strip, paving may continue at the Contractor's risk.

B. The Contractor will not be assessed a density pay adjustment for the amount of material required for construction of the control strips. Should the removal of any control strip be necessary, it shall be removed by the Contractor at no additional cost to the Owner.

C. The Engineer may require the Contractor to construct a control strip any time during placement of HMA based on the evaluation of compaction results.

3.13 PAVEMENT SURFACE CHECKS

A. The Contractor shall have available, at all times, a 10 ft straightedge approved by the Engineer. After final compaction of each course, the surface of each pavement course shall be true to the established line and grade and shall be sufficiently smooth so that when tested with a 10 ft straightedge placed upon the surface parallel with the center line, the surface shall not deviate more than 1/8 in. The transverse slope of the finished surface of each course when tested with a 10 ft straightedge placed perpendicular to the center line, the surface shall not deviate more than 3/16 in.

B. Transverse joints on each course shall be checked with a 10 ft straightedge immediately after the initial rolling. If the surface of each course varies more than 1/8 in. from true, the Contractor shall make immediate corrections acceptable to the Engineer so that the finished joint surface shall comply.

3.14 CURBS, GUTTERS, ETC.

Where permanent curbs, gutters, edges, and other supports are planned, they shall be constructed and backfilled prior to placing the HMA, which shall then be placed and compacted against them.

3.15 SHOULDERS

Shoulders abutting the HMA surface course of any two lane pavement that is being used by traffic shall be completed as soon as possible after completion of the surface course on that lane. Shoulder construction shall be as specified in the applicable portions of the Specifications and the Contact Documents.

END OF SECTION 32 12 16

32 30 00
TIMBER STRUCTURES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work shall consist of the removing and replacing of the existing timber stairs where indicated on the plans. The replacement shall be in kind except as noted below.

PART 2 - PRODUCTS

2.1 MATERIALS.

A. Structural Timber

1. Lumber and timber shall meet the requirements of AASHTO M168.
2. Knotholes and holes from causes other than knots shall be measured and limited as provided for knots. All visible pieces of lumber and timber having knots that are unsightly in appearance shall be rejected. Cluster knots and knots in groups are not permitted.
3. Only pieces consisting of sound wood free from any form of decay shall be accepted. No piece of exceptionally lightweight shall be accepted.
4. Lumber and timber shall conform to the dimensions specified for either rough or surfaced stock.
5. Lumber and timber to be graded as per NFPA National Design Specifications for Wood Construction and shall be rated for ground contact.

B. Preservative Treatment

1. Preservative treatment of lumber and timber shall be by the pressure process, and unless otherwise provided in the contract special provisions, be in accordance AWPA Standards and AASHTO Designation M 133.
2. Lumber and timber shall be pressure treated with Copper Naphthenate in AWPA P9 Type A Hydrocarbon Solvent.
3. All Douglas Fir and other species that are difficult to penetrate shall be incised prior to treatment.

C. Hardware

1. All hardware (machine bolts, carriage bolts, drift pins, lag screws, dowels, rods, nails, spikes, washers, connectors, etc.) shall conform to ASTM 307-97.
2. Unless a Dome Head Bolt or approved equal is used, all bolt heads or tightening nuts in contact with Structural Timber and lumber shall have a washer of sufficient thickness and bearing area to ensure a minimum deformation of the contacted surface when tightened to develop not more than the maximum allowable tensile stress of that bolt
3. Bolt heads or tightening nuts in contact with metal surfaces shall have a cut washer or approved equal placed between the bolt head or nut and the metal surface.

4. All hardware shall be hot-dipped galvanized in accordance with AASHTO M111-91.

PART 3 - EXECUTION

3.1 DEMOLITION

Demolish existing timber stairs. Any concrete or stone foundation is to remain and be reused. All materials removed shall become the property of the contractor.

3.2 CONSTRUCTION

A. Handrails: Must comply with the following code requirements.

1. Continuity: The handrail must be continuous along the entire length of the stairs, with no breaks or interruptions.
2. Height: The handrail should be between 34 and 38 inches above the nosing of the stair treads.
3. Grip Size: The handrail's gripping surface should be between 1.25 and 2 inches in diameter.
4. Clearance: There should be at least 1.5 inches of clearance between the handrail and any adjacent surface.
5. Return Ends: The handrail must return to a guardrail, or post at both the top and bottom of the stairs.

B. Diameter of Holes.

Holes bored in timber structures shall conform to the following:

1. Round drift bolts, spikes, and dowels - 1/16 in. less than the diameter of the device.
2. Square drift bolts, spikes, and dowels - equal to the smallest dimension of the device.
3. Machine bolts - same as the diameter of the bolts.
4. Rods - 1/16 in. larger than the diameter of the rods.
5. Lag screws - equal to the diameter of the screw at the base of the thread.
6. Connector bolts - 1/16 in. larger than the diameter of the connector bolts.

C. Bolt Assemblies.

Bolt heads or nuts, which come in contact with the timber, shall be fitted with a washer of the size and type specified. After all nuts are adequately tightened, the bolt threads shall be burred. The heads of carriage bolts require no washers.

D. Countersinking.

Countersinking shall be done wherever smooth faces are required. In treated timber, recesses formed in horizontal surfaces for countersinking shall be painted with an approved preservative. After the bolt or screw is in place, recesses shall be filled with an approved asphalt coating.

E. Connectors.

Connector holes shall be bored through members to be connected. The bolt hole shall be kept perpendicular to the face of the timber. When spike grids or split ring connectors are specified in the Contract Documents, they shall be installed in conformance with the manufacturer's recommendations.

F. Framing.

All timber shall be accurately cut and framed to provide even bearing over the entire contact surface. When making joints, shimming and open joints are prohibited.

G. Photos of exiting stairs













END OF SECTION 32 30 00

32 92 23.01
TURF ESTABLISHMENT

PART 1 GENERAL

1.1 DESCRIPTION

A. This work shall consist of soil preparation, seeding, fertilizing, liming, mulching, overseeding, refertilization and mowing all areas designated for turf establishment as specified in the Contract Documents or as directed by the Engineer.

1.2 SEEDING SEASONS AND SEED MIXES

A. Refer to the plans for the permanent and temporary seeding mixes.

PART 2 PRODUCTS

2.1 MATERIALS

A. Mulch Binder shall conform to MSHA 904.02 (Asphalt Binder) or the following:

1. Wood cellulose fiber shall be a processed wood product having uniform fiber characteristics, which will remain in uniform suspension in water under agitation and will blend with seed, fertilizer and other additives to form homogeneous slurry. The fiber shall perform satisfactorily in hydraulic seeding equipment without clogging or damaging the system. The slurry shall contain a green dye that provides easy visual inspection for uniformity of application.

2. The manufacturer shall furnish certification (A certification is a document which verifies that the material and work complies with the applicable specifications and includes the actual test results to confirm the statement). The contents of the certification shall be on the Contractor's/vendor's/manufacturer's letterhead or approved document and shall be duly signed by a company officer) showing conformance to the following:

WOOD CELLULOSE FIBER REQUIREMENTS	
Particle Length, inch	Approximately 1/2
Particle Thickness, inch	Approximately 1/16
Net Dry Weight Content	Minimum as stated on bag
TAPPI* T 509, pH	4.0 – 8.5
Ash Content, TAPPI* Standard T 413, % max	7.0
Water Holding Capacity, % min	90

* Technical Association of Pulp and Paper Industry

3. The material shall be delivered in packages of uniform weight, which shall not exceed 75 lb net weight and shall bear the name of the manufacturer, the net weight and a supplemental statement of the net weight content.

B. Agricultural Limestone shall contain not less than 85 percent calcium and magnesium carbonates. Dolomitic (magnesium) limestone shall contain at least 10 percent magnesium as magnesium oxide and 85 percent calcium and magnesium carbonates. Limestone shall conform to the following gradation:

SIEVE SIZE	MINIMUM PERCENT PASSING BY WEIGHT
No. 10	100
No. 20	98
No. 100	50

C. Fertilizer shall conform to MSHA 920.03.01.

D. Seed shall conform to notes the plans

E. Straw Mulch shall conform to MSHA 920.04.01.

F. Water. Water used in the planting, establishing or caring for vegetation shall be free from any substance that is injurious to plant life.

PART 3 EXECUTION

3.1 GENERAL

A. Seeding shall be performed when the temperature is above 32° F and the ground is not frozen.

3.2 Seeding Areas with less than 4 inches of topsoil. seeding shall consist of soil preparation, liming, seeding, fertilizing and applying and securing mulch.

A. Preparing Soil. Areas to be seeded shall conform to the specified finish grades and be free of any weed or plant growth. All areas (except serrated cut slopes) shall be loosened by discing, harrowing, raking or by other approved methods immediately prior to seeding, unless otherwise directed by the Engineer. The area shall be free of all clods, stones and other foreign materials larger than 3 inches. On and adjacent to commercial and residential properties, the size of stones and other foreign material shall not be larger than 1 1/2 inches. All gullies, washes or disturbed areas that develop subsequent to final dressing shall be repaired prior to seeding. On slopes less than 3:1 and on flat areas, the final seedbed shall be prepared so there is an even and uniform germination of seed and final stand of turf. To conserve moisture, a cultipacker may be run over the seedbed before or after seeding, but before mulching. The seed beds shall be as follows:

1. Slopes Less than 3:1. The topsoil shall be loosened to a depth of 2 inches and all track marks shall be removed.
2. Slopes 3:1 and Steeper. The subsoil shall be loosened to a depth of 1 inch.
3. Serrated Cut Slopes. The subsoil shall not be loosened. The areas shall be seeded and mulched in 50 ft maximum vertical increments.

B. Application Equipment. Equipment shall consist of spreaders, drills, hydroseeders or other equipment approved by the Engineer for applying materials either in a wet or dry form. All equipment shall be calibrated before application to the satisfaction of the Engineer so that materials are applied accurately and evenly to avoid misses and overlaps.

1. Hydroseeders shall display maximum capacity in gallons and be equipped with an agitation system capable of keeping all the solids in a state of suspension.
2. The mixture shall be directed upward into the air so droplets will fall in a uniform spray to avoid erosion or runoff.
3. Mechanical seeders shall be capable of placing seed at the specified rate.
4. Use of hydroseeders and spinner spreaders is prohibited during periods of high winds when the materials could land on sensitive areas or on sensitive structures.

3.7 Application Rates. Tractor Mowing. Mowing shall consist of using a minimum 5 ft flail or rotary tractor mower as directed by the Engineer. The vegetation shall be cut to 5 inches high before it reaches 20 inches high.

3.8 Hand Mowing. Mowing shall consist of using a minimum 19 inch hand mower as directed by the Engineer. Vegetation shall be cut to 3 to 4 inches high before it reaches 15 inches high.

3.9 Repairing Damaged Areas. Before final acceptance the Contractor shall repair or replace any seeding or mulching that is defective or damaged due to the Contractor's negligence at no additional cost to the Owner. When the Contractor elects to perform out of season work, the Contractor shall establish a good stand of grass of uniform color and density as approved by the Engineer. When it is not possible to make an adequate determination of the color, density and uniformity of the stand of grass, acceptance of the areas will be delayed until seeding requirements are in conformance.

END OF SECTION 32 92 23.01

32 14 00
UNIT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Products
   2. Execution

1.3 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Bluestone Pavers
   2. Decomposed Granite

B. Samples for Initial Selection: For the following:
   1. Each type of stone or decomposed granite indicated for color selection.
   2. Bluestone Pavers indicated for color selection.

1.4 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
   2. Mockups shall be a minimum 5'x5' section of the crushed gravel paths. Mockups of bluestone at fire pits shall be a full layout.
   3. Provide a minimum 3-day notice to Landscape Architect for mockup approval.

B. Pre-installation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store bluestone pavers and decomposed granite on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.

1.6 PROJECT CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or materials mixed with or coated with ice or frost. Do not build on frozen subgrade or setting beds.

PART 2 - PRODUCTS

2.1 BLUESTONE PAVERS

A. Large Fire Pit Irregular Bluestone (C-3) Bluestone Irregular.
1. Thickness: 2" minimum– 65ft^2 per ton
2. Color: Blue
3. Finish: Natural cleft
4. Compacted Stone dust setting bed.

2.2 DECOMPOSED GRANITE PATH MIX

A. Crushed Stone Pathway (P-1) Basis of Design: Path Mix: Stancills, sales@stancills.com, 410-939-2224 or approved equal.
1. Color/mix: English Gray
2. Sand and crushed stone shall consist of inert materials that are hard and durable, with stone free from surface coatings and deleterious materials. Gradation requirements shall be as follows:
3. Crushed Stone Sieve Analysis Percentage of Weight Passing a Square Mesh Sieve AASHTO T11-82 and T2782 1/4" MINUS AGGREGATE GRADATION

U.S. Sieve No.	Percent Passing by Weight
# 3/8"	100
# 4	90 – 100
# 8	75 – 80
# 16	55 – 65
# 30	40 – 50
# 50	25 – 35
# 100	15 – 20
# 200 to	10 – 15

A. Binder for Aggregate Surfaces (P-2) Basis of Design: Organic Lock Stancills, sales@stancills.com, 410-939-2224 or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas indicated to receive paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION STONE PAVING

A. Compact the subgrade as indicated to provide a stable base.

B. Place setting bed and compact prior to installing pavers, maintaining positive drainage.

3.3 BINDER FOR AGGREGATE PAVING

1. Per manufacturer's recommendation.

3.4 INSTALLATION, GENERAL

A. Do not use pavers with chips, cracks, voids, discolorations, or other visible defects.

B. pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.

C. Cut pavers as manufacturer identifies to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Locate cut units on at edges of paver fields. Use full units without cutting where possible. Hammer cutting is not acceptable.

D. Pattern: As indicated on plans.

E. Tolerances: Do not exceed 1/32-inch unit-to-unit offset from flush (lippage) or 1/8 inch in 10 feet from level, or indicated slope, for finished surface of paving. All walking surfaces shall satisfy applicable ADA standards to provide an accessible route.

3.5 REPAIRING, POINTING, AND CLEANING

A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

B. Replace or repair any crushed granite paving that has settled, moved or come out of compliance with ADA requirements (for bonded gravel surface) or does not provide positive drainage.

END OF SECTION 32 14 00

32 33 00
SITE FURNISHINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Tables.
2. Benches.
3. Individual Camp Fire Rings
4. Litter Receptacles

B. Related Requirements:

1. Division 03 Section "Cast-in-Place Concrete" for installing anchor bolts cast in concrete footings.
2. Division 31 Section "Earth Moving" for excavation for installing concrete footings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

C. Samples for Initial Selection: For units with factory-applied finishes.

D. Product Schedule: For site furnishings. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Material Certificates: For site furnishings.

1. Wood Preservative Treatment: Include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For site furnishings to be included in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Bench Replacement Slats: No fewer than two full-size units for each size indicated.
2. Anchors: 2 each for all types used for site furniture installation.

PART 2 - PRODUCTS

2.1 TABLES

A. Basis of design, Picnic Tables from recycled wood from Camp Small: https://www.treebaltimore.org/camp-small or approved equal to include:
   1. 8 FT Picnic Table and Bench (C-10). Basis of Design: Heavy Duty Picnic Table by Camp Small: https://www.treebaltimore.org/camp-small
      a. Locate as shown on plans
      b. Provide minimum of 3 accessible tables.
   2. 6 FT Picnic Table and Bench (C-9). Basis of Design: Heavy Duty Picnic Table by Camp Small: https://www.treebaltimore.org/camp-small
      a. Locate as shown on plans
   3. 8 FT. Heavy Duty 2-Sided ADA (6' Table with Extensions) by The Park Catalog. https://www.theparkcatalog.com/ . 866-280-9894.
      a. Located as shown on plans

2.2 BENCHES

A. Basis of Design: Taper Bench by Camp Smallhttps://www.treebaltimore.org/camp-small or approved equal.
   1. Locate as shown on plans.
   2. Surface mount with anchors.

2.3 INDIVIDUAL CAMP FIRE RINGS

A. Basis of Design 285 Sq. In Fire Ring with Adjustable Grate (Highland Products via The Park Catalog) or approved equal.
   1. 7" Ht.
   2. Located as shown on plans.

2.4 LITTER RECEPTACLES

A. Litter Receptacles (C-14) Victor Stanley, Ironsites Series 45-Gallon Side-Opening Litter Receptacle or approved equal. Model S-45. https://www.victorstanley.com/

B. Materials

1. 3/8" x 1" (10mm x 25mm) vertical solid steel bars; 1/4" x 2-1/2" (6mm x 64mm) horizontal solid steel band; 1/4" x 6" (6mm x 152mm) horizontal solid steel band; 3/8" x 3" (10mm x 76mm) steel support bars; 5/8" (16mm) solid steel top ring; leveling feet with a 3/8" (10mm) diameter threaded steel shaft.

2. 45-gallon capacity high density plastic liner weight not to exceed 7 lbs.

3. Plastic inner liners shall offer maximum capacity and strength with lightweight construction using critical molded ribs, integral handholds, and high strength materials.

C. Options

1. Lids: No Lid.
2. Standard colors: Black
3. Mounting plate: Three (3) anchor bolt holes.
4. Include optional bottom plate cover.

D. Finishes

1. All fabricated metal components are steel shotblasted, etched, phosphatized, preheated, and electrostatically powder-coated with TGIC polyester powder coatings. Products are fully cleaned and pretreated, preheated and coated while hot to fill crevices and build coating film. Coated parts are fully cured to coating manufacturer's specifications. The thickness of the resulting finish averages 8-10 mils (200-250 microns).
   a. Color: Silver

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.

B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.

C. Install site furnishings level, plumb, true, and securely anchored at locations indicated on Drawings.

D. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set

plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.

END OF SECTION 32 33 00

32 91 13
SOIL PREPARATION

PART 1 - GENERAL

1.1 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction soil analyses on imported soil and manufactured soils.

1. Notify Architect seven days in advance of the dates and times when laboratory samples will be taken.

B. Preconstruction Soil Analyses: Perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment and fertilizer recommendations by a university-based qualified testing agency performing the testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.

1. Have testing agency identify and label samples and test reports according to sample collection and labeling requirements.

2. Provide testing of existing soil, imported soils

1.2 PLANTING SOILS SPECIFIED BY COMPOSITION

A. General: Soil amendments, fertilizers, and rates of application specified in this article are guidelines that may need revision based on testing laboratory's recommendations after preconstruction soil analyses are performed.

B. Planting-Soil Type: Manufactured soil consisting of manufacturer's basic sandy loam according to USDA textures, blended in a manufacturing facility with sand, stabilized organic soil amendments, and other materials to produce viable planting soil.

1. Additional Properties of Manufacturer's Basic Soil before Amending: Soil reaction of Ph 5.5-6.5 and minimum of 4 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.
2. Unacceptable Properties: Manufactured soil shall not contain the following:

a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 2 percent by dry weight of the manufactured soil.
c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 1/2 inch (38 mm) in any dimension.

3. Blend manufacturer's basic soil with the following soil amendments and fertilizers in the following quantities to produce a sandy loam planting soil:

a. 30% medium coarse sand, minimum size 0.21 mm
b. 15% clay

c. 50% Topsoil – Silt Loam texture
d. 5% organic matter provided by composted leaves.

1.3 INORGANIC SOIL AMENDMENTS

A. Soil Amendments shall only be incorporated as indicated by soil testing and in order to bring soils into compliance with requirements.

B. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

1. Class: T, with a minimum of 99 percent passing through a No. 8 (2.36-mm) sieve and a minimum of 75 percent passing through a No. 60 (0.25-mm) sieve.
2. Class: O, with a minimum of 95 percent passing through a No. 8 (2.36-mm) sieve and a minimum of 55 percent passing through a No. 60 (0.25-mm) sieve.
3. Form: Provide lime in form of ground dolomitic limestone.

C. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 (3.35-mm) sieve and a maximum of 10 percent passing through a No. 40 (0.425-mm) sieve.

D. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

E. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through a No. 50 (0.30-mm) sieve.

F. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C 33/C 33M.

1.4 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows:
1. Leaf Gro Composted Leaves

B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: 1 lb/1000 sq. ft. (0.5 kg/100 sq. m) of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

E. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

1.5 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a university based - qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections:

1. Compaction: Test planting-soil compaction after placing each lift and at completion using a densitometer or soil-compaction meter calibrated to a reference test value based on laboratory testing according to ASTM D 698. Space tests at no less than one for each 1000 sq. ft. (100 sq. m) of in-place soil or part thereof.
2. Soil should be placed and compacted to no more than 82% Proctor.

C. Soil will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

END OF SECTION 32 91 13

32 92 00
TURF AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Lawn Seeding.
2. Lawn Sodding.

B. Related Requirements:
1. Section 329300 "Plants" for trees, shrubs, ground covers, and other plants as well as border edgings and mow strips.
2. Section 329113 Soil Preparation
3. Section 334600 "Subdrainage" for below-grade drainage of landscaped areas.

1.2 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Soil Preparation" and drawing designations for planting soils.

E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.3 PRE-INSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For landscape Installer.

B. Certification of Grass Seed: From seed vendor for each grass-seed mono stand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

1. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of supplier.

C. Product Certificates: For fertilizers, from manufacturer.

D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required maintenance periods.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.

1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
2. Experience: Five years' experience in turf installation in addition to requirements in Section 014000 "Quality Requirements."
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
4. Personnel Certifications: Installer's field supervisor personnel assigned to the Work shall have certification in all of the following categories from the Professional Landcare Network:

    a. Landscape Industry Certified Technician - Exterior.
    b. Landscape Industry Certified Lawncare Manager.
    c. Landscape Industry Certified Lawncare Technician.

5. Pesticide Applicator: State licensed, commercial.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

1.8 FIELD CONDITIONS

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of planting completion.

