

TECHNICAL SPECIFICATIONS
FOR
KAKAINA SUBDIVISION
WAIMANALO, KOOLAUPOKO, ISLAND OF OAHU, HAWAII

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These Technical Specifications supplement the applicable sections of the Standard Specifications for Road, Bridge and Public Works Construction, 1994, State of Hawaii and all applicable updates (bound separately).

All applicable sections of the following are incorporated by reference (inclusive):

1. STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION, September 1984, of the Departments of Public Works, County of Kauai, City and County of Honolulu, County of Maui, and County of Hawaii, of the State of Hawaii (bound separately).
2. WATER SYSTEM STANDARDS, dated 2002 of Department of Water Supply, County of Hawaii, Board of Water Supply, City & County of Honolulu, Department of Water, County of Kauai and Department of Water Supply, County of Maui, of the State of Hawaii and all applicable updates (bound separately).

CAUTION: For measurement and payment purposes, if there are discrepancies between these technical specifications, the Standard Specifications, and the proposal schedule, **measurement and payment will be in accordance with the PROPOSAL SCHEDULE.**

SECTION 01010 - GENERAL REQUIREMENTS

PART 1 - GENERAL

- 1.01 GENERAL REQUIREMENTS AND COVENANTS: The General Conditions, General Specifications, Special Provisions, and other applicable documents preceding these specifications shall govern all work specified hereinafter in all Divisions and Sections.
- 1.02 APPLICABLE REGULATIONS: The Contractor shall comply with all local laws, ordinances, rules and regulations pertaining to such work and must obtain all required permits, licenses, and certificates and publish and post all notices required thereby.
- 1.03 DESCRIPTION OF THE WORK: These specifications are divided for convenience into titled divisions and sections as set forth in the TABLE OF CONTENTS preceding these specifications and shall not be considered an accurate or complete segregation of the several units of labor and materials. No responsibility, either direct or implied is assumed by the Department of Hawaiian Home Lands (DHHL) for omissions or duplications of the subject matter. The Contractor will be held responsible for the complete work whenever or wherever the parts are described in one or more trade heads. Any mention in these sections or indication on the drawings of articles, materials, operations, or methods, require that the Contractor furnish each item so mentioned or indicated, of the kind, type, or design and quality of each item so mentioned on the drawings, and that the Contractor furnish all labor, materials, equipment, incidentals and supervision necessary to complete the work in accordance with the drawings and the true meaning and intent of these specifications, even though such mention of articles, materials, operations, methods, quality, qualifications or condition is not expressed in complete sentences.

Where devices or items, or parts thereof are referred to in the singular, it is intended that such references shall apply to as many such devices, items, or parts as are required to properly complete the work.

Schedule of work included in these specification sections are given for convenience and shall not be considered as a comprehensive list of items necessary to complete the work of any section.

The Contractor shall employ the usual standard practice of coordinating the work covered in each section with the work of other sections. The necessary information and the items, accessories, anchors, connections, patterns, templates, etc., shall be delivered when required in order to prevent any delay in the progress and completion of the work.

- 1.04 PLANS AND SPECIFICATIONS: These specifications are intended to cover all labor, materials and standards of workmanship employed in the work indicated on the plans and called for in the specifications or reasonably implied therein. The plans and specifications complement one another. Any part of the work mentioned in one and not represented in the other, shall be done the same as if it had been mentioned or represented in both.

The Contractor shall not alter from the drawings and specifications. In the event of errors or discrepancies, the Contractor shall immediately notify the Engineer.

All figured dimensions take precedence over scaled measurements. No important dimension shall be determined by scale.

Specifications and drawings are prepared in abbreviated form and may include incomplete sentences. Omissions of words or phrases such as "the Contractor shall", "as shown on the drawing", "a", "an", and "the", are intentional. Omitted words and phrases shall be provided by inference to form complete sentences.

- 1.05 REFERENCE STANDARDS: All work shall be done in accordance with the most current standards listed below as amended and/or amplified herein.

ASA American Standards Association

ASTM American Society for Testing and Materials

AISC American Institute of Steel Construction

ACI American Concrete Institute

UBC Uniform Building Code - current edition

END OF SECTION

SECTION 01340 - DRAWINGS TO BE FURNISHED BY CONTRACTOR

The following shall supplement the General Conditions.

1.01 Shop drawings and submittals shall be made in accordance with Section 5.5 - Shop Drawings and Other Submittals of the General Conditions.

1.02 The Contractor's stamp and verification of drawings shall consist of the following format:

KAKAINA SUBDIVISION
DHHL CONTRACT NO. IFB-12-HHL-001

(Contractor's Name) _____

(Signature) _____

(Date) _____

This submittal has been checked and verified in accordance with the requirements of the contract documents and any equipment submitted herewith can be installed in the allocated spaces.

Submittal No. _____

Specification Section No. _____

Paragraph No. _____

Contract Drawing Ref. _____

Subcontractor _____

Supplier _____

Manufacturer _____

Exceptions Taken: Yes _____ No _____

Details of Exception _____

1.03 The person signing the Contractor's submittal stamp shall be the one designated under the contract agreement with the DHHL. The signature shall be in original ink. Stamped signature will not be acceptable. Submittal for shall be completely filled out, signed and dated.

- 1.04 All changes made to the submittal drawings by the Contractor in the form of written or typewritten markings shall be initialed and dated by the Contractor.
- 1.05 When the Contractor takes any exception to the submittal drawings, such exception shall be brought to the attention of the Engineer. The exception shall be submitted with the shop drawings together with sufficient details and justifications.
- 1.06 Within 30 days after receipt of notice to proceed, the Contractor shall submit to the Engineer in duplicate, a schedule, listing all items that will be submitted for review and approval action by the DHHL, the State Department of Transportation, or the City & County. The schedule shall include, among other things, a list of shop drawings and manufacturer's literature, certificates of compliance, material samples, and guarantees. The schedule shall indicate the type of item, contract requirement reference; the Contractor's scheduled date for submitting the above items and projected needs for approval answers and procurement dates. In preparing the schedule, adequate time (minimum of 15 days) shall be allowed for review and approval; additional time shall be allowed to provide for possible resubmittal. Also, the scheduling shall be coordinated with the approved progress schedule.
- 1.07 The Contractor shall maintain at the job site two sets of full size contract drawings, marking them in red to show all variations between the construction actually provided and that indicated or specified in the contract documents, including buried or concealed herein, or where variations in scope or character of work from that of the original contract are authorized, the drawings shall be marked to define the construction actually provided. Where equipment installation is involved, the size, manufacturer's name, model number and power input or output characteristics are applicable shall be shown on the as-built drawings. The representations of such changes shall conform to standard and detail as necessary to clearly portray the as-built construction. The drawings shall be maintained and updated on a daily basis.

Monthly and final payments of the Contractor shall be subject to prior approval of the drawings.

On completion of the work, both sets of marked-up drawings shall be delivered to the Engineer, and shall be subject to his approval before acceptance.

END OF SECTION

SECTION 01430 - ENVIRONMENTAL PROTECTION

PART 1 - GENERAL

- 1.01 **GENERAL:** This section covers prevention of environmental pollution and damage during and as the result of construction operations under this contract and for those measures set forth in other sections of the TECHNICAL SPECIFICATIONS. For the purpose of this specification, environmental pollution and damage is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to utility of the environment for aesthetic, cultural and/or historical purposes. The control of environmental pollution and damage requires consideration of air, water, and land, and includes management of visual aesthetics, noise, solid waste, as well as other pollutants. It is the responsibility of the Contractor to investigate and comply with all applicable Federal, State and County laws and regulations concerning environmental protection and pollution control, and to secure all necessary permits.
- 1.02 **SUBMITTALS:** The Contractor shall submit an environmental protection plan in accordance with the provisions as herein specified. Environmental protection plan shall include but not be limited to the following:
- A. Methods for protection of features to be preserved within authorized work areas. The Contractor shall prepare a listing of methods to protect resources needing protection; i.e., trees, shrubs, vines, grasses and ground cover, landscape features, air and water quality, fish and wildlife, soil, historical, archaeological, and cultural resources.
 - B. Procedures to be implemented to provide the required environmental protection and to comply with all applicable laws and regulations. The Contractor shall set out the procedures to be followed to correct pollution of the environment due to accident, natural causes, or failure to follow the procedures set out in accordance with the environmental protection plan.
 - C. Drawings showing locations of any proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles or spoil material.
 - D. Environmental monitoring plans for the job site, including land, water, air and noise monitoring.
 - E. Methods of protecting surface and groundwater during construction activities.
 - F. Training for his personnel during the construction period.
- 1.03 **IMPLEMENTATION:** After receipt of Notice to Proceed, the Contractor shall submit in writing the above environmental protection plan for approval of the Engineer within 5 days after Notice to Proceed. Approval of the contractor's plan will not relieve the Contractor of his responsibility for adequate and continuing control of pollutants and their environmental protection measures.

- 1.04 SUBCONTRACTORS: Assurance of compliance with this section by subcontractors will be the responsibility of the Contractor.
- 1.05 NOTIFICATION: The Engineer will notify the Contractor in writing of any observed noncompliance with the aforementioned Federal, State or local laws or regulations, permits, and other elements of the Contractor's environmental protection plan. The Contractor shall, after receipt of such notice, inform the Engineer of proposed corrective action and take such action as may be approved. If the Contractor fails to comply promptly, the Engineer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or costs or damages allowed to the Contractor for any such suspension.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

- 3.01 PROTECTION OF ENVIRONMENTAL RESOURCES: The environmental resources within the project boundaries and those affected outside the limits of permanent work under this contract shall be protected during the entire period of this contract. The Contractor shall confine his activities to areas defined by the drawings and specifications.
- 3.02 PROTECTION OF LAND RESOURCES: Prior to the beginning of any construction, the Contractor shall identify all land resources to be preserved within the Contractor's work area. Except in areas indicated on the drawings or specified to be cleared, the Contractor shall not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and land forms without special permission from the Engineer. No ropes, cables, or guys shall be fastened to or attached to any trees for anchorage unless specifically authorized. Where such special emergency use is permitted, the Contractor shall provide effective protection for land and vegetation resources at all times as defined in the following subparagraphs.
- A. Work Area Limits: Prior to any construction, the Contractor shall mark the areas that are not required to accomplish all work to be performed under this contract. Isolated areas within the general work area, which are to be saved and protected, shall also be marked or fenced. Monuments and markers shall be protected before construction operations commence. Where construction operations are to be conducted during darkness, the markers shall be visible. The Contractor shall convey to his personnel the purpose of marking and/or protection of all necessary objects.
- B. Protection of Landscape: Trees, shrubs, vines, grasses, land forms and other landscape features indicated and defined on the drawings to be preserved shall be clearly identified by marking, fencing, or wrapping with boards, or any other approved techniques.
- C. Reduction of Exposure of Unprotected Erodible Soils: Earthwork brought to final grade shall be finished as indicated and specified. Side slopes and back slopes shall be protected as soon as practicable upon completion of rough grading. All earthwork shall be planned and conducted to minimize the duration of exposure of unprotected soils. Runoff from the construction site shall be controlled by

construction of diversion ditches, benches, and berms to retard and divert runoff to protected drainage courses.

- D. Disposal of Solid Waste by Removal From State Property: The Contractor shall transport all solid waste off State property and dispose of it in compliance with Federal, State and local requirements for solid waste disposal.
- E. Disposal of Chemical Waste: Chemical waste shall be stored in corrosion resistant containers, removed from the work area and disposed of in accordance with Federal, State, and local regulations.

3.03 PROTECTION OF WATER RESOURCES: The Contractor shall keep construction activities under surveillance, management and control to avoid pollution of surface and groundwaters. Special management techniques as shall be implemented to control water pollution.

- A. Protection of Waterways: Construction of drainage facilities as well as performance of other contract work which will contribute to the control of siltation shall be carried out in conjunction with the earthwork operations or as soon as thereafter as is practicable.

Prior to or during any suspension of construction operations for any appreciable length of time, the Contractor shall provide for any temporary erosion control measures deemed necessary. Such measures shall be continued until the permanent drainage facilities have been constructed and when called for, until the protective ground cover is sufficiently established to be an effective erosion deterrent. Should such measures fail and an appreciable quantity of material begins to erode into the natural waterway, the Contractor shall act immediately to bring the siltation under control.

- B. Pollution: The Contractor shall exercise every reasonable precaution throughout the life of the project to prevent pollution of rivers, streams or impoundments. Pollutants such as chemicals, fuels, lubricants, bitumens, raw sewage and other harmful waste shall not be discharged into or alongside of the stream, or into natural or manmade channels leading thereto. The Contractor shall also comply with the applicable regulations of the State Department of Land and Natural Resources and other statutes relating to the prevention and abatement of pollution.

The Contractor shall conduct his operations near harbors, bays, swimming and water recreation areas, to avoid and minimize pollution. He shall comply with the applicable regulations of the United States Department of Interior, State Department of Health and other authority having jurisdiction.

Monitoring of water areas affected by construction activities shall be the responsibility of the Contractor. All water areas affected by construction activities shall be monitored by the Contractor.

3.04 PROTECTION OF FISH AND WILDLIFE RESOURCES: The Contractor shall keep construction activities under surveillance, management and control to minimize interference with, disturbance to and damage of fish and wildlife.

3.05 PROTECTION OF AIR RESOURCES: The Contractor shall keep construction activities under surveillance, management and control to minimize pollution of air resources. All activities, equipment, processed, and work operated or performed by the Contractor in accomplishing the specified construction shall be in strict accordance with the State of Hawaii Public Health Regulations, Chapter 43, "Air Pollution Control." Special management techniques as set out below shall be implemented to control air pollution by the construction activities, which are included in the contract.

- A. Particulates: Dust particles, aerosols, and gaseous by-products from all construction activities and processing and preparation of materials shall be controlled at all times, including weekends, holidays and hours when work is not in progress. The Contractor shall maintain all excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and all other work areas within or outside the project boundaries free from particulates which would cause the air pollution standards mentioned above to be exceeded or which would cause a hazard or a nuisance. Sprinkling or other methods approved by the Engineer will be permitted to control particulates in the work area. Sprinkling, to be efficient, must be repeated at such intervals as to keep the disturbed area damp at all times. The Contractor must have sufficient competent equipment available to accomplish this task. Particulate control shall be performed as the work proceeds and whenever a particulate nuisance or hazard occurs.
- B. Hydrocarbons and carbon monoxide emissions from equipment shall be controlled to Federal and State allowable limits at all times.
- C. Odors shall be controlled at all times for all construction activities, processing and preparation of materials.
- D. Monitoring of air quality shall be the responsibility of the Contractor. All air areas affected by the construction activities shall be monitored by the Contractor.

3.06 PROTECTION FROM SOUND INTRUSIONS: The Contractor shall adhere to the requirements of the Department of Health and shall implement acceptable noise abatement methods to minimize the construction noise level.

Noise shall be kept within acceptable levels at all times in conformance with Title II, Administration Rules, Chapter 43, Community Noise Control, State Department of Health, Public Health Regulations. The Contractor shall obtain the pay for community noise permit from the State Department of Health when the construction equipment or other devices emit noise at levels exceeding the allowable limits.

All internal combustion engine-powered equipment shall have mufflers to minimize noise and shall be properly maintained to reduce noise to acceptable levels.

3.07 POST CONSTRUCTION CLEANUP: The Contractor shall clean up areas used for construction.

3.08 RESTORATION OF LANDSCAPE DAMAGE: The Contractor shall restore all landscape features damaged or destroyed during construction operations outside the limits of the approved work areas. Such restoration shall be in accordance with the plan submitted

for approval by the Engineer. This work will be accomplished at the Contractor's expense.

- 3.09 MAINTENANCE OF POLLUTION CONTROL FACILITIES: The Contractor shall maintain all constructed facilities and portable pollution control devices for the duration of the contract or for that length of time construction activities create the particular pollutant.
- 3.10 TRAINING OF CONTRACTOR PERSONNEL IN POLLUTION CONTROL: The Contractor shall train his personnel in all phases of environmental protection. The training shall include methods of detecting and avoiding pollution, familiarization with pollution standards, both statutory and contractual, and installation and care of facilities (vegetative covers and instruments required for monitoring purposes) to ensure adequate and continuous environmental pollution control.

END OF SECTION

SECTION 01440 - ARCHAEOLOGICAL FINDINGS

PART 1 - GENERAL

- 1.01 PRESERVATION AND RECOVERY OF HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES: Existing historical, archaeological, and cultural resources within the Contractor's work area will be so designated by the Engineer if any have been identified. The Contractor shall take precautions to preserve all such resources as they existed at the time they were pointed out to him. The Contractor shall provide and install all protection for these resources so designated and shall be responsible for their preservation during this contract. If during excavation or other construction activities in areas with existing or known resources, as well as in any other work area, any previously unidentified or unanticipated resources are discovered or found, all activities that may damage or alter such resources shall be temporarily suspended. Such temporary suspension of work shall not be attributable to the Contractor. These resources of cultural remains (prehistoric or historic surface or subsurface) include but are not limited to: any human skeletal remains or burials; artifacts; shell, midden, bone, charcoal, or other deposits; rocks or coral alignments, parings, wall, or other constructed features; and any indication or agricultural or other uses. Upon such discovery or find, the Contractor shall immediately notify the Engineer. When so notified, the Engineer will notify the State Historic Preservation Officer (SHPO) for further direction.

As directed by the Engineer, the Contractor may be allowed to continue any operation which would not further disturb the site(s); however, all work within the protected area shall be suspended until the Engineer is notified by the SHPO that all investigations or salvage operations have been completed.

END OF SECTION

SECTION 01750 - GUARANTEE

The Contractor guarantees all materials and equipment furnished to be in operable condition upon final acceptance of the work and that all such materials and equipment conform to the requirements of this contract and be fit for the use intended.

He further guarantees all such materials and equipment against defects and poor workmanship and, to the extent that he is responsible for design, the Contractor guarantees the design to meet the criteria and operating requirements specified against failure to perform in accordance with such criteria and operating requirements.

The period of this guarantee shall commence upon acceptance of the work by the appropriate agency, and shall extend through the project performance evaluation period not to exceed 1 year for all materials and equipment, provided that this period shall be extended from the time of correction of any defect or failures, corrected under the terms of this guarantee, for a like period for the corrected work.

The Contractor shall correct all defects or failures discovered within the guarantee period. The appropriate agency will give the Contractor prompt written notice of such defects or failures following their discovery. The Contractor shall commence corrective work within 10 days following notification and shall diligently prosecute such work to completion. The Contractor shall bear all costs of corrective work, which shall include necessary disassembly, transportation, reassembly and retesting, as well as repair or replacement of the defective material or equipment, and any necessary disassembly and reassembly of adjacent work.

Any period that a particular equipment is not operable due to its failure shall not be considered as a part of the guarantee period. The guarantee period shall be extended for a like period. If due to failure of other equipment the equipment is unable to perform its intended function, the guarantee period shall be extended for a like period. Time that equipment is operating shall be counted as applying to the warranty. Such time shall be determined by use of plant operator's log or other suitable documentation.

If the Contractor fails to perform corrective work in the manner and within the time stated, the Department of Hawaiian Home Lands (DHHL) may proceed to have such work performed at the Contractor's expense and his sureties will be liable therefor. The DHHL shall be entitled to reasonable attorney's fees and court costs necessarily incurred by the Contractor's refusal to honor and pay such costs of corrective work.

The Contractor's performance bond shall continue in full force and effect during the period of this guarantee.

The rights and remedies of the DHHL under this provision do not preclude the exercise of any other rights or remedies provided by this contract or by law with respect to unsatisfactory work performed by the Contractor.

This guarantee shall be deemed supplemental to guarantee provisions provided in other sections of the specifications for the individual units and systems of units so specified.

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02100 - CLEARING AND GRUBBING

PART 1 - GENERAL

1.01 GENERAL CONDITIONS: The General Conditions and Special Provisions preceding these specifications shall govern this section of the work.

1.02 WORK INCLUDED

- A. Furnish all labor, materials, equipment and tools necessary to accomplish all clearing and grubbing work as indicated on the plans and as specified herein.
- B. It shall be the responsibility of the Contractor to examine the project site and determine for himself the existing conditions.
- C. Obvious conditions of the site existing on the date of the bid opening shall be accepted as part of the work, even though they may not be clearly indicated on the plans and/or described herein or may vary therefrom.
- D. All debris of any kind accumulated from clearing or grubbing shall be disposed of off-site weekly and the whole area left clean. The Contractor shall be required to make all necessary arrangements related to the proposed place of disposal.
- E. Burning onsite will not be permitted.

PART 2 – PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 SEQUENCE OF WORK: All sequence of work shall be subject to the approval of the Engineer.

3.02 PROTECTION

- A. Adequate precautions shall be taken before commencing and during the course of the work to insure the protection of life, limb and property.
- B. The Contractor shall protect from damage all surrounding structures, trees, plants, grass, walks, pavements, utility boxes, etc. Any damages will be repaired or replaced by the Contractor to the satisfaction of the Engineer.

3.03 PERMITS: The Contractor shall apply for and obtain the necessary permits prior to the commencement of work. The Contractor shall pay for all fees.

3.04 BARRICADE: Erect temporary barricade to prevent people and animals from entering the project area, to the extent as approved by the Engineer. Such barricades shall not be less than 5'-0" in height. The extent of barricades may be adjusted as necessary with the approval of the Engineer. This work shall be accomplished to the satisfaction of DHHL and at no extra cost to DHHL. Barricades shall be removed upon completion of work and job site premises left clean.

3.05 MAINTAINING TRAFFIC

- A. The Contractor shall conduct operations with minimum interference to streets, driveways, sidewalks, etc.
- B. When necessary, the Contractor shall provide, erect and maintain lights, barriers, etc., as required by traffic and safety regulations with special attention to protection of life.

3.06 CONSTRUCTION LINES, LEVELS AND GRADES

- A. The Contractor shall verify all lines, levels and elevations indicated on the plans before any clearing, excavation or construction begins. Any discrepancy shall be immediately brought to the attention of the Engineer and any change shall be made in accordance with his instruction. The Contractor shall not be entitled to extra payment if he fails to report the discrepancies before proceeding with any work whether within the area affected or not.
- B. All lines and grades shall be established by a Surveyor licensed in the State of Hawaii.

3.07 CLEARING AND GRUBBING

- A. The Contractor shall clear off and remove from the entire area within the area to be graded, all rubbish, grass and weeds, stumps, large roots, buried logs, garbage, boulders and other unsuitable material. Where soft wet soils are encountered, light equipment should be used.
- B. The Contractor shall grub the ground surface within the area to be graded of all grass and weeds to 6 inches below present grades. Grub out tree root structures.
- C. Any stumps and roots larger than 3 inches in diameter shall be removed to a depth not less than 18 inches below the original grade level. Fill voids with select fill to maintain indicated grade.
- D. No excavation or filling shall be undertaken until area has been cleared and grubbed.

3.08 CONTRACT ZONE LIMITS: The Contract Zone Limits shown on the plans indicate only in general the limits of the work involved. The Contractor, however, is required to perform any and all necessary and incidental work which may fall outside of these demarcation lines.

- 3.09 VERIFICATION OF EXISTING GRADES: Verify existing grades, inverts, and improvements before any clearing and grubbing work is done. Immediately bring to the attention of the Engineer any discrepancy, and make any changes in accordance with his instructions. Starting of clearing and grubbing operations will be construed to mean that the Contractor agrees that the existing grades, inverts, and improvements are essentially correct as indicated. No extra compensation will be allowed if existing grades, inverts, and improvements are in error after verification thereof or if he fails to report the discrepancies before proceeding with any work.
- 3.10 CLEAN-UP: Clean up and remove all debris accumulated from construction operations from time to time, when and as directed by the Engineer. Upon completion of the construction work and before final acceptance of work, remove all surplus materials, equipment, etc., and leave entire job site clean and neat.