1. Spring Planting: March 30 – June 1
2. Fall Planting: September 1 – October 15

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 TURF SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species:

1. Quality: MD State-certified seed of grass species as listed below for solar exposure.
2. Quality: Seed of grass species as listed below for solar exposure, with not less than 85 percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed:
3. Full Sun: Kentucky bluegrass (Poa pratensis), a minimum of three cultivars.
4. Sun and Partial Shade: Proportioned by weight as follows:

    a. 50 percent Kentucky bluegrass (Poa pratensis).
    b. 30 percent chewings red fescue (Festuca rubra variety).
    c. 10 percent perennial ryegrass (Lolium perenne).
    d. 10 percent redtop (Agrostis alba).

5. Shade: Proportioned by weight as follows:

    a. 50 percent chewings red fescue (Festuca rubra variety).
    b. 35 percent rough bluegrass (Poa trivialis).
    c. 15 percent redtop (Agrostis alba).

2.2 FERTILIZERS

A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, and potassium in the following composition:
   1. Based on the results of the soils tests and recommendations of soil testing laboratory.
   2. All Fertilizers must comply with current Maryland Fertilizer Laws

B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
   1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.
   2. All Fertilizers must comply with current Maryland Fertilizer Laws

2.3 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

2.4 PESTICIDES

A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.

   1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
   2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
   3. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
2. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION

A. General: Prepare planting area for soil placement and mix planting soil according to Section 329113 "Soil Preparation."

B. Decompact soil by ripping to a depth of 12" prior to placement of planting soil or topsoil.

C. Remove debris greater than 2" diameter prior to placing soil. Smooth grades.

D. Placing Planting Soil: Place manufactured planting soil over exposed subgrade as indicated on the drawings.

3.4 FINISHED GRADING

1. Reduce elevation of planting soil to allow for soil thickness of sod. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

B. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.5 LAWN SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h).

1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
2. Do not use wet seed or seed that is moldy or otherwise damaged.
3. Do not seed against existing trees. Limit the extent of seed to outside edge of planting saucer.

B. Sow seed at a total rate of recommended rates of seed supplier.

C. Rake seed lightly into top 1/8 inch (3 mm) of soil, roll lightly, and water with fine spray.

D. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre (42 kg/92.9 sq. m) to form a continuous blanket 1-1/2 inches (38 mm) in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.

3.6 TURF RENOVATION

A. Renovate existing turf where indicated.

B. Renovate turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.

1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
2. Install new planting soil as required.

C. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.

D. Remove topsoil containing foreign materials, such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.

E. Mow, dethatch, core aerate, and rake existing turf.

F. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.

G. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.

H. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches (150 mm).

I. Apply soil amendments and initial fertilizer required for establishing new turf and mix thoroughly into top 4 inches (100 mm) of existing soil. Install new planting soil to fill low spots and meet finish grades.

1. Soil Amendment(s): according to requirements of Section 329113 "Soil Preparation."
2. Initial Fertilizer: Slow-release fertilizer applied according to the recommendations of the soil tests.

J. Apply seed and protect with straw mulch as required for new turf.

K. Water newly planted areas and keep moist until new turf is established.

3.7 TURF MAINTENANCE

A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, re-

grade, and replant bare or eroded areas and re-mulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches (100 mm).

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
2. Water turf with fine spray at a minimum rate of 1 inch (25 mm) per week unless rainfall precipitation is adequate.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
1. Mow Kentucky bluegrass annual ryegrass chewings red fescue to a height of 1-1/2 to 2 inches (38 to 50 mm).

3.8 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Architect:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. (0.92 sq. m) and bare spots not exceeding 5 by 5 inches (125 by 125 mm).

2. Satisfactory Understory Seed Mix: At the end of the maintenance period, a healthy, well rooted cover of plants, species representative of the seed mix.
3. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas not exceeding 5 by 5 inches (125 by 125 mm), and surface irregularities.

B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

3.9 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

D. Remove non-degradable erosion-control measures after grass establishment period.

3.10 MAINTENANCE SERVICE

A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:

1. Seeded Turf: A minimum of 60 days from date of Substantial Completion, provided that at the end of the maintenance period, a healthy, well rooted, even colored, viable turf has been established, free of weeds and bare areas not exceeding 5 x 5 inches and surface irregularities.

2. Sodded Turf: 30 days from date of Substantial Completion When initial maintenance period has not elapsed before end of planting season, provided that at the end of the maintenance period, a healthy, well rooted, even colored, viable turf has been established, free of weeds, open joints, and bare areas not exceeding 5 x 5 inches and surface irregularities.

   a. If turf is not fully established, continue maintenance during next planting season.

END OF SECTION 32 92 00

32 93 00
PLANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included: The Work of this Section includes, but is not limited to the following:

1. Trees
2. Shrubs
3. Ground covers
4. Perennial plants

1.2 REFERENCES

A. Standards: Comply with applicable recommendations of the following:
1. "Standardized Plant Names", American Joint Committee on Horticultural Nomenclature.
2. American Standard for Nursery Stock", American Association of Nurserymen (ANSI 260.1)
3. "Landscape Specifications Guidelines for Baltimore-Washington Metropolitan Areas", latest edition. Landscape Contractors Association of MD/DC/VA.

B. IGCC Submittals:
1. Per IGCC Manual as adopted by Baltimore City.

1.3 DEFINITIONS

A. Balled and Burlapped Stock: Exterior plants dug with firm, natural balls of earth in which they are grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of tree or shrub required; wrapped, tied, rigidly supported, and drum-laced as recommended by ANSI Z60.1.

B. Balled and Potted Stock: Exterior plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of exterior plant required.

C. Bare-Root Stock: Exterior plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for kind and size of exterior plant required.

D. Container-Grown Stock: Healthy, vigorous, well-rooted exterior plants grown in a container with well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for kind, type, and size of exterior plant required.

E. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted exterior plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag.

Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of exterior plant.

F. Finish Grade: Elevation of finished surface of planting soil.

G. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

H. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.

I. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.

1.4 SUBMITTALS

A. Samples for Verification: For each of the following:

1. Submit one pound samples, packaged in plastic bags, to the Architect for examination and approval prior to any landscape operations:
   a. Mulches.
   b. On-site soils.
   c. Imported soils.
   d. Organics.
   e. Soil mixes.

B. Material Certificates: Submit the following manufacturer's information and source data:
   a. Commercial fertilizers.
   b. Chemical additives.
   c. Organic materials
   d. Lime.
   e. Iron Sulfate.
   f. Filter Cloth/Soil Separator.
   g. Erosion Control Fabric.

C. Qualification Data: For landscape installer. Provide evidence of successful installations of similar scope within the last 5 years.

D. Material Test Reports: For existing surface soil and imported topsoil.

E. Planting Schedule: Submit planting schedule for installation of material including invasive management.

F. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of exterior plants during a calendar year. Submit before expiration of required maintenance periods.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Not less than 5 years documented successful experience in installation of work similar to Work in this Project.

B. Soil-Testing Laboratory Qualifications:

1. Meet the requirements of 32 9113 – Soil Preparation.

C. Manufactured Soil Analysis:
1. Meet the requirements of 32 9113 – Soil Preparation.

D. Provide quality, size, genus, species, and variety of exterior plants indicated, complying with applicable requirements in ANSI Z60.1, "American Standard for Nursery Stock."

E. Tree and Shrub Measurements: Measure according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches above ground for trees up to 4-inch caliper size, and 12 inches aboveground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.

F. Observation: Architect may observe trees and shrubs either at place of growth or at site before planting for compliance with requirements for genus, species, variety, size, and quality. Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, insects, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
1. Locally grown plants are preferred for this project. Provide documentation of sources of all plant material.
2. Notify Architect of sources of planting materials seven days in advance of delivery to site.

G. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Schedules for planting and soil testing, any requested substitutions, planting methods and site inspections will be reviewed.

H. Preliminary Plant Acceptance:
1. Architect or his representative may view plants at their place of growth or upon delivery. Architect reserves the right to tag plants at their place of growth.
2. For distant material, photographs may be submitted in lieu of on-site inspections or for preliminary reviews prior to on-site inspection.
3. Send Architect written request for plant inspection at their place of growth at least ten calendar days prior to digging.
4. Identify place of growth and quantity of plants to be inspected.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver exterior plants freshly dug.
1. Immediately after digging up bare-root stock, pack root system in wet straw, or other suitable material to keep root system moist until planting.

B. Do not prune trees and shrubs before delivery, except as approved by Landscape Architect. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of exterior plants during delivery. Do not drop exterior plants during delivery.

C. Handle planting stock by root ball.

D. Plants damaged in transit, storage or handling may be rejected at the sole discretion of the Architect. Contractor shall note that consideration for plant material damage may not be life threatening, but rather cosmetic such as broken branches or scratched trunks, to qualify plant for rejection.

E. Root balls which are not tight and properly prepared or show signs of damage will be rejected.

F. Deliver exterior plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set exterior plants trees in shade, protect from weather and mechanical damage, and keep roots moist.
   1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
   2. Do not remove container grown stock from containers before time of planting.
   3. Water root systems of exterior plants stored on-site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.
   4. If plant material is stored more than three days on site, return it to the nursery for proper care until it can be planted.

1.7 PLANT SEASONS

A. B&B, deciduous trees and shrub materials:
   1. Lowest Risk: March 1 to May 30 and September 15 to November 1.
      a. Deciduous plants dug and planted while dormant in spring or fall except those listed below.
      b. Deciduous plants dug during dormancy and planted after producing leaves providing they have been properly stored.
      c. Deciduous plants dug after leaves have fully expanded and harden off.
   2. Highest Risk:
      a. Deciduous plants dug in the spring during newly expanding leaf production.

B. Evergreen B&B material:
   1. Freshly dug evergreen material should not be moved without proper conditioning during active growth.

C. Summer dug B&B material shall be handled in one of the following methods in order to harden off:
   1. Properly hardened-off in field 7-10 days prior to digging by a gradual process of trenching and soaking, leaving the bottom surface of the ball attached to soil until shipping.
   2. Condition under irrigation in partial shade for at least 4 days prior to shipping.

D. Perennials:
   1. May be installed as soon as the ground is workable in Spring after March 1 until November 1.
   2. Any plants required to be installed after November 15, will require protective, supplemental mulching applied after December 15 and removed when weather permits around March 1.

E. Excluded Material:

1. The following trees may not be installed between November 15 and March 1: White oak (Quercus alba), Scarlet Oak (Quercus coccinea), Red Oak (Quercus rubra), Willow Oak (Quercus phellos), Flowering Dogwood Varieties (Cornus florida), Sweet Gum (Liquidambar styraciflua) and all conifers with the exception of White Pines (Pinus strobus).

F. Out of season plant installation:
1. Planting outside of the planting time stated in this Article shall be considered to be out of season plant installation.
2. Generally, out of season plant installation shall not be allowed.
3. Variance in planting seasons will only be permitted when authorized in advance by the Owner and Architect in response to Contractor's request. The Contractor shall not permit any out of season plant installation without this authorization.
4. If out of season plant installation is requested, the Contractor shall engage a professional horticulturalist, nurseryman or arborist to determine the proper time, based on plant species and weather conditions, to move, and install particular plant material to minimize plant stress.
   a. The written recommendations of the horticulturalist, nurseryman or arborist shall be submitted as part of the request to perform out of season plant installation.
   b. The Owner and Architect will respond in writing to this request.
5. The warranty for out of season plant installation shall be extended one calendar year to compensate for the variance.

1.8 WARRANTY

A. Contractor shall warrant that all trees, shrubs, vines, groundcovers, perennials, and bulbs planted under this Contract will be healthy and in flourishing condition of active growth for a Warranty Period of 24 Months from date of completion and initial acceptance of the work.

B. Any delay in completion of planting operations which extends the planting into more than one planting season shall extend the Warranty period correspondingly.

C. Contractor shall provide written warranty certificates to the Architect.

D. Warranty Provisions:
1. Remove plants that are in the opinion of the Architect, at least 25% dead, unsightly, or not in healthy condition.
2. Replace removed plants and plants missing due to Contractor's negligence. Replace when weather conditions permit and within specified planting period, or as directed by Landscape Architect.
3. Provide replacement plants closely matching adjacent specimens of same species.
4. Warrant replacement plants for additional period of one year from date of their acceptance after replacement.

1.9 MAINTENANCE

A. Begin maintenance immediately after plants are installed and continue to maintain for until Final Acceptance. The maintenance period begins after planting installation and continues until all the plants are accepted. At that time, a final site walk will be scheduled with the Architect and Owner and upon acceptance the site will be turned over to the Owner and their maintenance crews.

B. Maintenance Requirements:
   1. Protects plants and planting areas from damage.
   2. Keep plants healthy, vigorous, trim and neat.
   3. Prune to maintain plants in normal growth pattern.
   4. Spray to control disease and insects.
   5. Maintain mulch bed to 2 inch depth. Re-mulching of the plant materials is not required as part of the work.
   6. Keep beds free of weeds.
   7. Provide manpower in order to water all plant materials as required to maintain adequate moisture, and when directed by Architect.
   8. Maintain stakes and guys in taut and rigid state with wires in place and safety flags clearly visible. Remove stakes and guys when no longer necessary for plant establishment after one year.
   9. Reset plants to proper grade and upright condition if required and add topsoil and mulch to areas of settlement.
   10. Provide additional stakes as required to support trees particularly evergreens in areas prone to high winds or settlement.

PART 2 - PRODUCTS

2.1 TREE AND SHRUB MATERIAL

A. General: Furnish nursery-grown trees and shrubs complying with ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

B. Grade: Provide trees and shrubs of sizes and grades complying with ANSI Z60.1 for type of trees and shrubs required. Trees and shrubs of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.

2.2 PLANTS

A. Perennials: Provide healthy, field-grown plants from a commercial nursery, of species and variety shown or listed. Roots on container grown perennial shall be well established in the pots and how evidence of new growth. Recent transplants shall be grounds for rejection.

2.3 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
   1. Type: Shredded hardwood, un-dyed, mulching grade, uniform in size, and free from foreign matter. Lawn waste is not an acceptable component of mulches.

2.4 STAKE AND GUYS

A. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, free of knots, holes, cross grain, and other defects, 2 by 2 inches by length indicated, pointed at one end.

B. Guy and Tie Wire: ASTM A 641/A 641M, Class 1, galvanized-steel wire, 2-strand, twisted, 0.106 inch in diameter.

C. Guy Cable: 5-strand, 3/16-inch- diameter, galvanized-steel cable, with zinc-coated turnbuckles, a minimum of 3 inches long, with two 3/8-inch galvanized eyebolts.

D. Hose Chafing Guard: Reinforced rubber or plastic hose at least 1/2 inch in diameter, black, cut to lengths required to protect tree trunks from damage.

E. Flags: Standard surveyor's plastic flagging tape, white, 6 inches long.

2.5 MISCELLANEOUS PRODUCTS

A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.

2.6 PLANTING SOIL MIX

A. Meet the requirements of 32 9113 – Soil Preparation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive exterior plants for compliance with requirements and conditions affecting installation and performance. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Contact 'MISS UTILITY' at 800-257-7777 (72) hours prior to digging. Contractor shall take sole responsibility for any cost incurred due to damage due to these utilities.

C. Do not willfully proceed with planting as designed when it is obvious that conditions and/or obstructions exist due to changes in site conditions. Such conditions shall be brought to the immediate attention of the Landscape Architect. The Contractor will be held responsible for all necessary revisions due to failure to give such notification so that material can be relocated or conditions corrected prior to plant installations.

D. Remove any existing plant material necessary for the installation and the completion of the planting designed and contracted as part of this project.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, and lawns and existing exterior plants from damage caused by planting operations.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple exterior plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before planting. Make minor adjustments as required.

D. Lay out exterior plants at locations directed by Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings. Do not install plants until the Architect has approved the locations.

E. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks, branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
   1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting

3.3 PLANTING BED ESTABLISHMENT

A. Prepare Subgrade. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter.
   1. Apply superphosphate fertilizer directly to subgrade before loosening.
   2. Spread planting soil mix to the depths shown on the drawings but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

B. Finish Grading: Grade planting beds to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

C. Restore planting beds if eroded or otherwise disturbed after finish grading and before planting.

3.4 TREE AND SHRUB EXCAVATION

A. Pits and Trenches: Excavate circular pits with sides sloped inward. Trim base leaving center area raised slightly to support root ball and assist in drainage. Do not further disturb base. Scarify sides of plant pit smeared or smoothed during excavation.
   1. Excavate approximately three times as wide as ball diameter for balled and burlapped stock.

B. Subsoil removed from excavations may not be used as backfill.

C. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

3.5 SOIL DRAINAGE TEST

A. Before planting, determine that areas to receive plant material have adequate sub-drainage. Contractor is responsible for correcting all drainage conditions which may adversely impact the establishment of specified plantings.

   1. Perform water percolation tests for the following areas or as required in low areas where soils may not adequately drain.
   2. Test by digging tree and shrub pits to the full depth and dimensions indicated on drawings.
   3. Fill excavations to on third depth with water and allow to percolate before planting.
   4. If after 24 hours, water remains in excavation, perform a more detailed percolation test as described below and notify Architect in writing.
   5. At bottom of planting pit, excavate rectangular pit twelve inches x twelve inches x eighteen inches deep. Pour water into this small pit to a depth of six inches

(approximately four gallons). Note time required for water to be completely absorbed. Divide time noted by six, to achieve average rate of absorption for one inch of water. Submit results to Architect for review.

3.6 SOIL DRAINAGE IMPROVEMENTS

A. Where slope conditions permit, areas that do not drain properly may be drained to daylight with Architect's approval.
   1. Use three inch diameter slotted corrugated polyethylene non-perforated drainage tubing per ASTM F-405 within tree pit or bed areas. Provide non-slotted type beyond plant pits or plant bed areas.
   2. Minimum slope on drainage tubing shall not be less than 2%.

B. In areas that are low along streets and do not drain due to hydrostatic pressure, drainage improvements may require the following:
   1. Excavate the bottom of the plant pit or bed so that the unexcavated portion slopes towards the low side of the pit or bed area.
   2. Install drainage sack comprised of three inch diameter slotted corrugated polyethylene non-perforated drainage tubing per ASTM F-405, surrounded by washed gravel which is wrapped in geotextile filter fabric equal to Mirafi 140 S or N by Mirafi Inc
   3. Minimum slope on drainage tubing shall not be less than two percent.
   4. Provide a vertical standpipe at each tree pit.
   5. Connect slotted corrugated polyethylene non-perforated drainage tubing to nearby drain inlet where inverts permit.

3.7 TREE AND SHRUB PLANTING

A. Set balled and burlapped stock plumb and in center of pit or trench with top of root ball one inch above adjacent finish grades.
   1. Compact soil placed under root ball to prevent settlement.
   2. Remove burlap and wire baskets from tops of root balls and partially from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
   3. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.

B. Set balled and potted container-grown stock plumb and in center of pit or trench with top of root ball 1 inch above adjacent finish grades.
   1. Carefully remove root ball from container without damaging root ball or plant.
   2. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.

C. Organic Mulching: Apply 3-inch average thickness of organic mulch extending 12 inches beyond edge of planting pit or trench. Do not place mulch within 3 inches of trunks or stems.

3.8 TREE AND SHRUB PRUNING

A. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured or dead branches from flowering trees. Prune shrubs to retain natural character. Shrub sizes indicated are sizes after pruning.

3.9 GUYING AND STAKING

A. A. Upright Staking and Tying: Stake trees of 2-inch through 5-inch caliper. Stake trees of less than 2-inch caliper only as required to prevent wind tip-out. Use a minimum of 2 stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation and to extend at least 72 inches above grade. Set vertical stakes and space to avoid penetrating root balls or root masses. Support trees with two strands of tie wire encased in hose sections at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree. Use the number of stakes as follows:
   1. Use two stakes for trees up to 12 feet high and 2-1/2 inches or less in caliper. Space stakes equally around trees.
   2. All trees greater than 3" caliper and all trees in the planters should be guyed to supports mounted into the rock curb.
   3. Attach flags to each guy wire, 30 inches above finish grade.
   4. Paint turnbuckles with luminescent white paint.

3.10 TREE GUARD

A. Provide minimum 48" height tree bark protection for all planted trees on site.

B. Bais of Design: Premium rigid plastic mesh tree guard by A.M. Leonard, 6" diameter x 48" length. A.M. Leonard. 241 Fox Drive, Piqua, OH 45356. A.M. Leonard - Horticulture Tools & Supplies (amleo.com). 1 (800)-543-8955. Or approved equal.

3.11 GROUND COVER AND PLANTING

A. Set out and space ground cover and plants as indicated.

B. Dig holes large enough to allow spreading of roots,and backfill with planting soil.

C. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

D. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

E. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.12 PLANTING BED MULCHING

A. Mulch backfilled surfaces of planting beds and other areas indicated.
   1. Organic Mulch: Apply 3-inch average thickness of organic mulch, and finish level with adjacent finish grades. Do not place mulch against plant stems.

3.13 CLEANUP AND PROTECTION

A. During exterior planting, keep adjacent paving and construction clean and work area in an orderly condition.

B. Protect exterior plants from damage due to landscape operations, operations by other contractors and trades, and others. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged exterior planting.

3.14 DISPOSAL

A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property

3.15 ACCEPTANCE

A. The following shall be grounds for final acceptance of planting:
   1. Trees, shrubs and woody material shall be in healthy, living condition. Any material more than 25% dead shall be considered non-compliant.
   2. Lawns shall have 90% coverage with no less than 5 x 5 square inch bare spots before final acceptance.

B. There shall be an initial plant approval inspection and the contractor shall schedule a walk through inspections with the Engineer in the spring and fall of the first and second year anniversaries of the date of completion and initial acceptance of the work.

C. WARRANTY

   1. The landscape contractor shall be responsible for maintenance and tree care for a period of two (2) years. Services shall include, but not be limited to, weeding, mulching, trimming, pruning, edging, cultivation, fertilization, watering, pest control, vine removal, and any other maintenance necessary to ensure healthy, vigorous tree growth and well-kept property management.
      a. Watering shall be provided during the growing season as required
         1) First growing season, 1 time per week
         2) Second growing season, as needed but not less than once per month during July and August.
   2. Shrubs and groundcover plants shall carry a warranty of one (1) year.
   3. Periodic inspections shall be made for any evidence of disease or damage.
   4. Any plant showing signs of disease or damage or are more than 25% dead must be removed and replaced within 60 days of identification of failing conditions. Replacements may be delayed until the next growing season only if the 60 day period occurs outside of the identified planting season.
      a. All replacement plants must meet the size and criteria and other characteristics of newly planted material as required in the Forest Conservation Manual.
   5. Remove staking prior to final warranty acceptance with the exception of plants which had been replaced during the warranty period.
   6. Refer to notes on the plans for further guidance.

END OF SECTION 32 93 00

33 05 16
UTILITY STRUCTURES

PART 1 GENERAL

1.1 DESCRIPTION

A. Precast concrete utility structures shall include, but not necessarily be limited to, furnishing and installing precast concrete storm drain structures, manholes, valve and meter vaults, grade rings, and other miscellaneous structures of the configuration and to the extent indicated and in accordance with the Contract Documents.

B. Related Work Included Elsewhere

1. TRENCH EXCAVATION, BACKFILL, AND COMPACTION; SECTION 31 23 33 (TRENCHING AND BACKFILLING, POINT EXCAVATION AND BACKFILL)

2. Storm drainage structures; City of Baltimore DPW Speciifcations,2006, Section 33 49 00 (Storm Drainage Structures)

3. Water valves and appurtenances; Section 33 12 16 (Water Valves and Appurtenances)

4. Water services, meter settings, and vaults; Section 33 12 00 (Water Services)

5. Sanitary sewer manholes; City of Baltimore DPW Speciifcations,2006, 6ection 33 39 13 (Sanitary Utility Manholes, Misc. structures, Frame & Covers)

6. Dampproofing and membrane waterproofing; City of Baltimore DPW Speciifcations,2006, Section 03 15 13 (Dampproofing and Waterproofing)

C. Quality Assurance

1. Precast concrete utility structures shall be supplied by a qualified firm with a minimum of 3 years of continuous operations and which has performed at least three representative jobs, 3 years or older, comparable to precast work required for this Contract.

2. The Contract Manager will inspect all materials before and/or after installation to ensure compliance with the Contract Documents. Access shall be allowed the Contract Manager to the casting plant at any time to inspect the fabrication of units for City projects.

3. Precast units shall be substantially free of fractures and surface roughness. The planes of the ends of sections to be joined shall be perpendicular to their longitudinal axis within 5/8 inch. Precast units shall be subject to rejection on account of failure to conform to any of the Specification requirements. In addition, individual sections may be rejected because of any of the following:

a. Fractures or cracks passing through the wall, except for a single end crack

that does not exceed the depth of the joint.

b. Defects that indicate imperfect proportioning, mixing, and molding.

c. Surface defects indicating honeycombing or open texture.

d. Damaged or cracked ends, where such damage would prevent making a satisfactory joint.

e. Any continuous crack having a surface width of 0.01 inch or more and extending for a length of 12 inches or more, regardless of position in the section or wall.

f. For grade rings, cracks or fractures extending for a length of ½ inch or more regardless of position in the ring. Dimensional tolerances shall be + 1/4 inch.

4. Precast units shall be set so as to be vertical. The maximum allowable deviation, when measured from the top to the bottom of the completed unit, shall not exceed 1/4 inch.

5. The manufacturer or supplier shall store completed sections off the ground with ample space between rows and enough clearance above and below to allow full view of walls and joint ends for inspection purposes.

6. The Contract Manager reserves the right to require core samples of finished products.

7. All precast units shall be marked with the manufacturer's name or trademark, date of manufacture, and the ASTM and/or AASHTO specification under which the unit was manufactured.

D. Submittals

1. Shop Drawings
Shop drawing shall be submitted as specified in 01 33 23 (Shop Drawings, Product Data, and Samples) for all precast units. The shop drawings shall be fully dimensioned and show reinforcing, design loads, pertinent design calculations, and lifting and erection inerts. Shop drawings shall also include the precast unit manufacturer's handling, assembly, and installation directions and recommendations.

2. Certificates of Compliance
Certificates of compliance shall be submitted as specified in 01 33 23 (Shop Drawings, Product Data, and Samples) stating that the precast units furnished, and their components, meet the design, fabrication, and testing requirements specified in City of Baltimore DPW Specifications, 2006, Sections 03 41 00 (Precast Structural Concrete)

PART 2 - PRODUCTS

2.1 MATERIALS

A. Contractor's Options

1. The Contractor may furnish A 312 Grade TP 410 Stainless steel or reinforced plastic steps composed of ASTM A615, Grade 60 reinforcing bar (#4) completely encapsulated in copolymer polypropylene per ASTM D2146, Type II, Grade 43758for use in manholes, inlets, and vaults.

B. Detailed Material Requirements

1. Portland Cement Concrete

Portland cement concrete shall meet the requirements specified in Section 03 30 00 (Cast in place Concrete) except as modified herein. Portland cement for units to be used in sanitary sewer systems shall be Type II.

2. Concrete Reinforcement

Concrete reinforcement shall meet the requirements specified in City of Baltimore DPW Specifications, 2006, Section 03 21 00 (Reinforcing Steel)

3. Water from Other Than Potable Sources

Water shall meet the pH requirements of AASHTO T 26, Method B. Water shall not smell or be discolored. Water suspected of questionable quality shall meet limits of the comparison tests with distilled water in accordance with AASHTO T 26. The chloride concentration of water used in mixing and curing of Portland cement will be determined in accordance with ASTM D 512 and shall not have a chloride concentration exceeding 1000 ppm.

4. Joint Seals Between Sections

a. Flexible Joint Sealing Compound

Joint sealing material shall be cold-applied preformed plastic sealing compound meeting the following requirements:

Chemical Composition -	Minimum	Maximum	Test Method
Bitumen (Hydrocarbon Plastic Content) % by weight	50	70	ASTM D4
Inert Mineral Filler % by weight	30	50	AASHTO T111
Volatile Matter % by weight		2.0	ASTM D6
Physical Properties			
Specific Gravity at 77° F	1.20	to 1.35	ASTM D71
Ductility at 77° F minimum	5.0 cm		ASTM D113
Softening Point at 77° F minimum	320° F		ASTM D36
Flash Point, C.O.C. minimum	600° F		ASTM D92-57

Penetration				
77° F (150 gs.) 5 sec	50	to	120	ASTM D217

or shall be a specially formulated preformed joint sealant in rope like form which swells upon contact with water forming a compression type seal. The specially formulated preformed joint sealant shall meet the following requirements:

Chemical Composition				
Butyl Rubber Hydrocarbon % by weight	24.9			ASTM D297
Volatile Matter % by weight	below 1.0			ASTM D6
Physical Properties				
Specific Gravity at 77° F		1.57		
Penetration		58		ASTM D217 150 GTL
		85		ASTM D217 300 GTL
Flash Point		365		ASTM D93-97
Accelerated Aging		Maintain 99% Solids		4 hrs @ 212 F
Storage Life		Indefinite		
Application Temperature Range	5°F	to	125° F	
Service Temperature Range	-40°F	to	212° F	

b. Gaskets

Rubber gaskets shall meet the requirements of ASTM C 443.

5. Sanitary Sewer Manhole Materials

a. Flexible Gaskets Between Manhole and Frame
Flexible plastic gasket between manhole and manhole frame shall be extruded rope Type B, in accordance with AASHTO M 198, butylbased, 3/4-inch diameter minimum.

b. Jointing Mastic
Jointing mastic shall be an elastic, water resistant formulation of plastic bituminous materials and inert fillers so combined when applied to a vertical metal surface and heated to 120° F, the jointing mastic will neither slump nor loose plasticity. When applied directly from the container without further mixing the jointing mastic can be applied in an even, adherent coat within the temperature range of 20° to 100° F.

c. Manhole-to-Pipeline Connectors
Unless otherwise indicated in the Contract Documents, flexible gasket connectors for connecting pipes to manholes shall meet the requirements of ASTM C923.

d. Provide thermoplastic cast-in-place inserts with a working tensile load capacity of 1200 pounds for bolting down manhole cover frames where indicated on the Drawings. Inserts shall be ½ inch diameter by 2 3/4 inch minimum length.

6. Dampproofing and Waterproofing
   Dampproofing and waterproofing for exterior of precast structures shall be as specified in City of Baltimore DPW Specifications, 2006, Section. 03 15 13. (Dampproofing and Waterproofing)

7. Steps and Ladders
   A 312 Grade TP 410 Stainless steel or reinforced plastic steps composed of ASTM A615, Grade 60 reinforcing bar (#4) completely encapsulated in copolymer polypropylene per ASTM D2146, Type II, Grade 43758

8. Granular Bedding
   Granular bedding beneath precast units shall meet the requirements of AASHTO M 43, No. 57

9. Non-Shrink Mortar
   Quick-setting non-shrink cement mortar shall be as specified in City of Baltimore DPW Specifications, 2006, Section 03 62 00.01 (Non-Shrink Grouting).

PART 3 - EXECUTION

A. Design Criteria
   1. General

      a. Structural design for precast units shall be prepared by a registered Engineer for the precast concrete manufacturer. Units shall be designed for HS 25 load designation or 300 pounds per square foot live load, whichever is most critical for determining the concrete and steel stresses.

      b. Where more than one standard is referenced for any given unit, should there be a conflict, the more stringent requirement as determined by the Contract Manager, shall apply.

      c. Unit configuration shall be as shown on the Plans and/or Standard Details.

      d. Distribution of earth loading and live load shall be in accordance with ASTM C 857 or ASTM C 890.

      e. Walls shall be designed using an equivalent fluid pressure of 83 pounds per cubic foot and a 2 foot surcharge. The units shall also be designed to resist all stress encountered during casting, handling, and erection.

   2. Manholes

      a. Precast concrete manholes shall meet the requirements of ASTM C 478 except that the minimum compressive strength of the concrete shall be 4000 psi.

      b. Joints shall meet the requirements of ASTM C 443, shall be self-centering, and shall form a uniform water tight joint.

3. Inlets
   Precast inlets shall meet the requirements of AASHTO M 199.

4. Grade Rings
   Grade rings shall meet the requirements of ASTM C 478 and shall be one-piece, 2 or 3 inches thick, with anchors bolt holes as shown in the Standard Details.

5. Miscellaneous Water and Wastewater Structures
   Miscellaneous water and wastewater structures not otherwise covered shall meet the requirements of ASTM C 913.

B. Fabrication

1. The precast units shall be factory cast. Job site casting will not be permitted. Concrete in the precast elements shall be continuously placed to prevent formation of seams. The finished units shall be free of voids, cracks, and have beveled corners and edges. All inserts shall be securely attached or embedded in their property location.

2. Concrete strength of all precast units at 28 days shall be 4000 psi minimum, unless otherwise specified. It shall be the precast unit manufacturer's responsibility to insure that the specified concrete strength is maintained throughout production of the units. Mix design shall be those previously used by the manufacturer which have proven satisfactory for casting units similar to those specified and producing the required strength. All precast concrete shall be air entrained. Admixtures containing calcium chloride shall not be used.

3. Precast concrete units shall be manufactured in accordance with the applicable requirements of ASTM C 858, and as modified herein except that precast concrete units manufactured by the dry cast (packerhead) process are prohibited.

4. Wall sleeves or gaskets for piping, sumps, steps, access hatches, and other inserts as shown on the Plans and/or Standard Details shall be cast into the structure or inserted at the place of manufacture.

C. Product Handling

1. No precast unit shall be shipped in less than 15 days from date of manufacturer, unless the unit has been tested and is shown to be in full compliance with the Specifications.

2. Precast sections shall be transported and handled with proper equipment to protect the elements from damage. Sections shall be handled by means of lifting inserts embedded in the concrete. Damaged sections that cannot be satisfactorily repaired shall be replaced by new sections at no additional cost to the City.

3. Precast sections shall be stored on wooden blocks to hold them off the ground to prevent dirt and debris from entering the joining surfaces.

D. Installation

1. Excavation, foundation preparation, backfill, and compaction shall be as specified in Section 31 23 33 (TRENCHING AND BACKFILLING, POINT EXCAVATION AND BACKFILL)

2. Precast units shall be installed where and as shown on the Plans and Standard Details or as directed by the Contract Manager.

3. Pipe connection, penetrations, and other appurtenances shall be installed as specified in the following sections:

   a. Storm drainage structures; City of Baltimore DPW Specifications, 2006, Section, 33 49 00.

   b. Water valves and appurtenances; Section, 33 12 16.

   c. Water services, meter settings, and vaults; Section 33 12 00.,

   d. Sanitary sewer manholes; City of Baltimore DPW Specifications, 2006, Section 33 39 13..

4. Field modifications of precast units, such as cutting or enlarging holes or slots, will not be permitted without the specific approval of the precast unit's manufacturer the Contract Manager. Permitted modifications shall be made in strict and accordance with the manufacturer's directions and recommendations.

5. Mating surfaces shall be cleaned of all foreign materials such as dirt, mud, stones, etc., and where appropriate, joint sealing materials applied prior to assembly of the units.

END OF SECTION 33 05 16

33 11 00
WATER UTILITY DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

This Section includes requirements, but not necessarily be limited to, furnishing and installing water pipes, fittings, appurtenances, test, and chlorinate water pipes for a water supply and distribution system including fire protection to the limits indicated in accordance with the Contract Documents.

1.2 RELATED WORK INCLUDED ELSEWHERE

A. Trenching and Backfilling, Point Excavation and Backfill; Section 31 23 33.

B. Patch Existing Pavement and Reset Utility Services; Section 32 01 29.60

C. Water valve and appurtenances; Section 33 12 16.

D. Water services, Water Meter Settings, and Vaults; Section 33 12 00

1.3 QUALITY ASSURANCE

A. The Engineer will inspect all materials before and after installation to ensure compliance with the Contract Documents. When specific tests of materials are called for in the referenced standards and specifications, the Engineer has the option of requiring that any or all of these tests be performed for materials furnished for a specific project. When testing is required, it will be specified.

B. Ductile iron pipe (DIP) and fittings shall be sound and without defects and confirm to AWWA C151or C153. Repair of defects by welding or other methods will not be allowed. Field cut and remove damaged section of pipe to six inches (6") beyond damaged lining. Remove and replace rejected pipe,fittings, or appurtenances at Contractor's expense.

C. Polyvinyl chloride (PVC) pipe and couplings shall be homogeneous throughout and free from visible cracks, bubbles, blisters, holes, foreign inclusions, cuts, or scrapes on inside or outside surfaces, or other imperfections, which may impair the performance or life of the pipe. Each pipe shall be straight-to-within one and one quarter inch (1 1/4") per twenty foot (20') length of pipe when uniformly supported along its entire length, and shall have a true circular cross-section to within plus or minus one sixty fourth inch (± 1/64"). This pipe shall only be allowed in special applications of non-potable/treated lines with prior Owner approval. PVC pipe manufactured more than six (6) months prior to work site inspection will not be accepted. Loading, unloading, handling, inspection and storage of PVC pipe shall be in accordance with AWWA C605. PVC pipe shall be stored such that it does not deform or bend.

1.4 Tests and Examinations

A. General

1. Tests, in-process and final examinations to assure conformance with the Specifications shall be as established herein. Examinations to verify the quality of work shall be performed by persons other than those engaged in the activity being examined. Such persons shall not report directly to the production supervisor responsible for the work.
2. The Engineer, or his representative, reserves the right to inspect each section of pipe at various stages of production as indicated below in Paragraph 1.3, E, 3, In Pro
3. cess Examination. Accordingly, the manufacturer shall provide the Engineer with a written production schedule, which facilitates in-process examinations as described herein.
4. Testing shall be performed in accordance with the standard procedures referenced. In the absence of established written procedures, the test methods shall be documented by the manufacturer and proved by actual demonstration, to the satisfaction of the Engineer. At least one (1) copy of the procedures to be followed shall be available to
5. all appropriate personnel at the testing site for reference and use.
6. Materials and items previously checked with equipment and found to be out of calibration or adjustment shall be considered unacceptable until it can be determined that all applicable requirements have been met.
7. The manufacturer shall maintain records of all required tests and inspections. These records shall include documents such as records of materials, manufacturing, examination, repairs, and test data taken before and during fabrication. The Engineer reserves the right to request that specific data be i
8. ncluded in a report, which may not otherwise be included. Whenever tests and examinations are performed on a pipe element or pipe, the appropriate identification number shall be shown on the report. Copies of al
9. Reports of tests by the manufacturer, independent laboratory or material suppliers shall be given to the Engineer in such forms as to be appropriate for permanent records.
10. The Engineer shall have access to all records of tests and inspections related to pipe manufactured for use in the Contract, and shall also have the right to witness any tests being performed by the manufacturer or his suppliers relative to products, materials or the pipe being produced. The Contractor shall notify the Engineer sufficie
11. ntly in advance of pipe manufacturing so that the Engineer has the opportunity to monitor all pipe manufacturing operations.

B. Chlorination and Field Tests

1. The Contractor shall furnish all labor, tools, materials, and equipment necessary to perform the tests specified and to chlorinate the water mains. The cost of testing and chlorination including all materials, labor and equipment shall be included in the unit prices bid for the waterline.
2. All equipment used in testing shall be provided by the Contractor, and subject to the approval of the Engineer, and shall be such as to properly develop, maintain and measure hydrostatic test pressures and leakage rates.
3. Where devices such as meters, recorders, charts, plugs, caps, blind flanges, corporation stops or bulkheads are required to develop, maintain and measure test pressures, these devices shall be furnished and installed by the Contractor.
4. All defects revealed by the tests shall be corrected without cost to the Owner. Tests and repairs shall be continued until test requirements are met. Repairs to the various systems shall be made with new materials. When it is necessary to replace pieces of pipe, the

replacement shall be the same material and thickness as the defective piece. Tests shall be repeated after defects disclosed thereby have been made good.

5. The section of water main shall be filled by a metered connection from such existing fire hydrant or main as may be designated by the Engineer. When charging and testing water mains which are not sufficiently close to existing water mains carrying Owner water to permit connection direct by pipe or hose lines., Owner approved tank wagons shall be used to haul water and serve as suction tanks.

C. Chlorination, Flushing, and Bacteriological Testing

1. When the water mains are completed, each section shall be chlorinated in accordance with AWWA C601 except as noted below. A solution of hypochlorite of lime or chlorine gas shall be discharged into the water main, by means of continuous feed, near the point where the water main is being charged. This solution shall be of such strength and quantity as may be necessary to provide ten (10) parts per million, by weight of residual chlorine after twenty four

2. (24) hours, in the section of water main being charge

3. d. If the required residual is not obtained, the Contractor shall repeat the chlorination until it obtains this residual.

2. After the twenty four (24) hour (minimum) disinfection period, the Contractor shall flush the water main until the chlorine level is at or below one (1) ppm.

3. The Engineer shall determine the amount of main to be chlorinated and tested at any one time and reserves the right to separate the installation into several sections in the event of long extensions, or installations of pipe designed for different head conditions or for other reasons.

4. The Engineer will collect water samples in accordance with AWWA C652 and provide for their analysis for bacteriological quality. If the results meet the requirements of the WSSC's Water Quality Lab, and they release the main for active service, then, the water main can then be tied into the distribution system. Should the chlorine residual and bacteriological analysis not be satisfactory, the Contractor shall flush and re-chlorinate the water main until satisfactory results are obtained. Samples shall be taken for every street, court or section.

6. It shall be the responsibility of the Contractor to purge the line of the chlorinated water after it has been tested. No detectable chlorin

7. e can be released into a stream.. Upon successful testing and disinfection of the new water mains, the Contractor shall dispose of the chlorinated water using either of the following two methods. The Contractor must submit a proposed plan for method of disposal of chlorinated disinfection water to the Engineer for approval prior to proceeding.

a) Discharge directly into an available public sanitary sewer. The discharge point must be approved by the Engineer prior to implementation. The discharge rate must b

e controlled to avoid overloading of the sanitary sewer. This is the preferred method.

b) Pump the water main and haul the chlorinated water to a safe discharge location (sanitary sewer).

D. Hydrostatic/Leakage Testing

1. Hydrostatic Testing: Water mains and appurtenances shall be hydrostatically tested by the Contractor in accordance with AWWA C600 and as specified herein.

   a. All piping shall be adequately braced and supported during the tests so that no movement, displacement or damage will result from the application of the test pressure. Relief devices in the various systems shall be capped or plugged during the tests. The Contractor shall cap and buttress the new water main between the sections of the existing pipe. Whe

   b. re concrete pipe is installed, the Contractor shall furnish, at his own cost and expense, all necessary bulkheads, caps, plugs or other fittings required to s

   c. top off, temporarily, the main by means of sleeves and spacers or other approved methods. Piping systems shall not be tested against any valves. When hydrants are in the test section, the test shall be made against the operating valve in the hydrant. All hydrant branch valves shall be in the open position during this test phase.

   d. Ductile iron pipe (DIP), PVC, steel pipe (with gasketed joints) and prestressed concrete pressure pipe (PCCP) shall be hydrostatically tested by slowly filling the main with chlorinated water. The pressure shall be raised to a value as specified on the Contract drawings. The test pressure shown on the Contract Drawings shall be applied at the low point of the main shall be maintained for at least thirty (30) minutes. Test pressure shall not vary by more thanplus or minus five (±5) psi for the duration of the test. Before applying the specified test pressure, air shall be expelled completely from the section of piping under test. If permanent air vents are not located at all high points, air shall be bled thru a temporary outlet. In ductile iron pipe corporation cocks shall be installed at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged or left in place as required by the specifications.

E. Leakage Testing: After the satisfactory completion of the hydrostatic tests, the new installation of ductile iron, PVC, steel pipe (with gasketed joints) and concrete pipe shall then be subjected to a leakage test at working pressure of at least twenty-four (24) hours duration. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within five (5) psi of the specified test pressure after the pipe has been filled with water and air has been expelled. Leakage shall not be measured by a drop in pressure in a test section over a period of time. Until the leakage test requirements are met, the Contractor shall make all repairs that may be necessary to accomplish this. After all tests have been satisfactorily completed, the Contractor shall connect the new water main with the distribution system.