END OF SECTION

SECTION 02210 – SITE EARTHWORK

PART 1 – GENERAL

1.01 GENERAL CONDITIONS: The General Conditions and Special Provisions preceding these specifications shall govern this section of the work.

1.02 WORK INCLUDED: Furnish all labor, materials, services, equipment and related items necessary to excavate, fill, remove, transport, stockpile and dispose of all materials within the limits of the project required to construct the site work improvements in accordance with these specifications, dimensions, sections and details shown on the plans, and the approval of the Department of Hawaiian Home Lands (DHHL).

1.03 RELATED WORK IN OTHER SECTIONS

Trench Excavation and Backfill Section 02221
Temporary Soil Erosion Control..... Section 02270

SUBSURFACE SOIL DATA: Subsurface soil investigations have been made at the Kakaina Subdivision project site by Fewell Geotechnical Engineers, Ltd. entitled "Subsurface Investigation Report Kakaina Subdivision, Waimanalo, Oahu, Hawaii" dated July 9, 2007. Test pit logs are shown in the soils report. A copy of the complete soils report is available as part of the bid documents.

The Contractor is expected to examine the site and the record of soil investigation and decide for himself the character of materials to be encountered. The Engineer will not assume responsibility for variations of subsoil quality or condition at locations other than places shown and at the time investigations were made.

The soils report and its recommendations are made part of these specifications except where expressly modified herein.

1.04 PROTECTION

A. Erosion Control: The Contractor shall incorporate into his work schedule the Temporary Erosion Control Measures and the Permanent Erosion Control procedures indicated on the plans and as specified in the contract.

B. Dust Control: Every effort shall be made by the Contractor to keep dust to a minimum. Spraying the ground with water or other means of control shall be used wherever possible. The Contractor shall have an adequate supply of water for moisture conditioning of fill material.

Without limiting the generality or applicability of other indemnity provisions of the contract, the Contractor agrees that he shall indemnify and hold harmless the DHHL from and against all suits, actions, claims, demands, damages, costs and expenses (including but not limited to attorney's fees) arising out of any damage to any property whatsoever or injury to any person whomsoever, in any way caused or contributed to by dust from the Contractor's operations.

- C. Existing Utilities and Work Areas: The Contractor shall be responsible for the protection of existing surface and subsurface utilities and poles within and abutting the project site, trench excavations and other work areas.
- D. Finished Grades and Subgrades: All subgrades shall be kept moist until covered by subbase, base course, or concrete. All finished grades shall be kept moist until covered by landscaping or other permanent groundcover. Where shrinkage cracks are noted after compaction of the subgrade or finished grade, the subgrade or finished grade shall be rescarified, moisture-conditioned to above the optimum moisture content, and recompacted to the specified requirement at no additional cost to the DHHL. During construction, the Contractor shall properly grade and maintain all excavated surfaces to provide positive drainage and prevent ponding of water. In the event that ponding of water caused softening of the subgrades, the Contractor shall remove the soft soils and shall backfill the excavation with compacted fill at no additional cost to the DHHL.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. For Kakaina Subdivision, fills, backfills, select borrow, large over-sized rocks and boulders and rock fill shall conform to the soils report, entitled "Subsurface Investigation Report Kakaina Subdivision, Waimanalo, Oahu, Hawaii" prepared by Fewell Geotechnical Engineers, Ltd., dated August 3, 2007 and the plans entitled "Kakaina Subdivision."

PART 3 – EXECUTION

3.01 MASS GRADING

- A. Notification of Schedule: The Engineer shall be notified by the Contractor after clearing and grubbing and before any fill is placed; and also at least two weeks in advance before grading operations are scheduled to begin. Further, the Contractor shall advise the Engineer of the proposed overall schedule for earthwork operations.
- B. General: All cuts and fills to be constructed shall be monitored by a licensed geotechnical consultant (soils engineer) retained by DHHL, who shall approve all foundation preparation, fill material, methods of placing and compaction and perform field density tests during the grading. Geotechnical engineer shall notify the DHHL that the work appears to be in general conformance with the project documents based on observations and testing. No deviation from these specifications shall be made except upon the written approval of the Engineer and/or other public agencies having jurisdiction.
- C. Site Preparation: All site preparation work shall conform to the soils engineer's recommendations contained in the Soils Report.
- D. Boulder Disposal: All boulder disposal and related work shall conform to the soils engineer's recommendations contained in the Soils Report.

- E. Fill Placement and Compaction Requirements: All fill placement and compaction work shall conform to the soils engineer's recommendations contained in the Soils Report.
- F. Slopes: All work under this section shall conform to the soils engineer's recommendations relating to slopes contained in the Soils Report.
- G. Subdrainage: All subdrainage and related work shall conform to the soils engineer's recommendations contained in the Soils Report.
- H. Excavations: All excavation shall be made to the lines and grades as shown on the project plans. All excavation shall be inspected and approved by the Geotechnical Engineer. Where conditions encountered require, he shall direct the necessary modifications to be made.

Suitable material from excavation shall be used in the fill, and unsuitable material free of organic material from excavation shall be disposed of in the designated borrow site to replace material borrowed.
- I. Drainage: Care shall be exercised during grading so that areas involved will drain properly. Water shall be prevented from running over the slopes by the temporary berms, drainage swales, diversion by ditches, silting basins and the detention basin.
- J. Subgrade Preparation for Concrete Ditches: The subgrade shall be scarified to a minimum depth of 6 inches, moisture-conditioned to above the optimum moisture content, and compacted to a minimum of 90 percent relative compaction. Select borrow subbase (contingent item) may be required below the concrete slabs as recommended by the Geotechnical Engineer.
- K. Field Testing: The Engineer shall be notified at least two days prior to the start of grading. A pre-grading conference shall be held between the parties involved so as to discuss methods of operations, site problems and scheduling. Field density tests shall be taken by the Geotechnical Engineer retained by the DHHL.
- L. Supervision: At all times, the Contractor shall have a responsible field superintendent on the project in full charge of the work with authority to make decisions. He shall cooperate with the Engineer in carrying out the work. Any instructions given to him by the Engineer shall be considered to have been given to the Contractor personally.
- M. Rainy Weather: No fill shall be placed, spread or rolled during unfavorable weather. When the work is interrupted by rain, operations shall not be resumed until field tests by the Engineer indicate that conditions will permit satisfactory results.
- N. Unforeseen Conditions: If unforeseen or undetected soil conditions such as soft spots, existing utility trenches, structure foundations, voids or cavities, boulders, seepage water or expansive soil pockets, etc. are encountered, the Contractor at

his sole expense shall make all necessary corrective measures in the field as such conditions are detected.

- 3.02 UNSUITABLE EXCAVATED MATERIAL: The Contractor shall remove from the site all unsuitable excavated material unless specified otherwise by the Engineer. The unsuitable material not containing organic material shall be hauled and placed in the excavation for coralline material where shown on the drawings. Unsuitable material containing organic material shall be disposed of off-site.

Removal, including hauling and disposal, of the unsuitable material will not be paid for directly, but shall be considered incidental to the project.

END OF SECTION

SECTION 02221 – TRENCH EXCAVATION AND BACKFILL

PART 1 – GENERAL

- 1.01 GENERAL CONDITIONS: The General Conditions and Special Provisions preceding these specifications shall govern this section of the work.
- 1.02 WORK INCLUDED: Furnish all labor, materials, tools, equipment and related items necessary for excavating and backfilling trench for drain lines, sewer lines, electrical units, CATV, and appurtenances in conformity with the dimensions, profiles, section and details shown on the plans. Work shall be governed by Section 11 of the Standard Specifications as amended herein. The Contractor shall be solely responsible for the means, techniques, procedures, and sequences for dewatering and bracing and shoring the excavation.
- 1.03 RELATED WORK IN OTHER SECTIONS

Site Earthwork.....	Section 02210
Potable Water System	Section 02713
Storm Drainage System	Section 02721
Underground Detention System	Section 02722
Sanitary Sewer System	Section 02731
Exterior Electrical Work	Section 16301

- 1.04 SUPPLEMENTS: All excavated material shall be unclassified regardless of its composition, whether soil, solid rock, coral, asphalt pavement, concrete, rubbish or other material.

The installation and removal of sheeting shall be done in a manner that will not cause settlement or disturbance of the pipe cradle material.

All existing ground, roadways and other improvements damaged, destroyed or disturbed shall be, at the Contractor's expense, replaced, reconstructed and restored in kind to an equal or better condition satisfactory to the Engineer.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Materials for roads shall be in accordance with the following sections of the Standard Specifications, as revised, except as amended on the plans and/or in the specifications herewith:

Trench Excavation and Backfill..... Section 703

- B. Trench Backfill: Trench backfill shall meet the requirements of Structure Backfill A or Trench Backfill A of Section 703.20 and 703.21 respectively, of the Standard Specifications.
- C. Pipe Cushion: Pipe cushion shall consist of No. 3B fine gravel as described by ASTM C33 (No. 67 gradation).

PART 3 – EXECUTION

- 3.01 TRENCH BOTTOMS: Should the trench bottom be within 2 feet of the soft clayey material, the trench shall be overexcavated to provide 2 feet of suitable material under the bottom of the trench. Suitable material shall be coralline material or crushed rock required by the particular utility company and installed as specified herein.
- 3.02 PLACEMENT AND COMPACTION: Trench backfill shall be moisture-conditioned to within 3 percent of the optimum moisture content, placed in level lifts not exceeding 8 inches in loose thickness and compacted to a minimum of 90 percent maximum dry density per ASTM Test Method D1557.

END OF SECTION

SECTION 02270 – TEMPORARY SOIL EROSION CONTROL

PART 1 – GENERAL

- 1.01 GENERAL CONDITIONS: The General Conditions and Special Provisions preceding these specifications shall govern this section of the work.
- 1.02 WORK INCLUDED: Submit three (3) sets of the erosion control materials for approval by the Engineer. Furnish all labor, materials, services, equipment and related items necessary to implement the temporary erosion control measures, submitted separately, as required by these specifications and as ordered by the Engineer during the life of the contract to control water pollution through the use of berms, dikes, dams, sediment basins, fiber mats, netting, gravel, mulches, grasses, slope drains, and other erosion control devices or methods.
- A. Temporary erosion and siltation control measures as described herein shall be applied to any erodible material within this project, including local material sources and work areas.
 - B. The Contractor shall be responsible for providing the necessary erosion control measures which are shown on the plans or which may be ordered by the Engineer. All grading operations shall be performed in conformance with the applicable provisions of the "Water Pollution Control and Water Quality Standards" contained in the "Public Health Regulations," State Department of Health.
 - C. The Contractor shall be responsible for promptly (next day after storms) removing all silt and debris resulting from his work and deposited in drainage facilities, roadways, neighboring lands, and other areas.

1.03 RELATED WORK IN OTHER SECTIONS

Site Earthwork..... Section 02210

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Mulches: To be bagasse, hay, straw, fiber mats, netting, wood cellulose, bark, wood chips, or other suitable material acceptable to the Engineer and shall be reasonably clean and free of noxious weeds and deleterious materials.
- B. Slope Drains: To be constructed of fiber mats, plastic sheets, or other materials acceptable to the Engineer.

PART 3 – EXECUTION

3.01 TEMPORARY EROSION CONTROL

- A. The Engineer has the authority to limit the surface area exposed by clearing and grubbing and to limit the surface area exposed by excavation, borrow and fill operations. The Engineer may also direct the Contractor to provide immediate, permanent, or temporary pollution control measures to prevent contamination of streams, lakes, ponds, drainage channels and pipes, roads, neighboring lands, and other areas.

Except for specified measures which may be shown on the plans, the Contractor shall determine the appropriate erosion control measures to use. Such work may involve the construction of temporary berms, dikes, dams, sediment basins, and slope drains, and the use of temporary mulches, mats, and grassing, or the construction and use of other control devices or methods as necessary to control erosion.

- B. The Contractor shall incorporate all erosion control measures shown in the plans. The erosion controls may be modified as necessary to adjust to conditions that develop during construction. All modifications are subject to approval by the Engineer.
- C. The Contractor shall limit the surface area exposed by grubbing, stripping of topsoil, and grading to that which is necessary for him to perform the next operation and which is within his capability and progress in keeping the finish grading, mulching, grassing, and other such pollution control measures current.

The grubbing of the vegetative root mat and stumps and the stripping of topsoil shall be confined within the limits of grading which can be actively and continuously prosecuted within 15 calendar days. The area to be graded shall be limited to the minimum area necessary to accommodate the Contractor's equipment and work force and shall not at any time exceed 15 acres, unless otherwise stated on plans, without prior approval of the Engineer.

Any area remaining bared or cleared for more than 10 calendar days and which is not within the limits of active construction shall be immediately hydro-mulch seeded or remedied as directed by the Engineer at the Contractor's expense without cost to the Department. All areas where finish grading has been completed shall be grassed within three calendar days after the completion of grading for that area.

- D. The Contractor shall, at the end of each work operation in any one day, shape the earthwork in such a manner as to control and direct the runoff to minimize the erosion of soils. He shall construct earth berms along the top edges of embankments or along the property line with adjacent properties, streams and water channels, to intercept any runoff. Temporary slope drains shall be provided by carry runoff from the top of cuts and fills. Temporary facilities for controlled discharges shall be provided for runoff impounded, directed, or controlled by project activities or by any erosion control measure employed.

- E. Cut slopes shall be shaped, topsoil added if necessary, and planted as the work progresses. In no case shall the exposed surface be greater than 15 feet in height. Whenever major excavation is suspended or halted and the slope is bared for more than 15 consecutive days, the exposed surfaces shall be hydro-mulch seeded or protected as directed by the Engineer at the Contractor's expense without cost to the Department of Hawaiian Home Lands.

Fill slopes shall be finished as specified and in accordance with the requirements outlined for cut slopes above.

- F. Construction of berms, cofferdams, or other such construction in or near the vicinity of streams, ponds, waterways, or other bodies of water shall be with approved materials.
- G. The temporary erosion and siltation control measures outlined in these specifications are minimum requirements and shall not preclude the provision of any additional measures which the Contractor may deem necessary. Damages caused by the erosion of soils and the pollution of downstream areas shall be the responsibility of the Contractor and all costs for repairing, correcting, replacing and cleaning damaged or polluted facilities shall be borne by the Contractor.

END OF SECTION

SECTION 02485 – PLANTING GRASS

PART 1 – GENERAL

- 1.01 GENERAL CONDITIONS: The General Conditions and Special Provisions preceding these specifications shall govern this section of the work.
- 1.02 WORK INCLUDED: Furnish all labor, materials, tools, equipment and related items necessary to complete hydro-mulching as shown on the plans and specified herein.
- 1.03 RELATED WORK IN OTHER SECTIONS:

Landscape PlantingSection 02950

PART 2 – PRODUCTS

- 2.01 MATERIALS: Materials for planting grass shall be in accordance with the following sections of the Standard Specifications as revised, except as amended on the drawings and/or in the specifications herewith:
- Hydro-Mulch Seeding..... Section 641

PART 3 – EXECUTION

- 3.01 The Contractor shall plant grass by hydro-mulching.
- 3.02 Grass shall be planted in accordance with the sections of the Standard Specifications noted hereinbefore.
- 3.03 Hydro-mulching shall be applied only to slope areas, exclusive of lot pads, swales, benches and road right-of-ways.

END OF SECTION

SECTION 02500 – ROAD PAVEMENT

PART 1 – GENERAL

- 1.01 **GENERAL CONDITIONS:** The General Conditions and Special Provisions preceding these specifications shall govern this section of the work.
- 1.02 **WORK INCLUDED:** Furnish all labor, materials, tools, equipment and related items necessary to complete, in place, asphalt concrete pavement for roads in conformity with the dimensions, profiles, sections and details shown on the plans.
- 1.03 **SUBMITTALS:** The Contractor shall submit for approval, the job mix formula for the Asphalt Concrete to be supplied for the project. The job mix formula shall indicate the source of aggregates and grades of bituminous material to be used in the mix. The total amount of bituminous binder in the mix shall be between 4.5 percent to 8.0 percent by weight depending on the specified Asphalt Concrete Mix. All test data used to develop the job mix formula shall also be submitted. The job mix formula for the mixture shall be in effect until modified in writing by the Engineer. Should a change in sources of materials be made, a new job mix formula shall be established and approved before the new material is used.

The bituminous mixtures shall be designed using procedures contained in Chapter III, Marshall Method of Mix Design, of the Asphalt Institute's Manual Series No. 2 (MS-2), current edition, and shall meet the requirements of Table I below:

TABLE I
REQUIREMENTS FOR MARSHALL METHOD OF MIX DESIGN

Test Property	Mix #2	Mix #3	Mix #4	Mix #5
Number of Blows	75	75	75	75
Stability, lb (minimum number)	2,000	2,000	2,000	2,000
Flow, 0.01 in.	8 - 16	8 - 16	8 - 16	8 - 16
Percent air voids	4 - 6	4 - 6	4 - 6	4 - 6
Percent air voids in mineral aggregate (min.)	13	14	16	18

The job-mix formula for each mixture shall establish a single percentage of aggregate passing each required sieve size and a single percentage of bituminous material to be added to the aggregate.

After the job-mix formula is established, all mixtures furnished for the project shall conform thereto within the following ranges of tolerances in Table II below:

TABLE II
RANGE OF TOLERANCES FOR JOB-MIX FORMULA

Passing No. 4 and larger sieves	± 7 percent
Passing No. 8 to No. 100 sieves (inclusive)	± 4 percent
Passing No. 200 sieve	± 2 percent
Bitumen	± 0.4 percent

Acceptance Sampling and Testing of the Bituminous Mixture.

- A. The Contractor shall provide laboratory testing for control and acceptance functions during periods of mixture productions: One (1) field Marshall Test, asphalt content test, gradation analysis, and specific gravity test for each mixture.
- B. The compacted mixtures of the in-place pavement shall not be less than 91 percent of the specific gravity (ASTM D2041, commonly called the Rice Method) of the combined mixture without voids.
- C. Two (2) core or cut samples per street for the determination of the thickness and density of the completed pavements (or using nuclear gauge for determination of density) shall be obtained and/or tested by the Contractor at no extra cost (including that to restore the affected area). The size and locations of the samples will be directed by the Engineer.
- D. All data for the control and the acceptance testing shall be submitted.

PART 2 – PRODUCTS

- 2.01 **MATERIALS:** Materials for roads shall be in accordance with the following sections of the Standard Specifications, except as amended on the plans and/or in the specifications herewith:

Roadway Excavation.....	Section 203
Aggregate Subbase Course	Section 305
Aggregate Base Course	Section 304
Bituminous Surface Treatments	Section 410
Asphalt Concrete Pavement, Mix No. 3 or 4	Section 401
Standard Street Survey Monuments.....	Section 614

Asphalt cement grade shall be PG 64-16.

PART 3 – EXECUTION

- 3.01 INSTALLATION: Stake out the areas to be paved using wooden stakes on which the final finish elevations, base course and subgrade elevations are clearly marked. All stakes and elevations shall be approved by the Engineer before any work is done.

Contractor shall fine grade the subgrade under the pavement and sidewalk by bringing the subbase or coralline material to the proper grade from the mass grade elevations to the proper shape before installing the base course or concrete sidewalk.

Install roadways in accordance with the applicable sections noted hereinbefore.

- 3.02 COMPACTION TESTING: The Contractor shall notify the Engineer at least 5 days prior to the start of fine grading for the roadway subgrade. Field density tests will be taken on the roadway subgrade, and aggregate base course by the Geotechnical Engineer retained by the Contractor. The Contractor shall be responsible for any corrective measures required as a result of inadequate compaction.

- 3.03 CLEANING OF SURFACES: Immediately before applying the prime coat or tack coat, the surface to be treated shall be swept clean of all loose material, dirt, excess dust or other objectionable material. No application shall be permitted when the surface to be treated is appreciably damp or when weather conditions are unsuitable.

Apply asphalt surface treatments at the rates specified in Section 410 of the Standard Specifications.

- 3.04 ADJUSTMENT OF EXISTING UTILITY STRUCTURES TO FINISHED GRADE: Adjust existing utility structures to finished grade in accordance with the Standard Specifications.

- 3.05 REPAIRS OF EXISTING ASPHALT CONCRETE PAVEMENTS: Repair to the original conditions and to the satisfaction of the Engineer all existing asphaltic concrete pavements that have been damaged by construction activities, including damage done by heavy equipment.

- 3.06 PLACING ASPHALT CONCRETE PAVEMENT: Install asphalt concrete pavement as specified in Section 401 of the Standard Specifications.

END OF SECTION

SECTION 02520 – CONCRETE CURBS, GUTTERS, SIDEWALKS, DRIVEWAY APRONS AND CURB RAMPS

PART 1 – GENERAL

- 1.01 **GENERAL CONDITIONS:** The General Conditions and Special Provisions preceding these specifications shall govern this section of the work.
- 1.02 **WORK INCLUDED:** Furnish all labor, materials, tools, equipment and related items necessary to complete, in place, concrete curbs, gutters, sidewalks, driveway aprons and wheelchair ramps in conformity with the dimensions, profiles, sections and details shown on the plans.
- 1.03 **APPLICABLE SECTIONS:** Work shall be in accordance with the following sections of the Standard Specifications, except as amended on the plans and/or in the specifications herewith:
- | | |
|-------------------------------------|-------------|
| Portland Cement Concrete | Section 411 |
| Curb and/or Gutter | Section 609 |
| Sidewalk..... | Section 608 |
| Reinforced Concrete Driveways | Section 610 |
| Reinforcing Steel..... | Section 602 |

PART 2 – PRODUCTS

- 2.01 **MATERIALS:** Materials shall conform to the sections of the Standard Specifications noted hereinbefore.

PART 3 – EXECUTION

- 3.01 **INSTALLATION:** The Contractor shall be responsible for precisely laying out the curbs, gutters, sidewalks, driveway aprons and curb ramps shown on the contract plans in accordance with the sections of the Standard Specifications noted hereinbefore. The Contractor shall note that the plan and profile curb grades are based on the standard 6-inch high curbs and shall make necessary adjustments for the difference in height of the rolled curb as shown in the DPW Standard Details.
- 3.02 **QUALITY CONTROL FOR CURB RAMPS:** The Contractor shall install curb ramps to the dimensions and grades shown in the plans. Installation of the curb ramps shall be within the tolerance range shown in the table below.

CONSTRUCTION TOLERANCE		
Surface Slope per Plans	Allowable Slope Tolerance	Allowable Flatness Tolerance
Less than 5%	+0.9% max.	1/4" max. gap
5% - 8.3%	+1.2% max.	3/8" max. gap
Greater than 8.3%	+1.5% max.	1/2" max. gap
For Horizontal Plan Measurements, Length of Intended Dimension	Horizontal Tolerance Allowed	
Less than 12"	+1/4" or -1/4"	
12" - 36"	+3/8" or -3/8"	
Greater than 36"	+1/2" or -1/2" in each 10'	

The method of measuring the surface requires a 24" long digital level to be placed so, when set on the measured sloped surface, it reads the steepest slope of any part of the measured surface.

The method of measuring flatness requires a 24" long level to be placed so it is centered over any trough or balanced on a ridge with equal gap at both ends of the level. Measure the gap under the level at troughs and at the end of the level at ridges.

Horizontal measurements are to be made with a steel tape.

- 3.03 **MEASUREMENT AND PAYMENT FOR CURB RAMPS:** Reinforced concrete curb ramps shall be measured for payment by the square foot. Payment of the accepted curb ramps shall be full compensation for excavating, backfilling, installing reinforcing steel, concrete expansion joints, special drop curbs, bed course material, and furnishing all labor, materials, equipment, tools, and incidentals necessary to complete the work.

END OF SECTION

SECTION 02577 - PAVEMENT MARKERS, STRIPING AND MARKINGS

PART 1 - GENERAL

- 1.01 **GENERAL CONDITIONS:** The General Conditions and Special Provisions preceding these specifications shall govern this section of the work.
- 1.02 **WORK INCLUDED:** Furnish all labor, materials and equipment required to accomplish the installation of all pavement markers, reflectorized white and yellow traffic pavement striping and other markings in conformance to the "Manual on Uniform Traffic Control Devices for Streets and Highways," 2009, the "Standard Details for Public Works Construction" of the City & County of Honolulu, September 1984, and these plans and specifications. This work shall also include the removing of existing pavement markers and removing or eradicating of existing pavement striping and markings when called for in the plans and/or directed by the Traffic Engineer.
- 1.03 **SUBMITTALS:** Submit material certifications, test results and brochures for all pavement markers and traffic paint materials to the Traffic Review Branch, Department of Planning and Permitting, City and County of Honolulu. A copy of the submittal shall be submitted to the Engineer.

PART 2 - PRODUCTS

- 2.01 **GENERAL:** Materials shall conform to the requirements of Pavement Markers, Adhesives for Pavement Markers, and Pre-Mixed Reflectorized White and Yellow Traffic Paint, as specified in these specifications.

2.02 MATERIALS

A. Pavement Markers

1. **Description of Markers:** The markers shall have the shape, dimensions and tolerances as shown on the plans. The markers shall be of uniform composition and free from surface irregularities, cracks, checks, chipping and other physical damage interfering with appearance or application.
2. **Type of Markers**
 - a. **Type A - Non-Reflective White Markers and Type J Non-Reflective Yellow Markers.**
 - 1) **Class III Ceramic Type.** For use on Portland cement concrete and asphalt concrete road surfaces.
 - 2) **Class IV Ceramic Type.** For use only on Portland cement concrete road surfaces.
 - 3) **The class of non-reflective white marker to be used shall be at the option of the Contractor, subject to the above limitations.**
 - b. **Type B - Two-Way Clear Reflective Markers**

- c. Type C - Red-Clear Reflective Markers
- d. Type D - Two-Way Yellow Reflective Markers
- e. Type E - Yellow-Clear Reflective Markers
- f. Type G - One-Way Clear Reflective Markers
- g. Type H - One-Way Yellow Reflective Markers

3. Markers

- a. Non-Reflective Markers: Type A and J pavement markers shall have the following characteristics:

- 1) Composition of Markers: The composition of finished markers shall conform to the following: The Class III and IV pavement markers shall consist of a heat-fired, vitreous, ceramic base and a heat-fired, opaque, glazed surface to produce the properties required in these specifications. The markers shall be produced from any suitable combination of intimately mixed clays, shales, talcs, flints, feldspars, or other inorganic material which shall meet the properties herein required. The markers shall be thoroughly and evenly matured and free from defects which affect appearance or serviceability.

- 2) Properties of Markers: The properties of finished markers, Class III and Class IV, shall conform to the following:

- a) Finish: The top surface of the marker shall be convex and the radius of curvature shall be between 3-1/2 inches and 6 inches except that the radius of the 1/2 inch nearest the edge may be less. Any change in curvature shall be gradual. The top and sides shall be smooth and free of mold marks, pits, indentations, air bubbles, or other objectionable marks or discolorations.

The bottoms of the ceramic markers shall be free from gloss or glaze and shall have a number of integrally formed protrusions approximately 0.050 inch projecting from the surface in a uniform pattern of parallel rows.

Each protrusion shall have a face parallel to the bottom of the marker. The area of each parallel face shall be between 0.01 and 0.065 square inches and the combined area of these faces shall be between 2.2 and 4.4 square inches.

The protrusions shall be circular in section.

The number of protrusions should be not less than 48 nor more than 200.

To facilitate forming and mold release, the sides of each protrusion may be tapered. This taper shall not exceed 15 degrees from perpendicular to the marker bottom. Markers manufactured with protrusions whose diameter is less than 0.15 inch may have an additional taper not exceeding 30 degrees from perpendicular to the marker bottom and extending not more than one-half the total height of the protrusion.

The overall height of the marker shall be between 0.68 to 0.80 inch.

- b) Glaze Thickness: The thickness of the glazed surface shall be not less than 0.007 inch at any point located more than 1/4 inch from the edge of the marker circumference. The glaze thickness shall be measured on a fractured edge with a calibrated reticle of a microscope of at least 25 power.
- c) Moh Hardness: The glazed surface of the marker shall have a hardness of a 6 minimum in the Moh hardness scale. This shall be determined relative to the mineral orthoclase which has a hardness of 6. With moderate hand pressure, it must be possible to scratch orthoclase with the marker but not possible to scratch the marker with the orthoclase.
- d) Directional Reflectance (Type A markers only): The 45°, 0° directional reflectance of the marker when tested in accordance with ASTM E97, shall have the following values:

Glazed Surface	75 minimum
Body of Marker.....	65 minimum

The test on the glazed surface shall be made on the top of the convex surface of the marker. The test on the body of the marker shall be made on a flat surface of the marker from which the glaze has been removed by grinding with carborundum wheel.

- e) Yellowness Index (Type A markers only): The yellowness index of the marker when tested in accordance with ASTM E313 shall have the following values:

Glazed Surface	0.07 maximum
Body of Marker.....	0.12 maximum

The test on the glazed surface shall be made on the top of the convex surface of the marker. The test on the body of the marker shall be made on a flat surface of the marker from which the glaze has been removed by grinding with a carborundum wheel.

- f) Color (Type J markers only): The chromaticity of the glazed surface of the marker shall be within the following limits:

Purity76 to 96 percent

Dominant Wave Length.....579 to 585 mu

Total Luminous Reflectance
(Y value) 0.41 minimum

Chromaticity measurements shall be made in accordance with California Test Method No. 660.

- g) Water Absorption: The average water absorption of the ceramic marker when tested in accordance with ASTM C373 shall not exceed 2.0 percent of the dry weight of the test piece.

- h) Autoclave Test: The glazed surface of the marker shall not craze, spall or peel when subjected to one cycle at 100 psi for one hour of the autoclave test when tested in accordance with ASTM C424.

- i) Strength Test: A random sample of five markers of each type and/or class used will be selected for the load test. Each Class III marker shall support a minimum load of 1,500 pounds and each Class IV marker shall support a minimum load of 750 pounds when the load is applied in the following manner: The base of the marker shall be made flat using plaster of paris or some other suitable material. Sufficient amount of material shall be applied to the base of the marker to fill the spaces around the protrusions up to the faces of the protrusions. The protrusions shall not protrude from the prepared finished base. The prepared marker shall be centered, base down, over the open end of a vertically positioned hollow metal cylinder. The cylinder shall be 1-inch high, with an internal diameter of 3 inches and a wall thickness of 1/4 inch. A load necessary to break the marker shall be applied at a speed of 0.2 inch per minute to the top of the marker through a 1-inch diameter solid metal cylinder centered on the top of the marker. Failure shall consist of a breakage of the marker at a load of

less than 1,500 pounds when applied to Class III markers or less than 750 pounds when applied to Class IV markers.

- j) Sampling: Twenty markers selected at random will constitute a representative sample for each batch consisting of 10,000 markers or less. Forty markers will constitute a representative sample for lots consisting of more than 10,000 markers. The lot size shall not exceed 25,000 markers. However, if a batch represents less than 100 markers, the Engineer may delete sampling and may accept the markers based on certification of compliance and certified test results.

- k) Tolerances

- (1) Three test specimens shall be randomly selected from the sample for each test except as noted in (i) above, and tested for compliance in accordance with these specifications. Should any one of the specimens fail to comply with the requirements of these specifications, additional samples consisting of double the number of samples originally taken will be tested. The failure of any one of these additional samples shall be cause for rejection of the entire lot or shipment represented by the sample.

- (2) At the discretion of the Engineer, a resample may be taken consisting of double the number of samples originally taken. Tolerances for resamples shall be in the same ratio as specified above

- l) Packaging: Shipments shall be made in containers which are acceptable to common carriers and packaged in such a manner as to insure delivery in perfect condition. Any damaged shipments shall be replaced by the Contractor. Each package shall be clearly marked as to the name of the manufacturer, type, color, quantity enclosed, lot and/or batch number, and date of manufacture.

- b. Reflective Pavement Markers: Reflective pavement markers shall be of the prismatic reflector type consisting of a methyl methacrylate or suitably compounded acrylonitrile butadiene styrene (ABS) shell filled with a mixture of an inert thermosetting compound and filler material. The exterior surface of the shell shall be smooth and contain

one or two methyl methacrylate prismatic reflector faces of the color specified.

The reflective lens shall not contain any voids or air space, and the back of the lens shall be metallized.

The shell shall be fabricated in a manner that will provide a mechanical interlock between the thermosetting compound and the shell. The thermosetting compound shall bond directly to the backside of the metallized lens surface.

The base of the marker shall be flat (the deviation from a flat surface shall not exceed 0.050 inch), rough textured and free from gloss or substances which may reduce its bond to the adhesive. The presence of a soft or resin-rich film on the surface of the base will be cause for rejection.

Reflective markers shall conform to the following requirements:

- 1) **Optical Performance:** The specific intensity of each reflective surface, when tested at 0.2 degrees angle of divergence, shall not be less than the following specified values:

Specific Intensity			
	Clear	Yellow	Red
0° Incidence Angle	3.0	1.5	0.75
20° Incidence Angle	1.2	0.60	0.30

NOTE:

- a) **Angle of Incidence.** The angle formed by a ray from the light source to the marker and the normal to the leading edge of the marker face.
- b) **Angle of Divergence.** The angle formed by a ray from the light source to the marker and the returned ray from the marker to the measuring receptor.
- c) **Specific Intensity.** The mean candle power of the reflected light at a given incidence and divergence angle for each foot candle at the reflector on a plane perpendicular to the incidence light.

$$\frac{(R_L)(D^2)}{I_L} SI =$$

Where: SI = Specific Intensity

R_L = Reflected Light

I_L = Incident Light

D = Test Distance

- d) **Test Method:** The markers to be tested shall be located with the center of the reflecting face at a distance of 5 feet from a uniformly bright light source having an effective diameter of 0.2 inch. The photocell receptor width shall be 0.05 inch and shall be shielded to eliminate stray light. The distance from the center of the light source aperture to the center of the photocell shall be 0.21 inch. If a test distance of other than 5 feet is used, the source and receptor shall be modified in the same proportion as the test distance.
- 2) **Color:** The color of the reflectors when illuminated by an automobile headlight shall be an approved clear, yellow or red color as required. Off-color reflection will constitute grounds for rejection.
- 3) **Strength Requirements:** A random sample of 3 markers shall be selected for the load test. The marker shall support a minimum load of 2,000 pounds as applied in the following manner: The marker shall be centered, base down, over the open end of a vertically positioned hollow metal cylinder. The cylinder shall be 1-inch high, with an internal diameter of 3 inches and a wall thickness of 1/4 inch. A load necessary to break the marker shall be applied at a speed of 0.2 inch per minute to the top of the marker through a 1-inch diameter solid metal cylinder centered on the top of the marker. Failure shall consist of either:
 - a) breakage or significant deformation of the marker at load of less than 2,000 pounds, or
 - b) significant delamination of the shell and the filler material regardless of the load required to break the marker.
- 4) **Sampling:** Six markers will be selected at random from each batch for testing. However, if a batch represents less than 100 markers, the Traffic Engineer may delete sampling and may accept the markers based on certification of compliance and certified test results.

- 5) Tolerances: Should any one of the samples selected for strength testing fail to comply with the strength requirements of these specifications, six (6) additional samples will be tested. The failure of any of these additional six (6) samples will be cause for rejection of the entire lot or shipment represented by the samples.
- 6) Packaging: Shipments shall be made in containers which are acceptable to common carriers and packaged in such a manner as to insure delivery in perfect condition. Any damaged shipments shall be replaced by the Contractor. Each package shall be clearly marked as to the name of the manufacturer, color, type, lot number, quantity enclosed, and date of manufacture.

B. Adhesive for Pavement Markers

1. General: The adhesives shall be furnished as two components. The adhesives are described as Standard Set Type and Rapid Set Type.

All adhesives shall have a white A epoxy component and a black B curing agent component, each packaged separately. The mixing ratio of Component A to Component B shall be one-to-one by volume. The color of the material when mixed shall be approximately that of Color Nos. 26132 to 21652 of Federal Standard No. 595-A. The Standard Set Type is a compositional specification, together with test requirements. The Rapid Set Type is based on laboratory test requirements only. No volatile solvents or thinners shall be present in the epoxy adhesives requirements.

2. Properties of the Adhesives: The adhesive shall have the following properties:

- a. Pot Life: The pot life shall be 12 minutes maximum and 7 minutes minimum for Standard Set Type and 5 minutes minimum for Rapid Set Type when tested as follows at 77°F ± 3°F: Mix equal volumes of Components A and B in an 8-ounce, unwaxed paper cut 2 inches ± 1/4 inch at base to give a 170 grams ± 10 grams total mass. Mix 60 seconds ± 5 seconds before timing for pot life. Test with a tongue depressor with minimum stirring. Record the time the material becomes unusable as the pot life. With most materials this shall be approximately the time a hard lump forms in the center.

- b. Shear Strength: When tested as follows, the shear strength shall be not less than 1,000 psi for Standard Set Type and 900 psi for Rapid Set Type.

Bond three concrete blocks 2 inch x 3-1/2 inch x 7 inch of 7-sack concrete together with the 7-inch sides parallel forming two areas of contact 3-1/2 inch x 3-1/2 inch by overlapping the blocks. The test specimen then has a base of two blocks and a second surface formed by the center block. Apply the adhesive to the contact surfaces and allow to cure for 24 hours at 77°F ± 3°F. Cap the base

of the specimen with an approved capping compound and test at a load rate of 10,000 pounds per minute. A swivel type head must be used at the top of the testing press. Computations are based on a total area of 24.5 square inches (shear strength = total load/24.5).

- c. Viscosity: The viscosity of each component when measured in a three-fourths filled standard round quart paint can shall be between 1.0×10^5 and 3.0×10^5 centipoises for Standard Set Type and 0.8×10^5 and 2.2×10^5 centipoises for Rapid Set Type when measured as follows: Stir the components vigorously for 30 seconds with a spatula. Remove entrained air by vigorously tamping and measure viscosity within 10 minutes after stirring. Use Brookfield Viscometer, Model RVT at 5.0 RPM with a Model C Brookfield Helipath Stand and Helipath TD Spindle having a crossarm length of 0.804 inch for Standard Set Type and T.E. Spindle for Rapid Set Type. Use weight included in spindle set. Component and ambient temperature is to be $77^\circ\text{F} \pm 3^\circ\text{F}$ at time of measurement. Reading shall be taken at approximately the center of the vertical travel of the spindle.

- d. Viscosity--Shear Ratio:

$$\frac{\text{Viscosity at 0.5 RPM}}{\text{Viscosity at 2.5 RPM}}$$

This ratio shall be 2.0 minimum for Standard Set Type and 1.8 minimum for Rapid Set Type for Component A and 1.9 minimum for Component B. Take the above viscosities at the same time and conditions as in subsection (C) above.

- e. Bond Strength

- 1) Clean a 4 inch x 4 inch area on a flat surface of a concrete block made with 7-sack concrete and having a tensile strength in excess of 250 psi.
- 2) Use the equipment and load described in California Test Method No. 420. Condition test equipment, concrete and epoxy at test temperature for 24 hours before test.
- 3) Mix adhesive on a tin plate with a trowel or spatula for 60 seconds ± 5 seconds. Immediately start timing, place adhesive on pipe cap and press firmly in place on concrete. Just before the required test time, insert the dynamometer hook into pipe cap.
- 4) After curing 3-1/3 hours for Standard Set Type and 25 minutes for Rapid Set Type at $77^\circ\text{F} \pm 3^\circ\text{F}$ measured from the end of the mixing period, the bond strength shall be at least 200 psi.

- f. Weight per Gallon, Pounds at $77^\circ\text{F} \pm 3^\circ\text{F}$ (Standard Set Type).

Component A 11.5 - 11.8

Component B 11.7 - 12.1

Composition:

STANDARD SET TYPE	
Component A	Parts by Weight
Epoxy Resin ¹	100
Titanium Dioxide, TT-P-422, Type III or IV	7.31
Resin Grade Asbestos ²	5.00
Talc ³	37.64
Component B	
N-Aminoethyl Piperazine ¹	23.16
Nonylphenol ⁵	52.00
Carbon Black, TT-P-343, Form 1, Class B	0.22
Talc ³	77.37
Resin Grade Asbestos ²	1.00

¹Viscosity, 5-7 poises at 25°C; epoxide equivalent 175-195; Color (Gardner), 5 maximum; manufactured from epichlorohydrin and bisphenol A. The reactive diluent shall be butyl glycidyl ether.

²Specific gravity, grams per ml., 2.45; moisture content, % by weight, 2.0 maximum; surface area, square meters per gram, 60 approximately; reflectance, G.E. brightness, 72-76; nature of surface charge, electropositive (cationic); Ph in water, 9.5; bulking value, gallons per 100 lbs., 4.8; oil absorption (DOP), pound per 100 lbs., 120; refractive index, n_D 25°C, 1.54-1.56; wet bulk density in water, after dispersion, 2 grams per liter, settling after 1 hr., 100 ml. clear maximum; dry bulk density, pounds per cubic foot, 4.

³Percent passing U. S. No. 325 sieve, 94-96; maximum particle size, 70 microns, oil absorption (Gardner-Coleman), 6-7 ml. per 20 grams; fineness in oil (Hegman) 1-2; specific surface, 0.5-0.6 square meter per gram; consistency (40% suspension in linseed oil) 55-60 KU.

⁴Color (ALPHA) 50 maximum; amine value 1250-1350 based on titration which reacts with the three nitrogens in the molecule; appearance clear and substantially free of suspended matter.

⁵Color (ALPHA) 50 maximum; hydroxyl number 245-255; distillation range, °C at 760 mm first drop 295 minimum, 5% 298 minimum, 95% 325 maximum; water, % (K.F.) 0.05 maximum.

g. Directions for use

Any settling of fillers or pigments in Components A or B shall be completely redispersed to provide a homogeneous mix before the components are used. Just before use, Components A and B shall be mixed in a one-to-one ratio by volume.

When the Rapid Set Type adhesive is used, the components shall be mixed by a 2-component type automatic mixing and extrusion apparatus. The temperature of the Rapid Set Type adhesive shall be maintained at 65°F to 85°F before mixing. The temperature of the Standard Set Type adhesive shall be maintained at 60°F to 100°F before mixing. Any heating of epoxy adhesive shall be done by the application of indirect heat.

Packaging and Labeling of Adhesive: Each adhesive component shall be packaged in containers not larger than 5 gallons in volume. The containers shall be new steel, not less than No. 24 gage and shall otherwise meet Interstate Commerce shipping standards. Each container shall be clearly labeled with designation (Component A or B), type (Standard or Rapid Set), manufacturer's name, date of manufacture, batch number (a batch shall consist of a single charge of all components in a mixing chamber), directions for mixing, and the following warning:

CAUTION

This material will cause severe dermatitis if it is allowed to come in contact with the skin or eyes. Use gloves and protective creams on the hands. Should this material contact the skin, wash thoroughly with soap and water. Do not attempt to remove this material from the skin with solvents. If any gets in the eyes, flush for 10 minutes with water and secure immediate medical attention.

Sampling: One quart sample of each of the components (A and B) from each batch will be sampled for testing.

Certification: The Contractor shall submit to the Engineer a certificate of compliance indicating that all types of adhesives conform to the requirements of the specifications.

C. Pre-Mixed Reflectorized White and Yellow Traffic Paint

1. General: Qualification of Reflectorized Traffic Paint: Only those traffic paints which have qualified in the latest completed prequalification tests conducted by the State Department of Transportation and having a Weighted Rating (W) of at least 6.5 for reflectorized white and 7.0 for reflectorized yellow at the completion of the road test will be permitted for use on this project. Quick dry paints shall not be used.

The phrase "latest completed prequalification tests" shall mean either those traffic paints which have been prequalified by the State Department of Transportation at the time this contract becomes effective or those traffic paints which have been listed by the State Department of Transportation as meeting the prequalification tests of the State Department of Transportation at the time the Contractor is doing pavement striping. The Traffic Engineer will furnish a list of prequalified traffic paints upon the request of the Contractor.

The Contractor may use other materials designed for pavement striping, such as adhesive striping, on temporary detours with the approval of the Traffic Engineer. Such materials shall meet the color and reflection requirements for traffic paints.

2. Pre-Mixed Reflectorized White and Yellow Traffic Paint

- a. General: The pre-mixed reflectorized white and yellow traffic paints shall be composed of a pigment binder and glass spheres and shall be suitable for use as traffic markings on concrete, bituminous macadam and asphalt concrete pavements. These paints shall be ready for use without any subsequent addition of glass spheres or solvent. The white paint shall be pure white and free from tint. The yellow paint shall be within the green and red tolerance limits when compared with U. S. Federal Highways Administration's "Standard Color Chips for Highways Signs."

The term "pre-mixed reflectorized" shall refer to the finished mixture of pigmented binder and glass spheres. The terms "pre-mixed compound" and "compound" shall mean the same thing. The term "binder" shall refer to the pigment and vehicle alone (not including glass spheres). The term "spheres" shall refer only to the glass spheres incorporated in the compound.

The pre-mixed reflectorized white and yellow traffic paints shall be mixed at the factory ready for immediate application, using spray machines without thinning, at the normal rate of application used for these purposes by the Department of Transportation Services.

The traffic paints shall be well-ground and mixed. The paints shall not exhibit any characteristics of skinning, settling, thickening, or living. The paints shall be readily mixed to a uniform consistency, capable of being applied through the spray machine without clogging or causing other operational difficulties. The mixing of the paint shall be performed in the normal manner followed by the Department of Transportation Services.

The paint shall be capable of drying to an elastic adherent finish and shall not show appreciable discoloration with age. The volatile material shall have a minimum solvent action on asphalt and be of such character that any gums and nonvolatile components of the vehicle will entirely dissolve therein and not precipitate from the

solution on standing. The paints shall be of such quality that a dry film thereof will not darken or otherwise discolor excessively when exposed to sunlight.

- b. Tests: In addition to the above-mentioned requirements, the pre-mixed reflectorized white and yellow traffic paints shall conform to the following requirements:
- 1) Composition: The composition, formulation, and milling of the paints shall in all respect be identical to the sample and manufacturer's certificate of formulation thereof submitted in accordance with the Department of Transportation Services' requirements.
 - 2) Consistency: This test shall be performed in accordance with ASTM D562. The paint, as received, shall have a consistency as determined by the Stormer Viscosimeter and expressed as Krebs units at 77°F between 75 and 90.
 - 3) Wet Hiding Power: When applied with a 0.008 inch Bird Film Applicator on Standard Mores Black and White Hiding Power Chart, Form 05, as supplied by the Leneta Company, P. O. Box 86, Ho-ho-kus, New Jersey 07423, the paint shall completely hide black.
 - 4) No Pickup Time: The paint shall be tested in accordance with ASTM D711, except that the wet film shall be applied to the glass with a 0.005 inch Bird Film Applicator. The drying time for no pickup shall be not less than 5 minutes or more than 40 minutes.)
 - 5) Chemical Analysis: The Department of Transportation Services shall have the option to perform a chemical analysis of said paints to determine if the paints conform with the manufacturer's certificate of formulation and that they are identical with the sample of paint submitted for prequalification test under the latest "Notice to Prospective Bidders for Furnishing Traffic Paint." (The Department of Transportation Services retains the right to check formulation by any approved method.
 - 6) Weight per Gallon: The paint supplied by the successful bidder shall be within ± 0.5 Department of Transportation Services prior to installation of materials.
 - 7) Glass Spheres: The glass spheres used in the compound shall be colorless, clean and transparent, free from milkiness and air bubbles. Not more than 20 percent of the glass spheres shall be irregular or fused spheroids when tested in accordance with the method used by the Department of Transportation Services.