1) Allowable leakage in ductile iron pipe at various pressures are shown in the following Table:

Table B - Allowable leakage for Ductile Iron Pipe per 1000 ft. of pipeline* - gph

Avg. Test Pressure	Nominal Pipe Diameter - in.														
psi	4	6	8	10	12	16	20	24	30	36	42	48	54	60	64
450	0.64	0.95	1.27	1.59	1.91	2.55	3.18	3.82	4.78	5.73	6.69	7.64	8.60	9.56	10.19
400	0.60	0.90	1.20	1.50	1.80	2.40	3.00	3.60	4.50	5.41	6.31	7.21	8.11	9.01	9.61
350	0.56	0.84	1.12	1.40	1.69	2.25	2.81	3.37	4.21	5.06	5.90	6.74	7.58	8.43	8.99
300	0.52	0.76	1.04	1.30	1.56	2.08	2.60	3.12	3.90	4.68	5.46	6.24	7.02	7.80	8.32
275	0.50	0.75	1.00	1.24	1.49	1.99	2.49	2.99	3.73	4.48	5.23	5.98	6.72	7.47	7.97
250	0.47	0.71	0.95	1.19	1.42	1.90	2.37	2.85	3.56	4.27	4.99	5.70	6.41	7.12	7.60
225	0.45	0.68	0.90	1.13	1.35	1.80	2.25	2.70	3.38	4.05	4.73	5.41	6.03	6.76	7.21
200	0.43	0.64	0.85	1.06	1.28	1.70	2.12	2.55	3.19	3.82	4.46	5.09	5.73	6.37	6.80
175	0.40	0.59	0.80	0.99	1.19	1.59	1.98	2.38	2.98	3.58	4.17	4.77	5.36	5.96	6.36
150	0.37	0.55	0.74	0.92	1.10	1.47	1.84	2.21	2.76	3.31	3.86	4.41	4.97	5.52	5.82

*If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size. This chart was derived using the formula:

$L = (SD(P)^{.5})/113,200$, where L = allowable leakage, in gallons per hour

S = length of pipe tested, in feet D = nominal diameter of pipe, in inches

P = average test pressure during the leakage test, in pounds per square inch (gauge).

2) Allowable leakage in polyvinyl chloride (PVC) pipe at various pressures are shown in the following Table:

Table C - Allowable leakage for PVC Plastic Pipe with Elastomeric Joints per 1000 ft. of pipeline or 50 Joints* - gph

Nominal Pipe Size	Average Test Pressure in Line – P.S.I.		
Inches	150	200	250
4	0.33	0.38	0.43
6	0.50	0.57	0.64
8	0.66	0.76	0.85
10	0.83	0.96	1.07
12	0.99	1.15	1.28

*If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size. This chart was derived using the formula: $L = (ND(P)^{.5})/7400$, where L = allowable leakage, in gallons per hour N=number of joints in line tested, D = nominal diameter of pipe, in inches P = average test pressure during the leakage test, in pounds per square inch (gauge)

F. Continuity Testing for PVC Pipe

After backfilling, the Contractor shall test the tracer wire to demonstrate electrical continuity between fire hydrants or any other type of testing appurtenances and through the length of the PVC pipeline installed. Any discontinuity shall be located, repaired, and retested at the Contractor's expense until continuity is achieved.

1.5 SUBMITTALS

A. Shop Drawings shall be submitted as specified in 01 33 23 (Shop Drawings, Product Data, and Samples) for the following materials, and shall include the following information:

1. Ductile iron pipe (DIP) and fittings: product information and dimensions; pressure rating or class; storage, handling, and installation recommendations.

2. Polyvinyl chloride (PVC) pipe and couplings: product information and dimensions; pressure rating; storage, handling, and installation recommendations for pipe, joint restraint devices, pipe couplings, wire connector splice kits, service saddles, and manufacturer's instructions for tapping pipe.

3. Certificates of Compliance

   a. The manufacturer shall provide an affidavit certifying that the underground pipe, fittings, and appurtenances comply with the standards cited in the piping and fitting schedules. Submit certificates of compliance before delivery of materials in accordance with 01 33 00 (Submittal Procedures) for pipe and fittings furnished by the Contractor under this Section. Certificates shall include Owner Contract Number, job location, Contractor's name, types, classes and strengths of pipe, dimension ratio (for PVC pipe), manufacturer's identification codes for nominal

size, production record code, date of manufacture and pipe manufacturer's name. Certificates of compliance for concrete materials are specified in 03 30 00 (Portland Cement Concrete Structures).

b. The certificates of compliance for the following materials shall state that the item supplied is in accordance with the requirements specified here

c. in:

1) Ductile iron pipe (DIP) and fittings, joint restraint devices, and pipe couplings.

2) Polyvinyl chloride (PVC) pipe, joint restraint devices, pipe couplings, tracer wire, wire connector splice kits, detection tape, and service saddles.

6. Certified Test Results

1. Submit certified test results before delivery of materials in accordance with 01 33 00 (Submittal Procedures) for pipe and fittings furnished by the Contractor under this Section. Certificates shall include Owner Contract Number, job location, Contractor's name, types, classes and strengths of pipe and pipe manufacturer's name. Certified test results shall be submitted for the following:

a. Ductile iron pipe (DIP) and fittings

b. Polyvinyl chloride (PVC) pipe: Submit manufacturer's written transcript of test results, for sustained pressure, pipe dimension, burst pressure, flattening resistance, and extrusion quality test. Frequency of performing the tests and the methods of selecting test specimens shall be in accordance with AWWA C900.

PART 2- PRODUCTS

2.1 MATERIALS

A. Portland cement concrete for pipe fitting buttresses and anchorages shall be Mix No. 1 for unreinforced concrete buttresses and Mix No. 3 for reinforced concrete buttresses. Concrete mixes shall be as specified in 03 30 00 (Portland Cement Concrete Structures)

B. Polyvinyl chloride (PVC) pipe

1. Pipe

a. PVC pipe four inches (4") through twelve inches (12") in diameter shall be manufactured in twenty foot (20') lengths in accordance with AWWA C900 with cast/ductile iron pipe equivalent outside diameters.

b. Pipe shall have a dimension ratio (DR) of 18, pressure class of one hundred sixty (160) psi, and shall utilize elastomeric-gasketed push-on joints for joining pipes in accordance with AWWA C900.

c. Pipe, gaskets, and gasket lubricant shall be suitable for potable water systems and shall meet NSF 61.

d. All PVC pipe shall be factory marked on the spigot end for depth of insertion into the bell and factory tested in accordance with AWWA C900.

2. Fittings for use with PVC water mains shall be ductile iron in accordance with Paragraph 2.1,D,3. PVC fittings, if approved by the Engineer, must be molded. No fabricated fittings will be allowed.

3. Couplings

Pipe couplings for PVC water mains shall be suitable for potable water service and shall have epoxy or nylon coated ductile iron center and end rings.

4. Joint Restraint

a. Horizontal and vertical bends, tees, caps and fittings shall be buttressed or anchored in accordance with the Plans, Paragraph 2.1,C,5,c and Details for Construction, or as directed by the Engineer. Valves, when connected to PVC pipe, shall be iron body resilient seat gate valves and anchored in accordance with the detail shown on the Plans and shall have one (1) full length of pipe on each side of the valve.

b. Joint restraints for harnessing joints shall be in accordance with the Paragraph 2.1,C,5 4 and the

c. requirements below:

1) All joint restraint devices shall be Underwriter Laboratory (UL) approved.

2) PVC pipe shall not be deflected. If deflection is required in a restrained joint, use ductile iron pipe or fittings.

3) Where a restrained joint is required between PVC pipe and a fitting, the fitting shall be ductile iron mechanical joint. Joint restraint for this joint shall meet ASTM F1674. Contact Water and Waste Water Engineering Division for the approved list of manufacturers,

4) Where a restrained joint is required for PVC push-on joint, joint restraint shall be preapproved Contact Water and Waste Water Engineering Division.

5. Connections

a. Connections to PVC waterlines shall be by using fittings, such as tees, indicated on the Plans.

b. Saddles are required for two inch (2") and smaller connections to PVC waterlines. Saddles with clamps shall provide full support around the circumference of the pipe and shall not distort, scratch, or damage the pipe when tightened. Only tapping saddles manufactured specifically for AWWA C900 PVC pipe shall be used. Saddle and clamps/straps shall be formed to meet the curvature of the pipe. Saddles with clamps

c. shall be manufactured for underground service, shall be rated for a minimum service of 150 psi an

d. d shall be brass or bronze alloy meeting ASTM B62 or B584 and AWWA C800 or ductile iron saddles meeting ASTM A536 or A395 with two 18-8 stainless steel

straps and shall be epoxy or nylon coated. Saddles shall have watertight gaskets of Fuma-N rubber meeting ASTM D2000 or nitrile around the tap hole.

C. Ductile Iron Pipe and Fittings

1. Pipe

a. Pipe shall be manufactured in accordance with the requirements of AWWA C151 except that the metal thickness shall be as described herein. Pipe nominal lengths may be eighteen through twenty feet (18' to 20') and shall include all jointing materials.

b. All pipe and fittings shall be designed and constructed to withstand all external pressure caused by overburden as indicated on the profile and traffic loads to which the pipe may be subjected.

c. All ductile iron pipe shall be Class 54 ". All ductile iron pipes will be designed for a Type 1 laying condition, unless otherwise specified in the contract documents.

d. Unless otherwise specified, outside diameter of ductile-iron plain end shall be the same as for mechanical-joint cast or ductile-iron pipe.

2. Joints

a. Joints may be mechanical, flanged or rubber gasketed push-on type. Unless otherwise noted, all joints shall be in accordance with AWWA C111. Provide all joint accessories, as required, to connect with plain end of push-on joint pipe or cut pipe.

b. Flanged joints shall meet requirements of AWWA C115 and as supplemental herein. Flange bolts, nuts and washer shall be carbon steel ASTM A307, Grade B with good, sound, well fitting threads. Nuts shall be cold punched, hexagonal, trimmed and chamfered. Heads, nuts

c. and threads shall be ANSI B1.1. Bolts shall have one quarter inch (1/4") project beyond the nut when the joint with gasket is assembled. Gaskets shall be full-faced, one eighth inch (1/8") thick rubber. No flanged joints should be direct buried.

d.

3. Fittings

a. Fittings forty eight inches (48") and smaller diameter shall be mechanical joint bell, ductile-iron in accordance with AWWA C 153 for compact fittings sizes four inches through sixteen inch (4" to 16"), including dimensions and weights.

b. Fittings fifty four inches (54") and larger diameter shall be push-on bell, ductile-iron, proprietary restrained joints in accordance with AWWA C153.

c. Fittings shall be designed and constructed to withstand a pressure not less than as specified in AWWA C 153 or for the adjacent pipe , whichever is greater.

d. Provide exterior asphaltic coating per AWWA C-110 and interior double thickness cement-mortar lining and seal coated inside in accordance with per AWWA C-104; or provide interior and exterior fusion bonded epoxy coating, 6-8 mills in thickness, conforming to AWWA C116.

e. The cast markings required in AWWA C153, clearly mark on each fitting the year, month and date cast, and number of lot.

f. The gasket dimensions shall conform to the dimensions and tolerances per AWWA C111 Section 11-8, or with special designs and/or shapes shall meet the performance requirements of AWWA C111 Section 11-10. The size, mold number, gasket manufacturer's mark, manufacturer's country, the letters *MJ* and the year of manufacture shall be molded or permanently marked on the gasket. The molded markings shall not be on the sealing surface.

g. When flange fittings or connecting pieces are required, they shall meet requirements of AWWA C153. Flanges shall be cast integrally with body and shall have the same thickness over their entire circumference. Faces shall be perpendicular to axis of pipe. Bolt holes shall be equally spaced and shall straddle the centerline of the fitting. Provide all joint accessories required.

h. All fittings shall be complete with all joint accessories, rubber gaskets, bolts and nuts.

4. Lining and Coating

a. All pipe and fittings shall be cement-lined in accordance with AWWA C104, double thickness. This lining shall be sealed with a bituminous seal coat. The outside surface shall be bituminous coated per AWWA C151. All buried metal pipe and/or appurtenance that do not have factory applied protective coating or whose coatings have been damaged shall receive one (1) prime coat and one (1) finish coat of field-applied coating system applied in accordance with AWWA C210. Field coatings shall be complete prior to

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c. ine tests.

5. Joint Restraint

a. Restrained joint pipe and fittings shall be of the pipe manufacturer's standard design for ductile iron, and steel pipe and fittings. Unless otherwise noted, pressure ratings for pipe harnessing components shall not be less than the pipe working pressures. All rubber gasketed push on type-restrained joints should only be provided by manufacturer or suppliers who are authorized and licensed by the manufacture and they should be designed applied handled and installed in strict accordance with DIPRA and the p

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c. pe manufacturer's recommendations. Push-on joint ductile-iron pipe with proprietary restraint shall be as follows:

1) For pipe thirty six inches (36") and smaller in diameter: Contact Water and Waste Water Engineering Division for the approved list of manufacturers.

2) For pipe forty two inches (42") and larger diameter: Contact Water and Waste Water Engineering Division for the approved list of manufacturers.

d. Retainer glands for restraint of mechanical joint, ductile-iron pipe twenty four inches (24") and smaller diameter shall be designed to fit standard mechanical joint bells conforming to AWWA C111. Glands shall be manufactured of ductile-iron conforming to ASTM A536 with a restraining mechanism of size and arrangement per manufacturer's recommendations, of the following type:

1) Ductile-iron wedges in combination with special, heat-treated set screws with or without twist-off nuts, torqued per manufacturer's recommendation; or
2) Hardened steel set screws with knurled and cupped points, with or without twist-off nuts.
3) Retainer glands shall, at a minimum, meet the working pressure ratings for the pipe.
4) Contact Water and Waste Water Engineering Division for the approved list of manufacturers

e. Rod for tie rod assemblies shall meet the material requirements of ASTM A 193, Grade B7, and shall be threaded for at least eight inches (8") on both ends. Rod shall be three quarters of an inch (3/4") diameter unless otherwise noted. Nuts shall meet the requirements of ASTM A 194. Manufactured tie rod and accessories shall result in the completed restrained joint assembly having a minimum working pressure rating of two hundred (200) psi. Steel for strapping and harnessed joints shall be minimum three quarters of an inch (3/4") diameter and meet requirements of ASTM A588 and A307. All nuts and bolts and harness tie rods shall be steel, zinc plated with an epoxy or nylon coating, or ANSI 304 Grade Stainless Steel. T bolts, harness tie rods, coupling bolts, flanged joint bolts, etc. shall be designed to provide at least one (1) complete thread projecting beyond the nut when properly tightened. Any such threaded unit that fails to meet this requirement shall be replaced at no additional cost to the Owner.

D. Tracer Wire for Non-Metallic Pipelines: Tracer wire shall be AWG No. 4 insulated stranded copper wire with a 45-mil polyethylene insulation. The wire shall be blue, have "UL" markings and suitable for direct bury applications.

E. Marker Tape for Non-Metallic Pipelines: Visual Detection Tape shall be three inches (3") wide (minimum) metallic blue plastic tape lettered "water" in black graphics. Copper Pipe and Fittings shall be as per 33 12 00 (Water Services, Water Meter Setting, and Vaults).

F. Masonry work shall meet requirements of 04 21 13 (Brick Masonry).

G Precast concrete shall meet requirements of 33 05 16.13 (Precast Concrete Utility Structures).

H. Granular Bedding shall meet requirements of 31 23 33 (Trenching and Backfilling, Point Excavation and Backfill).

I. Cut and Cover Casing Pipe shall be the requirements of 33 41 00 (Storm Utility Drainage Piping) for reinforced concrete pipe

PART 3- EXECUTION

3.1 GENERAL

A. Pipe delivery and distribution shall be scheduled to provide minimum interference with required maintenance of traffic. Pipe delivery shall be coordinated with pipe installation as directed.

B. Ductile iron pipe, fittings, valves and appurtenances shall be unloaded, handled and stored in accordance with AWWA C600. If damage or coating abrasion occurs and is deemed repairable, it shall be repaired at the Contractor's expense and to the satisfaction of the Engineer, in accordance with these specifications. If damage is not repairable in the opinion of the Engineer, such pipe, fittings, valves or appurtenance will be rejected and shall be removed and replaced at the Contractor's expense.

1. At all times during construction of the pipeline the Contractor shall take every precaution to prevent damage to the protective coating. Suitable approved tools and equipment shall be used for convenient and safe handling of coated ductile iron pipe and fittings. Metal chains, cables, tongs, forklifts or other equipment likely to cause damage to the coating will not be permitted. Web slings shall be a type that will not damage the coating. Slings should be a minimum of eighteen inches (18") wide and of su
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3. ficient strength to handle the weight of the piping safely. Slings shall not pass through the pipe. Hooks on the end of the pipe will not be allowed.
4. In preparation for transporting pipe, the use of web slings is necessary for tie downs. If cables or chains are used during transportation, they must be properly padded with approved, suitable material as required to protect the coating from damage while in transit.
5. Use of a padded horizontal separator strip between successive rows of pipe is necessary to prevent damage to the pipe coating, i.e., rug material with outer wrap strips over it for all contact areas where pipe will rest.
6. No metal tools or heavy objects shall be permitted to come into contact unnecessarily with the finished coating.
7. Workmen shall not be permitted to walk on the coating, except when absolutely necessary and approved by the , in which case, they shall wear shoes with rubber or composition soles and heels or other suitable footwear which will not damage the coating.

C. PVC pipe, shall be unloaded, handled and stored in accordance with AWWA C605. If damage or coating abrasion occurs and is deemed repairable, it shall be repaired at the Contractor's expense and to the satisfaction of the Engineer, in accordance with these specifications. If damage is not repairable in the opinion of the Engineer, such pipe, will be rejected and shall be removed and replaced at the Contractor's expense. Store pipe so it does not deform or bend. If pipe is stored out of doors or otherwise e

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E. posed to direct sunlight cover with an opaque material with provision for adequate air circulation.

3.2 PREPARATION

A. Trench excavation and suitable bedding shall be complete to proper grade per 31 23 33 (Trenching and Backfilling, Point Excavation and Backfill) before pipe is placed. Any adjustment due to improper trench grade or settlement shall be accomplished at Contractor expense. If the pipeline floats or collapses from accumulation of water in trench or from other causes, approved repair and replacement shall be at no cost to the Owner.

B. The pipeline trench excavation shall be dewatered sufficiently to allow pipe joints to be made under dry conditions. No joint shall be made under water.

C. No pipe shall be laid upon a foundation into which frost has penetrated, nor at any time when there is danger of ice formation or frost penetration at the bottom of the excavation. In freezing weather, open trench length shall be kept to a minimum and the excavation promptly backfilled after the pipe has been installed.

D. A firm, even bearing throughout the length of the pipe shall be provided by tamping select fill in the haunch area and at the side of the pipe to achieve the required bedding support angle. Bell holes shall be dug sufficiently large to insure that joints are properly made and the pipe is firmly bedded for the full length of the barrel. Prestressed concrete cylinder pipe and fittings shall be installed in accordance with requirements of AWWA M9, except as otherwise provided herein. Blocking will not be permitted.

E. When horizontal or vertical deflection of pipe from a straight line is necessary, the maximum permissible joint deflection shall not exceed the manufacturer's recommendations. Keep the pipe straight while pushing the pipe home. The joint deflection shall only be completed after the pipe is homed. Otherwise, change in alignment or grade shall be accomplished by use of pipe fittings which are the same diameter and strength as straight pipe.

3.1 PIPE INSTALLATION

A. All pipe shall be installed in accordance with the recommendations of the pipe manufacturer, Contract Documents and as specified herein. These recommendations shall include maximum trench width, if more restrictive than that shown in the Standard Details; bedding requirements; backfill material and compaction, where applicable. In addition, the following shall apply unless otherwise noted:

1. Polyvinyl chloride (PVC) pipe shall be installed in the trench accordance with the plans.
2. Ductile iron pipe (DIP) and fittings shall be installed in accordance with the Standard Details for buttresses and anchorages and the recommendations of the Ductile Iron Pipe Research Association.
3. After the backfill has been placed, the struts in steel shall be removed and shall remain property of the Contractor. The openings of all pipe and specials where the pipe and specials have been cement-mortar lined in the shop shall be protected with suitable bulkheads to maintain a moist atmosphere and to prevent
4. unauthorized access by persons, animals, water or any undesirable substance. The bulkheads shall be so designed to prevent drying out of the interior of the pipe. The Contractor shall introduce wat
5. er into the pipe to keep the mortar moist where moisture has been lost due to damaged bulkheads.

B. Proper and suitable tools and appliances for safe and convenient handling and joining of pipes and fittings shall be used. Slings shall not damage the exteriors and/or coating of the pipe, and shall be wide canvas or rubber-coated belts.

C. Pipe and fittings shall be carefully handled and lowered into the trench. Pipe shall be installed with special care to insure that each length abuts against the next to produce no shoulder or unevenness

of any kind along the inside bottom half of the pipeline. No wedging or blocking will be permitted in installing any pipe unless directed by written order or permission in writing is obtained from the Engineer. Under no condition shall pipe be subjected to a blow or shock to bring it to required line and grade.

D. No pipe shall be brought into position until the preceding length has been thoroughly bedded and secured in place. Care shall be used to secure watertightness and prevent damage to, or disturbing of, the joints during the refilling process. After pipes have been installed and joints have been made, there shall be no walking on or working over the pipe, except as may be necessary in tamping the backfill material, until the backfill is at least two feet (2') over the top of the pipe.

E. The pipes shall be thoroughly cleaned before being installed and shall be kept clean until acceptance of the completed work. Open ends of all pipelines shall be provided with a stopper carefully fitted to keep dirt and other substances from entering. This stopper shall be kept in the end of the pipeline at all times when installation is not in progress. Surfaces of both pipe sections to be in contact with rubber gasket seal shall be thoroughly wire brushed to remove all loose rust and foreign matter, le

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G. ving clean smooth surfaces for jointing.