- 8) Glass Spheres Content: There shall not be less than 4.00 pounds of glass spheres per gallon of finished pre-mixed reflectorized traffic paint.
- 9) Gradation of Spheres: Glass spheres shall meet the following gradation when tested in accordance with ASTM D1214, using U. S. Standard Sieves:

Sieve Size	Percent Passing
#40	100
#50	90 - 100
#100	20 -75
#200	0 - 15

- c. Packing: Marking and Batching: The paints shall be delivered in clean open-head steel drums. Each container shall bear a label with the following information shown thereon: Name and address of the manufacturer, shipping point, trademark or trade name, kind of paint, formula, number of gallons, date of manufacture and batch number.

All paint pails shall have a positive and permanent seal.

- d. Sampling and Testing: The Contractor shall furnish paint samples from each paint batch to an independent testing laboratory. At least two samples from each batch consisting of one quart each in sealed containers will be used for testing.

No paint shall be used or paid for except as authorized by the Traffic Engineer until laboratory tests (excluding the laboratory test for settling) are completed, or if the paint fails to meet the requirements of these specifications.

D. Preformed Pavement Markings

1. General: The preformed pavement marking tape shall consist of a film with glass beads on a conformable backing precoated with a pressure sensitive adhesive. The tape shall be capable of being adhered to asphalt concrete or Portland cement concrete without the use of heat, solvents or other additional adhesive means, and shall be immediately ready for traffic after application.

The size, quality and refractive index of the glass beads shall be such that the performance requirements as specified herein are met. The beads shall not be easily removed when the material surface is scratched with a thumbnail.

The preformed pavement marking tape shall contain selected pigments blended to provide standard highway colors of white or yellow. The tape shall maintain a uniform color under both daylight and night lighting conditions throughout its expected life.

Preformed works and symbols shall conform to the applicable shapes and sizes outlined in the latest edition of the FHWA publication, "Manual on Uniform Traffic Control Devices for Streets and Highways" (MUTCD), as amended.

When stored in a cool, dry area indoors, the tape shall be suitable for use a minimum of one year after the date of purchase.

2. Classification: Preformed pavement marking tape shall be of various types and compositions and for applications as specified as follows:
 - a. Temporary Preformed Pavement Marking Tape: Temporary tape shall be capable of performing for the duration of a normal construction period and shall then be capable of being removed intact or in large pieces.
 - b. Permanent Preformed Pavement Marking Tape
 - 1) Type I permanent tape shall be durable and capable of performing as specified herein when subjected to a high traffic volume and severe wear conditions such as repeated shear action from crossover and stop, start, or turn movements. Removal should not be easy.
 - 2) Type II permanent tape shall be used for highway edge of pavement lines. The tape shall be capable of performing satisfactorily when subjected to low traffic volumes, less severe wear action than for Type I, and primarily free rolling traffic.
 - 3) Type III permanent tape shall be used for symbols, legends and intersection markings such as stopbars and crosswalks in areas of high wear or as needed.
3. Reflectance: The films shall have the following initial minimum reflectance value of 0.2 degree and 0.5 degree observation angles and at an entrance angle of 86 degrees as measured in accordance with the testing procedure of Federal Test Method Standard 370. The photometric quantity to be measured shall be specific luminance (SL), and shall be expressed as millicandelas per square foot per foot candle (mcd/ft.²/fc).

INITIAL MINIMUM REFLECTANCE VALUE

		Specific Luminance (mcd/ft. ² /fc)			
		White		Yellow	
Observation Angle Classification		0.26°	0.5°	0.2°	0.5°
Temporary		1770	1270	1310	810
Permanent	Type I	550	380	410	250

	Type II	960	760	680	510
	Type III	550	380	410	250

The sample size shall be 2.0 feet x 2.5 feet and the test distance shall be 50 feet. The angular aperture of both the photoreceptor and light projector shall be 6 minutes of arc. The reference center shall be the geometric center of the sample, and the reference axis shall be taken perpendicular to the test sample.

4. **Skid Resistance:** The surface of the preformed pavement marking tapes shall provide an initial minimum skid resistance value of 45 BPN when tested in accordance with ASTM E303.
5. **Temporary Preformed Pavement Marking Tape**

- a. **Composition:** The tape shall be a highly reflective, conformable, pliant polymer material intended for marking applications where removability is required.

The tape shall consist of a mixture of high quality polymer materials and pigments and shall not contain metallic foil. Glass beads shall be distributed throughout the pigmented area and in a reflective layer bonded to the top surface. The performance of the glass beads shall meet the durability and reflectance criteria specified herein.

The tape shall be reinforced with a non-metallic medium and shall be precoated with a pressure sensitive adhesive.

The tape shall be capable of adhering to roadway surfaces under climatic and traffic conditions normally encountered in the construction work zone. Newly applied tape shall be capable of being immediately exposed to traffic without pickup or distortion by vehicles.

- b. **Thickness:** The film without adhesive shall have a minimum thickness of 0.03 inch (0.76 mm).
- c. **Removability:** The tape shall be removable from asphalt cement concrete or Portland cement concrete, either manually or with a roll-up device, at temperatures about 40°F (4°C), and without the use of heat, solvents, grinding or sandblasting. The tape shall meet this requirement even after traffic exposure on transverse applications in accordance with the following:
 - 1) Time in place - 632 days
 - 2) ADT per lane - 9,000 (23% trucks, 3.5 axles/unit)
 - 3) Minimum axle hits - 13,000,000

6. **Permanent Preformed Pavement Marking Tape**

- a. **Type I**

- 1) **Composition:** Tape shall consist of a mixture of high quality polymeric materials, pigments and glass beads, with a reflective layer of beads bonded to the top surface.
- 2) **Thickness:** The film without adhesive shall have a minimum thickness of 0.06 inch (1.52 mm).
- 3) **Conformability and Patchability:** The tape shall be conformable to pavement contours, breaks, faults, etc., through the action of traffic at normal pavement temperatures. Worn or missing areas shall be repairable with butt spliced patches of the same material.
- 4) **Tensile Strength and Elongation:** The tape shall have a minimum tensile strength of 40 pounds per square inch and minimum elongation of 75 percent at break when tested in accordance with ASTM D638. The sample size shall be 6 inches x 1 inch and shall be tested at a temperature between 70°F and 80°F with a jaw speed of 10 to 12 inches per minute.
- 5) **Reflectivity Retention:** Glass beads shall be strongly bonded and not easily removed by traffic. The tape shall be tested for reflectivity retention as follows:
 - (a) A sample 2 inches x 6 inches shall be bent around a 1/2-inch diameter mandrel with the 2-inch dimension perpendicular to the mandrel axis. Examination of the area with 5x magnifier shall show less than 10 percent of the beads with 40 percent or less embedment in the binder.
 - (b) **Taber Abraser Simulation Test:** Using a Taber Abraser with an H-18 wheel and a 125 gram load, a sample shall be tested for 200 cycles and then inspected with a magnifier of 5-power or larger.

No more than 15 percent of the beads shall be lost due to popout and bead erosion shall be the major mode of failure.
- 6) **Effective Performance:** The tape shall be neat and durable and shall not flow or distort due to temperature or vehicle impacts. The pliant polymer shall provide a cushioned, resilient substrate that shall reduce bead crushing and loss for the life of the marking. The film shall be weather resistant and shall show no appreciable fading, lifting or shrinkage throughout its usage. The tape shall show no significant tearing, roll back, or other signs of poor adhesion during its useful life which shall be a minimum of one year from the date of installation.

Immediately after application, the tape shall be capable of being impacted by vehicles without being picked up or distorted.

b. Type II

- 1) Composition: The retroreflective pavement marking material shall consist of glass beads embedded in a white or yellow film with a thin, flexible conformable backing which is precoated with a pressure sensitive adhesive.
- 2) Thickness: The film with adhesive shall have a minimum thickness of 0.025 inch (0.64 mm).
- 3) Abrasive Resistance: Samples of test material shall not wear through to the conformable backing surface in less than 400 cycles when tested in accordance to Federal Test Method Standard 141, Method 6192, except using an H-22 wheel and a 250 gm load.
- 4) Acid Resistance: The beads shall show resistance to etching, hazing or delamination of bead surface after exposure to a 1 percent solution of sulfuric acid. The test shall be performed as follows:

Soak one gram of beads in 100 cc of a 1 percent H_2SO_4 solution for 100 hours. Then decant the acid solution and dry the beads at 100°C. Microscopic examination of a sample of the beads shall show no more than 5 percent of the beads altered by the acid.
- 5) Reflectivity Retention: The requirements shall be as described in 6.a.5).
- 6) Effective Performance: The requirements shall be as described in 6.a.6).

c. Type III

- 1) Composition: The retroreflective pavement marking film shall consist of a mixture of high quality polymeric materials, pigments and glass beads distributed throughout its base cross sectional area, with a reflective layer of beads bonded to the top urethane wear surface. The edges of the preformed tape shall be clean cut and true.
- 2) Thickness: The film without adhesive shall have a minimum thickness of 0.06 inch (1.52 mm).
- 3) Conformability and Patchability: The tape shall be conformable to pavement contours, breaks, faults, etc., and

worn or missing areas shall be reparable with the same materials in accordance with the manufacturer's instructions.

- 4) **Tensile Strength and Elongation.** The material shall have a minimum tensile strength of 350 pounds per square inch and a minimum elongation of 50 percent at break when tested in accordance to the provisions of ASTM D638. The sample size shall be 6 inches x 1 inch and shall be tested between 70-80°F with a jaw speed of 10 to 12 inches per minute.

- 5) **Reflectivity Retention:** The glass beads shall be strongly bonded and not be easily removed by traffic wear.

The predominant mode of failure shall be "wear down" of the beads at 200 cycles when no more than 15 percent of the beads shall be lost due to popout using a Taber Abraser with an H-18 wheel and a 125 gram load.

- 6) **Glass Bead Retention:** When a 2-inch x 6-inch (5.08 x 15.24 cm) sample is bent over a 1/2-inch diameter mandrel (with a 2-inch dimension perpendicular to the mandrel axis), microscopic examination of the area on the mandrel shall show no more than 10 percent of the beads with entrapment by the binder of less than 40 percent.

- 7) **Installation:** The markings shall be applied and tamped in accordance with the manufacturer's recommendations.

E. Reflective Thermoplastic Compound Pavement Markings

1. **General:** Reflective thermoplastic compound pavement markings shall be a substance, free of volatiles, which is machine applied to the pavement surface in a hot molten state and which, after cooling to the ambient temperature, and without polymerization or other chemical change, forms a traffic marking stripe of the quality and appearance as specified herein.

The material used shall be a product especially compounded for traffic markings.

The installed stripe shall not be slippery when wet.

The compound shall not deteriorate by contact with sodium chloride, calcium chloride, oil content of pavement materials, or from oil droppings from traffic.

In the plastic state, the material shall not give off fumes which are toxic or otherwise injurious to persons or property. The material shall not break down or deteriorate if held at the plastic temperature for a period of 4 hours, or by reason of four reheatings to the plastic temperature.

There shall be no obvious change in color of the material as a result of up to four reheatings, or from batch to batch.

To insure the best possible adhesion, the compound shall be installed in a melted state of a minimum temperature of 375°F, and the material shall not scorch or discolor if kept at temperatures between 380°F to 450°F for up to 4 hours.

The pigmented binder shall be well-dispersed and free from all skins, dirt, foreign objects, or such ingredients as will cause bleeding, staining, or discoloration.

After application and proper drying time, the material shall show no appreciable deformation or discoloration under local traffic conditions, and in an air and/or road temperature ranging from 0° to 120°F.

Under this specification, the term "drying time" shall be defined as the minimum elapsed time, after application, when the stripe shall have and retain the characteristics required by the preceding sections. In addition, the drying time shall be established by the minimum elapsed time after application, after which normal local traffic will leave no impression or imprint on the applied marking.

The drying time shall not exceed a characteristic straight line curve, the lower limits of which are 2 minutes at 50°F, the upper limits of which are 15 minutes of 90°F, both temperatures measured at a maximum relative humidity of 70 percent.

The stripe shall maintain its original dimensions and placement. The exposed surface shall be free from tack. Cold ductility of the material shall be such as to permit normal movement with the road surface without chipping.

The marking shall have a uniform cross section. Pigment shall be evenly dispersed throughout the material. The density and character of the material shall be uniform throughout its thickness.

The material shall not smear or spread under normal traffic conditions at temperatures below 120°F.

The filler to be incorporated with the resins or binders shall be a white calcium carbonate or equivalent filler.

The white thermoplastic shall have a pigment containing not less than 6 percent per Titanium Dioxide, and, after setting, shall be pure white, free from dirt or tint.

Yellow reflectorized thermoplastic compound shall be "Federal Yellow."

The binder shall consist of a mixture of non-drying synthetic resins at least one of which is solid at room temperature. The total binder content of the thermoplastic compound shall be not less than 15 percent nor more than 35 percent by weight.

The material shall not change in its color and brightness characteristics after prolonged exposure to sunlight.

During manufacture, reflectorizing beads shall be mixed into the material to the extent of not less than 20 percent nor more than 50 percent by weight of the material. The beads that are applied to the surface of the material shall be automatically applied at a uniform rate of approximately 3 pounds of glass beads to every 100 square feet of line.

The glass beads used in the formulation shall have a refractive index of not less than 1.51 when tested by the liquid immersion method at 25°C; shall consist of 70 percent min. by count of true spheres; shall be free from air inclusions; and shall have the following gradation:

U. S. Sieve Number	Percent Passing
30	90-100
40	35 - 100
100	0-10

Not less than 70 percent of the spheres shall meet the following requirements:

- a. The surface of the spheres shall be smooth, lustrous, and free from film scratch and pits.
- b. The spheres shall be clear and transparent and shall not be ovoid in shape or fused spheroids.
- c. The spheres shall show high autocollimating efficiency. Not more than 1 percent shall be black, amber, or milky.

The glass beads dropped on the applied marking shall have a refractive index of not less than 1.51 when tested by the liquid immersion method of 25°C, shall consist of 70 percent min. by count of true spheres; shall be free from air inclusion; and shall have the following gradation:

U. S. Sieve Number	Percent Passing
20	90-100
80	0-10

Not less than 70 percent of the spheres shall meet the following requirements:

- a. The surface of the spheres shall be smooth, lustrous, and free from film scratch and pits.

- b. The spheres shall be clear and transparent and shall not be ovoid in shape or fused spheroids.
- c. The spheres shall show high autocollimating efficiency. Not more than 1 percent shall be black, amber, or milky.

2. Specifications and Tests

a. Color

- 1) White: Initially white; as demonstrated by a standard color difference meter such as the Gardner Color Difference Meter manufactured by Gardner Laboratories, Inc., Bethesda, Maryland, the material shall show deviations from a magnesium oxide standard not greater than the following:

Scale Definition	Mag Oxide Standard Sample	
Rd Reflectance	100	70 minimum
a Redness-Greenness	0	-5 to +5
b Yellowness-Blueness	0	-10 to +10

- 2) Yellow: Initially yellow; equal to standard color chips using Federal test method standard 141 Method 4252.

- b. Color Retention: The retention of the initial color shall be determined as follows: Specimens shall be prepared and tested from the samples submitted in accordance with ASTM D620-57T, "Tentative Method of Test for Colorfastness of Plastics." The ultraviolet light source shall be as specified from the test procedure or optionally may be a General Electric 275 watt sunlamp bulb, type RS, with built-in reflector. After 100 hours of exposure, specimens shall show no perceptible color change when compared visually with an unexposed specimen.
- c. Water Absorption: Material shall have not more than 0.5 percent by weight of retained water, when tested by ASTM D570, procedure a.
- d. Softening Point: Material shall have a softening point of not less than 90°C, as determined by ASTM E28.
- e. Specific Gravity: Specific gravity of compound at 25°C shall be from 1.9 to 2.5.
- f. Impact Resistance: The impact resistance shall not be less than 15 inch-pounds at 77°F after the material has been heated for 4 hours at 400°F and cast into bars of 1-inch cross sectional area and 3 inches long and placed with 1-inch extending above the vise in a

cantilever beam (Izod Type) tester using the 25-inch pound scale. See ASTM D256 for description of this instrument.

- g. **Bond Strength:** When two concrete blocks 2 inches by 3-1/2 inches by 7 inches are cemented together on the 3-1/2 inch by 7-inch faces with a 1/16 to 1/8-inch layer of the thermoplastic traffic line material and tested according to ASTM C321, the bond strength shall not be less than 150 pounds square inch.
- h. **Indentation Resistance:** The reading of the Shore Durometer, Type A, as described in ASTM D2240 after 15 seconds shall not be less than the amounts herein designated when the material is tested after heating for 4 hours at 400°F, and cooled to the following temperatures:

Temperature	Reading
115°F	65
77°F	95
40°F	95

- 3. **Packaging:** Each unit container shall be clearly and adequately marked to indicate the color of the material, the process batch number or similar manufacturer's identification, the manufacturer's name and location of plant, and the date of manufacture.

The material shall be delivered to a designated area in unit containers as processed by the manufacturer. Each unit container when filled shall weigh no less than 24 lbs. or more than 52 lbs.

- 4. **Warranty:** Thermoplastic compound pavement marking material furnished and installed under this specification shall be guaranteed by the Contractor against failure due to poor adhesion resulting from defective materials or methods of application.

For approved pavements carrying 30,000 vehicles per day or less, the successful bidder shall guarantee to replace, without cost to the City, that part of the pavement markings installed under this contract which, in the opinion of the Engineer, has not remained to perform useful service as follows:

- a. **Crosswalks and Stop Lines:**

90 percent of the total of any one intersection for one year.

75 percent of the total of any one intersection for 2 years.

50 percent of the total of any one intersection for less than 3 years.

b. Lane Lines, Edge Lines, and Center Lines:

90 percent of a unit for one year.

80 percent of a unit for 2 years.

60 percent of a unit for 3 years.

(A "Unit" is defined as any length of highway having installed thereon 2,000 lineal feet of line of specified width in any combination or pattern.)

The replacement material installed under this guarantee shall be guaranteed the same as the original material, from the date of the original installation.

5. Equipment: The material shall be applied to the pavement by an extrusion method wherein one side of the shaping die is the pavement and the other three sides are part of the equipment.

The equipment shall provide continuous mixing and agitation of the material. Conveying parts of the equipment shall be constructed to pavement accumulation and clogging. All parts of the equipment which come in contact with the material shall be easily accessible and exposable for cleaning and maintenance.

All mixing and conveying parts including the shaping die shall maintain the material at the plastic temperature.

The equipment shall assure continuous uniformity in the dimensions of the stripe. The thickness of the material on the pavement shall be no less than 3/32 inch and no more than 3/16 inch measured as an average in any 3-foot length.

The applicator shall cleanly cut off square stripe ends and shall be capable of applying "skip" lines. The use of pans, aprons or similar appliances which the die overruns will not be permitted.

Beads applied to the surface of the completed stripe shall be applied by an automatic bead dispenser attached to the liner in such a manner that the beads are dispensed almost instantly upon the completed line. The bead dispenser shall be equipped with an automatic cutoff control synchronized with the cutoff of the thermoplastic material.

The equipment shall be constructed to provide for varying die widths to produce varying widths of traffic markings.

A special kettle shall be provided for melting and heating the composition. The kettle shall be equipped with an automatic thermostatic control device so that heating can be done by controlled heat transfer liquid rather than direct flame, to provide positive temperature control and prevent overheating of the composition.

The applicator and kettle must be equipped and arranged to satisfy the requirements of the National Fire Underwriters.

The applicator shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc.

The applicator shall be capable of containing a minimum of 125 pounds of molten material.

6. Application: The Contractor shall clean off dirt, blaze, paint, tape and grease where necessary and as directed by the Engineer.

The material may be installed in variable widths from 2 inches to 12 inches.

On pavements containing less than 6 percent bituminous asphalt and on all concrete pavements, the Contractor shall prestripe the application area with a binder material as recommended by the manufacturer.

The compound shall be installed in a melted state at temperatures of 380°F to 450°F.

The minimum installed thickness of the line as viewed from a lateral cross section shall be not less than 3/32nds of an inch at the edges, nor less than 1/8th of an inch in the center. The measures shall be taken as an average throughout any 36-inch section of the line.

The new line when applied over an old line of compatible material shall bond itself to the old line in such a manner that no splitting or separation takes place during its useful life.

The finished lines shall have well-defined edges and be free of waviness.

PART 3 - EXECUTION

- 3.01 **GENERAL:** Pavement markers and markings shall be applied to surfaces that have been thoroughly cleaned and are free of dirt, dust, curing compound, grease, oil, moisture, loose aggregates, unsound layers and any other material which would adversely affect the bond of the adhesive or paint.

In the installation of pavement markers, the cleaning of Portland cement concrete and asphalt concrete surfaces shall be by blast cleaning. Clean, newly placed asphalt concrete need not be blast cleaned unless the surface contains an abnormal amount of asphalt or the surface is contaminated with dirt, grease, oil or any other material which would adversely affect bonding.

Unless otherwise specified, the Contractor shall establish control points, satisfactory to the Traffic Engineer, spaced at intervals that will insure accurate location of pavement markers and striping. Markers, paints and tape shall not be applied when moisture or foreign matter is present on the pavement surface or when wind conditions are such as to cause dust to be deposited on the prepared areas or to prevent satisfactory application of the marker adhesive or paint.

The Contractor shall paint temporary guidelines and outline of arrows, legends and crosswalks with a 2-inch wide brushed line on the day the roadway is opened to traffic which shall be approved by the Traffic Engineer before permanent lines are painted.

The Contractor shall furnish and place all warning and directional signs necessary to direct and control the traffic during marker installation or the striping operations. Warning signs shall be set up before the beginning of each operation and extra signs shall be kept well ahead of the marking or painting equipment.

The Contractor shall install all markers and apply all pavement striping before opening roadways to public traffic except that when connections to existing pavements are made or when temporary detours carry public traffic, the Contractor shall mark or stripe the connecting pavements on the day that the roadway is open to traffic.

If it is necessary to run public traffic over roadways soon after paving, the Contractor shall paint, on the day of each day's paving, temporary guide dashes at the traffic stripe or marker location on the pavement, as guidance for drivers, until the permanent markings can be placed. The Contractor shall maintain and repaint, if necessary, all temporary markings until the permanent striping and/or markers are installed. This work shall be considered incidental to the items of paving, pavement markers and/or pavement striping, and no separate payment will be made therefor.

Permanent pavement markers, striping and markings shall be applied no sooner than 7 calendar days nor later than 14 calendar days after completion of the pavement.

- 3.02 **PAVEMENT MARKERS:** Unless otherwise ordered in writing by the Traffic Engineer, markers shall be cemented to the pavement with Standard Set Type adhesive. If ordered by the Traffic Engineer, the Contractor shall use Rapid Set Type adhesive for the Standard Set Type adhesive at no extra cost to the City.

If the Contractor uses Rapid Set Type adhesive, he shall submit samples of the markers and Rapid Set Type adhesive proposed for use to the Traffic Engineer, for testing and approval, at least 10 days before the date of its intended use.

The adhesive shall be placed uniformly on the cleaned pavement surface or on the bottom of the marker in a quantity sufficient to result in complete coverage of the area of contact of the marker with no voids present and with a slight excess after the marker has been pressed in place. The marker shall be placed in position and pressure applied until firm contact is made with the pavement. Excess adhesive around the edge of the marker, excess adhesive on the pavement, and adhesive on the exposed surfaces of the markers shall be immediately removed. Soft rags moistened with mineral spirits conforming to Federal Specification TT-T-291E or kerosene may be used, if necessary, to remove adhesive from exposed faces of pavement markers. No other solvent shall be used. The marker shall be protected against impact until the adhesive has hardened to the degree designated by the Traffic Engineer.