H. Straight pipe shall be furnished in standard uniform lengths. Approved short pipe lengths shall be used where needed to meet line and grade as closure pieces. Whenever a pipe requires cutting, to fit into the line or bring it to the required location, the work shall be done in a manner that leaves a smooth, square end. Field cut pipe lengths shall be filed or ground to resemble the plain end of pipe as manufactured.

1. Cut PVC pipe ends shall have burrs removed and the end beveled to match factory bevel. Field spigots shall be stop-marked with a felt tip marker or wax crayon for the proper length of assembly insertion.
2. Any lining damaged due to field cutting shall be repaired by the Contractor as specified herein.

G. After completion of water main work, unused pipe, and fittings and joint restraint pieces shall remain the property of the Contractor and be removed from the site. No additional compensation will be made.

H. In addition to the other requirements specified herein, when installing PVC water mains, the Contractor shall also furnish and install the following:

1. A copper tracer wire located on the left side, looking up station, and in the gravel bedding for the pipe. The wire shall be continuous in length with no breaks. The wire shall be laid with all mainline piping including stubs and fire hydrant laterals and shall be attached to the pipe at the most remote valve locations at all ends of the main. Connections to
2. existing tracer wire or splicing of wire shall be accomplished via wire nuts rated for the gauge wire used and wrapped in electrical tape.
3. A minimum two inch (2") wide blue marker tape shall be located in the trench, two feet (2'), plus or minus one half foot (0.5), above the pipe along the length of all mainline piping including all stubs and fire hydrant laterals.

I. Minimum Pipe Cover and Clearances

1. Water mains shall have no less than forty two inches (42") of cover measured from the existing and/or established grade to the top of the pipe whichever is lower, except as noted on the Plans. When crossing sub-surface obstructions, twelve inch (12") minimum clearance shall be maintained between the pipe and the obstruction.
2. When crossing sanitary sewers, water pipe sections shall be centered over the sewer so that joints on both sides are the maximum distance from the sewer.

J. Jointing Pipe

1. General

Before any joints are made in the trench, the Contractor shall demonstrate to the Engineer by making a sample joint that methods the Contractor will employ conform with the Specifications, will secure a watertight joint, and that the workmen whom the Contractor intends to use for this work are familiar with the requirements for making proper joints.

2. Push-On Gasketed Joints

a. Prior to making gasketed joints, both mating pipe ends and the gasket shall be cleaned of all foreign material. The gasket shall then be inserted in or stretched over the cleaned gasket seat and lubricant applied to the gasket and the mating pipe end. The lubricant shall be approved for use in potable water and shall be harmless to the rubber gasket. Use only lubricant supplied by the pipe manufacturer. Pipe shall be laid with bell ends looking ahead in the direction of laying. As soon as the spigot ri g is centered in the bell of the previously laid pipe, it shall be forced home with approved equipment. After the gasket of Prestressed Concrete Pipe is compressed, verify the position of the gasket in the spigot ring groove with a feeler gage provided by the pipe manufacturer. Assembly of PVC plain end into bell shall follow PVC pipe manufacturer's recommendations. Do not deflect PVC pipe at connection to ductile iron fitting.
b. Ductile Iron pipe joints shall be assembled per AWWA C600 to insure joints that safely permit movement caused by expansion and contraction as well as slight ground settling or shifting.

3. Mechanical Joints

a. Contact surfaces shall be cleaned and coated with an approved lubricant just prior to slipping gasket over plain end and into socket. A cast iron gland shall be positioned on the spigot end of the pipe, followed by a rubber gasket thoroughly lubricated with its tapered side facing the bell. The spigot shall then be inserted fully into the bell. The rubber gasket shall then be moved into position by hand until it is flush with the face of the bell. The gland shall then be placed against
b. the face of the ru
c. bber gasket and the bolts inserted and made finger tight. Bolts shall be drawn up evenly on alternate sides beginning at the top, keeping the gland parallel to the face of the bell at all times. All nuts shall be tightened uniformly with a torque in accordance with the manufacturer's recommendations.
d. A retainer gland shall not be used on any pipe joint or fitting connecting ductile-iron pipe to existing cast-iron pipe.

e. Unless otherwise specified, diameter of ductile-iron plain ends shall be the same as for mechanical-joint cast or ductile-iron pipe

f. After each ductile-iron or steel pipe, fitting and valve is jointed complete, each joint area including restraint elements shall be cleaned, inspected and approved before next section is installed.

K. Thrust Restraint

1. All thrust due to static and dynamic forces, including water hammer, at bends, tees, wyes, valves, fire hydrants, drain blowoffs, and dead end blowoffs shall be counteracted by an approved restraint method, whether or not indicated on Drawings. When connecting pipe or fittings to existing facilities, provide sufficient restraint to counteract all thrusts.
2. Buttresses and anchorages shall be installed at all caps, horizontal bends, tees, hydrants, branches, and beneath all vertical bends. Buttresses and anchorages shall be of concrete or concrete and steel. Buttresses and anchorages shall extend to solid, undisturbed soil and shall be constructed in accordance with the Standard Details, as shown on the Plans, or as directed by the Engineer.
3. Restrained joints and joint restraint systems shall be assembled in accordance with the system manufacturer's recommendations. Tie rod nuts shall be tightened by hand and then tightened one additional turn by wrench. Restraint elements shall be protected agains corrosion using field-applied primer and coating system per AWWA C210. All coatings shall be complete before line testing.

L. Polyvinyl chloride (PVC) pipe

Refer to Paragraph 2.1,B,4 of this Specification.

M. Ductile Iron Pipe

a. All twelve inch (12") and smaller diameter mechanical joint ductile iron water mains and fittings, including valves and fire hydrants, shall be installed using ductile-iron retainer glands in place of standard follower glands.
b. Provide factory-welded steel thrust collars or retainer glands embedded in in-line thrust blocks on ductile iron water mains where shown on drawings.
c. Restraint of thrust forces in push-on joint ductile-iron pipe shall be provided by an approved proprietary harnessing system installed in accordance with manufacturer's printed instructions. Work includes all excavation necessary to install harnessing.
d. Restraint of mechanical joint ductile-iron pipe shall be accomplished by using approved ductile-iron retainer glands in lieu of follower glands, installed in accordance with manufacturer' printed instructions.
e. Torque range for retainer gland set screws shall be in accordance with manufacturer's recommendations.
f. Where specifically indicated, undrilled steel thrust collars with concrete thrust blocks, drilled steel thrust collars with harnessing, steel tie rods strapped securely outside of the mechanical joint flanges, or use eye tie-bolt which allows tightening the joint before restraint is applied, shall be used to provide thrust force restraint. Collars, rods and other steel harness items shall be per manufacturer's recommendations and approved in advance by the Engineer.
g. After each ductile-iron restrained joint is complete, the joint restraint elements shall be

cleaned and inspected.

N. Extra Fittings/Specials

1. Prior to making connections to existing pipe, for closure sections and for field changes due to unanticipated interference, the Contractor shall:

   a. Verify the size of existing pipe in service and provide pipe and fittings with the correct diameter sleeves, sleeve-type couplings, or closure piece to connect to existing pipe or to complete a closure. Limits of pipe and fittings for this purpose shall be approved on detailed drawings submitted by the Contractor to permit closure or to meet fixed outlet points by field alteration of approach lengths to compensate for differences between design and actual laying lengths; and/or
   b. Verify unanticipated interference and provide additional fittings as needed and as approved on detailed drawings submitted by the Contractor to permit field changes in line and grade needed due to unanticipated obstructions in the actual locations of interfering underground structures or junction water main, including use of additional fittings.

2. Fittings and adjustments necessary to facilitate closures and proper connections shall be included in the work whether or not indicated on the Drawings.

   a. Drawings show the more likely arrangement of fittings and specials, but these details cannot be guaranteed due to inevitable field conditions and adjustments.
   b. Where connections to existing pipe, closure sections or unanticipated obstructions require a change in line or grade of proposed water main alignment, Extra Fittings, Contractor Furnished and requisite retainer glands for twenty four inch (24") and smaller diameter ductile-iron pipe water main shall be furnished and installed.

O. Maintaining Water Service

1. Connections to existing work shall be made by the Contractor in the presence of the Engineer at such a time and in such manner as directed and approved by the Engineer. The Contractor shall submit to the Engineer, for review and approval, a schedule for any proposed system disruption along with a draft letter of notice to the effected customers. Upon approval by the Engineer, the Contractor shall notify, in writing, the customers in the area to be effected by the shut-off. The Contractor shall notify the Engineer for approval at least 48 hours prior to cutting or abandoning a water main. All valves necessary for making connections will be operated by the Owner's Represetative or the Owner Valve crews. The Contractor shall complete the connections with the greatest possible speed so that the public will be inconvenienced as little as possible. Existing water service shall be maintained at all times except when disconnecting or connecting new work. Existing water mains paralleling new water mains shall be kept in service until new water mains are complete, temporarily capped as needed, tested, chlorinated and charged. When specified in the "Special Provisions," the Contractor shall make connections at night. Unless otherwise indicated, the Contractor shall cut existing water mains, remove pipe, fittings, and appurtenances to make required connections; connect new water mains; reconnect existing water mains; and perform all work necessary or incidental thereto.
2. When a tapping sleeve and valve is to be used for making the connection, the Contractor

shall not proceed with the installation until directed to do so by the Engineer. The tapping sleeve and valve shall be prepared in accordance with 33 12 16 (Water valve and appurtenances). Where it is necessary to remove an existing buttress to make a connection, the removal shall be done by the Contractor without additional compensation therefore.

P. Abandonment

1. Cap ends of mains as shown. Place required concrete blocking to retain the cap on the water main to remain in service.
2. Where mains are to be abandoned and removed to a fitting or valve cut and plug main at fitting or valve. When shown on the Contract Plans, remove and salvage abandoned valves, valve boxes, and fire hydrants within the limits of abandonment and deliver to Owner warehouse. Pipe, fittings and other appurtenances that are removed but not required to be salvaged, shall become the property of the Contractor and shall be removed and disposed of offsite.
3. For abandonment of water mains twenty inch (20") and larger diameter, construct a brick bulkhead nine inches (9") thick or install an approved plug or cap at each location where the pipe was cut or valve removed.
4. For abandonment of water mains smaller than twenty inch (20") diameter, install bulkheads using brick masonry, twenty five hundred (2500) psi concrete, gray iron plugs or caps at the end of abandoned sections.

END OF SECTION 33 11 13

33 12 00
WATER SERVICES, WATER METER SETTINGS, AND VAULTS

PART 1 - GENERAL

1.1 DESCRIPTION

The Contractor shall lay water house services and appurtenances to the lines and grades shown on the Contract Documents or designated by the Engineer. All materials (except water meters) shall be furnished by the Contractor to successfully make the required installations. Water meters, furnished by the City of Baltimore and paid for by the property Owner, shall be installed by the Contractor.

1.2 QUALITY ASSURANCE

A. Quality assurance for pipes, fittings, valves, and appurtenances furnished by the Contractor shall be in accordance with the latest national standards and as specified herein.

B. Field Tests: Water services and water meter settings will be visually inspect a static pressure test by the Engineer.

C. Quality assurance for precast concrete utility structures is specified in 03 40 00 (Precast Concrete)

PART 2 - PRODUCTS

2.1 MATERIALS FURNISHED BY CITY OF BALTIMORE

The City of Baltimore will furnish meters for all services, the cost shall be the responsibility of the contractor.

2.2 DETAILED MATERIAL REQUIREMENTS

A. Ductile Iron Pipe.
Ductile Iron Pipe and Fittings shall be as specified in the City of Baltimore Standard Specifications

B. Copper.
Copper Pipe shall be as specified the City of Baltimore Standard Specifications

C. Miscellaneous Materials.
Reference is also made to the City of Baltimore Standard Specifications for the several items incorporated in the work such as concrete, masonry, valves, reinforcement and castings:

PART 3 - EXECUTION

D. Work under this section shall conform to the City of Baltimore Standard Specifications and the following.

Water house services shall be jacked or bored under paved roads unless otherwise directed by the Engineer. Services installed in areas other than paved roads shall be open cut.

Corporation taps shall be installed in water mains only after the main has been chlorinated and tested in accordance with the City of Baltimore Standard Specifications. Valve boxes shall be extended 18" above grade during construction, with final adjustments to grade made after final tie-in to the house connection is made. See City of Baltimore E Standard Specifications for water house service abandonment procedures.

E. HYDROSTATIC AND LEAKAGE TEST. Completed water house services shall be hydrostatic and leak tested in accordance the City of Baltimore Standard Specifications and no leakage shall be allowed. Test pressure shall be at the water main line pressure.

F. DISINFECTION OF SERVICES. Disinfection of water house services shall be performed by the Contractor as specified in the City of Baltimore Standard Specifications, without additional payment. Prior to beginning the sterilizing operation, the Contractor will submit to the Engineer for approval a schedule listing details of the sterilizing procedure to be followed.

END OF SECTION 33 12 00

33 12 16
WATER VALVES AND APPURTENANCES

PART 1 GENERAL

1.1 DESCRIPTION

Water valve and appurtenance installation shall include, but not necessarily be limited to, furnishing and installing resilient wedge gate, butterfly, and air release and vacuum valves or assemblies with appurtenant valve vaults or roadway valve boxes and accessories in accordance with the Contract Documents.

1.2 Quality Assurance

A. Quality assurance for pipes, fittings, valves, and appurtenances furnished by the Contractor shall be in accordance with the latest national standards as specified herein.

B. Field Tests

1. Water valves and appurtenances installed at the same time as a new water main shall be tested, after installation, by the Contractor along with the water main in accordance with 33 11 00 (Water Utility Distribution Piping)
2. Water valves and appurtenances installed in an existing water main will be visually inspected for leakage by the Resident Engineer at the existing water main line pressure before the excavation is backfilled. The valve and joints shall be leak free under line pressure.
3. Tapping sleeves and valves shall be tested after assembly on the existing water main but prior to making the tap. The Contractor shall pressurize the complete assembly to a minimum of 150 psi or 1 ½ times the working pressure, whichever is higher. The Resident Engineer will visually inspect the tapping sleeve and valve for leakage. No leakage will be permitted.

C. Quality assurance for precast concrete utility structures is specified in 03 41 00 (Precast Structural Concrete)

1.3 Submittals 01 33 00 SUBMITTAL PROCEDURES

Affidavits, certifications, and manufacturer's test results shall be submitted as specified in the 01 33 00 (Submittal Procedures) for all gate and butterfly valves as follows:

For Gate Valves: 3-inch through 24-inch

Catalog Data

Prior to purchase of the valve, the Contractor shall submit to the Resident Engineer, for approval, catalog data, net weight, and certified assembly drawings. No valve shall be furnished or installed unless approved in writing by the Resident Engineer.

Affidavit

An affidavit of compliance shall be furnished by the manufacturer that specifies tests have been performed and that all components and the product comply in all respects with requirements of specifications.

Records of Tests

Record of physical and chemical properties, operating and hydrostatic tests shall be furnished.

For Butterfly Valves: 30-inch through 72-inch:

Test data shall be furnished by manufacturer.

The Contractor shall submit manufacturer's certified drawings of the valves including valve operators, gear ratios, electrical schematics (where electrical operators are furnished), and parts lists.

An affidavit from the manufacturer shall be submitted stating that valves furnished comply with all applicable provisions of this specification.

Certified test reports covering performance, leakage, and hydrostatic tests shall be furnished.

A statement shall be submitted by the Contractor giving required number of turns of the operating nut to move the disc from fully open to fully closed (or vice versa) position.

PART 2 PRODUCTS

2.1 MATERIALS

A. Washed gravel for dewatering and air release valve, and air/vacuum valve shall meet the gradation requirements of AASHTO M43, Size number 67.

B. Ductile iron and concrete pressure fittings, shall be as specified in 33 11 13 (Public Water Utility Distribution Piping).

C. Tapping saddles and corporation stops shall be as specified in the contract documents.

D. Portland cement concrete for miscellaneous valve appurtenances and cast-in-place vaults shall be the Mix Number indicated on the Standard Details or Contract Documents and as specified in 03 30 00 (Portland Cement Concrete Structures).

E. Precast concrete vault and manhole sections and grade rings shall be as specified in 03 41 00 (Precast Structural Concrete). Mix Number shall be as indicated on the Standard Details.

F. Brick for valve support and miscellaneous valve appurtenances shall be sewer brick as specified in 33 39 13 (Sanitary Utility Sewerage Manholes, Miscellaneous Structures, Frames and Covers).

G. Mortar for brickwork shall be as specified in 04 21 13 (Brick Masonry).

H. Castings for Frames, Covers, and Steps: Iron castings shall conform to A 48, Class 35B Covers shall be labeled in accordance with the Standard Details. Steps and ladders shall be as dimensioned on the Standard Details. Manhole steps shall conform to A 312 Grade TP 410 Stainless steel or shall be reinforced plastic steps composed of ASTM A615, Grade 60 reinforcing bar (#4) completely encapsulated in copolymer polypropylene per ASTM D2146, Type II, Grade 43758.

I. Gate Valves: 3-inch through 24-inch

1. General

a. Gate valves 3-inch through 24-inch diameter nominal pipe size shall be resilient wedge type.. Resilient Seated Gate Valves shall be encapsulated solid gate iron body with a sealing mechanism manufactured and tested to the requirements of AWWA Standard C-509, C-515 as applicable for a design working pressure of 250 P.S.I. The manufacturer's name, pressure rating, year of manufacture and size shall be cast on valve body. Each valve shall be tested to 500-psi hydrostatic pressure. In any and all cases of conflict between these specifications and AWWA C-509 or C-515, these specifications shall govern but only to the extent of such conflict.

b. In addition to the requirements of the AWWA Standards, the valve shall meet the following specification:

2. Valve body, bonnet and rubber encapsulated gate shall be Ductile Iron conforming to ASTM A-536 or ASTM A-395 or Cast Iron conforming to ASTM A-126 Class B. Shell thickness of body and bonnet components shall conform to Table 2 Sec. 4.4 AWWA C-509. Stems shall be manganese bronze in accordance with ASTM B-132, having a minimum tensile strength of 60,000 psi. Bonnet bolts shall be stainless steel in accordance with ASTM A-193 Gr. B.8 304SS, ANSI B 18.2.1. Bonnet nuts shall be stainless steel in accordance with ASTM A 194 Gr. B.8 304SS, ANSI B18.2.2. Tapped holes with stud bolts are prohibited. Valves shall have a non-rising stem, 2-inch square operating nut, which shall turn right (clockwise) to open. Valves shall be furnished with mechanical joint ends (in accordance with AWWA C-111), complete with bolts, nuts, retainer glands and gaskets, unless flanged (in accordance with ANSI B16.1, Class 125) or other type ends are indicated on the plans. Retrainer glands, lugs or grip rings will be required for new installations requiring retaints. Valves shall be vertical type unless otherwise approved, with double o-ring stem seals without gearing or bypass valves. 0-ring seal plates shall be cast or ductile -iron; seal plate bolts and nuts shall be 304 stainless steel ANSI B18.2.1. When both "O" rings are located above the thrust collar, the bearing area shall be fusion-bonded epoxy coated, and contain a thermoplastic washer to reduce friction. When the thrust collar is located between two "O" rings the entire space between the "O" rings shall be lubricated. Four inch to 12-inch valves shall have a maximum number of valve turns of three diameters plus 3 turns. The maximum number of valve turns for larger valves, butterfly valves, shall be as given in the following table:

Table I Valve Turns

Diameter	Min.-Max. Turns
16" Vertical	50-51 (No Gearing)
16" Horizontal	95-110 (Gearing)
20" Vertical	62-63 (No Gearing)
20" Horizontal	120-135 (Gearing)
24" Vertical	95-155 (Gearing)
24" Horizontal	95-155 (Gearing)

3. Valve body and bonnet shall be coated on all exterior and interior surfaces with a fusion

bonded epoxy conforming to the requirements of AWWA Standard for Protective Epoxy Interior Coatings for Valves and Hydrants; C-550. Painted surfaces and spray applied epoxy coatings are not acceptable. Manufacturer shall certify that the coating will conform to following sections of the Standard:

a. Section 2-Materials. (Relating to the suitability of the coating for use in a potable water system).
b. Section 4-Tested and Inspection. (Relating to qualification and production testing).
c. The valve shall be designed so that during operation, or cycling of the valve, there is no friction or abrasion or rubbing together of the gate and body that can wear away any rubber or epoxy and expose bare iron. Valve manufacturer shall provide evidence from an independent testing laboratory that its valve can operate through 1000 cycles or operation at 250 P.S.I. unbalanced closing pressure and flow to open discharge without causing damage to the epoxy coating in body and gate and/or rubber coating on gate.
d. Gate shall be covered with rubber over all interior and exterior ferrous surfaces. The rubber shall be securely bonded to the gate body, including the part, which houses the stem nut. The stem hole through the gate shall be full opening top to bottom, and shall also be covered with rubber.
e. The upper "O" ring stem seal shall be replaceable with the valve under pressure in the full-open position.
f. Resilient seated tapping valves shall be furnished with the tapping flange having a raised face or lip designed to engage the correspondence recess in the tapping sleeve flange in accordance with MSS-SP60. Tapping valves without the raised face on the tapping flange are not permitted since they do not assure the proper alignment requirement to prevent damage by a misaligned shell cutter. The interior of the waterway in the body shall be a full opening and capable of passing a full sized shell cutter equal to the nominal diameter of the valve.
g. Valves shall be pre-approved by the Department of Public Works, Bureau of Water and Wastewater, Utility Engineering Division.

2. Tapping Valves and Sleeves

a. Valves for tapping service shall meet all the requirements for gate valves. . Tapping valves shall conform to Gate Valves 3 f, above, unless otherwise stated in the contract documents. All tapping sleeves shall be furnished with an outlet for testing. All tapping sleeves shall be iron body mechanical joint or stainless steel and must be pre-approved by the Owner. Before placing sleeve, clean existing pipe and check pipe outside diameter and ovalness to verify that sleeve will fit and be watertight. Install sleeve and valve. Keep closest edge of sleeve a minimum of nine inches from face of existing joint bell. Water test the assembly in accordance with manufacturer's instructions to ensure watertightness in the presence of the Engineer before tapping the existing pipe.

J. Butterfly Valves: 30-inch through 72-inch

1. Rubber seated butterfly valves shall be manufactured in accordance with AWWA C504 as modified herein. Valves shall be Class 250B, suitable for direct burial, and designed for a differential pressure across the valve of 250 psi, and a minimum flow of 15 feet per second for

opening and closing. The rating shall be based on a design stress of 3 to 1 on the yield strength or 5 to 1 on a tensile strength of the materials used. 30-inch to 48-inch valves shall be furnished with mechanical joint ends (conforming to AWWA C110/ANSI A21.11 and AWWA C-111) complete with bolts, nuts, retainer glands, lug and grip rings restraints and gaskets. 54-inch to 72-inch valves shall be furnished with flanged joint ends (ANSI B16.1 Class 250), unless otherwise noted in the Contract Documents. Flanged joint ends shall be accompanied with flanged and plain-end pieces assembled to the valve's flanged ends with bolts, nuts and gaskets. Each flanged and plain-end piece shall have an overall laying length of not less than 12-inches nor more than 18-inches.

2. Disk: The Valve disc shall be designated and tested in accordance with AWWA C504.00. The valve disc shall be constructed of stainless steel ASTM A-296, Grade CF8M; cast iron ASTM A-48, Class 40 or ASTM A 436, Type I; or ductile iron ASTM A-536, Grade 65-45-12. The disc edge shall have a stainless steel; type 316 edges, sizes 30-inch through 48-inch, and a minimum type 304, for sizes above 54-inch, for mating with the rubber seat. Discs shall be of the flow through design with no internal cores or ribs transverse to the flow. Refer to the Department of Public works, Bureau of Water and Wastewater, Utility Engineering Division's approved list at the Water Engineering Office.
3. Seat: The valve seat shall be of a rubber compound complying with AWWA C504.00, Section 8. Valve seats shall be located in the valve body or on valve disk as specified in the Special Provisions. Valves employing snap rings, retaining rings, or screws that penetrate the rubber will not be accepted. Seats shall be a full 360 degrees without interruption and have a plurality of grooves mating with a spherical disc edge-seating surface. Valves 30-inch diameter and larger shall have adjustable seats of a design that permits replacement in the field without removal of the valve from the line.
4. Shaft: Shall be horizontal when the valve is installed in the water main. Valve shafts shall be stainless steel ASTM A-564, type 630, and condition H-1100. Stub shafts or through shafts are acceptable. The valve shaft/disc connection shall be made through the use of on-center taper pins. Taper pins shall be made of the same material as the shaft. The material shall be ASTM A-564, type 630, condition H-1100. Shafts seals shall be split V-type, self-adjusting. O-rings are not acceptable. Valves shall be supplied with 1-1/4-inch square or round extension shafts, in 10-foot lengths, which are to be cut and assembled in the field installations.
5. Actuators: All actuators shall meet design requirements as specified in AWWA C504.00 Mechanical stops shall be provided in accordance with AWWA C504.00 maximum input load requirements and capable of adjustment for 90 degree (+/-5%) of valve travel. The valve actuator shall be suitable for buried service. The gearing shall be such as to locate the operating nut in the vertical position. All actuator gears shall be for quarter turn valve applications. The input shaft shall be stainless steel with bronze bushings at the out put drive sleeve and shall also be equipped with adjustable mechanical stops to prevent over travel of the valve disc in the open and closed position. A stop-limiting device shall be provided in the input to the operators for open and closed position and all operator components between the input and these stops shall be designed to withstand without damage an input torque of 300-foot pounds. Gearing provided on the valves shall be such as to provide operation with an average 80-foot pounds input torque at the operating nut. The valve operator shall be sized to operate the valve with the specified flow and pressure in either direction. Valve actuators may be worm gear or traveling nut type with a 2-inch square operating nut, which shall turn right (clockwise) to open. Actuators shall be fully enclosed in a gasketed grease-filled enclosure suitable for direct burial. As approved by the Department of Public Works, Bureau of Water and Wastewater, Utility Engineering Division.
6. All butterfly valves shall be supplied with an over torque protector, which will indicate size of valve, direction to open and valve turn count. Refer to the Department of Public works, Bureau of Water and Wastewater, Utility Engineering Division's approved list at the Water Engineering Office.

7. Body: The valve body shall be constructed of cast iron ASTM A-126 Class B. Minimal body wall thickness shall be equal to that specified in AWWA Standard C504, Table 1 for Class 250B Gray Iron body material. Valves shall have "250" cast into the valve body casting. The entire valve body, both internal and external surfaces, except for the seating surface, shall be epoxy coated. The epoxy coating shall be a minimal of 7 mils nominal of NSF approved 2-part epoxy.
8. Buried valves shall be furnished with an extension stem terminating 12-inches below finished grade in accordance with the Standard Details.

K. Air/Vacuum Release Valve

1. The air/vacuum valve shall be of the type that automatically releases to atmosphere large amounts of air found in pipelines during filling cycle and allows air into a line when it is being drained or when a vacuum occurs.
2. The air/vacuum valve shall have a cast iron body and cast iron cover. The internal compound lever mechanism shall be stainless steel and all other internals including float shall be stainless steel to avoid galvanic action. The stainless steel float shall withstand a minimum pressure of 1,000 psi.
3. All materials of construction shall be certified in writing to conform to ASTM specifications as follows:

PART	MATERIAL	SPECIFICATION
Body and Cover	Cast Iron	ASTM A48, Class 30
Internal Linkage	Stainless Steel	Series 300
Float & Internals	Stainless Steel	Series 300 Seat Buna-N
Exterior Paint	Phenolic Primer	FDA approved for potable water Red Oxide

4. All internals shall be easily removed through the top cover without removing the main valve from the lines.
5. An isolating valve shall be installed between force main and air/vacuum release valve for maintenance.
6. Air/Vacuum release valve shall be installed in an easily accessible vault. Vault shall be adequately vented to meet air/vacuum release valve requirement.
7. The valve manufacturer shall furnish installation and maintenance instruction manuals with each valve.

L. Screw Type Roadway Valve Boxes and Covers

1. Screw type roadway valve boxes and covers shall be made of gray iron conforming to the requirements of ASTM A48, Class 35B, as noted in section 3.1 of AASHTO M306 and shall meet the dimensional and marking requirements indicated on the Standard Details. The iron material used in products provided shall have a minimum recycled material content of 75%. The recycled materials shall consist of post-consumer material.
2. All casting manufacturers shall be approved suppliers of cast iron products to the Maryland Department of Transportation and Owner. All manufacturers shall be able to demonstrate that there is an acceptable quality control program at the producing foundry and upon request shall furnish a quality control manual. As part of the quality control program the producing foundry shall be made available for the purpose of conducting an audit prior to supplying casting. All valve box parts shall be manufactured at the same producing facility.

3. Castings shall be of uniform quality, free from sand holes, gas holes, shrinkage, cracks and other surface defects. Castings shall be reasonably smooth and well cleaned by shot blasting. Surfaces of the castings shall be free from burned-on sand and shall be reasonably smooth. Runners, risers, fins, and other cast-on pieces shall be removed from the castings and such areas ground smooth. Bearing surfaces between covers and top sections shall be cast or machined with such precision that uniform bearing shall be provided throughout the perimeter area of contact. As-cast dimensions may vary within accepted foundry tolerances as outlined in the Iron Castings Handbook published by the American Foundrymen's Society, Inc. Nominally, casting dimensional tolerances shall be +/- 1/16" per foot. All published casting weights are average and approximate values and shall vary +/- 5%. Casting dimensions and specific tolerances are identified on the associated casting drawings. Castings shall meet the meet weight and dimensional criteria as shown on the associated drawings. All castings shall fit together properly and be fully interchangeable.
4. All gray iron valve boxes shall be rated for traffic service.
5. Inspections shall be in accordance with 9.1.2 of AASHTO M306. Results of these tests shall be furnished to the purchaser upon request. The heat or production date and product numbers, as cast on the casting shall be the basis of trace-ability and recording of the tests.
6. A foundry certification shall be furnished to the purchaser stating that each lot meets the requirements of this specification. Applicable documentation shall be made available to the purchaser upon request.
7. Each casting shall be identifiable and show, at a minimum, the following: name of the producing foundry, country of manufacture (such as "Made in USA"), ASTM A48, CL 35B, individual part number, cast or heat date. All castings shall be marked in accordance with all applicable laws and/or regulations. Castings shall include all lettering as shown on the specification drawings.
8. The purchaser may conduct random checks on the castings. These random checks shall be conducted in accordance with AASHTO M306, Section 6.0 guidelines.

M. Miscellaneous Small Pipe and Appurtenances

When indicated on the Standard Details or the Plans, the following materials shall meet the material requirements of the referenced standards or specifications:

1. Galvanized steel pipe - ASTM A 120, Schedule 40.
2. Standard malleable iron fittings, galvanized - ASTM A 153, A 197.
3. Brass pipe - ASTM B 43.
4. Bronze gate valves - FSS WW-V-54c.

N. Valve extension stems shall be 1 ¼ -inch square or round cold-rolled steel and furnished with a 2-inch square nut.

PART 3 EXECUTION

A. General

1. Excavation, foundation preparation, backfill, and compaction shall be as specified in 31 23 33 (Trenching and Backfilling, Point Excavation and Backfill).
2. Construction methods shall be in accordance with 33 11 13 (Public Water Utility Distribution Piping).
3. Valves shall be restrained, supported, and strapped to tees, crosses, dead ends, stubs, or outlets in accordance with the Standard Details.

B. Buried Gate and Butterfly Valves

1. Buried gate and butterfly valves shall be installed in accordance with the Standard Details and at the locations shown on the Plans or as directed by the Engineer.
2. Unless otherwise shown on the Plans, all gate valves 16-inch diameter and smaller and all butterfly valves shall be supported as shown in the Standard Details, and shall be installed with an adjustable roadway valve box.
3. Roadway valve boxes shall be set at right angles to the water main, centered and plumb over the valve operating nut. Backfill shall be compacted under and around valve boxes to insure that no vertical loads are transmitted to the valve operators. Valves box sections shall overlap a minimum of 6 inches.

C. Valves in Vaults or Manholes

Dewatering and air release and vacuum valves shall be installed in manholes or vaults in accordance with the Standard Details and/ or Contract Documents.

END OF SECTION 33 12 16

33 31 00
SANITARY SEWERAGE UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section includes requirements to construct and test sanitary sewage system complete in place.

1.2 REQUIREMENTS FOR MANUFACTURERS AND SUPPLIERS BEFORE DELIVERY

A. Test materials as set forth in applicable referenced specifications and as required herein.

B. Inspect and Test Materials: Follow Section 01 45 00 and as specified herein.

1. Notify Owner 14 days before manufacture of pipe and fittings.
2. Pipe manufacturer:
    a. Furnish materials to be tested.
    b. Furnish labor to assist Engineer with inspections and tests.

C. Readiness for Inspection.

1. Pipe will be ready to inspect when it meets requirements of specified tests.
2. Pipe manufacturer or supplier: Before inspection of pipe for Contractor's order is scheduled furnish Owner with:
    a. The Owner's contract number and Contractor's name.
    b. Pipe diameters, design, and classes.
    c. Footage of pipe included in order.
    d. Adequate quantities of pipe of required diameters, design, and classes.

D. Requirements for Cold-weather Conditions for Precast Materials Inspection and Testing of Precast Concrete Manholes.

E. Plant or Site Inspected Materials Markings: See Section 01 45 00.

1.3 SUBMITTALS

A. Submit following Section 01 33 00.

1. Results of source quality control tests performed on profile PVC pipe at point of manufacture.
2. Method for maintaining sewage flows.
3. Shop drawings, manufacturer's installation recommendations, and operation and maintenance manuals for slide gates and operators.
4. Manufacturer's literature and installation guidelines for profile PVC pipe.

B. Packing list, invoice, or delivery ticket with every shipment, to contain the Owner contract number, type and class of pipe, length, and other pertinent information.

C. Installation and Repair Recommendations.

1. Submit manufacturer's recommended installation and repair methods and procedures for pipe and structures for approval before material fabrication.
2. Submit manufacturer's recommended installation procedures for PVC lined or HDPE lined precast concrete manholes.

D. Concrete Design Mixes: See Sections 03 30 00.

E. For more specific handling of different kinds of pipe, see Installation herein.

F. Sewer Service Connection Testing: Closed Circuit Television (CCTV) color CD-ROM and inspection report as specified under Field Testing.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pipe and Fittings

1. General:
   Pipe between structures or between structure and terminus: Same size and material and by same manufacturer. Each pipe and fitting: Mark with manufacturer's name or trademark, specification designation, pipe class and strength, production shift code, and manufacture date and location
2. Gravity Sewer
   a. PVC Pipe and Fittings (See Pipe 12 inch and smaller: AWWA C900 and C905 PVC Pipe and Fittings).
      1) Standards
         a) PVC pipe and fittings 4-inch and 6-inch diameter: ASTM D3034, wall thickness classification SDR 35 or SDR 26.
         b) PVC pipe and fittings 8-inch through 15-inch diameter: ASTM D3034, wall thickness classification SDR 35.
      2) Length: Not less than 12 feet
      3) Joints and fittings: Integral bell gasketed joint is designed so when assembled elastomeric gasket inside bell is compressed radially on pipe spigot it forms watertight joint.
         a) Gasket: ASTM F477.
      4) Legible markings: ASTM D3034, ASTM F679, ASTM F794, or ASTM F1803 and with date and location of manufacture.
         a) Pipe and fittings not marked as specified herein will be rejected.
         b) Pipe and fittings manufactured more than 1 year before date of work site inspection will not be accepted.
      5) Approved pipe manufacturers:
         a) Charlotte Pipe and Foundry Co., 4 inch through 15 inch.
         b) IPEX, Inc., 4 inch through 27 inch, Ultra Rib open pipe, 18 inch through 24 inch.
         c) National Pipe and Plastics, Inc., 4 inch through 24 inch.
         d) North American Pipe Co., 4 inch through 24 inch.
         e) JMTM Eagle, 4 inch through 15 inch, open profile, 18 inch through 30 inch.
      6) Approved fittings manufacturers:
         a) GPK Products, Inc.
         b) JMTM Eagle.
         c) Multifittings, Ltd./Ipex, Inc.
         d) The Harrington Corporation.
         e) Vassallo Industries.
         f) Colonial Engineering, Inc.
         g) Plastic Trends, Inc.
         h) Freedom Plastics, Inc.

B. Connection Appurtenances.

1. Connections 8" and larger will be made by way of Manhole built over existing sewer following Standard Details.
2. Saddles: For connecting sewer service connections to existing main line.
   a. PVC Main: Follow manufacturer's recommendations.
   b. Approved saddle manufacturers for connecting to asbestos cement, vitrified clay, concrete, cast iron, or ductile iron sewer pipe with outside diameter:
      1) The General Engineering Company, SEALTITE Type "S" saddle with FERNCO adapter, following GENECO Drawing R-3450-D,
      2) Romac Industries, Inc., "CB" style saddles.
      3) FERNCO, EZ Tap
      4) Or equal.
   c. Approved wye manufacturer for making wye connection to asbestos cement, vitrified clay, concrete, cast iron, or ductile iron sewer pipe with outside diameter 36-inch and smaller:
      1) The General Engineering Company, SEALTITE Type "E" saddle with FERNCO adapter following GENECO Drawing R-3413-D1, View 1.
      2) Or equal.
3. Thimbles: Use where conditions preclude use of a tee or saddle when connecting to existing sewer pipe.
   a. Approved manufacturers:
      1) Inserta Tee.
      2) Or equal.
5. Coupling/Adapters: For connections between different types of pipe and point repairs:
   a. Approved manufacturers:
      1) FERNCO Joint Sealer Co. with shear ring.
      2) DFW by NDS non-shear.
      3) Or equal.
6. Flexible Gasket Connectors:
   a. For connecting pipes to sewer manholes,
   b. Transition Gasket to connect DIP to PVC Pipe.
      1) Approved manufacturers:
         a) Harrington Corporation.
         b) Romac Industries.
         c) Or equal.
7. Stoppers for non-pressure pipe.
   a. Open ends of pipe, branches and connections: Close with pre-molded gasket joint stopper meeting requirements for pipe used.
   a. Watertight mechanical plug for placement on interior of pipe.
   g. Tapping valves: Use with tapping sleeves having flanged inlets compatible with outlet flange of tapping sleeve.

A. Mechanical joint outlet.

B. Other tapping valve requirements: See specifications for gate valves in Section 33 11 16.

C. Miscellaneous Materials.
1. Cast-in-Place Concrete: See Section 03 30 00.
2. Pipe Embedment Material
3. Precast Concrete Manholes
4. Castings, Miscellaneous Metal Connectors, and Appurtenances, follow Standard Details and Drawings.

5. Lamphole Style Cast Iron Cover Assembly:
   a. Approved manufacturers for 4 inch Cleanout:
      1) Bingham & Taylor Corporation; Approved Foundry: Culpeper Virginia.
         a) Frame and Cover SN 4881-9006-7 Model No. I5TL54SSWSSC.
      2) Capital Foundry, Inc.; Approved Foundry: UMA Iron and Steel, Calcutta, India.
      3) Chesapeake Foundries, Inc.; Approved Foundry: Carnation Industries, Ltd. Calcutta, India. (Imported by Creswell Trading Co.)
         a) Cover: Part no. CLTS-1.
         b) Frame: Part no. CLF-2, per approved drawings.
      4) Or equal.
   b. Approved manufacturers for 6 inch Cleanout:
      1) Bingham & Taylor Corporation; Approved Foundry: UMA Iron and Steel Calcutta, India
         a) Cover: Model No. INDMLAMPLID
         b) Frame: Model No. INDMLAMPBOX
      2) Capital Foundry, Inc.; Approved Foundry: UMA Iron and Steel, Calcutta, India.
      3) Chesapeake Foundries, Inc.; Approved Foundry: Cresmac Foundry, Kolkata, India.
      4) East Jordan Iron Works, Inc., Catalog No. 1565.
      5) Or equal.
6. Masonry Work: See Section 04 21 13.
7. Mortar Bonding Admixture: Addition to mortar for installation of precast concrete grade ring adjustment.
   a. Approved manufacturers and admixtures:
      1) Euclid Chemical Co., Flex-con.
      2) Parchem Construction Products, Nitobond Acrylic.
      3) Thoro System Products, Inc., Acryl-60.
8. Curing Compound: ASTM C 309, Type 2, Class B white pigmented resin based for use with parging and precast grade rings.
9. Manhole Steps.
   a. Concrete structures: ASTM C 478.
      1) Minimum 1/2 inch diameter steel reinforcing bar: ASTM A615.
      2) Grade 60 or deformed wire: ASTM A496.
      3) Encase in polypropylene: ASTM D4101.
   b. Masonry structures:
      1) Meet above requirements for concrete structures.
      2) Manufacturer's standard specially designed for brick or block walls.
   10. Geotextile, Type A:.
11. Asphalt-Based Waterproof Coating on Brick Transition on Manholes:
   a. Approved manufacturers and coatings:
      1) Lasting Paints, Stix-tite Roof and Foundation Coating MA-241 or FMA-241.
      2) Seaboard Asphalt Products Company (153), Clippership heavy duty fibrated roof coating LN-13S.
      3) Or equal.
12. Quick-Setting Non-Shrink Grout: See 03 30 00.
13. Flexible Gasket between Manhole and Manhole Frame: Extruded rope type B, following AASHTO M198 butyl based, 3/4-inch diameter minimum.
   a. Approved manufacturers and models:

1) Hamilton Kent Manufacturing Co., Kent Seal II.
2) ADCO Products, Flex-lok.
3) Press-Seal Gasket Corporation, E-Z Stick.
4) Concrete Sealants, Inc., CS-302.

14. Manhole Frames and Covers.
    b. Castings:
        1) From iron melted by any process and following ASTM A48, Class 35 minimum.
        2) Cleaned by sandblasting or other approved process.
    c. Drilling and tapping of bolt holes: Done in manner so frames and covers of any manufacturer are interchangeable with those of another manufacturer.
    d. Frames and covers: Do not paint or coat.
    e. Approved Manufacturers:
        1) East Jordan Iron Works (Acceptable 22 inch alternate: EJIW Drawing No. 2060ZVH frame and 2065AVHPT cover, Drawing No. 206001).
        2) Neenah Foundry (Acceptable 22 inch alternate: Neenah frame and platen lid bolted, watertight manhole, Drawing No. NF-0785 015C).
        3) Capital Foundry (22 inch, 30 inch, and 36 inch; Approved Plant: NIF Iron and Steel, Calcutta, India).
        4) Chesapeake Foundry Inc. (22 inch only; Approved Plant: Cresmac Foundry, Kolkata, India).
15. Mastic and Mortar for Filling Pipe Joints.
    a. Mastic: Elastic water resistant formulation of plastic bituminous materials and inert fillers.
        1) When applied to vertical metal surface and heated to 120 degrees F jointing mastic will neither slump nor lose plasticity.
        2) When applied directly from container without further fixing jointing mastic can be applied in even, adherent coat within temperature range of 20 to 100 degrees F.
        3) Capital Foundry (22 inch, 30 inch, and 36 inch, Approved Plant: NIF Iron and Steel, Calcutta, India).
        4) Chesapeake Foundry Inc. (22 inch only; Approved Plant: Cresmac Foundry, Kolkata, India
    b. Mortar: One part Type II cement and 3 parts of mortar sand following ASTM C144.
16. Tracer Wire PVC AWWA C900 and C905: See Section 33 12 00.