The adhesive requires that the mixing operation and placing of the markers be done rapidly. When hand mixing or machine mixing the Standard Set Type adhesive, all markers shall be aligned and pressed into place within 5 minutes after mixing is started. When hand mixing Standard Set Type adhesive, not more than one quart shall be mixed at one time. Any mixed batch which becomes viscous so that the adhesive cannot be readily extruded from under the marker on application of slight pressure shall not be used.

When the Rapid Set Type adhesive is used, the components shall be mixed by a two component type automatic mixing and extrusion apparatus, the markers shall be placed within 60 seconds after the adhesive has been mixed and extruded and no further movement of the marker will be allowed.

Automatic mixing equipment for the epoxy adhesive shall use positive displacement pumps and shall properly meter the components in the specific ratio, ± 5 percent by volume of either component. At the beginning of each day and at any other time ordered by the Traffic Engineer, the ratio shall be checked by the Contractor in the presence of the Traffic Engineer. This check shall be made by disconnecting the mixing heads, or using suitable bypass valves, and filling two suitable containers with the unmixed components. The mixing head shall properly mix two components so that there is no trace of black or white streaks in the mixed material.

The Standard Set Type adhesive shall not be used when either the pavement or the air temperature is less than 50°F. The Rapid Set Type adhesive shall not be used when either the pavement or the air temperature is less than 30°F. No markers shall be installed if the relative humidity of the air is greater than 80 percent or if the pavement is not surface dry. The Traffic Engineer shall be the judge as to when the adhesive has set sufficiently to bear traffic. The following table may be used as a guide; however, the times shown may vary, depending upon field conditions:

TIME TO BEAR TRAFFIC		
Temperature* (°F)	Standard Set Type (Hours)	Rapid Set Type (Minutes)
100	1-1/2	15
90	2	20
80	3	25
70	4	30
60	5	35
50	7	45
40	No Application Below 50°F	65
30		85
		No Application Below °F

*The temperature indicated is either pavement surface or air temperature, whichever is lower. The hardness of the rim of epoxy around the marker shall not be used as an indication of the degree of cure of the epoxy under the marker.

Types A and J pavement markers that are used to delineate 10-foot lane stripes shall be installed in sets of four markers as called for on the plans. Installation of fractional sets (i. e., one, two or three markers) will not be permitted. The length of the 10-foot stripe and 30-foot gap may vary ± 1 foot to properly distribute the spacing of stripes.

No pavement markers shall be installed over longitudinal or transverse joints of the pavement surface.

- 3.03 **PAVEMENT STRIPING AND MARKINGS:** Pavement striping and markings shall be of the length, width and placement specified and shall conform to the Department of Transportation Services' Standards.

Traffic paint shall be applied at a nominal film thickness of 0.015 inch, utilizing a wheeled, hand or self-propelled applicator machine. The traffic paint applicator machine shall have appropriate shields of nozzle controls which will permit sharp pavement stripe definition. The traffic paint applicator machine shall have an air stream nozzle which can direct compressed air immediately before the area of paint application for the purpose of cleaning the pavement prior to paint application.

Pavement arrows, legends, and crosswalks shall be applied with appropriate templates (refer to "Traffic Standards Manual" of the Department of Transportation Services, dated July 1976).

No stripe shall be less than the specified width. No stripe shall exceed the specified width by more than 1/2 inch. The length of the 10-foot painted segment for skip stripe may vary ± 1 foot and the 30-foot gap between segments may vary ± 1 foot. The alignment of the stripe shall not deviate from the intended alignment by more than 1 inch on tangents and on curves up to and including one degree. On curves exceeding one degree, the alignment of the stripe shall not deviate from the intended alignment by more than 2 inches.

When necessary to correct a deviation which exceeds the permissible tolerance in alignment, that portion of the stripe so affected shall be removed plus an additional 30 feet in each direction, and a new stripe then provided in accordance with these specifications.

All stripes, segments of stripes and markings shall present a clean cut, uniform appearance. All striping and markings which fail to meet the requirements specified herein, or are marred or damaged by traffic or from other causes, shall be corrected prior to acceptance by the City at the Contractor's expense. All misted areas, dripped and spattered paint shall be removed to the satisfaction of the Engineer.

The freshly painted stripe shall be protected by cones or other satisfactory devices until the traffic paint is dry and will not transfer to car tires. All stripes damaged by traffic, or pavements marked by traffic crossing wet paint, shall be repaired or corrected as specified below.

The Contractor shall submit to the Traffic Engineer test specimens as requested. Test films shall be applied to a suitable plane rigid surface. The area shall be of sufficient size to permit film thickness measurement to be made at least 1 inch from any edge.

- 3.04 **REMOVING EXISTING PAVEMENT MARKERS, STRIPING AND MARKINGS:** Existing pavement markers shall be removed by methods that cause the least possible damage to the pavement or surfacing.

Where specified on the plans and/or directed by the Traffic Engineer, existing pavement striping and markings shall be removed to the fullest extent possible by methods that will not materially damage the surface or texture of the pavement, or leave impressions on the roadway that could be confused with permanent striping during inclement weather or night

driving conditions. Any damage to the pavement or surfacing caused by the removal operations shall be repaired by the Contractor at his expense by methods acceptable to the Traffic Engineer.

Painting over the existing striping and markings will not be permitted. Burning off existing striping and markings will be permitted using an approved method using excess oxygen.

Sand or other material deposited on the pavement as a result of removing pavement markers, traffic striping and markings shall be removed as the work progresses. Accumulation of sand or other material which may constitute a hazard to traffic will not be permitted.

Extraneous traffic striping and markings shall be removed before any change is made in the traffic pattern.

- 3.05 PREFORMED PAVEMENT MARKING TAPE: Preformed pavement marking tape may be applied manually or with the tape applicators approved by the tape manufacturer. All markings shall be applied in accordance with the tape manufacturer's recommendations and as specified herein.

The Contractor shall install permanent preformed pavement marking tape only at the locations shown on the plans and as specified herein.

Preformed pavement marking tape shall not be applied over other markings or old paint. The Contractor shall remove all old markings and otherwise prepare the surface for tape application as specified.

The minimum temperatures for the application of preformed pavement marking tape shall be 60° (15°C) for air and 70°F (21°C) for roadway surfaces, with both temperatures rising. The maximum temperature shall be 150° (66°C) for roadway surfaces.

The Contractor shall prime existing roadway surfaces with an approved primer immediately prior to the application of permanent preformed pavement marking tape. The Contractor shall apply the primer as recommended by the tape manufacturer and as directed by the Engineer.

The Contractor may use tapes of different widths to form a specified stripe width (i. e., two 4-inch wide tapes may be used to form an 8-inch wide stripe); however, 12-inch wide stripe shall be of a single width and payment shall be made for the specified stripe width as shown on the plans and called for in the proposal.

The Contractor shall use butt splices only and shall not overlap the tape material.

All markings shall be thoroughly tamped with approved mechanical tampers. Additionally, the Contractor shall slowly drive on the newly applied markings several times with a truck.

All areas marked with preformed pavement marking tape shall be ready for traffic immediately after application.

- 3.06 REMOVAL OF TEMPORARY TAPE TRAFFIC MARKINGS: The Contractor shall remove all temporary tape striping placed to delineate traffic lanes, crosswalks, stop bars, etc., prior to the laydown of the finish asphalt concrete mix #4 layer.

- 3.07 METHOD OF MEASUREMENT: Pavement markings, including lane striping, will not be measured.

Pavement markers will not be measured.

Crosswalk markings will be measured as complete units of painted crosswalk marking as indicated on the plans and in the proposal.

Pavement arrows, legends and words will be measured as complete units of the type and design specified on the plans and in the proposal.

- 3.08 BASIS OF PAYMENT: The accepted quantities of the various types of pavement markers will be paid for as part of the linear foot quantity of the appropriate pavement striping complete in place. The price includes full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved, in furnishing and placing pavement markers complete in place, as shown on the plans, as specified herein or as directed by the Engineer.

Pavement striping, including pavement markings such as stop lines (or stop bars), will be paid for at the lump sum price bid in the proposal which price shall be full compensation for furnishing all labor, materials, tools, equipment and incidentals and for doing all the work involved in furnishing and installing traffic pavement striping complete in place as shown on the plans, including the removal of existing extraneous paint or paint stripe, as specified herein or as directed by the Engineer.

The quantity of pavement striping noted in the proposal is based on the striping plan. If the completed work deviates from the striping plan, the unit price for the adjusted striping work will be determined by dividing the lump sum price bid in the proposal by the quantity noted in the proposal. The lump sum price bid will be adjusted by the amount determined by multiplying the above unit price by the length of striping added or deleted. The adjusted striping work will be measured as follows: pavement stripes 12 inches or less in width (including between line spacing) will be measured as a single stripe; pavement stripes over 12 inches wide will be measured as two stripes; and the unpainted spaces, up to 25 feet, between painted stripe segments will be included in the measurement.

The accepted quantities of crosswalk markings will be paid for at the contract unit price per each thermoplastic or taped crosswalk marking as indicated on the plans and in the proposal, in place complete.

The accepted quantities of pavement arrows, legend and words will be paid for at the contract unit price per each as indicated in the proposal, in place complete.

The contract price shall be full compensation for furnishing all labor, materials, tools, equipment and incidentals and for doing all the work involved as shown on the plans, as specified herein or as directed by the Engineer.

Removal of existing pavement markings and markers shall be considered incidental to the various payment items.

END OF SECTION

SECTION 02713 – POTABLE WATER SYSTEM

PART 1 – GENERAL

- 1.01 GENERAL CONDITIONS: The General Conditions and Special Provisions preceding these specifications shall govern this section of the work.
- 1.02 WORK INCLUDED: Furnish all labor, materials, tools, equipment and related items necessary to complete, in place, the potable water system in conformity with the dimensions, profiles, sections, and details shown on the plans. Work shall be governed by the Water System Standards, Board of Water Supply, City and County of Honolulu, et al., State of Hawaii, 2002," hereinafter referred to as the BWS Standards.

PART 2 – PRODUCTS

- 2.01 MATERIALS: All materials shall conform to the BWS Standards. Water mains shall be polyvinyl chloride (PVC), Class 150, plastic pipe conforming to AWWA C900. Fittings shall be Class 350 ductile iron with mechanical joints. Gate valves shall be cast iron, Class 150, with mechanical joints. Fire hydrants shall be wet-barrel type. Laterals shall be copper, Types A and C-1, as shown on the plans.

PART 3 – EXECUTION

- 3.01 INSTALLATION: The installation, testing, disinfection and acceptance of water lines shall be governed by the BWS Standards.

The Contractor shall be responsible for precisely laying out the various utility lines shown on the contract plans as provided elsewhere in these specifications. The location shown on the contract plans of the various existing utility lines which the new lines are to cross over or under or connect to were determined on the basis of the best information available; however, no assurance can be provided that the actual locations will be precisely as shown on the contract plans.

In performing all work, the Contractor shall exercise due care and caution necessary to avoid any damage to and impairment in the use of any existing utility lines. Any damage inflicted on existing lines resulting from the Contractor's operations shall be immediately repaired and restored as directed by the Engineer at the Contractor's expense.

Connections to or the lowering or relocation of existing mains shall be done by the Contractor in accordance with the BWS Standards. The Contractor shall furnish all necessary pipe, fittings, appurtenances and other incidental materials.

Trenching, pipe cushion and backfilling for the water main shall be in accordance with the BWS Standards.

The Contractor shall coordinate the connection of the new water line with the Engineer. The Contractor shall inform the Engineer a minimum of one week prior to the date of the actual connection. The inverts shown on the plans are approximate only, and the Contractor shall adjust the slope of the new water line as necessary to construct a fully functional and acceptable system. The Contractor shall ensure that all piping, fittings, materials, tools, equipment and incidentals are at the site and ready for connection.

END OF SECTION

SECTION 02721 – STORM DRAINAGE SYSTEM

PART 1 – GENERAL

- 1.01 GENERAL CONDITIONS: The General Conditions and Special Provisions preceding these specifications shall govern this section of the work.
- 1.02 WORK INCLUDED: Furnish all labor, materials, tools, equipment and related items necessary to complete, in place, the storm drainage system including, catch basins, storm drain manholes, drain inlets, swales, drainage ditches and detention basin in conformity with the dimensions, sections, and details shown on the plans. Work relating to the storm drain system shall be governed by the Hawaii Standard Specifications for Road, Bridge, and Public Works Construction 1994, State of Hawaii and these Technical Specifications.
- 1.03 CONTRACTOR SUBMITTALS: Shop drawings shall be submitted for drain inlet grating.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Materials for the storm drainage system shall be in accordance with the sections of the Standard Specifications noted hereinbefore.

Portland Cement Concrete	Section 411
Concrete Structures	Section 503
Structural Concrete	Section 601
Reinforcing Steel	Section 602
Culverts and Storm Drains	Section 603
Manholes, Inlets and Catch Basins	Section 604
Fences	Section 607

PART 3 – EXECUTION

- 3.01 INSTALLATION: Install the storm drainage system in accordance with the sections of the Standard Specifications noted hereinbefore.
- 3.02 The Contractor shall be responsible for precisely laying out the catch basin and drain inlet locations shown on the contract plans. The location shown on the contract plans of the various existing utility lines which the new lines are to cross over or under or connect to were determined on the basis of the best information available; however, no assurance can be provided that the actual locations will be precisely as shown on the contract plans.
- 3.03 In performing all work, the Contractor shall exercise due care and caution necessary to avoid any damage to and impairment in the use of any existing utility lines. Any damage inflicted on existing lines resulting from the Contractor's operations shall be immediately repaired and restored as directed by the Engineer at the Contractor's expense.

END OF SECTION

SECTION 02722 – UNDERGROUND DETENTION SYSTEM

PART 1 – GENERAL

1.01 GENERAL CONDITIONS:

- A. These specifications provide minimum performance criteria for the underground detention system required for the project.
- B. The plans and specifications utilized the proprietary “CUDO Stormwater Systems product for the design and permitting process, however, the Contractor may use another product that meets the project requirements.
- C. Minimum drainage criteria is as follows:
 - 1. Q_{50} (in) = 18.44 cfs (minimum);
 - 2. Q_{50} (out) = 8.6 cfs (or less); and
 - 3. Detention Volume = 23,400 cu-ft (or more).
- D. Other requirements:
 - 1. The required physical footprint of the product used shall not impact other associated improvements of the project.
 - 2. If another product is proposed by the Contractor, the following shall be submitted for review and approval by the Owner’s representative.
 - a. Identification of all variances of the proposed product from these specifications;
 - b. Approval of any special permits required in addition to those already obtained for the project; and
 - c. Certification by a professional engineer, licensed in the State of Hawaii that the product proposed is equal to or better than the CUDO Stormwater System product and meets all other project requirements.

1.02 WORK INCLUDED:

- A. Provide excavation and base preparation per Geotechnical Engineer’s recommendations and/or as shown on drawings, to provide adequate support for project design loads and safety from excavation sidewall collapse. See 2.02 Materials.
- B. Provide CUDO Cube modular system products or equal and install per the manufacturer’s instructions.

C. Related Work:

1. Subgrade excavation and preparation under Section 02210 – Site Earthwork.
2. Surface Drainage materials – Section 02721- Storm Drainage System as needed.

1.03 QUALITY ASSURANCE:

- A. Follow Section 01340 and 01750 requirements.
- B. Installation: Performed only by skilled work people with satisfactory record of performance on bulk earthworks, pipe, chamber, or pond/landfill construction projects of comparable size and quality.

1.04 SUBMITTALS:

- A. Submit manufacturer's product data and installation instructions per Section 01340. Drawings to be furnished by Contractor.
- B. Submit CUDO Cube module or equal for review. Reviewed and accepted samples will be returned to the Contractor.
- C. Submit material certificates for geotextile, geogrid, base course and backfill materials.

1.05 DELIVERY, STORAGE, AND HANDLING:

- A. Protect CUDO Cube modular system or equal products from damage during delivery, and store under tarp to protect from sunlight when time of delivery to installation exceeds one week. Storage should occur on smooth surfaces, free from dirt, mud and debris.
- B. Handling is to be performed with equipment appropriate to the size (height) of cubes and site conditions, and may include hand, hand cart, forklifts, extension lifts, etc.

1.06 PROJECT CONDITIONS:

- A. Review installation procedures and coordinate CUDO Cube or equal installation with other work affected, such as grading, excavation, utilities, construction access and erosion control to prevent all non-installation related construction traffic over completed CUDO Cube or equal installation, especially with loads greater than design load.
- B. Protect partially completed CUDO Cube or equal installation against damage from other construction traffic when work is in progress and following completion of backfill be establishing a perimeter with highly visible construction tape, fencing, or other means until construction is complete.

- C. Protect adjacent work from damage during CUDO Cube or equal installation.

PART 2 – PRODUCTS

2.01 AVAILABILITY

- A. Manufacturer: CUDO Stormwater Products Inc. – P.O. Box 497 – Occidental CA 95465 (Tel) 877-876-3345. (Fax) 707-876-3346, or equal.

2.02 MATERIALS

- A. Base of Excavation: Shall be smooth, level and free of lumps or debris.
- B. Geotextile: Use non-woven geotextile with weight of at least 4 oz per square yard, appropriate for the soil type and depth conditions. Fabric shall be placed on the floor of the excavation, and the sides and top of the modular system. Equivalent system must use an equivalent geotextile material as recommended by the manufacturer.
- C. CUDO Cube modular units: The CUDO product will arrive on site with the required number of components to complete your project. Those components will consist of (as required) CUDO half cubes, top/bottom grates, stacking couplers, side plugs, and/or lateral connectors. Assembly of the completed CUDO system will be done on site per project specific assembly details with their simple snap together feature, or equal.
- D. Side and Top Backfill: Using structural fill, sand or other free-draining material as specified by the project engineer, backfill the sides of the CUDO system evenly in 12" lifts to minimum of 95% with a mechanical compactor. Bring the backfill to the top of the CUDO system and then continue backfill placement in accordance with the project's specific requirements for the type and location of Geogrid over the top of the CUDO system. Side and top backfill for an equivalent system must meet the manufacturer's criteria and the recommendations of the soils report.
- E. Geogrid: Use Tensar BX-1200 or equivalent to reinforce backfill above CUDO Cubes to support H20 loads (otherwise not required). Geogrid should extend 3 feet beyond the cube footprint. Equivalent system must use an equivalent geogrid as recommended by the manufacturer.
- F. Utility Marker: Use metallic tape at corners of install to mark the area for future utility detection.

PART 3 – EXECUTION

3.01 SITE EXCAVATION

- A. The contractor shall excavate the site to the width, depth and length necessary to accommodate and install the CUDO stormwater system including provisions for cover over the system and depth below the system in accordance with the project engineer's specifications.

- B. Examine prepared excavation for smoothness, compaction and level. Do not start installation of CUDO Cubes until unsatisfactory conditions are corrected. Check for presence of high water table, which must be kept at levels below the bottom of CUDO structure at all times.
- C. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance if existing conditions are found unsatisfactory, contact Project Manager for resolution.

3.02 BASE PREPARATION

- A. Generally a base material of sand or stone should be used and be compacted to 95%. The specific nature of the material will depend upon a myriad of factors, including but not limited to soil reports and end use of system (detention or retention). The base must be finished evenly to provide a level surface for the CUDO installation.
- B. It is helpful to identify the outline of the structure on the floor of the excavation, using spray paint or chalk line, to ensure squareness during cube placement.

3.03 INSTALLATION OF CUDO CUBES

- A. Either a nonwoven filter fabric material or an impermeable liner will be required to surround the perimeter of the CUDO system. Either product shall be laid to the contour of the excavation bottom and side walls with a minimum of 12" overlapping, or as specified by the project engineer.
- B. The assembled CUDO cubes shall be placed on top of the fabric/liner material in accordance with the project's specific layout details. Maintain a level top at all times and keep the units in a straight line in each direction. Complete any inlet/outlet pipe connections in accordance with the project's details. Connect the inspection/cleanout port riser material to the top of the CUDO as shown on the project layout detail. Pull the fabric/liner material taut around the CUDO's to completely seal the system, using duct tape to temporarily secure the material overlaps in place.
- C. Start backfilling with recommended backfill, compacting in 12" maximum lifts. Place backfill carefully to avoid shoving or damaging cubes. Use a powered mechanical compactor to compact backfill on structure sides with care to avoid damage to geotextile or liner.
- D. Backfill above system should be compacted in 6" lifts. When backfill reaches an elevation of 12" above the system, place a layer of geogrid directly over the top of the backfill (required only when there will be traffic loads (H2O loads) above the cubes), extending 3' beyond the cube footprint.

- E. Place sufficient backfill (Section 2.02 E) material over geogrid to ensure support of design loads. Place cover backfill in 6" lifts and compact with vibrating plates or walk behind rollers (do not use drivable rolling compactors) to a minimum of 95% compaction. Take care to place backfill on top of structure to avoid damage to structure, geotextile or liner, using low pressure tire or track vehicles.
- F. Ensure that all unrelated construction traffic be kept away from the limits of excavation until project is complete and final surface materials are in place.
- G. Place surfacing materials, such as groundcovers (no shrubs or trees), or paving materials over the structure with care to avoid displacement of cover fill and damage to surrounding areas.
- H. Installation of an equivalent system must meet all manufacturers' recommendations and requirements of these contract documents.

3.04 CLEANING

- A. Perform cleaning during the installation of work and upon completion of the work. Remove from site all excess materials, debris, and equipment. Repair any damage to adjacent materials and surfaces resulting from installation of this work.

END OF SECTION

SECTION 02731 – SANITARY SEWER SYSTEM

PART 1 – GENERAL

- 1.01 GENERAL CONDITIONS: The General Conditions and Special Provisions preceding these specifications shall govern this section of the work.
- 1.02 WORK INCLUDED: Furnish all labor, materials, tools, equipment and related items necessary to complete, in place, the sewer system in conformity with the dimensions, profiles, sections, and details shown on the plans. Work relating to the storm drain system shall be governed by the following sections of the Hawaii Standard Specifications for Road, Bridge, and Public Works Construction 1994, State of Hawaii:

Sewer System Section 625
Manholes, Inlets and Catch Basins Section 604

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Sewer Pipe: Vitrified Clay Pipe, Extra Strength
- B. Sewer Manholes: As specified in Section 604 – Manholes, Inlets and Catch Basins of the “Standard Specifications.”
- C. Materials for the sewer system shall be in accordance with the sections of the Standard Specifications noted hereinafter.

PART 3 – EXECUTION

- 3.01 INSTALLATION: Install the sewer system in accordance with the sections of the Standard Specifications noted hereinbefore.
- 3.02 The Contractor shall be responsible for precisely laying out the sewer line shown on the contract plans. The location shown on the contract plans of the various existing utility lines which the new lines are to cross over or under or connect to were determined on the basis of the best information available; however, no assurance can be provided that the actual locations will be precisely as shown on the contract plans.
- 3.03 In performing all work, the Contractor shall exercise due care and caution necessary to avoid any damage to and impairment in the use of any existing utility lines. Any damage inflicted on existing lines resulting from the Contractor's operations shall be immediately repaired and restored as directed by the Engineer at the Contractor's expense.

END OF SECTION

SECTION 02840 – TRAFFIC SIGNS

PART 1 – GENERAL

- 1.01 GENERAL CONDITIONS: The General Conditions and Special Provisions preceding these specifications shall govern this section of the work.
- 1.02 WORK INCLUDED: Furnish all labor, materials, tools, equipment and related items necessary to accomplish the installation of all traffic signs as indicated on the plans and specified herein.
- 1.03 SUBMITTALS: A list of component parts indicating the description of each part, the materials from which it has been fabricated (including ASTM numbers where applicable and a statement certifying compliance to the material specification.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Asbestos Prohibition: No asbestos containing materials or equipment shall be used under this section. The Contractor shall ensure that all materials and equipment incorporated in the project are asbestos-free.
- B. Materials shall be in accordance with Section 621 – Traffic Control Signs of the State Standard Specifications, except as shown on the plans or amended in the specifications herewith.

PART 3 – EXECUTION

- 3.01 INSTALLATION: Installation of signs shall be in accordance with Section 621 – Traffic Control Signs of the State Standard Specifications, except as shown on the plans or amended in the specifications herewith.

END OF SECTION

SECTION 02950 – LANDSCAPE PLANTING

PART 1 - GENERAL

1.01 SUMMARY

- A. Provide landscape plantings in the areas shown on the Drawings with plants in a healthy, vigorous growing condition. All work indicated on the Drawings by notes shall be provided whether or not specifically mentioned in this Standard or the Specifications. Any items not specifically shown in the Drawings or specified, but normally required to conform with such intent, are considered part of the work.
- B. The work of this Section includes but is not limited to the following:
 - 1. Pre-planting weed control.
 - 2. Soil preparation.
 - 3. Fine grading.
 - 4. Planting operations.
 - 5. Maintenance.
 - 6. Warranties.

- 1.02 CODES AND STANDARDS: Perform work in accordance with all applicable laws, codes and regulations required by authorities having jurisdiction over such work and provide for all inspections and permits required by Federal, State and local authorities in furnishing, transporting and installing materials.

1.03 SUBMITTALS

- A. Substitutions:
 - 1. If any plant specified is not obtainable, submit a written substitution request to the Architect during the bidding period. This request may present either a different size of the same species or a similar alternate species with the proposed adjustments to the Contract price for each.
 - 2. Substitutions of plant materials will not be permitted unless authorized in writing by the Architect.
- B. Construction Schedule: At the preconstruction meeting, provide a written projected planting schedule noting the estimated completion date, number of working days required and any special coordination requirements.
- C. Selection, Tagging and Ordering Plant Material:
 - 1. Submit documentation to Architect prior to start of work under this Section that all plant material has been ordered.
 - 2. Plants shall be subject to inspection and rejection by Architect at place of growth and after delivery for conformity to specifications.

D. Soil Material:

1. The landscape contractor shall provide an even 4" layer of screened soil material over all new planting areas. The landscape contractor shall be responsible for screening, amending, hauling, and installing the screened soil material over all planting areas on the project site. The landscape contractor shall also be responsible for coordinating placement and fine grading of the soil material with the general contractor.
2. The landscape contractor shall be responsible for submitting a soil analysis of the screened soil material at the beginning of the project for review and approval by the Architect.

E. Delivery Receipts and Invoices: Delivery receipts and copies of invoices for material used will be subject to checking by the Architect and subsequently delivered to the Owner.

1.04 JOB CONDITIONS

A. Acceptance of Previous Work: Inspect and accept the condition of the site relative to this section before commencing with the work covered herein. If not acceptable, notify the Architect in writing. By proceeding with the work under this section, the Contractor indicates his acceptance of all previous related work.

B. Meet on Site: Prior to commencing work, meet with the Architect and all other concerned parties on the site to review the work under this section. Request this meeting one week prior to the desired meeting time.

C. Underground Utilities and Obstructions: Verify the location of all underground utilities and other obstructions that may affect the work. Any obstructions encountered shall be reported to the Architect. Repair all damage to any known utility line or other underground obstruction at Contractor's expense. Report damage to any unknown utilities to the Architect.

D. Protection:

1. Provide necessary safeguards and exercise caution against injury or defacement of existing site improvements. Prevent vehicles of any kind from passing over sidewalks, curbs, etc., unless adequate protection is provided. Do not store materials or equipment, or operate equipment near or under the branches of any existing plants that are to remain, except as actually required for construction in those areas.
2. Be responsible for any damage resulting from landscape planting operations. Repair all damage to return the area to the previous condition at Contractor's expense.

E. Clean Up: Keep all areas of work clean, neat and orderly at all times during the period of Contract. Clean all construction areas at the end of each day.

F. Samples and Test: Architect reserves the right to take and evaluate samples of materials for conformity to Specifications at any time. Furnish samples upon request

by the Architect. Rejected materials shall be immediately removed from the site at Contractor's expense.

G. Pre-maintenance Inspection and Final Inspection:

1. At the completion of all landscape planting operations and prior to the beginning of the formal maintenance period, the pre-maintenance inspection shall be held. At the completion of the formal maintenance period, the final inspection shall be held.
2. Request these inspections of the Architect five (5) working days prior to the completion of work in order that a mutually agreeable time for inspection may be arranged.
3. The Architect, Contractor, and Owner, or their representatives, shall be present at the inspection.
4. At the time of inspection, the Contractor shall have all the areas under the contract free of weeds, dead leaves and trash, neatly cultivated and raked. All stakes, guys and plant basins shall be in good order. At the final inspection, lawns shall be neatly cut and all clippings removed.
5. If, after the pre-maintenance inspection, the Architect and the Owner are of the opinion that all work has been performed in accordance with the drawings and specifications, written notice of preliminary acceptance will be given. This report will note any items which must be corrected and state the date of commencement and completion of the formal maintenance period.
6. If, after the final inspection, the Architect and the Owner are of the opinion that all work has been performed in accordance with the drawings and specifications, written notice of acceptance and completion of the project will be given. If all or certain portions of the work are not acceptable under the terms and intent of the drawings and specifications, a reasonable amount will be retained and the final payment and the formal maintenance period for the unaccepted work and any related items shall be extended at no cost to the Owner until the defects in the work have been corrected and the work is accepted by the Architect and the Owner.

1.05 WARRANTY

A. Plant Material:

1. All plant materials furnished or relocated under this section shall be warranted in writing, for a period of one year from the date of final acceptance against improper installation, defective, unsound or diseased conditions that may appear. The Contractor shall not be responsible for warranty of any plant material subject to relocation onsite for temporary storage.
2. Upon receipt of written notice from the Owner of the death of any warranted plant materials shall be promptly replaced with same species as originally planted, and shall be of a size closely approximating the size of the plant if normal growth had occurred since the original planting. Replacement shall be subject to all requirements of the specifications.

3. When plants are replaced, advise the Owner, in writing, of the necessary establishment maintenance which must be performed. If this information is not provided, the Contractor will be liable for total cost of replacement should the replaced plant die.
4. The Contractor shall guarantee all trees and palms provided under this contract for a period of one year from the date of final acceptance. Immediately replace any plants that decline or die during the warranty period using the same type and size as originally planned.
5. The expense of replacement shall be borne by the Contractor if replacement is necessary during the maintenance period, or shall be evenly shared by the Owner and the Contractor if replacement is necessary after the maintenance period but during the remainder of the warranty period.
6. Contractor shall not be held liable for loss of plant materials after final acceptance due to lack of care, vandalism, acts of God, or accident. The Owner must show that the plants have been maintained properly.

B. Special Warranty:

1. All plant materials furnished under this section shall be warranted as to the species, hybrid, flower color and/or variety specified.
2. If after acceptance of the project, any warranted plant material proves to be of a different species, hybrid, flower color and/or variety not initially determinable, replace that plant with a new plant of the originally specified species, hybrid, flower color and/or variety. The new plant shall be equal in size to that of the incorrect plant at the time of its removal. The new plant shall meet the quality standards, be subject to the warranty, and be installed according to the specifications.
3. There is no time limit to this warranty, although it does not include plants reverting to the general species. The Owner will determine the nonconformance of plant materials, and notify the Landscape Contractor in writing of the required replacement work. All materials and work shall be at the expense of the Landscape Contractor. All work shall be completed within 15 working days from the date of the Owner's letter.

C. Liability: The liability under the warranty shall include the repair of damage to the work of other contractors, or damage to the Owner's property caused by the failure of the work performed under this section. All of the provisions of this section apply to work performed to satisfy the requirements of the warranty.

D. Other Work: All other work shall be warranted for a period of one year from the date of preliminary acceptance.

PART 2 – PRODUCTS

2.01 SCREENED SOIL MATERIAL

A. General:

1. Texture: As near as practical to the native subgrade texture.
2. Nutrients: Provide imported soil with sufficient quantities of available nitrogen, phosphorus, potassium, calcium and magnesium to support normal plant growth or amendable to support normal plant growth according to the soil analysis recommendations.

- B. Natural, fertile, friable soil of loamy character to pass through 1" screen. Free of clay, refuse, branches, stones, noxious seeds, weeds (especially nut grass), roots, subsoil or other material detrimental to normal plant growth.

C. Physical Properties:

1. Designation: Sandy loam or loamy sand, USDA classification of fraction passing sieves.

Class	Particle Size Range	Maximum Percentage	Minimum Percentage
Coarse Sand	0.5-2.0 mm	15	0
Silt plus Clay	<0.05 mm	50	15
Gravel	2-13 mm	20	0
Rock	1/2-1 inch	10% volume	
Organic		15	0

D. Chemistry:

1. Salinity: Saturation Extract Conductivity (ECe), less than 3.0 mmhos. Cm at 25 degrees C.
2. Sodium: Sodium Absorption Rate (SAR), less than 1.0 ppm.
3. Boron: Saturation Extraction Concentration, less than 1.0 ppm.
4. Reaction: pH of saturated paste: 6.0 - 7.0.

- E. Screened soil shall contain sufficient quantities of available nitrogen, phosphorus, potassium, calcium and magnesium to support normal plant growth according to the soil analysis recommendations.

- F. Red Humic latasol soils, or types known as "Palolo Clay" or "Lualualei Clay" or similar materials will be not accepted.

2.02 SOURCE QUALITY CONTROL

Soil Analysis for Imported Soil: Take representative soil samples from the proposed source area. Submit samples to approved soil laboratory for analysis for required fertilizers.

1. Clearly label samples with the project name, date of sampling, sample numbers, and source on site.
2. Perform tests on each individual sample unit for conformance to the specifications, including physical and chemical soil properties (% of sand, silt, and clay and O.M.), pH, soil fertility, and salinity.
3. Provide a written analysis on each individual sample as well as fertility recommendations or corrective measures, if required, to provide the specified turf material a healthy growing medium.

2.03 SOIL & BACKFILL MIXES

- A. Screened soil layer: Provide a 4" layer of screened soil over all new landscaped areas.
- B. Backfill Mix for Trees and Shrubs: Mix thoroughly prior to placing:
4 parts screened topsoil
1 part organic soil conditioner
15 lbs. Gro-Power per cubic yard of mix
- C. Backfill Mix for Single Trunk Palms: Mix thoroughly prior to placing:
3 parts washed sand
1 part organic soil conditioner
15 lbs. Gro-Power per cubic yard of mix

2.04 FERTILIZER

- A. General: N-P-K as recommended by soil analysis, uniform in composition, free-flowing and suitable for application with approved equipment, delivered to the site in unopened containers, each fully labeled, conforming to the applicable fertilizer laws, and bearing the name or mark of the manufacturer.
- B. Plant Tablet: Agriform 21 gram tablet, Woodace 15 gram size or approved equal.
- C. Maintenance Period: 15-15-15 or 16-16-16 or as required by soil analysis recommendations.

2.05 ORGANIC SOIL AMENDMENT

- A. Soil Amendment: Organic non-nutrient soil conditioner shall be "Menehune Magic" as manufactured by Hawaiian Earth Products, (Kapolei, Oahu), Maui "Eco" Compost, "Kellogg's Nitrohumus Soil Conditioner" or approved equal.
- B. Organic nutrient soil conditioners (humus) shall be Gro-Power Plus (5-3-1), Ferto (6-4-2) or approved equal.

- C. Peat Moss: Partially decomposed stems and leaves of moss, free from dirt, salt, coarse roots and other deleterious materials.

2.06 PRE-PLANTING HERBICIDE

Monsanto "Round-Up" or equal.

2.07 PRE-EMERGENT WEED CONTROL

Snapshot, Ronstar-G, Treflan, Eptam, Vegitex or approved equal.

2.08 PLANT MATERIAL

- A. Quantities: Provide sufficient quantities of plant materials needed to complete the work as shown on the planting plans and indicated in the drawings. Quantities indicated on the plant list are approximate only and are provided for the convenience of the Contractor. The planting plans shall have precedence over the plant list.
- B. Nomenclature: Names of plants shall conform with names generally accepted in the local nursery trade, and as interpreted by the Landscape Architect.
- C. Condition:
 - 1. All trees, shrubs, vines and ground covers shall have a normal habit of growth and shall be sound, healthy, vigorous and free from insect infestations.
 - 2. The minimum acceptable size of all trees and shrubs measures after pruning, with branches in normal positions, shall conform to the measurements specified on the plant list.
 - 3. Caliper measurement shall be taken at a point on the trunk 6" above natural ground line for trees up to 4" in caliper and at a point 12" above the natural ground line for trees over 4" in caliper.
 - 4. Plants that meet the measurements specified, but do not possess a normal configuration or balance of height and spread will be rejected.
 - 5. Trees and shrubs larger in size than specified may be used, but the use of larger plant materials will make no change in the Contractor price.
 - 6. Trees and shrubs shall have been grown in containers of the size stated on drawings, and shall have sufficient roots to hold the rootball together after removal from containers without being rootbound.
 - 7. Specimens, field grown and field stock trees shall have a rootball of sufficient size to support the plant's recovery from transplanting. Trees delivered with small or inadequate rootballs will be rejected.
 - 8. Any tree or shrub with weak, thin trunks not capable of supporting itself when planted in the open will be rejected.

9. Trees will be straight and of uniform shape without damaged, crooked, or multiple leaders, unless specified. Trees with abrasions of the bark, sunscalds, disfiguring knots, or fresh cuts of limbs over 1/2" which have not been pruned and painted or completely calloused will be rejected.
10. Sprigs shall be healthy, vegetative material with well-established roots at one or more nodes. Sprigs shall be acquired from a State certified a commercial grass grower. Sprigs shall be cut from a healthy strand of grass, free of weeds and other grasses. The source is to be inspected and approved by the Owner or his representative. Sprigs and stolons are to be delivered and planted on the same day they are harvested to assure optimum rooting. No sprigs or stolons shall be accepted which are not in a cool, moist, fresh condition. If it is impossible to plant sprigs at once, they shall be kept in a cool shady area with air circulation and kept moist.

2.09 WATER AND TEMPORARY AUTOMATIC IRRIGATION

- A. Unless directed otherwise, potable water will be readily available to the Contractor at no expense to the Contractor.
- B. Provide a temporary above-grade automatic system for the duration of the maintenance period and not to exceed one year from acceptance. The temporary automatic irrigation system shall consist of, but is not limited to, the following:
 1. Automatic Irrigation Controller including a minimum of 3 independent programs, 7 day program cycle, and 8 start times per program per day.
 2. Shut off and isolation valves.
 3. PVC or HDPE mainline and distribution lines, inclusive of joint restraint systems if necessary to prevent pipe movement during system operation.
 4. Slow closing remote control valves constructed of glass filled nylon and includes: fabric-reinforced diaphragm, internal screen scrubber mechanism to prevent debris clogging, and pressure regulation.
 5. Gear driven rotor heads with adjustable arc, pressure regulation, and check valves for large radius areas.
 6. Pop-up spray heads with pressure regulation, check valves, and nozzles with matched precipitation rates for small radius areas.
 7. All labor, materials and appurtenances required to install and maintain the temporary irrigation system.
- C. The landscape contractor shall remove the temporary irrigation system in its entirety upon completion of the maintenance period and shall repair any areas damaged during the removal of the temporary irrigation system at no additional cost to the client.

2.10 MISCELLANEOUS MATERIALS

- A. Wood Stakes: 2x2x8 ft. rough construction grade redwood or eucalyptus with no paint or stain.
- B. Hose and Wire Ties: 5/8" diameter 2-ply reinforced rubber garden hose with #12 ga. galvanized iron wire.
- C. Guy Wire: #12 ga. galvanized iron for 15 and 25 gallon trees and palms. #9 ga. galvanized iron for coconut palms and field grown trees.
- D. Rebar: #4 - 24" minimum length for 15 and 25 gallon trees. #7 - 36" minimum length for larger trees.
- E. Marker: Plastic surveyor tape. Bright color, minimum 18" long. Use same color throughout the project.
- F. Filter Fabric: "Poly Filter-x," "Tytar," or approved equal.
- G. Root Barrier: "DeepRoot UB24-2" or approved equal, as manufactured by:

DeepRoot
Contact: Graham Ray, DeepRoot US
graham@deeproot.com
1-800-458-7668

PART 3 - EXECUTION

3.01 CLEARING

- A. Clear all planting areas of existing vegetation not specified to remain and all other debris and foreign material considered a hindrance to planting operations and/or unsightly in appearance.
- B. Maintain previously established grades and swales.

3.02 PRE-PLANTING WEED CONTROL

- A. Apply preplanting herbicide to all visible weeds, before and after soil placement.
- B. Protect all existing plants from damage.
- C. Grass planting shall commence only after 100% control of weeds has been completed and accepted by the Architect.

3.03 SOIL PREPARATION

- A. Provide an even layer of screened soil over all planting areas. Screened soil material shall be amended according to the soil analysis recommendations.
- B. Transport screened soil material to the project site. Place an even 4" layer minimum of screened soil within all new planting areas. Coordinate all work with the general

contractor to insure proper placement of screened soil material and fine grading in relation to the sites overall grading and drainage plan.

- C. Verify locations of all utility lines. Repair any utilities or structures damaged as a result of these operations.

3.04 FINE GRADING

- A. Adjust finish grading with screened soil as necessary. Grades shall be smooth and even on a uniform plane with no abrupt changes or pockets, and shall slope away from all buildings. Verify the surface drainage of all planting areas, and notify the Architect of any discrepancies, obstructions, or other conditions considered detrimental to proper execution of the work.
- B. Landscape work shall be tied to existing conditions and controls such as existing trees and landscape features, utility lines, pavement and curbs, etc. Finished grades shall bear proper relationship to such controls. Adjust all new work as necessary to meet the conditions and fulfill the intention of the drawings.
- C. After initial settlement, the finish grade shall be lower than adjacent pavements and edgings:
 - 1. Bermudas and Seashore Paspalum: ½" through ¾"
 - 2. St. Augustine: ¾" through 1"
 - 3. Shrubs and Ground covers: 1" through 1-1/2"
- D. Immediately prior to planting operations, all planting areas shall be cleaned of weeds, debris, rocks over 1" in diameter, and clumps of earth that will not break up.

3.05 HYDROSEEDING

- A. Areas to be hydroseeded with Seashore Paspalum shall be brought to a smooth even surface according to civil grading plans. Maintain previously established grades and swales.
- B. After ground surfaces have been raked smooth and on an even plane, in accordance to specifications and upon approval by Architect and Owner or his representative, proper soil moisture must be obtained then broadcast seeds uniformly by hand at a minimum rate of 10 pounds per 1,000 square feet.
- C. Determine the proper fertilizer required, for both planting and on-going maintenance, for the plant materials. Determine the quality, analysis and ratio; method of application; and frequency of the fertilizer, to insure sufficient nutrients for the sustained growth of the plant material.

3.06 POST PLANTING FERTILIZATION

- A. 10 to 15 days from sprig installation apply 1 lb. of Actual N using 33-0-0 and/or 45-0-0. Repeat nitrogen application every 5 to 7 days until turf has completely covered the planted area.

- B. After the third application of nitrogen apply a complete fertilizer with a minimum of 2 lbs. of P_2O_5 and a minimum of 2 lbs. of K_2O . When turf has completely covered the area, adjust N-P-K based on tissue and soil test recommendation.
- C. Apply 2 ounces per 1000 SF of SeaQuential Plus Micros every 15 to 20 days 15 days past sprig installation.

3.07 SOIL AND DRAINAGE CONDITIONS

- A. Apply soil retention erosion control fabric on all slopes equal to or greater than 3:1 prior to planting operations.
- B. Notify the Architect in writing of all soil or drainage conditions encountered during planting operations which the Contractor considers detrimental to growth of plant material. Include a cost proposal for the correction of the problem for approval before proceeding with work.
- C. If drainage conditions of plant pits appear unsatisfactory, test drainage by filling with water. Conditions permitting the retention of water in planting the pit for an excessive period of time shall be brought to the attention of the Architect.

3.08 CONCRETE AND PLASTIC HEADERS

Install headers between all groundcover and grass areas where shown. The header shall smoothly follow the finish grade with even radii and straight runs. Headers shall meet walkway edges or other hardscape features at a 90-degree angle (12 inch minimum length) unless otherwise detailed or directed by the Architect.

3.09 PLANTING OPERATIONS

A. Handling Plants:

- 1. Handle plants in a manner to avoid any damage to the plant.
- 2. Protect plants at all times from sun or drying winds. Plants that cannot be planted immediately on delivery shall be kept in the shade, well protected and adequately watered.
- 3. All specimens, field grown and field stock trees shall be planted the same day they are delivered to the site.

- B. Plant Pits: All trees and shrubs shall be installed in round pits with vertical sides, twice the diameter and 1-1/2 times the depth of the rootball or container.

C. Setting Container and Larger Plant:

- 1. Plants shall be centered and set on the appropriate compacted backfill mix that has been puddled and settled.
- 2. Plants shall be set with the soil level even with the finish grade and planted to give the best appearance in relationship to adjacent structure or surroundings.

3. Use appropriate backfill mix to continue filling plant pits. Set plant plumb and brace rigidly in position until backfill mix has been tamped solidly around rootball. When three-fourths of the pit is backfilled, water thoroughly, saturating the rootball.
 4. Evenly distribute planting tablets per manufacturer's instructions. Continue filling pits to finish grade with backfill mix.
 5. When the plant pit is filled, form saucer berm around plants as noted on details.
 6. Water all plants immediately after planting.
- D. Guying: Immediately after planting Guy all trees as detailed. Notify Architect of situations where guying may not be prudent to resolve tolerance and safety considerations.

3.10 GROUND COVER

Install plant material in moist soil in the areas and at the spacings shown, in neat rows, ensuring complete coverage of all planting areas including under and around trees and shrubs. Spacings shown in the plant list or on the drawings are triangular spacing, unless otherwise noted.

3.11 PRE-EMERGENT WEED CONTROL

Immediately after planting, apply pre-emergent weed control "Snapshot" material to all planted areas which will not be seeded.

3.12 PLANTING MAINTENANCE

- A. Maintain all plants and planted areas in optimum growing condition and appearance.
- B. Maintenance, as specified below, shall coincide with the delivery of the first plant materials to the site and shall continue 60 days after commencement of the formal maintenance period or until the approval of the final inspection. Care of plant materials during installation is not considered part of the formal maintenance period.
- C. Maintenance shall include, but is not limited to:
 1. Protect areas susceptible to traffic by erecting barricades immediately after planting.
 2. Irrigate planting areas as required to insure active growth keeping areas moist but not saturated. Regulate irrigation as necessary to avoid erosion and gullyng.
 3. Fertilize all planting areas every four (4) weeks in accordance with the soil analysis recommendations and five (5) days prior to final inspection. Exercise proper caution and take measures necessary to avoid plant burns.
 4. Keep all planting areas free of weeds and undesirable grasses through daily weeding, if required. Remove the entire root system. Dispose of all weeds in

appropriate trash containers. Failure by the contractor to keep planting areas free of weeds during the maintenance period will result in continued extension of the maintenance period until such time as weeds and undesirable grasses have been removed to an acceptable condition by the Architect.