2.2 SOURCE QUALITY CONTROL

A. General.
1. Notify Engineer at least 10 working days before performance of tests required herein.
2. Manufacturers or Suppliers: Responsible for facilities, equipment, and competent personnel for conducting load bearing, hydrostatic, and other tests required in applicable reference specifications.
    a. Set up instruments, gages, and other testing and measuring equipment to evaluate quality of proper range, type, and accuracy to verify conformance with specification requirements.
    b. Assure that equipment is calibrated and certified at annual intervals.
        1) Calibrate against measurement standards with known relationship to national standards.

2) Calibrate and certify gages on equipment to which they belong, and keep them on that piece of equipment following certification.
3) Do not use instruments, gages, testing, and measuring equipment found to be out of calibration or adjustment until applicable requirements have been met.
4) Hire agency regularly engaged in this type of activity to perform calibration.

B. PVC Pipe.
1. Test Standards for Gravity Pipe:
a. PVC pipe 4 inch through 15 inch diameter: ASTM D3034.
b. PVC pipe 18 inch through 27 inch diameter: ASTM F679.
c. Elastomeric gaskets: ASTM D3212.
d. Closed profile PVC pipe: ASTM F1803.
e. Open profile PVC pipe: ASTM F794.
2. Test Standards for Pressure Pipe: AWWA C900 and C905.
3. Engineer may request that pipe manufacturer witness source quality control testing of PVC pipe and fittings specified herein.

PART 3 EXECUTION

3.1 PUBLIC NOTIFICATION
A. Service Connection Contracts
1. Deliver written notice to owner 48 hours prior to commencement of work being conducted, including a local telephone number for inquiries or complaints.

3.2 INSTALLATION OF SANITARY SEWER
A. Inspect and Test Materials: Follow Section 01 45 00 and as specified herein.

B. Handling of Pipe and Fittings after Delivery
1. Unloading and handling.
a. PVC pipe and fittings: Use proper equipment, avoiding severe impact blows, especially during cold weather.
b. PVC pressure pipe and fittings: AWWA C605.
c. Ductile and gray iron pipe, DIP fittings, and appurtenances: Follow Section 33 11 13.
d. RCP, manholes, and appurtenances: Use crane or backhoe of proper capacity equipped with appropriate slings to protect material from damage.
e. Storage: Store in reasonably level area, well drained, away from brush, and in area accessible for inspection.
1) Store individual pieces or bundles with safe walking space and clearance between to allow full view for inspection purposes.
2) Do not place excavated or other materials over or against stored pipe.
3) Store on flat surface so barrel of pipe is evenly supported and not piled more than 4 feet high.
4) Do not stack bundles or containers.
5) If left bundled, place bundles on flat smooth surface with boards in contact with ground.
6) Gasket: Store in cool place out of direct sun.
2. Inspection and Repair: Pipe will be inspected before installation.
a. Repair damage during handling and placement following Engineer's direction and approved manufacturer's recommendation.

b. Remove and replace at no expense to Owner damaged pipe deemed not repairable by Engineer.
c. Closed profile PVC pipe:
1) Do not repair in field.
2) Acceptable marks: Scrapes or gouges less than 2 inches in length and less than 1/2 total wall thickness on exterior of barrel.
3) Dispose of damaged pipe following manufacturer's recommendation.

3. Cleanliness.
a. Clean and remove foreign matter from each pipe, fitting, and appurtenance before placing in trench.
b. Should foreign matter be observed in previously installed pipe, fitting, or appurtenance, cease work until foreign matter is removed.
c. Close open ends of pipes and fittings with watertight cap or plug when work is stopped.

C. Trench Excavation, Backfill, and Test Pits: Follow Section 31 23 33.
1. Before pipe installation:
a. Dig test pits to determine size, type, and exact location of existing pipe to which proposed pipe will connect.
b. Excavate sufficient trench in advance and test pit all existing underground utilities/structures, whether shown on Drawings or visually identified in field, to:
1) Verify actual locations.
2) Make reasonable changes in line and grade to resolve conflicts, at Engineer's approval.
c. Furnish Engineer location and elevation information when previously unknown or different underground utilities/structures are encountered.
2. Perform additional work made necessary because of failure to take above precautions at no cost to the Owner.

D. Pipe Embedment Material: Follow Standard Details and Section 31 23 33.
1. Encasement and/or concrete cradle where indicated.

E. Pipe Placement.
1. Before pipe installation bring bedding material to grade along entire length of pipe to be installed.
2. Excavate bell holes, for type placed, at each joint to permit proper joint assembly and firm bedding for entire length of pipe barrel.
3. Install pipe to true uniform line and grade with continuous bearing of barrel on bedding material.
4. Where indicated, place erosion checks or concrete anchors following Standard Details.
a. Cure concrete anchors minimum of 2 hours before placing backfill.
5. Install pipe upgrade with bell pointing upstream. Pipe may be installed with bell pointing downstream with Engineer's approval.
6. Place each section of pipe to form close concentric joint with adjoining section and to prevent sudden offsets in flow line.
7. Place sufficient backfill on each section of pipe, as it is installed, to hold it firmly in place.
8. PVC AWWA C900 and C905 Pressure Pipe: Follow Section 33 11 13.

F. Point Repairs: Replacement of existing sewer from 5 linear feet to 10 linear feet to correct identified problems with sewer main.

G. Verification of Design Slope and Invert Elevations:
   1. Installations of 0.5 Percent or Less: Survey immediately upon completion of each segment before setting the cone section.
   2. Reinstall segment(s) of pipe where slope or elevations are not to design at no additional cost to the Owner.

H. Work Orders designated as an emergency shall commence work within 24 hours of issuance.

3.3 JOINTS

A. PVC Pipe:
   1. Clean joint surfaces immediately before jointing.
   2. Apply lubricant, align spigot to bell, inserting until it contacts gasket evenly all around, then force pipe units together with proper equipment.
      a. Insert spigot ends into bells to depth marked on pipe.
      b. If spigot depth reference mark is missing, improperly placed, or on field-cut pipe, mark depth reference around entire circumference of pipe before making joint.
   3. Field Cut:
      a. Cut square and bevel outer edge same as factory-made spigot ends.
      b. Closed profile PVC pipe: Seal exposed cells on cut ends following manufacturer's recommendation.
      c. Open profile PVC pipe: Cut 18 inch and larger pipe following manufacturer's recommendation.

A. PVC AWWA C900 and C905 Pressure Pipe: Follow Section 33 11 00.

3.4 SEWER SERVICE CONNECTIONS

A. Install following Standard Details and Contract Documents.

B. Service connections to DIP, PVC AWWA C900, and C905.
   1. PVC SDR 26.
   2. Install transition gasket to mechanical joint tee.

B. Tapping Existing Main:
   1. Tap existing sewer with motor driven tapping machine utilizing diamond core bit.

3.5 CONNECTIONS TO EXISTING SEWERS AND MANHOLES

A. Install following Standard Details and Contract Documents.

B. Verify proposed connection for grade, alignment and existing pipe material to existing sewer before installation of pipe.

C. Maintain existing sewage flows during connection to existing sewer.
   1. Take precautions and employ methods required to prevent sewage backup.
   2. Bypass pumping may be used as option for flow diversion.
   3. Return diverted sewage to sanitary system and do not discharge on surfaces or into streams or storm drains.

a. Use enclosed bypass flumes equivalent in size to existing sewer being diverted, when required.

4. Immediately clean and disinfect raw sewage spills and overflows caused by operation.
   a. Immediately report sanitary sewer spills and overflows onto any surface to the Owner.

D. Connect pipe to existing concrete manhole by core drill method.
   1. Unless otherwise noted, provide flexible gasket connector following manufacturer's recommendation.

E. When connecting DIP or RCP to existing brick manhole: Follow Standard Details.

F. When building manhole on existing sewer: Follow Standard Details.

G. Sewer service connections: Connect to existing main line sewers as specified herein and following Standard Details.

3.6 INSTALLATION OF CASING PIPE IN OPEN CUT

A. Install casing pipe in open cut following Section 31 23 33 and specified herein.

3.7 MANHOLES

A. General: Watertight.

B. Construction and Handling.
   1. Construct manholes of precast sections, cast-in-place concrete, following Standard Details and Drawings.
   2. Precast Manholes.
      a. Protect plant-accepted manhole sections from damage while in storage at plant, in transit, and at Contract site.
         1) Handle with proper size equipment, using only appropriate lifting holes or eyes.
         2) Keep joint ends of sections clean and place on wood blocks, pallets, or other appropriate material, never on ground.
      b. Install manhole sections following manhole manufacturer's written assembly instructions and as specified herein.
         1) Before assembly, inspect joint ends for defects or damage that may prevent watertight joint.
         2) Thoroughly clean joint surfaces, remove debris and foreign matter, and keep joint surfaces clean during assembly.
         3) Manhole rejected by Engineer: Removed and replaced at no expense to the Owner.
         4) Repair damaged manhole sections following manufacturer's recommended repair methods.
   3. Cast-in-place concrete manholes: See Section 03 30 00.
      a. Flexible gasket connectors:
   4. Lined Manholes.
      a. Installation: Follow Manufacturer's recommendations.
      b. After installation of lined precast concrete manholes, visually inspect lining for damage. Repair damaged surfaces following manufacturer's submitted recommendations.

C. Flow Channel/Benches.

1. Form appropriate flow channel/bench in bottoms of manholes: Follow Standard Details.
2. Brick: Follow masonry work for manholes in Section 04 20 00 and Standard Details.
3. Precast concrete.
    a. Fill unfinished gap in channel/bench to permit pipe installation by applying bonding compound and non-shrink grout, finish flush with contour of channel/bench and cure following bonding compound and grout manufacturer's recommendations.
    b. No repair or modification to channel slope, other than unfinished gap, will be permitted.

D. Pipe to Manhole Connections.
1. Cut pipe square before installation.
    a. Place so springline edges of pipe are flush with inside wall or extend a maximum of 2-1/2 inches following manufacturer's recommended installation procedures.
    b. Where pipe is extended into manhole, coordinate slope of pipe and slope of notch in invert to ensure smooth transition.
    2. Fit flexible gasket connector between pipe and manhole described herein except for following connections:
    a. When pipe enters manhole at slope greater than 10 percent.
    b. Where pipe enters manholes at angle.
    c. Where manhole is built over existing sewer pipe, except when existing sewer pipe is PVC.
    d. When either DIP or RCP is connected to existing brick manhole.
e. Parallel connections.
    3. Insert pipe following connector manufacturer's written recommendations.
        a. Ensure that pipe is centered in connector, that full barrel portion of pipe is fully inserted, and that pipe is properly bedded immediately adjacent to manhole.
        b. When flexible gasket connector is not used for reasons stated herein, use quick setting non-shrink grouted pipe to manhole connections and bentonite collar following Standard Details.
        c. Keep excavation dry and do not backfill until 2 hours have elapsed to permit grout to cure.
    4. When AWWA C900 and C905 pipe is to be grouted using solvent cement:
        a. Apply solvent cement following manufacturer's instructions to entire exterior portion of pipe to be grouted into wall.
        b. Coat softened pipe exterior with concrete sand and allow pipe exterior to harden.
        c. Grout sand-coated pipe into wall.

E. Set bentonite collar at pipe to manhole connections following Standard Details, for following situations:
1. For pipes 15 inch and larger diameter except at outside drop manholes.
2. When manhole depth is 16 feet or over, except at outside drop manholes.
3. When flexible connector is not used.
4. When a flexible connector is installed in existing manhole, except at outside drop manholes.

F. Set manhole steps for each manhole following Standard Details and manufacturer's recommendations.

G. Install watertight frame and cover on each manhole following Standard Details.
   1. Transitions:
      a. Install anchor rods in bolt inserts and align to pass through bolt holes in flange of manhole frame.
         1) When bolt slot inserts are used, align as specified herein, then fill and pack mortar in bolt slot inserts and around anchor rods.
      b. Precast Concrete Grade Ring Transition:
         1) For all sizes frame and cover, see option for use of brick transition below.
         2) Following Standard Details for height requirements.
         3) Set precast concrete grade rings in full beds of Type M mortar minimum ¼ inch and maximum 1 ¼ inch thick.
      b. From April through November, wet grade rings and top of cone section immediately before placing mortar.
            a) Mortar mix following Section 04 20 00.
            b) Point horizontal circumferential and vertical mortar joints, inside and outside, full width, maximum 3/8 inch in depth.
         (1) Fill annular space between anchor rods and bolt holes, pack with mortar on top ring, and finish flush with ring surface.
            d) After mortar has cured, place flexible gasket following Standard Details.
            e) Set frame and bolt in place and provide watertight seal.
      c. Brick Transition:
         1) For manholes with frame and cover 30 inch and larger diameter.
         2) Following 04200 for brick and mortar.
         3) Following Standard Details for height requirements.
         4) Parge exterior of brick with 2 coats of mortar and extend parging below top section of precast manhole section.
            a) Each coat 1/4 to 3/8 inch thick and cure between coats.
            b) Apply curing compound to each coat.
         5) Place a bed of mortar maximum 1 inch thick on top of brick transition.
         6) After mortar has cured, place flexible gasket following Standard Details.
         7) Set frame and bolt in place and provide water tight seal.
         8) Apply 2 coats of asphalt base waterproofing following Standard Details.
         9) Protect waterproof coating from direct sunlight.
   2. Frame and Cover placement without transition: Before placing manhole frame and cover on precast cone, install anchor rods in bolt inserts and align to pass through bolt holes in flange of manhole frame.
      a. When bolt slot inserts are used, align as stated above, then fill and pack mortar in bolt slot inserts and around anchor rods.
      b. Place flexible gasket following Standard Details.
      c. Set frame and bolt in place and provide water tight seal.

H. When manhole is located within new subdivision and in area where surface is scheduled to be improved, set marker stakes following Standard Details.

I. Set pipe stubs, at manholes following Drawings, minimum of 18 inches long with watertight stopper in end away from manhole.

J. Lined manholes: Follow Standard Details, specified herein, or following drawings.

K. Slide Gates: Install following manufacturer's recommendations.

3.8 FIELD TESTING

A. Schedule proposed tests with Engineer at least 3 working days in advance.

B. Gravity Sewer - Except for 42-inch and larger RCP.
1. Perform Air Test including service connections, with low air pressure after completion of backfill.
a. Before placing testing apparatus, inspect sewers and manholes and eliminate discernible water leaks.
b. Contractor may perform preliminary tests at his own discretion for his information, without presence of Engineer, at no cost to the Owner.
c. Perform tests in presence of Engineer.
1) Provide material, equipment, and labor required.
2) Test sewers from manhole to manhole or from manhole to terminus.
3) Contractor may before air testing RCP, soak interior with clean water.
a) Remove water before air testing begins.
d. Conduct Test as Follows:
1) Place test plugs at each manhole or terminus and securely brace.
2) Determine depth of groundwater level above inverts immediately before testing.
3) Engineer will increase gage pressures accordingly but total pressure including increased amount of groundwater backpressure at springline of pipe shall not exceed 5.5 psi.
4) Add air slowly to test section until internal air pressure, on gage, stabilizes at 4 psi or at increased pressure determined for correction of groundwater backpressure.
a) Do not allow personnel in manholes while test is being performed or when test section is under air pressure.
b) If leakage is indicated at test plugs, relieve pressure before eliminating leak.
5) When air pressure is stabilized, disconnect hose and compressor and allow pressure to decrease to 3.5 psi, plus correction for groundwater backpressure.
6) Record time period for pressure drop 0.5 psi, from 3.5 to 3.0 psi plus groundwater correction.
7) Pipes failing to maintain holding times in Air Test Tables herein will not be accepted. If test section fails test:
a) Make repairs or replace
b) Retest as specified herein.
c) At no cost to the Owner.
8) Owner will observe test for each test segment, once without charge to Contractor.
2. Perform Pipe Mandrel Deflection Test - PVC pipe 15 inch and smaller.
a. Thoroughly clean test section prior to test.
b. Contractor may perform preliminary test at his own discretion, for his information, without Engineer's presence and at no cost to the Owner.
c. Perform test in presence of Engineer.
1) Provide material, equipment and labor required.
d. Push or pull mandrel through pipeline.

e. Failure of mandrel to pass a point or section in pipe indicates pipe barrel deflection in excess of 5 percent.
   1) If section fails test:
   a) Excavate and re-bed or replace failed section and backfill.
   b) Retest section as specified herein.
   c) At no cost to the Owner.
   f) The Owner will observe test for each section, once, without charge to Contractor.

C. Force Mains: Follow Section 33 11 13 and specified herein.

1. Pressure Test: Fill length of force main in test section with water and subject it to maximum sustained internal pressure plus water hammer, at low point, following Drawings or Special Provisions.
2. Leakage Test.
   a. Test at sustained internal hydrostatic following Drawings or Special Provisions at highest invert elevation or at least 100 psi.
3. If pressure test is less than 100 psi, perform leakage and pressure test concurrently.
4. If test results show displacement, damage, or leakage in excess of allowable amount, repair displacement and damage, and eliminate leakage. Retest until specified conditions meet Engineer's acceptance at no cost to the Owner.

D. Sewer Service Connections:.
1. Sewer Service Connections.
   a. Give 3 days notice to Owner before CCTV Inspection.
   b. Inspect by CCTV sewer service connections from cleanout to main line sewer.
   c. Repair or replace defective sewer service connections installed under this Contract and retelevise within 5 working days.
      1) Defects:
         a) Intermediate low points between cleanout and mainline connection.
         b) Cracked pipe.
         c) Infiltration.
         d) Joints:
            (1) Not made in accordance with manufacturer's recommendations.
            (2) Deflected joints.
                e) Excessive vertical pipe deflection.
      2) Replacement of defective sewer service connections installed under this contract, and retelevising will be at no additional cost to the Owner.

E. Manholes.
1. After manhole installation is completed and within guarantee period, each manhole will be inspected for water tightness.
   a. Provide adequate confined space ventilation for inspection access.
   b. Eliminate leakage at manhole, and repair using approved written procedures and repair recommendations from manufacturer in presence of Engineer and manufacturer's representative.

F. Slide Gate and Operator.
1. Field inspection and testing: Follow Section 01 45 00.

3.9 ABANDONMENT

A. Sewers: See Standard Details.
   1. AC Pipe:
      a. Comply with OSHA requirements for sawing AC pipe.
      b. Use water during sawing to prevent dust from being generated, and to shield and contain debris.
      c. Allow only workers directly involved in sawing AC pipe in work area during sawing operations.
      d. Remove sections of AC pipe after cutting.
         1) Follow OSHA requirements.

B. Manholes and Structures: See Standard Details.

C. Service Connections: Abandon following Drawings or as specified if not shown.

   1. If connection to main line sewer is with tee, wye or saddle, remove service connection pipe from mainline connection and replace with approved watertight plug.
   2. If connection to main line sewer is with thimble, remove thimble and perform mainline point repair.
   3. AC pipe: Follow Sewer Service Connection Renewals.

END OF SECTION 33 31 00

33 41 00
STORM UTILITY DRAINAGE PIPING

PART 1 GENERAL

1.1 DESCRIPTION

A. The storm utility drainage piping shall include, but not necessarily be limited to, furnishing and installing concrete pipes, metal pipes, structural plate pipes and structural plate pipe arch culverts that are composed of curved plates bolted together in the field as specified in the Contract Documents or as directed by the Engineer.

B. This work shall consist of placing the size and type of concrete pipes, metal pipes, structural plate pipes and structural plate pipe arch culverts on a firm bed to the specified line and grade; including all pipe connections to existing pipes, inlets, end walls, or manholes; and cleaning the existing pipes as specified in the Contract Documents or as directed by the Engineer.

PART 2 PRODUCTS

2.1 MATERIALS

A. Trench backfill shall conform to 31 23 33 (Trenching and Backfilling).

B. Concrete Mix No. 2. Concrete mix No. 2 shall conform to MSHA 902.10

C. Gravel bedding material for pipe shall be meet the requirements of 31 23 33 (Trenching and Backfilling)

D. Submit certificates of compliance before delivery of materials in accordance with 01 33 00 for pipe and fittings furnished by the Contractor under this Section. A certification is a document which verifies that the material and work complies with the applicable specifications and includes the actual test results to confirm the statement. The contents of the certification shall be on the Contractor's/vendor's/manufacturer's letterhead or approved document and shall be duly signed by a company officer. Certificates shall include Owner Contract Number, job location, Contractor's name, types, classes and strengths of pipe and pipe manufacturer's name.

E. Pipe. Pipe shall conform to the follows:

MATERIAL	SPECIFICATION	REMARKS
Nonreinforced Concrete Pipe	M 86, Class 3	—
Reinforced Concrete Pipe	M 170, Class 4 & 5	54 in. and smaller diameter, load bearing option.
		60 in. and larger diameter, material option.
Concrete End Sections	M 170	—
Polyvinyl Chloride (PVC) Profile Wall Pipe	M 278, PS 46	12 in. to 15 in. diameter, SDR 35
Polyvinyl Chloride (PVC) Pipe	AASHTO Bridge Section 18 PVC Ribbed Pipe	—
	M 278 (a)	Underdrain outlet pipe
	M 278 (a)	Perforated underdrain
Reinforced Concrete Arch Culvert	M 206	—
Reinforced Concrete Elliptical Pipe	M 207	Horizontal elliptical pipe only.
Preformed Rubber Joint for Circular Pipe	M 198, Type A	—
Corrugated Steel Pipe, Pipe Arches & Underdrain	M 36 (b), (c)	End finish shall be annular corrugations
Corrugated Aluminum Alloy Pipe	M 196 (b)	End finish shall be annular corrugations
Structural Plate for Pipe, Pipe Arches & Arches	M 167	—
Polyethylene (PE) Precoated Corrugated Steel Pipe	M 245 & M 246	Minimum thickness 10 mil on each of the surfaces.
Reinforced Concrete Low-Head Pressure Pipe	C 361	Pond spillways

(a) Perforations shall conform to the requirements of F 758.
(b) Bands with dimples are prohibited
(c) All Corrugated Steel Pipe shall be aluminum-coated Type 2 conforming to M 274 unless otherwise specified.

2.2 SOURCE QUALITY CONTROL

1. Reinforced concrete culvert and storm drain pipe and fittings and arch and elliptical pipe shall be free from fractures or cracks that extend through the wall of the pipe or fitting; surface defects indicating honeycombed or open texture; defects that indicate imperfect proportioning, mixing, and molding; damaged or cracked ends where such damage would prevent making a satisfactory joint; or any continuous crack having a surface width of 0.01 inch or more and extending for a length of 12 inches or more. Materials and finished product testing shall be in accordance with AASHTO M 170, M 206, or M 207 as

detailed in AASHTO T 33, and as specified herein. Acceptability of pipe through 54-inch diameter, or with a maximum 54-inch rise, and classes produced in accordance with design tables found in AASHTO M 170, M 206, or M 207, or the modified and special designs permitted therein, shall be determined by results of a three-edge bearing test for a load to produce a 0.01-inch crack. If the load exceeds the requirements before the 0.01-inch crack is reached, the load may be relieved and the pipe accepted for use. For pipe 60-inch diameter, or with a 58-inch rise, and larger, acceptance will be based on materials tests specified in AASHTO M 170, M 206, or M 207.

2. Reinforced concrete pipe conforming to the Specifications will be accepted on the manufacturer's certification based on the requirements outlined above. This includes the sampling, testing, documentation, and certification of the product by the manufacturer.

   a. Shipment. Units may be shipped to the Owner's projects under either of the following conditions:

      1) The required testing for all units in the lot has been completed with acceptable results and all of the units to be shipped are at least the age of the test specimens at testing.
      2) Units otherwise conforming to all test criteria may be shipped prior to completion of absorption testing if the concrete mix and manufacturing process used have historically produced the required absorption results, with final acceptance pending acceptable test results.

   The quality control stamp shall be affixed to each unit shipped.

   b. Certification. A manufacturer's certification shall accompany each shipment of pipe. A copy of the certification shall be delivered to the Engineer and the Contractor for each shipment. The certification shall include the following:

      1) The plant name, address, and location.
      2) Size and class of the pipe.
      3) Date of manufacture and shipment.
      4) Number of units or linear feet.
      5) Owner Contract number,
      6) Statement of Specification compliance.
      7) Signature of the quality control manager.

PART 3 EXECUTION

3.1 DELIVERY, STORAGE AND HANDLING

1. Delivery of pipe shall be coordinated with installation or shall be unloaded with proper equipment along the line of work, outside trench limits near as practicable to point of final placement, facing in proper direction and properly wedged secure. It shall be stored away from brush, poison oak or ivy and in an accessible area for inspection.
2. Reinforced concrete pipe, specials and appurtenances shall be unloaded and handled with a crane or backhoe of adequate capacity equipped with appropriate slings to protect the material from damage.
3. If damage occurs and is deemed repairable, it shall be repaired as directed by the Engineer in accordance with manufacturer's recommendations. If damage is not repairable in the opinion of the Engineer, such pipe and specials will be rejected and shall be removed and replaced at the Contractor's expense.

3.2 INSTALLATION AND REPAIR RECOMMENDATIONS

1. Submit manufacturer's recommended installation and repair methods and procedures for pipe.
2. Repairs shall be performed by the manufacturer using specifically trained personnel and shall proceed only after approval of the Engineer and in his presence.
3. Above submittal may be waived when the manufacturer has his approved installation and repair methods on file with the Engineer.

3.3 CONCRETE PIPES, METAL PIPES, PVC PIPES

A. General:
   a. Pipe lengths and gradients shall be verified by the Contractor and shall be acceptable to the Engineer before installation.
   b. Pipe End walls, when visible from the roadway, shall be constructed parallel to the roadway and askew pipe shall protrude through the end wall. End walls, not visible from the roadway, shall be constructed normal to the center line of the pipe.
   c. The existing pipes shall be cleaned and the material disposed of as directed by the Engineer.

B. Excavation: Refer the specification 31 23 33 (trenching and backfilling) for pipe trenching specifications.

C. Bedding:
   a. Refer the specification 31 23 33 (trenching and backfilling) for pipe bedding specifications
   b. When rock is encountered, it shall be removed and replaced with a minimum 8 in. of granular bedding in conformance with the standard details and 32 11 23 (Aggregate Base Course) as directed by the Engineer.
   c. When unsuitable foundation material is encountered, it shall be removed and replaced with selected backfill for the full width of the trench as directed by the Engineer.

D. Installation: Prior to pipe installation bring bedding material to grade along entire length of pipe to be installed. Install pipe to a true uniform line and grade as indicated with continuous bearing of barrel on bedding material. Pipes shall be laid with hubs upgrade. A single lay hole through the shell of the pipe will be permitted with an approved lifting device. The lay hole shall be cast in the pipe during fabrication or cored without damaging any reinforcement. After installation, the lay hole shall be permanently sealed by filling with mortar, rubber plug, or other means approved by the engineer. Wood plugs are prohibited.

E. Joints:
   a. Pipe joints shall be sealed in a manner appropriate to the pipe material.
   b. Reinforced Concrete Pipe Joints shall be sealed with rubber type gaskets (circular pipe) or resilient type material (elliptical pipe) conforming to M 198. Mortar joints are prohibited.

c. Metal Pipe joints shall be butted and sealed with rubber gaskets and the sections joined with approved coupling bands conforming to 2.1 E.

d. Class PS50 PVC pipe shall be installed with one or more of the following joint systems as specified or shown on the Plans:
   a. Elastomeric gasket joints meeting ASTM D 3212
   b. Belled ends
   c. Sleeve-type couplings
   d. Stop-type couplings
   e. Solvent cement-type joints

F. Pipe Connections:
   a. Pipe connections may be either prefabricated or constructed in the field.
   b. A field pipe connection shall include cutting a hole in one pipe, inserting and trimming the connecting pipe, and placing a concrete collar using Concrete Mix No. 2 at the connection.
   c. In the case of corrugated pipes, a welded connection may be substituted for the concrete collar. The weld shall be coated with a zinc-rich paint coating in conformance with M 36.
   d. Refer to 30 40 00 for pipe connections to drainage structures.

G. Pipe Encasement: When specified in the Contract Documents or when directed by the Engineer, pipes shall be encased using Concrete Mix No. 2.

H. Backfill: Refer Specifications 31 23 33 (Trenching and Backfilling) for pipe backfilling specifications.

I. Removal of Existing Pipe: Culverts: When specified in the Contract Documents, existing pipe culverts shall be removed and become the property of the Contractor. Backfilling of trenches resulting from pipe removal shall conform to 31 23 33 (Trenching and Backfilling).

J. Relaying Existing Pipe: When specified in the Contract Documents, removed culverts shall be salvaged and relaid in conformance with these Specifications relating to new pipe.

K. Abandoned Pipes: When specified in the Contract Documents or when directed by the Engineer, abandoned pipes shall be plugged using Concrete Mix No. 2 or brick masonry.

3.4 STRUCTURAL PLATE PIPE AND ARCH CULVERT

1. Fabrication: The plates, including required holes, shall be shop fabricated to the required dimensions. The plates shall be shipped complete with proper markings and include all necessary connection devices such as bolts, nuts and washers. The Contractor shall provide working drawings, including erection diagrams and strutting tables acceptable to the Engineer. Erection diagrams shall include proposed lengths and lifting locations of preassembled sections. Fabrication shall not be performed until working drawings are approved by the Engineer.

   The plate configurations shall have radii and curvature conforming to AASHTO Standard Specifications for Highway Bridges. When bottom plates are specified to be thicker than

top and side plates, the thicker plates for circular pipes shall cover at least 25 percent of the periphery of the circle. For pipe arches, the thicker plates shall include corner plates as well as bottom plates. These culverts shall be laid on a firm bed true to line and grade as specified in the Contract Documents.

Bolt holes along those edges of the plates that will form longitudinal seams in the finished structure shall be staggered in rows 2 in. apart, with one row in the valley and one in the crest of the corrugations unless otherwise specified in the Contract Documents. Bolt holes along those edges of the plates that will form circumferential seams in the finished structure shall provide for a bolt spacing of not more than 12 in. The diameter of the bolt holes in the longitudinal seams shall not exceed the diameter of the bolt by more than 1/8 in.

Edges shall be shop cut to line and grade and shall be free from oxide and burrs. Connections shall be staggered so that no more than three plates come together at any one point. Plates shall be formed to provide lap joints.

2. Excavation: When a structural plate pipe or structural plate pipe arch is to be laid on existing ground, on or under fill, embankment shall be constructed to a height of at least 18 in., but not more than 3 ft above the proposed top of the pipe. The trench shall then be excavated to receive the pipe. The width of trench shall be sufficient to permit thorough tamping of the backfill under the haunches and around the pipe. This width shall be twice the outside diameter of the pipe or the outside diameter plus 18 in. on each side, whichever is less. All suitable material removed from the excavation shall be placed in backfill or stored for future use. Excavated material shall not be wasted without permission of the Engineer. Boulders, logs or other unforeseen unsuitable material encountered shall be removed from excavated material prior to placing as backfill. Unsuitable material shall be disposed of in an approved disposal area.

3. Foundation Preparation: Structural plate pipe or structural plate pipe arch: Structural plate pipe or structural plate pipe arch bedding shall conform to 3.3.C. Rails shall be set and the foundation screeded to be coincidental with the exact shape of the bottom plates, and the screeding shall be done immediately prior to erection.

4. Erection: When strutting is required for structural plate pipe or structural plate pipe arch, it shall be uniform from end to end. Struts shall be left in place until backfills are completed. Nuts and bolts shall be tightened between 100 and 200 ft·lb of torque.

   When washers are specified for structural plate pipe or structural plate pipe arch, they shall be placed under the turned element. Bolts shall first be distributed over the section being assembled and holes made to align by shifting the plates. For bottom plates, the nuts shall be inside the structure. Nuts shall not be drawn tight until the section is assembled. Before backfilling, all nuts shall be finally tightened and tested to ensure compliance with torque requirements.

5. Backfill: Earth for backfill for structural plate pipe or structural plate pipe arch shall be free from large lumps, clods, and rocks and shall be placed along the side of the culvert for the full width of the trench in layers not exceeding 6 in. uncompacted depth. Compaction shall conform to 31 23 33. Each layer shall be compacted on both sides of the pipe by means of an approved mechanical tamper. Special care shall be taken to compact the fill thoroughly under the haunches of the pipe.

The backfill shall be elevated uniformly along each side of the structural plate pipe or structural plate pipe arch to a height of not less than 18 in. above the top of the structure. For structures without headwalls, backfill shall start in the center of the structure. If the structure includes headwalls or spandrel walls, backfilling operations shall start at one wall and extend toward the opposite side. When batteries or multicell installations are specified, backfill between cells shall be elevated equally on each side of each cell.

No trucks or construction equipment shall be allowed to pass over any part of a structural plate pipe structure until the backfill has been completed and tamped up to a height of not less than 18 in. above the structure.

6. Concrete Invert: When specified in the Contract Documents, the invert of structural plate pipe or structural plate pipe arch culverts shall be paved using Concrete Mix No. 2. The concrete shall be placed and cured as specified in 03 30 00 (Portland Cement Concrete Structures).

7. End treatments: Ends of structural plate pipes and structural plate pipe arches shall be shop fabricated on a bevel to fit and be flush with the slope and alignment of the surface through which they protrude, except that where an end wall or masonry slope protection is specified, the ends of the structural plates shall then be shop fabricated to fit that construction. The ends of all structural plate pipes and structural plate pipe arches that require an end treatment (end wall or slope protection) shall contain hook bolts for anchorage into the concrete.

END OF SECTION 33 41 00

33 44 19
STORMWATER FACILITIES

PART 1 GENERAL

1.1 DESCRIPTION

A. Install stormwater facilities as specified.

PART 2 PRODUCTS

2.1 MATERIALS

A. The following is a summary of the applicable material specifications:

No. 57 Aggregate	MSHA 901.01
No. 2 Aggregate	M-43, No. 2
Topsoil	31 14 13
Coarse Sand	MSHA 920.01.05(a)(1)
Soil Stabilization Matting	32 91 16
Turfgrass	MSHA 920.06
Bioretention Soil Mix (BSM)	MSHA 920.01.05
Fertilizer	MSHA 920.03.01
Shredded Hardwood Bark (SHB) Mulch	MSHA 920.04.03

Subdrain Pipe, Fittings and Geotextile Sock. Perforated and solid-wall polyvinyl chloride profile wall drain pipe (PPWP) meeting M-304 or corrugated polyethylene drainage pipe (CPP) meeting M-252, Type S and Type SP. Perforated pipe shall have two rows of slotted perforations with an opening area of 20 cm2/m to 21 cm2/m. When specified, use the geotextile sock recommended and supplied by the subdrain pipe manufacturer.

PART 3 EXECUTION

3.1 CONSTRUCTION

A. Site Protection. Prior to constructing SWM filtration facilities, ensure that the SWM facility site areas are protected from vehicular traffic and is not used for erosion and sediment controls, stockpiles or equipment storage.

B. Site Preparation. Unless facilities are off-line and will receive no runoff, construct facilities only after all surrounding and adjacent areas are permanently stabilized. Divert flow from entering the SWM filtration facility areas unless same-day stabilization is specified for the SWM filtration facility location. Prevent trash, debris and sediment from entering SWM filtration facilities during construction.

C. Schedule. Perform SWM filtration facility activities during dry weather and when soil moisture conditions are suitable and unless the facility is off-line or flow diversions are in place. Only work with soil that is friable and not in a muddy or frozen condition. Cease operations when soil and overall conditions are otherwise unsuitable.

D. Excavation. Use methods of excavation that minimize compaction of the underlying soils. Where feasible, operate equipment from locations adjacent to SWM filtration

facilities rather than within the facility area. Use only wide-track or marsh-track equipment, or light equipment with turf-type tires to excavate, grade, and place materials. Do not use equipment with narrow tracks or narrow tires, rubber tires with large lugs, or high-pressure tires.

E. Excavation Area Bottom Preparation. Only work with soil that is friable and not in a muddy or frozen condition. When present, remove any standing water from the excavation area. Prepare the bottom of the excavated area as follows. Till to a minimum depth of 8 in. to loosen soil.

F. Geotextile. Place tightly against the vertical sides of the excavation area, pulling tight to eliminate wrinkles and folds and pin securely. Eliminate any voids between the geotextile and the underlying soil and avoid wrinkling and folding the geotextile. Maintain a minimum 12 in. overlap at the geotextile joint ends or breaks. Pin longitudinal joints, overlaps and edges securely with pins spaced no greater than 10 ft on center. Do not place geotextile on the bottom of the excavated area.

G. Miscellaneous Structures. Furnish and install according to MDSHA Section 305.

H. Aggregate. Place aggregate in layers as specified. Prevent soil, fines, and other debris from contaminating the aggregate. Remove contaminated aggregate and replace with clean aggregate.

I. Subdrain Pipe. Cap the ends of all subdrain pipe not terminating in a cleanout, vent, or drainage structure unless otherwise specified. Ensure perforations are placed on the bottom of the horizontal subdrain pipe runs.
   1. Cleanouts. Install solid-wall pipe vertically and connect to horizontal subdrain with approved manufactured connections. Provide a counter-sunk screw cap on the exposed ends.
   2. Vents. Install solid-wall pipe vertically and connect to the horizontal subdrain with approved manufactured connections. Provide a ventilated screw cap on the exposed ends. Ventilation holes or slots shall be no larger than 1/4 in. in diameter or width. The sum total area of the openings shall be no less than 1 in^2. Ensure that the ventilation openings are above the maximum specified water surface elevation.
   3. Observation Wells. Use perforated and solid-wall pipe. Place the geotextile sock over the perforated pipe portion and secure at both ends. Provide a screw capon the exposed end extending 2 in. above the surface. When a concrete collar is specified, ensure the top of the well is flush with the surface of the concrete collar.

J. Coarse Sand. Place coarse sand in horizontal layers not exceeding 12 in. After each lift, spread the course sand to provide a uniform surface then spray or sprinkle water to saturate the lift until water flows from the subdrain outlet. Use an appropriate sediment control device to capture any discharged sediment-laden water from the subdrain outlet. Place, spread, and water course sand to uniform surface true to depth, line, cross section and elevation to ensure the completed work is as specified after settlement. Prevent soil, fines and other debris from contaminating the coarse sand. Remove contaminated coarse sand and replace with clean coarse sand.

K. Bioretention Soil Mix (BSM). Place BSM in horizontal layers not exceeding 12 in. After each lift, spread the BSM to provide a uniform surface and spray or sprinkle water to saturate the entire area of BSM until water flows from the subdrain outlet. Use an approved sediment control device to capture any discharge sediment-laden water. Place, spread, and water BSM to uniform surface true to depth, line, cross section and elevation to ensure the completed work is as specified after settlement. Prevent soil, fines, and other debris from contaminating the BSM. Remove contaminated BSM and replace with uncontaminated BSM.

L. Topsoil. Place topsoil as specified. Do not blend topsoil into BSM when topsoil is placed on top of BSM.

M. Soil Stabilization Matting (SSM). As specified in MSHA 709.

N. Vegetation Installation and Establishment. Unless facilities are off-line or flow diversions are in place, install seed, sod, trees, shrubs, perennials, and annuals within SWM filtration facility areas immediately after final grading. In the event that vegetation cannot be installed and established due to time-of-year or weather restrictions, keep diversion controls in place until such time that permanent vegetation may be established. Do not use machinery other than hand held within the BSM footprint. Turfgrass Establishment. As specified in MDSHA Section 705.

3.3 AS BUILT CERTIFICATION

A. Inspect stormwater management facilities during specified stages of construction, and furnish a completed (SWM) Facility As-Built Certification Package to the Engineer certifying that the SWM facilities have been constructed as specified in the Contract Documents, Inspection of SWM facilities and completion of the SWM Facility As-Built Certification Package may only be performed by an As-Built Inspector.

B. As-Built (AB) Inspector. Furnish an approved AB Inspector to complete the As-Built Certification. AB Inspectors require licensure in the State of Maryland as a Professional Engineer or Professional Land Surveyor, experienced in SWM design and construction.

C. To request approval, furnish a one-page resume for the AB Inspector at least two weeks prior to the start of construction of any SWM facility. The resume shall include the AB Inspector's name, contact information, relevant professional license(s), employer's name, and relevant work history. Failure to receive approval for the AB Inspector or to monitor the specified construction stages will be grounds for replacement.

D. SWM Facility As-Built Certification Package. The Certification Package certifies that the SWM Facilities have been constructed as specified. The submitted package shall include, at a minimum, photographs during specified construction phases, written descriptions of each phase, completed tabulations and checklists, completed certification forms, material testing reports, turf/vegetation establishment report and green-line revision plans for each facility

E. Stages for As-Built Inspections by the AB Inspector. Perform minimum inspections for SWM facilities as follows:
   1. Microbio.
      a. During excavation to subgrade.
      b. During placement and backfill of subdrain systems and observations wells.

c. During placement of stone and geotextile.
d. Upon completion of final grading and establishment of permanent stabilization.

2. Underground Storage.
e. During excavation to subgrade.
f. During placement of shells, piping and stone backfill.
g. Upon completion of final grading and establishment of permanent stabilization.

F. Surveys, Computations, and Red-Line Revision Requirements. Upon completion of each SWM facility, survey each SWM facility and provide green-line revisions that include the following items:
1. Contours. Indicate the grading of the SWM facility using one foot contour intervals.
2. Miscellaneous Features. Include all other pertinent features in and around the SWM facility, such as freeboard, water surface elevations, and setbacks.

G. Tolerances. Tolerance limits for green-line as-built information is as follows:

1. Earthwork Tolerance. Elevations must be within 3 in. of elevations specified in the Contract Documents.
2. Freeboard. Freeboard must be no less than specified in the Contract Documents.

When tolerances are exceeded, furnish computations for the storage volumes, discharge rates, detention times, and other applicable documentation to demonstrate that the SWM facilities meet all of the designed parameters.

H. Submission Requirements. Furnish two hard-copies and one digital copy in PDF format of the SWM Facility As-Built Certification Package to the Engineer. Incomplete SWM Facility As-Built Certification Packages will not be accepted. The Engineer will submit one copy to the Office of Resources and Environmental Protection (OREP) for review and approval. When SWM facilities do not meet the design parameters, reconstruct, re-inspect, resurvey and recalculate deficient aspects of the SWM facilities and furnish the revised information in the SWM Facility As-Built Certification Package.

END OF SECTION 33 44 19

37 37 00
RIPRAP DITCHES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work shall consist of constructing riprap ditches and riprap ditches with capping as specified in the Contract Documents or as directed by the Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS.

A. Riprap shall conform to MSHA 901.02 and 901.03

B. Geotextile, Class as specified. Geotextile shall conform to MSHA 921.09

C. 2 to 4 in. Stone. Stone shall conform to M43, No.1.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Excavation shall conform to the line and grade specified in the Contract Documents. Ditch sides and bottom shall be smooth and firm, free from protruding objects that would damage the geotextile, and constructed in a manner acceptable to the Engineer. Refer to MSHA 402.03.01 for excavated material.

3.2 GEOTEXTILE PLACEMENT

A. The geotextile shall be placed on the prepared subgrade with the adjacent edges overlapped a minimum of 2 ft. Damaged geotextile shall be replaced or repaired at no additional cost to the Owner in a manner acceptable to the Engineer.

3.3 RIPRAP PLACEMENT

A. Stones shall be placed by mechanical or other acceptable methods to produce a reasonably graded mass of stone. Placing the stones by methods that cause extensive segregation is prohibited. The depth of the riprap shall be as specified in the Contract Documents.

3.4 BACKFILL

A. Any excavation voids existing along the edges and ends of the placed riprap shall be backfilled with suitable material to blend in with contiguous slopes, ditch lines, or existing ground. Riprap placed in the clear recovery area shall be capped with a layer of 2 to 4 in. stone.

END OF SECTION 37 37 00