5. Inspect all plants, including lawn, for disease or insect damage weekly. Treat affected material immediately.
6. Remove damaged or diseased growth from trees and shrubs. Treat cuts larger than a 1/2" diameter with specified tree paint.
7. Immediately remove any dead or dying plants not in a vigorous thriving condition. Replacement shall be the same species and size as originally planted.
8. Restake, tighten, repair guys and reset to proper grades or upright position any plants that are not in their proper growing position.
9. As it becomes evident that certain ground covers have not uniformly or properly established, replant the areas immediately with the same plants and quantity as specified for the initial planting and maintain as specified for 90% coverage of healthy, actively growing grass and ground covers for approval during the final inspection.

END OF SECTION 02950

SECTION 02951 – WATER AND TEMPORARY AUTOMATIC IRRIGATION

PART 1 - GENERAL

- 1.01 Unless directed otherwise, potable water will be readily available to the Contractor at no expense to the Contractor.
- 1.02 Provide a temporary above-grade automatic system for the duration of the maintenance period and not to exceed one year from acceptance. The temporary automatic irrigation system shall consist of, but is not limited to, the following:
 - A. Automatic Irrigation Controller including a minimum of 3 independent programs, 7 day program cycle, and 8 start times per program per day.
 - B. Shut off and isolation valves.
 - C. PVC or HDPE mainline and distribution lines, inclusive of joint restraint systems if necessary to prevent pipe movement during system operation.
 - D. Slow closing remote control valves constructed of glass filled nylon and includes: fabric-reinforced diaphragm, internal screen scrubber mechanism to prevent debris clogging, and pressure regulation.
 - E. Gear driven rotor heads with adjustable arc, pressure regulation, and check valves for large radius areas.
 - F. Pop-up spray heads with pressure regulation, check valves, and nozzles with matched precipitation rates for small radius areas.
 - G. All labor, materials and appurtenances required to install and maintain the temporary irrigation system.
- 1.03 The landscape contractor shall remove the temporary irrigation system in its entirety upon completion of the maintenance period and shall repair any areas damaged during the removal of the temporary irrigation system at no additional cost to the client.

END OF SECTION

DIVISION 3 - CONCRETE

SECTION 03300 – CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

- 1.01 GENERAL CONDITIONS: The General Conditions and Special Provisions preceding these specifications shall govern this section of the work.
- 1.02 WORK INCLUDED: Cast-in-place concrete and reinforcing steel for concrete slabs and footings. Work shall be in conformance to Section 411 – Portland Cement Concrete and Section 602 – Reinforcing Steel of the Standard Specifications.
- 1.03 QUALITY ASSURANCE:
- A. Codes: Comply with the provisions of the following codes, specifications and standards, except as otherwise shown or specified.
 - 1. Concrete Reinforcing Steel Institute, "Manual of Standard Practice"
 - 2. ACI 318 "Building Code Requirements for Reinforced Concrete"
 - 3. ACI 304, "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete"
 - 4. ACI 311, "Recommended Practice for Concrete Inspection"
 - B. Concrete Testing Service
 - 1. The Contractor will employ, at his own expense, a testing laboratory experienced in the testing of concrete materials and mixes to perform material evaluation tests. This laboratory shall be the official testing agency for this project.
 - 2. Materials and installed work may require testing and retesting, as directed by the Engineer, at any time during the progress of the work. Allow free access to material stockpiles and facilities at all times. Test, if not the retesting of rejected materials and installed work, shall be done at the Contractor's expense.
 - 3. Tests shall comply with ASTM Standards whenever applicable.

PART 2 – PRODUCTS

2.01 CONCRETE MATERIALS

- A. Portland Cement: ASTM C150, Type I
- B. Aggregates: ASTM C33

1. Fine Aggregates: Clean, Sharp, Natural sand or rock sand as manufactured locally free from loam, clay, lumps or other deleterious substances.
 2. Course Aggregates: Clean, uncoated, processed aggregate containing no clay, mud loam or foreign matter.
- C. Reinforcing:
1. ASTM A615-51, Grade 60
 2. ASTM A185, galvanized welded wire fabric

2.02 CONCRETE ADMIXTURES

- A. Air-Entraining Admixtures: ASTM C260
- B. Water-Reducing Admixtures: ASTM C494, I Type D
- C. Set Control Admixtures: ASTM C494, as follows
1. Type B, retarding
 2. Type D, water-reducing and retarding
- D. Set Control Admixtures: ASTM C494, as follows

2.03 PROPORTIONING AND DESIGN OF MIXES

- A. Prepare design mixes for each type of concrete; 28-day compressive strengths shall be 3,000 psi (Class A); 2,500 psi (Class B); 2,000 psi (Class C) and in the Standard Specifications.
- B. Proportion mixes by either laboratory trial batch or field experience methods, using materials to be employed on the project for each class of concrete required.
- C. Unless otherwise noted, Class A concrete shall be used for all electrical ducts, reaction blocks, slabs and walls; Class B concrete for curb and gutter, and sidewalk applications.

2.04 JOINT MATERIALS

- A. Premolded Joint Fillers: Premolded material of specified thickness composed of fiberboard impregnated with asphalt.
- B. Joint Sealing Compound: Tremco Butyl Sealant or approved equal.
- C. Epoxy-Resin Bonding Agent: Two component, mineral filled epoxy polysulfide polymer complying with FS MMM-G-650, Type I or Type II, Grade A.

2.05 MOISTURE BARRIER: Provide moisture barrier over prepared base material where shown on plans. Use only materials which are resistant to decay when tested in accordance with ASTM E154, as follows: Polyethylene sheet not less than 6 mils thick.

2.06 CURING MATERIALS

A. Curing compounds for membrane curing shall conform to ASTM C309.

B. Liquid Curing - Hardening Compound: Aqueous solution of sodium silicate with non-acid penetrating agent, reacting chemically with free lime in concrete to form a hard, non-dusting surface which will not inhibit bonding with future finishes. Products offered by manufacturers to comply with the requirements for liquid curing hardening compounds include the following:

1. Demicon: Castle Chemical Corp.
2. Eucosil: Euclid Chemical Co.
3. Chem Hard: L&M Construction Chemicals

2.07 EPOXY GROUT: Manufactured grout with built-in bonding material subject to approval of the Engineer.

PART 3 - EXECUTION

3.01 PREPARATION: Pre-Placement Inspection -- Before placing concrete, inspect and complete the formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other crafts involved in ample time to permit the installation of their work; cooperate with other trades in setting such work, as required.

3.02 CONCRETE PLACEMENT

A. General: Place concrete in compliance with the practices and recommendations of ACI 304 and as herein specified.

1. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, provide construction joints as herein specified. Perform concrete placing at such a rate that concrete which is being integrated with fresh concrete is still plastic. Deposit concrete as nearly as practicable to its final location to avoid segregation due to rehandling or flowing. Do not subject concrete to any procedure which will cause segregation.
2. Screen concrete which is to receive other construction to the proper level to avoid excessive skimming or grouting.
3. Do not use concrete which becomes non-plastic and unworkable, or does not meet the required quality control limits, or which has been contaminated by foreign materials. Do not use retempered concrete. Remove rejected concrete from the project site and dispose of it in an acceptable location.

B. Concrete Conveying

1. Handle concrete from the point of delivery and transfer to the concrete conveying equipment and to the locations of final deposit as rapidly as practicable by methods which will prevent segregation and loss of concrete mix materials.
2. Provide mechanical equipment for conveying concrete to ensure a continuous flow of concrete at the delivery end. Provide runways for wheeled concrete conveying equipment from the concrete delivery point to the locations of final deposit. Keep interior surfaces of conveying equipment, including chutes, free of hardened concrete, debris water, and other deleterious materials.

C. Placing Concrete Slabs

1. Deposit and consolidate concrete slabs in a continuous operation, within the limits of construction joints, until the placing of a panel or section is completed.
2. Consolidate concrete during placing operations using mechanical vibrating equipment, so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3. Bring slab surfaces to the correct level with a straightedge and strike off. Use bull floats or darbies to smooth the surface, leaving it free of humps or hollows. Do not sprinkle water on the plastic surface. Do not disturb the slab surfaces prior to beginning finishing operations.
4. Maintain reinforcing steel in the proper position continuously during concrete placement operations.

- D. Dowel installation where shown. Prepare for bonding of dowels and anchors to existing concrete by using drilled holes and a two-component epoxy which is manufactured for this specific purpose. Install in accordance with manufacturer's requirements to develop strength of dowels.

3.03 CONCRETE SLAB FINISHES

Slabs: Finish by tamping the concrete to force aggregate away from the surface and screen at the proper level. Float the surface and lightly trowel. When concrete has set sufficiently to ring under the trowel, give a second troweling to produce a smooth, dense surface free from trowel marks and sweeps, air bubbles or other imperfections of troweling.

3.04 CONCRETE CURING AND PROTECTION

A. General

1. Protect freshly placed concrete from premature drying and excessive cold or hot temperature, and maintain without drying at relatively constant temperature for the period of time necessary for hydration of the cement and proper hardening of the concrete.
2. Start initial curing as soon as free moisture has disappeared from the concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 72 hours.
3. Begin final curing procedures immediately following initial curing and before the concrete has dried. Continue final curing for at least 7 days and in accordance with ACI 301 procedures. Avoid rapid drying at the end of the final curing period.

B. Curing Methods

1. Perform curing of concrete by moist curing, or by moisture retaining cover curing, by membrane curing, or by combinations thereof, as herein specified for a continuous period of 14 days.
2. Liquid Curing-Hardening Compound: Apply to horizontal surfaces when concrete is dry to touch by means of power spray, hand spray, or hair broom in accordance with manufacturer's directions.

C. Curing Unformed Surfaces

1. Initially cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by moist curing, whenever possible.
2. Moist cure surfaces to receive fluid applied waterproof membranes and composition flooring. Do not cure by membrane curing or curing compounds.
3. All slabs not receiving a finish floor material shall receive a liquid curing-hardening compound in accordance with the manufacturer's recommendations.
4. Final cure unformed surfaces, unless otherwise specified, by any of the methods specified above, as applicable.

- D. Protection from Mechanical Injury: During the curing period, protect concrete from damaging mechanical disturbances including load stresses, heavy shock, excessive vibration, and from damage caused by rain or flowing water. Protect all finished concrete surfaces from damage by subsequent construction operations.

3.05 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures from the passage of work by other trades, unless otherwise shown or directed, after the work of other trades is in place. Mix, place and cure concrete as herein specified, to blend with in-place construction. Provide all other miscellaneous concrete filling shown or required to complete the work.
- B. Epoxy Adhesive: For application on corrective work where the ordinary methods of remedy are deemed inadequate by the Engineer. Type of adhesive shall be subject to the approval of the Engineer.

3.06 CONCRETE SURFACE REPAIRS

A. Repair of Unformed Surfaces

- 1. Test unformed surfaces such as monolithic slabs, for smoothness and to verify surface plane to the tolerance specified for each surface and finish. Correct low and high areas as herein specified.
- 2. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using a template having the required slope. Correct high and low areas as herein specified.
- 3. Repair finish unformed surfaces that contain defects which adversely affect the durability of the concrete. Surface defects, as such, include cracks in excess of 0.03 inch wide or which penetrate to the reinforcement or completely through non-reinforced sections regardless of width, spalling, popouts, honeycomb, rock pockets, and other objectionable conditions.
- 4. Correct high areas in unformed surfaces by grinding, after the concrete has cured sufficiently so that repairs can be made without damage to adjacent areas.
- 5. Correct low areas in unformed surfaces during, or immediately after completion of surface finishing operations by cutting out the low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to the Engineer.

B. Finishing of Formed Surfaces

- 1. Joint marks and fins shall be removed and surfaces left smooth and dense. Tieholes and honeycombing shall be repaired with cement and sand mortar.
- 2. Exposed concrete surfaces shall be vigorously and thoroughly rubbed with a sand cement mortar the consistency of a thick paint to fill all voids and provide a smooth surface. There shall be no discernible thickness of mortar on the surface.

PART 3 – EXECUTION

- 3.01 INSTALLATION: Installation of signs shall be in accordance with Section 621 – Traffic Control Signs of the State Standard Specifications, except as shown on the plans or amended in the specifications herewith.

END OF SECTION

SECTION 16301 - EXTERIOR ELECTRICAL WORK

PART 1 - GENERAL

1.01 GENERAL CONDITIONS:

- a) The General Conditions and Special Provisions preceding this Specification shall govern this section.
- b) Specification and Plans complement each other and what is specified, scheduled or mentioned by one shall be binding as if called for by both. Specification and Plans are intended to specify nature, quantity and quality of electrical work.
- c) Before bidding, visit project site, carefully review each section of the Specification and all Drawings of this Contract, and obtain from utility companies their standards, drawings and specifications for the work to be provided. Verify details, report any error, conflicts or omissions to the Owner's representative (hereafter referred to as Engineer) at least 10 calendar days before submission of bids for interpretation or clarification. If errors or omissions are not reported, Contractor shall provide necessary work at no cost to the Department to properly complete intent of Specification and Drawings.

By submitting a proposal of the work included in this contract, the Contractor shall be deemed to have made such examination and to be familiar with and accept all conditions of the job site.

1.02 WORK INCLUDED:

- A. In general, provide complete underground electric, telephone, CATV, communications, street and landscape lighting, and power systems within project boundaries. Furnish all labor, materials (except as hereinafter noted), tools, equipment and appliances required to provide and install all Electrical Work, complete, as indicated on the Drawings and/or as herein specified, and as required for its correct and proper operation. The Drawings note various sizes of equipment as determined for basis of design; the Electrical Work, however, shall be installed to comply with the equipment furnished by the successful supplier. The work shall include but not necessarily be limited to:
 - 1. Complete underground raceway system including trenches, ducts, manholes, and boxes, to be used by the Hawaiian Electric Company (HECO) for their cables and equipment.
 - 2. Complete underground raceway system including trenches, ducts, manholes, and boxes, to be used by Sandwich Isles Communications, Inc. for their cables and equipment.
 - 3. Complete underground raceway system including trenches, ducts, and boxes, to be used for CATV cables and equipment.
 - 4. Complete underground raceway system including trenches, ducts, and boxes, to be used for communication system cables and equipment.
 - 5. Complete street lighting system.

6. Coordinate work and arrange for periodic inspections by Hawaiian Electric Co., Hawaiian Telcom, Sandwich Isles Communications, Inc., Oceanic Time Warner Cable, State Inspectors, City & County Inspectors, and Engineer.
 7. Pass test mandrel through all ducts and conduits, and make corrections as directed by inspectors or Engineer.
 8. Provide pulling wire, No. 12 AWG galvanized steel or polypropylene cord, in all empty ducts and conduits, unless indicated otherwise. Provide duct measuring/cable pulling tape in all Hawaiian Electric Company, Hawaiian Telcom and Sandwich Isles Communications, Inc. ducts and conduits.
 9. Immediately report and pay for damages to existing equipment.
- B. Obtain and pay for electrical permits, arrange for periodic inspection by local authorities and deliver certificate of final inspection to Engineer.
 - C. Contractor shall check and test the installation for completeness and functional operation as described by the Drawings and specified herein. Final test shall be in the presence of Engineer and representatives of the utility companies, Sandwich Isles Communications, Inc., and the City. Contractor shall arrange and pay for all testing costs. Should intermediate or final inspections of the duct system reveal crushed, damaged or impassable ducts, the Contractor shall repair those sections of duct system, including repairs to paved surfaces and concrete structures, at no additional cost to the Department.

1.03 SPECIAL CONDITIONS:

- A. Contractor shall install duct systems and schedule the electric, telephone, CATV, communications, street and landscape lighting work within the timetable set by the General Contractor.
- B. Contractor shall verify ductline requirements, duct entry configurations and their locations, for each utility company and Sandwich Isles Communications manhole and handhole, with the respective utility company and Sandwich Isles Communications.
- C. Contractor shall make detailed arrangements for work by utility companies and Sandwich Isles Communications, Inc. pertaining to this Contract. Payment to utility companies for their work shall be by the Department.
- D. Contractor shall closely coordinate all work with Sandwich Isles Communications, Inc. (SIC). All trenches must be inspected prior to backfilling material. The Contractor shall notify the SIC Inspector (Customer Service Toll Free No. 1-888-995-7274) at least 72 hours prior to pouring of concrete or backfilling trenches.
- E. Arrange for the General Contractor to identify the locations of all civil site utilities (i.e. drain, water and sewer lines, etc.) and driveways prior to layout of electric, telephone, street light and CATV systems.
- F. Contractor and General Contractor shall closely supervise and coordinate all electrical work with the utility companies and Sandwich Isles Communications, Inc. to ensure that proper roadway drainage is maintained during construction. Should damage and erosion occur during construction, the Contractor or General Contractor

shall repair all damage and restore existing grade at no additional cost to the Department.

1.04 RELATED WORK BY OTHERS:

- A. Service cables and transformer(s), final connection thereto, and metering equipment by Hawaiian Electric Company. Obtain service raceway, grounding, transformer, and metering requirements before bidding, fabricating, constructing and installing. Make detailed arrangements for all work by utility company pertaining to Contract.
- B. Connection of street light circuits to utility company power source shall be by ((Hawaiian Electric Company.
- C. Telecommunications utility cables and equipment shall be by Sandwich Isles Communications, Inc. and/or respective communications provider for this operator area.
- D. Equipment utilizing electricity shall be provided by respective sections of Specification. Furnishing of equipment controllers (motor starters), unless otherwise specified, and providing complete control and interlock is provided by respective section supplying equipment. Installation of complete feeder or branch circuit system, and power wiring to equipment and controllers shall be part of electrical work.

1.05 SUBMITTALS:

- A. Shop Drawings: Within four weeks of award of Contract and prior to installation, submit complete shop drawings and manufacturer's literature for Engineer's review before any work is fabricated. Submit six sets of manufacturer's literature and/or fabrication drawings for the following:
 - 1. Complete street light standards and accessories, including computerized footcandle arrays showing illumination levels for all project roadways..
 - 2. Complete electric and utility system pullboxes, handholes, manholes, conduit and accessories. For utility system pullboxes, handholes, and manholes, obtain approvals from respective utility company prior to submission for Engineer's review.
 - 3. Utility companies' drawings.
- B. Prequalification: Brand names, manufacturer's names and catalog numbers indicate standard of design and quality required. Where materials or products specified herein are designated by manufacturer's name, any request to substitute materials or products other than those specified shall be approved by the Engineer. Burden of proof of equality of proposed substitutions will be the responsibility of the Contractor. List of substitute material together with qualifying data shall be submitted for approval at least ten days before bid opening.

Submission shall be as follows:

EXAMPLE:

<u>Item</u>	<u>Manufacturer and Catalog Number Specified</u>	<u>Substitute Manufacturer And Catalog Number</u>
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- C. Shop drawings and catalogue cuts for substitute materials shall clearly specify compliance with and/or deviation from specified material. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; and "achieve the same end use and results as materials formulated in accordance with the referenced publications". Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance. Review of shop drawings and catalogue cuts shall not release Contractor from complying with intent of Drawings and Specifications.
- D. Intent of Shop Drawing and Catalog Cut Review:
1. Shop drawing and catalog cut submittals processed by the Engineer are not Change Orders. The purpose of the submittals by the Contractor is to demonstrate to the Engineer that he understands the design concept, that he demonstrates his understanding by indicating which equipment and material he intends to furnish and install and by detailing the fabrication and installation methods he intends to use;
 2. If deviations, discrepancies or conflicts between shop drawings and Specifications are discovered either prior to or after shop drawing submittals are processed by the Engineer, the design drawings and specifications shall control and shall be followed;
 3. The fact that a manufacturer does not offer a specific option or meet a minimum guaranteed performance specification, called for herein or in a formal bid specification, is not deemed proprietary when such is available from one or more manufacturers.
- E. Approvals rendered on shop drawings shall not be considered as a guarantee of measurements or site conditions. Where drawings are approved, said approval does not relieve the Contractor from his responsibility for furnishing material or performing work as required by the Contract Drawings and Specifications.
- 1.06 **GUARANTEE AND CERTIFICATE:** Defective materials and workmanship shall be removed and replaced at no cost to the Department. For period of one year after acceptance of work by the Department, materials and workmanship developing defects and malfunctions shall be repaired and/or replaced, to conform to intent of the Specification and Drawings at no additional cost to the Department.

PART 2 – PRODUCTS

- 2.01 **GENERAL:** All materials shall be new, except as specifically noted, and shall bear the label of Underwriters's Laboratories whenever standards have been established and label service is normally and regularly furnished by the agency.
- 2.02 **MATERIALS:**

- A. Direct Buried Conduits (for below grade use):
1. Under Sidewalk or Protective Concrete Topping: Conduits for electric systems shall be round bore, PVC (polyvinyl chloride) Schedule 40 plastic or approved equal. Conduits for telephone, CATV, and communication systems shall be round bore, PVC (polyvinyl chloride) Schedule 40 plastic, or approved equal. Conduits for street lighting and secondary power systems shall be PVC (polyvinyl chloride) Schedule 40.
 2. Under Road Pavement or Grassed Areas: Conduits for electric systems shall be round bore, PVC (polyvinyl chloride) Schedule 80 plastic or approved equal. Conduits for telephone, CATV, and communication systems shall be round bore, PVC (polyvinyl chloride) Schedule 40 plastic, or approved equal. Conduits for street lighting and secondary power systems shall be PVC (polyvinyl chloride) Schedule 80.
- B. Concrete Encased Conduits (for below grade use): Conduits for electric systems shall be round bore, PVC Schedule 40 plastic or approved equal. Conduits for telephone system shall be round bore, PVC Type GT42 or Schedule 40 plastic or approved equal. Conduits for CATV and communications systems shall be round bore, PVC Schedule 40 plastic or approved equal. Conduits for street lighting and secondary power systems shall be PVC Schedule 40.
- C. Metal Raceways: (for above grade use)
1. Conduits: EMT (where indicated) and galvanized rigid steel.
 2. Flexible conduit: Zinc-coated inside and outside; for wet or moist areas -- liquid-tight with factory fittings.
- D. Conduit and Duct Accessories: Couplings, spacers, plugs, and accessories shall be as recommended by the manufacturer of conduits and ducts and shall be of the same schedule as the ducts which are connected to it, unless indicated otherwise.
- E. Ground Rods: Diameter shall be adequate to permit driving to full length of the rod, but not less than 5/8" in diameter unless otherwise indicated. Ground rods for street light standards shall be 5/8" x 10'-0" copper-cladded steel core. Ground rods for Hawaiian Telcom shall be 5/8" x 8'-0" galvanized steel. All others shall be 5/8" x 8'-0" copper-cladded steel core, unless indicated otherwise.
- F. Wire Mesh: Welded steel wire fabric for reinforcing concrete, galvanized, conforming to ASTM Specification A185.
- G. Concrete: Ready mixed type with compressive strengths as shown on Drawings. Concrete material and aggregates shall conform to latest ASTM Specifications. Concrete aggregates for ductlines shall be 3/4" maximum in size.
- H. Backfill Material Type A: Black or beach sand, earth or earth and gravel mixture. Material used shall be non-expansive. If earth and gravel mixture, rock size shall be 1-inch or smaller and shall not contain more than 20% rock particles by volume. This fill shall be used over concrete encased ducts and over direct buried ducts after backfill Type B has been placed.
- I. Backfill Material Type B: Black or beach sand, earth or earth and gravel mixture. Material used shall be non-expansive. If earth and gravel, mixture must pass a

½-inch screen and contain not more than 20% rock particles by volume. This fill shall be used all around direct buried conduits.

- J. Manholes, Handholes and Pullboxes: Shall be the type noted on the drawings and shall be constructed in accordance with the applicable details as indicated. Manholes, handholes and pullboxes may be precast or cast-in-place

1. Precast Manholes, Handholes and Pullboxes: Provide precast manholes, handholes and pullboxes complete with all hardware and accessories (i.e. cable racks, steps, pegs, etc.), and strengths as required for cast-in-place manholes, handholes and pullboxes. Identify each casting by having the manufacturers name and address cast into an interior face or permanently attached thereto.

- a. Precast manholes, handholes and pullboxes shall have a smooth trowel finish for horizontal surfaces.
- b. Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete manholes, handholes and pullboxes.
- c. Precast manholes assembly, including frame and cover shall be rated for AASHTO Class H20 wheel loading, unless otherwise indicated.
- d. Sandwich Isles Communications UM-35 manhole assembly units shall be by Hawaii Precast, per master purchase agreement. Covers shall have the "SIC" logo. Manhole cover bolts shall be stainless steel 3/4" Pentahead, unless otherwise noted.
- e. Sandwich Isles Communications Handholes: Shall include 20K traffic load rated cover(s). Handhole cover bolts shall be stainless steel 3/4" Pentahead, unless otherwise noted.

1. UH 3X5 Handhole (Pullbox) Assembly Unit: Shall be by Hawaii Precast, per master purchase agreement, and include ground rod, ¾" stainless steel penta-head bolted covers with "SIC" logo. Part Number (UH35) or equal.

2. UHC 30X48X33 Handhole (Pullbox) Assembly Unit: Consist of one Armorcast polymer concrete box and cover assembly, with ground rod, ¾" stainless steel penta-head bolted covers with "SIC" logo. Part Number (A6001430TA-SIC4) or equal.

3. UHC 13X24X36 Handhole (Pullbox) Assembly Unit: Consist of one Armorcast polymer concrete box and cover assembly, with ground rod, ¾" stainless steel penta-head bolted covers with "SIC" logo. Part Number (A6001946TA-SIC2) or equal.

2. Cast-in-Place Manholes and Handholes: Concrete used shall provide 4000 pounds compressive breaking strength at 28 days maturity. Floor surface shall have a steel trowel finish. Walls shall be of monolithic concrete construction. The complete manhole assembly, including cover, shall be rated for AASHTO Class H20 wheel loading. Submit manufacturer's certificate of compliance with requirements.

3. Pulling-in Irons: Shall be steel bars bent in the form indicated and cast in the manhole or handhole walls. In the wall they shall be not less than 6 inches above or below, and opposite the conduits entering the manhole or handhole. Pulling-in irons shall be projected into the handhole and manhole approximately 6 inches. Irons shall be zinc coated after fabrication.
 4. Cable Racks: Including hooks and insulators, shall be sufficient to accommodate the cables and shall be spaced not more than 18 inches horizontally. The wall bracket shall be channel or T-section steel. The hooks shall be of steel or malleable iron and shall be of the removable type. Insulators shall be dry-process glazed porcelain. The metal portion of racks shall be zinc-coated after fabrication. Cable racks for use in existing manholes shall be compatible with existing rack supports.
 5. Cast end bells shall be provided; "knock outs" shall not be allowed.
 6. Concrete bricks shall be concrete masonry units conforming to ASTM C 139.
- K. Wires and Cables: Conductors shall be copper, No. 12 AWG minimum; No. 10 AWG and smaller, solid and round; No. 8 AWG and larger, 7 or 19 strands concentric.
1. Conductors No. 10 and smaller shall be type THWN/THHN, except that ground wire may be type TW. Conductors No. 8 AWG and larger shall be type RHW-USE, XHHW-USE or THW with neoprene jacket. For street light circuits, exterior and below-grade locations, conductors shall be type RHW-USE.
 2. Grounding conductors shall be 1/c - #4 bare copper unless indicated otherwise.
 3. Wires and cables for locations and uses not specified above shall be suitable for the purpose and in accordance with the NEC.
- L. Sandwich Isles Communications BM 2(5/8)(8) Housing Ground Assembly Unit: Consists of providing a copper clad ground rod, ground rod clamp and the required length of bare #6 AWG tinned copper ground wire connected to an auxiliary grounding connector (included in the housing assembly unit) within the housing. The first set of parentheses indicates the required diameter of the ground rod, and the second set of parentheses indicates the length of the ground rod.
- M. Connectors and Terminals: Connectors and terminals shall be designed and approved for use with the associated conductor material, and shall provide a uniform compression over the entire contact surface. Solderless terminal lugs shall be used on all stranded conductors. Crimp type connectors will be acceptable, however, the type which makes only one indentation will not be acceptable. The crimping tool shall make a minimum of four indentations around the circumference of the cable. In addition, crimp type connectors to be used on 250 MCM and larger conductors shall have adequate length for two sets of indentations on each half of the connector.
1. Gaskets shall be of neoprene or Buna N rubber, and shall be a resilient, heat-resistant and oil-resistant grade having low compression set and high tear strength.
 2. Cap screws shall be of a cadmium or zinc-coated steel or of copper-silicon alloy, and shall be of extra-large size and closely spaced so as to maintain a tight joint.
- N. Waterproof Connection Kits: Shall be quick disconnect in-line fuse holder (6 ampere fuse link unless indicated otherwise) fused for hot leg. The fuse holder body shall be molded plastic made in two sections where lead side section shall have a captive nut and

waterproofing ring. Fuse holder shall be TRON and manufactured by BUSSMANN, or approved equal.

- O. Luminaires: Provided complete with all necessary mounting hardware and accessories, lamps, ballasts, etc., as specified herein and on the Drawings. Ballasts for high-intensity discharge lamps shall be integrally mounted in luminaire housing and be regulated, constant wattage, high power factor type, designed to operate the respective type of lamp indicated. Lamps shall be low mercury content type, and TCLP-compliant, passing the EPA's Toxic Characteristic Leaching Procedure test for non-hazardous waste. Where indicated, luminaire housing shall be provided with 3 wire twist lock receptacle mounted in the housing for individual photo electrical control.
- P. Poles: Shall be vandal resistant, with access handhole, for anchor base mounting, complete with fixture luminaire aperture, hot-dipped galvanized anchor bolts, etc. as indicated on the Drawings. Pole strength design shall be for minimum of 105 MPH winds.
- Q. Hardware, Supports, Backing, Etc.: All hardware, supports, backing and other accessories necessary to install electrical equipment shall be provided. Wood materials shall be "wolmanized" treated against termites, iron or steel materials shall be galvanized for corrosion protection, and non-ferrous materials shall be brass or bronze.

PART 3 – EXECUTION

3.01 GENERAL:

- A. Rules and Permit: The entire installation shall conform to ordinances of the City and County of Honolulu; National Electrical Safety Code (NESC); and shall be made in strict accordance with the latest rules and regulations of the National Board of Fire Underwriters, the currently adopted edition of the National Electrical Code (NEC) and the local Electrical Bureau. The Contractor shall obtain and pay for the electrical permit as required by local laws and rules. All work shall be inspected by the proper local authorities as it progresses. The Contractor shall pay all inspection fees and shall deliver certificates of completion and inspection to the Engineer before final payment will be made. Costs of permits and inspection fees shall be included in the Contractor's bid price.
- B. Materials and Workmanship: All labor and materials of every kind shall be subject to the approval of the Engineer who shall be afforded every facility for ascertaining the competence of such labor and examining such materials as he may deem necessary. Concealed work shall be reopened at random as directed during formal inspection by Engineer or Electrical or Utility Inspector.
- C. Qualification of Installers: For actual fabrication, installation and testing of the Work of this section, use only thoroughly trained and experienced workmen completely familiar with items required and with manufacturers' recommended methods of installation. In acceptance or rejection of installed work, no allowance will be made for lack of skill on part of workmen.
- D. Construction Methods: Construction shall conform to construction practices as recommended by the American Electricians Handbook by Croft (latest edition), American National Standards Institute (ANSI), Edison Electric Institute, National Board of Fire Underwriters (NBFU), National Electrical Code (NEC), National Electrical Manufacturer's Association (NEMA), National Electrical Safety Code (NESC), National Fire Protection Association (NFPA), Underwriters' Laboratories,

Inc. (UL) and applicable instructions of manufacturers of equipment and material supplied for this project.

- E. Inspection: Skill and competency of workmanship shall be subject to the approval of the Engineer, inspectors of the utility companies, Sandwich Isles Communications, Inc., Oceanic Time Warner Cable, the State of Hawaii and the City and County of Honolulu. Notification for inspection shall be given to the respective companies or agencies three working days in advance of work.
- F. Record Drawings: The Contractor shall maintain an accurate and adequate record of each change as it occurs, regardless of how ordered. As-built drawings shall be prepared in accordance with project requirements.
- G. Plans and Specification: This specification is intended to cover all labor, materials and standards of workmanship to be employed in the work indicated on the plans and called for in the specification or reasonably implied therein. The plans and specification supplement one another. Any part of the work mentioned in one and not represented in the other, shall be done the same as if it has been mentioned in both. The Contractor shall not make alterations in the drawings and specification.
- H. Discrepancies and Interpretations:
 - 1. Should the Contractor find any discrepancies in or omissions from any of the documents or be in doubt as to their meaning, he shall advise the Engineer who will issue any necessary clarification within a time period which does not disrupt the progress of the work.
 - 2. All interpretation and supplemental instructions will be in the form of a written addenda to the Contract Documents.
 - 3. Should any discrepancy arise from the failure of the Contractor to notify the Engineer, the higher quality or larger quantity of item shall prevail. Engineer shall make the final interpretation and judgement.
 - 4. In the event of a discrepancy between small scale drawings and large scale details, or between drawings and specification, on which is in violation of any regulations, ordinances, laws or codes, the discrepancy, if known by the Contractor, shall be immediately brought to the attention of the Engineer for a decision before proceeding with the particular work involved. Work carried out disregarding these instructions will be subject to removal and replacement at the Contractor's expense.
- I. Symbols: The standard electrical symbols together with the special symbols, notes and instructions shown on the drawings indicate the work and outlets required and are all to be included as a part of this specification.
- J. Coordination: This specification is accompanied by plans, sections and elevations, and site plans indicating locations of all outlets, controls, service runs, and other electrical apparatus. These locations are approximate and, before installing, the Contractor shall study the adjacent civil utility and landscaping details and actually make the installation in the most logical manner. Any outlet may be relocated within ten feet before installation at the direction of the Engineer. The circuit routing is typical only and may be varied in any logical manner.
- K. Before installation, verify all dimensions, conditions and sizes of equipment at job

site. Installation shall be complete in every detail as specified and ready for use.

- L. Work shall conform to ordinances of City and County of Honolulu; latest edition of National Electrical Code (NEC); National Electrical Safety Code (NESC); and Regulations and Standard Practices of Hawaiian Electric Company, Inc., Hawaiian Telcom, Inc. and Sandwich Isles Communications, Inc.

- M. Applicable rules, standards and specifications of following associations shall apply to materials and workmanship:

American National Standards Institute (ANSI)
Illumination Engineer Society (IES)
National Board of Fire Underwriters (NBFU)
National Electrical Manufacturer's Association (NEMA)
National Fire Protection Association (NFPA)
Underwriters' Laboratories, Inc. (UL)

Applicable instructions of manufacturers of equipment and material supplied for this project.

- N. All metallic materials shall be protected against corrosion. Exposed metallic parts of outdoor apparatus shall be given a rust-inhibiting treatment and standard finish by the manufacturer. All such parts as boxes, bodies, fittings, guards and miscellaneous parts made of ferrous metals but not of corrosion-resistant steel, shall be zinc-coated in accordance with ASTM A153. The Contractor shall not join dissimilar metals that will result in deterioration due to galvanic corrosion.

3.02 CONSTRUCTION REQUIREMENTS:

- A. Trench Excavation:

1. Dimensions and locations of trenches for boxes, transformer and equipment pads, direct buried conduits and ductlines shall be as indicated on Drawings. Trench width and depths shall be sufficient to accommodate proper installation of conduit banks and cables.
2. Should material at bottom of trench for direct buried conduits not be equal to backfill material Type B, the trench shall be excavated an additional 3" to permit backfilling with Type B backfill.
3. Where a trench is excavated on slope, sides are to be vertical, and depth measured at lowest side. All measurements are to be based on final grades.
4. Bottom of trenches to be flat and smooth.
5. Trenches shall be widened at equipment pads, manhole, handhole and pullbox sites to permit proper entry of conduits.
6. Trenches shall be approved by respective utility inspectors prior to any ducts being installed.
7. All excavations for manholes, pullboxes and handholes in excess of the required depths shall be filled with concrete or crushed lava rock.

8. Excavate 30'-0" on both sides of manhole and handhole locations prior to installation of manhole and handhole. If water, drainage or sewer lines are encountered, provide smooth transitions in conduits and route below the respective utility line.
9. Sheathing and bracing as required shall be provided to support sides of excavations from cave-ins.
10. Provide drainage and pumps to keep trenches dry.
11. Saw cut all edges of existing sidewalks and pavement before trenching.
12. Excavated material may be placed alongside trench; however, it shall not interfere with utility company work.
13. Utility companies and Sandwich Isles Communications, Inc. shall be notified a minimum of seventy-two hours before commencing excavations.

B. Backfill:

1. Ducts, boxes, and conduit installations shall be approved by the respective inspector from utility company and Sandwich Isles Communications prior to backfilling. All excavations for boxes in excess of the required depths shall be filled with concrete or crushed lava rock.
2. Should material below utility company and Sandwich Isles Communications' direct buried conduits not be equal to 3" (thickness) of backfill material Type B, trench shall be deepened by 3", and backfilled with Type B backfill.
3. Backfilling shall be to finished grades indicated on accompanying Drawings, and matching existing conditions.
4. Backfill material shall be completely free of wood or other debris. Excavated material may be reused as backfill, providing that it conforms to the requirements of Type A and Type B backfill. For excavated material used to backfill Sandwich Isles Communications ducts, a written soils report of conformance by a licensed third party Geotechnical Engineer is required prior to backfilling using the excavated material.
5. Type B backfill over conduits shall be installed under the supervision of the respective utility companies' and Sandwich Isles Communications' inspector.
6. Backfill material shall be placed in maximum of 8" layers in loose thickness before compacting. Backfill shall be thoroughly compacted with hand or mechanical tampers to 95% of ASTM D1557 maximum dry density. In no case shall tamping be accomplished by using the wheels or tracks of a vehicle.
7. Backfill over conduit bends at transformer and switchgear pads shall be Type A or better.

C. Installation of Conduit And Duct Bank:

1. Bottom of trench shall be clean, smooth, and well-graded and approved by utility company inspectors.

2. Saw cut, ream and taper ducts and conduits with manufacturers' approved tool.
3. Couplings and bells shall be tight to prevent entry of dirt or concrete into ducts and conduits. Stagger the joints of the ducts by rows and layers so as to provide a ductline having the maximum strength.
4. Provide spacers to maintain proper separation between ducts.
5. Changes of direction shall not exceed 4 degrees per length of conduit or duct. Radii and turns shall be made with appropriate duct bends and sweeps.

Horizontal bends for Hawaiian Telcom, Sandwich Isles Communications, CATV, and communications conduits/ducts shall be constructed with 25-foot minimum radius curves unless indicated otherwise or approved by the respective Hawaiian Telcom, Sandwich Isles Communications, Inc. and CATV inspector, or Engineer. Angled couplings are not permitted. If factory made bends are to be provided, the contractor shall demonstrate their suitability to the Engineer and inspectors by pulling the respective mandrel completely through the bend prior to installation. Vertical bends for Hawaiian Telcom, Sandwich Isles Communications, CATV, and communications conduits/ducts shall be constructed with 20-foot minimum radius curves unless indicated otherwise or approved by the respective inspector or Engineer.

6. Ducts shall be clean and free from debris, rubbish and water.
7. After each day's work, provide temporary watertight conduit plugs or seals at the end of conduit banks to prevent entry of moisture, dirt, rubbish, debris, or concrete. Ducts for Sandwich Isles Communications use shall be provided with Jackmoon Plug or equivalent. Duct tape is not acceptable. At the completion of construction, provide water tight plugs for all Sandwich Isles Communications ducts as specified withing the Sandwich Isles Communications Construction Notes.
8. Pass a test mandrel conforming to the respective utility company, City & County of Honolulu or the Engineer's requirements, through the entire length of each duct or conduit to test for burrs and obstructions. Unless indicated otherwise, mandrel shall be 14" long and shall have diameter of $\frac{1}{2}$ " less than inside diameter of duct. Mandrel for Hawaiian Telcom and Sandwich Isles Communications ducts shall be 12" long and shall have diameter of $\frac{1}{4}$ " less than inside diameter of duct. Mandrel shall be pulled through each Sandwich Isle Communications duct, after which a brush with stiff bristles shall be pulled through to make certain that no particles of earth, sand, or gravel have been left in the duct. The Sandwich Isles Communications Inspector shall be present during the mandrel testing. If burrs or obstructions are encountered, that section shall be replaced at no additional cost to the Department.
9. Unless indicated otherwise, install #12 AWG galvanized iron pulling wire or polypropylene cord, having a breaking strength of at least 200 pounds, in each conduit after testing.
 - a. For electric utility company ducts, provide cable pulling tape (NEPTCO WP1800P Muletape or approved equal) in each new duct.

- b. For Hawaiian Telcom ducts, provide duct measuring/cable pulling tape (NEPTCO WP1800P Muletape or approved equal) in each new duct.
- c. For Sandwich Isles Communications ducts, provide duct measuring/cable pulling tape (NEPTCO WP1800P Muletape or approved equal) in each new duct.

Using the duct measuring/cable pulling tape, the Contractor shall measure at least one duct of a common duct run. The distance shall be marked on a copy of the record prints and submitted to the respective Hawaiian Telcom and Sandwich Isles Communications inspector for record keeping.

- 10. Terminate ducts in end-bells where ductlines enter manholes and handholes. Ducts shall enter handholes at 90 degree angle. Ducts entering handholes at angles other than 90 degrees may be permitted, but only when specified by the Engineer.
- 11. Apply thin coat of sealing compound on ducts and conduits at couplings and bells.
- 12. Conduits stubbed for future connections shall be plugged and marked.
- 13. Securely anchor duct banks prior to pouring concrete encasement to prevent ducts from floating. Utility Company and Sandwich Isles Communications duct banks shall be inspected and approved by the respective inspector prior to placing concrete and backfilling.
- 14. When pouring concrete, prevent heavy masses of concrete from falling directly on ducts. If unavoidable, protect ducts with plank.
- 15. Direct flow of concrete down sides of duct bank to bottom, allowing concrete to rise between ducts, filling all open spaces uniformly.
- 16. To ensure against voids in concrete, work a long, flat splicing bar or spatula liberally and carefully up and down the vertical rows of ducts. Mechanical vibrators shall be used for stacked duct banks of three ducts or higher.
- 17. Cure concrete for a minimum of 72 hours before permitting traffic and/or backfilling.
- 18. Warning Tapes:
 - a. 6" wide warning tape, red in color with a black imprinted message "CAUTION ELECTRIC LINE BURIED BELOW", shall be placed 12" below finish grade over electric ducts or the concrete jacket for electric ducts for the entire length of ductline installations.
 - b. 4" wide warning tape, orange in color with a black imprinted message "WARNING - STOP DIGGING - CALL HAWAIIAN TELCOM, COMMUNICATIONS CABLE BURIED BELOW, FAILURE TO COMPLY COULD RESULT IN LEGAL ACTION", shall be placed

12" below finish grade over Hawaiian Telcom ducts or the concrete jacket for telephone ducts for the entire length of ductline installations. See Hawaiian Telcom's HTCO Standard Drawing 34028.

- c. A 3" wide warning tape, orange in color with black imprinted message "CAUTION BURIED FIBER OPTIC CABLE BELOW" shall be placed 12" above all Sandwich Isles Communications ducts or the concrete jacket for said ducts for the entire length of ductline installations.

D. Concrete and Brick Work:

1. Concrete, ready mixed according to ASTM C94-98.
2. Convey concrete from mixer to forms rapidly to prevent segregation. Free drop shall be limited to five feet, unless authorized by inspector.
3. Placing:
 - a. Clean and remove all debris from inside forms and trenches before placing concrete.
 - b. Place concrete only on clean damp surfaces, free from water.
 - c. Place concrete in forms, in horizontal layers not exceeding 18" thickness.
 - d. Place concrete to avoid segregation of materials and displacement of ducts, inserts and reinforcing.
 - e. Vibrate structural concrete thoroughly during and immediately after placing to ensure dense watertight concrete.
 - f. Prior to placing concrete for utility company ductlines, the Contractor shall obtain the approval of the respective inspector.
4. Forming:
 - a. Forms shall be of good sound lumber with sufficient strength and conforming to shapes and dimensions indicated on Drawings.
 - b. Forms shall be treated with non-staining form oil immediately before each use.
5. Patching: Patch all voids, pour joints and holes before concrete is thoroughly dry. Use mortar of same proportions as original concrete.
6. Curing: Curing of concrete shall be accomplished by impervious membrane method with liquid membrane compound. Apply two or more coats to obtain a total of one gallon for each 150 square feet of concrete surface.
7. Reinforcing Steel:

- a. Clean reinforcing of mill or rust scale and form to dimensions indicated.
 - b. Install reinforcing in proper locations and secure in place to prevent movement during concrete placing or vibrating.
8. Concrete Brick and Hollow Concrete Block Work:
 - a. Concrete brick and hollow block shall be laid in full bed of mortar, both horizontally and vertically.
 - b. Mortar shall be one part (by volume) cement and three parts (by volume) fine aggregate, thoroughly mixed and used when fresh. Retampering will not be allowed. Mortar shall have a minimum 28 days strength of 2,500 psi.
 - c. Setting bed shall be of depth required to bring top of blocks flush with finish line.

E. Manholes, Handholes And Pullboxes:

1. Boxes shall be installed approximately where shown. The exact location of each manhole, handhole and pullbox shall be determined after careful consideration has been given to the location of the driveway apron, other utilities, grades, and pavement. Manholes, handholes and pullboxes shall be of the type noted on the Drawings and shall be constructed in accordance with the applicable details as indicated. Provide number of cable racks and pulling-in irons as required by the respective utility company. A machine-finished seat shall be provided to insure a perfect joint between frame and cover. Covers shall be machined to prevent rocking within frames. In paved areas, the tops of pullbox, handhole and manhole covers shall be flush to grade with the sidewalk or with the finished surface of the paving, unless otherwise noted. In unpaved areas, the top of handhole covers shall be approximately 1/2 inch above the finished grade; Sandwich Isles Communications' handholes/manholes shall be set approximately 1" above the finished grade in unpaved areas.
2. Precast Handhole and Pullbox Installation: Commercial precast assembly shall be set on 6 inches of level, 90 percent compacted crushed rock fill, 3/4 inch to 1 inch size, extending 12 inches beyond the handhole/pullbox on each side. Granular fill shall be compacted by a minimum of four passes with a plate type vibrator. Provide number of cable racks and pulling-in irons as required by the respective utility company, complete with all hardware including steps and pegs.

Pits for Sandwich Isles Communications precast handholes and manholes are to be flat and smooth, free of rocks, rock chips, hardened lumps of dirt, debris and all deleterious material. A six-inch layer of compacted sand shall be placed as a base for the precast manholes and handholes. Set handhole or manhole on a level area, in the bottom of the excavation, on a 4" layer of crushed rock, for drainage purposes.

3. Hawaiian Telcom Manholes, Handholes and Pullboxes:
 - a. Provide a ground rod in each manhole, handhole and pullbox, except for 12" x 20" pullboxes and pullboxes adjacent to electric utility company transformer locations.
 - b. Ground rods are to extend 4" above the finished pullbox/handhole/manhole floor (grade). All connections to the ground rod will be made by Hawaiian Telcom or the communication system operator.
4. Sandwich Isles Communications Manholes, Handholes and Pullboxes:
 - a. Provide a 5/8" diameter x 8-foot copper clad ground rod at handholes and manholes, as indicated on the Drawings.
 - b. Damp-proofing shall be provided on all exterior precast manhole and handhole walls. All dust, dirt and other deleterious substances shall be removed from the concrete surface. The concrete surface shall be thoroughly dry before the damp-proofing is applied. The concrete surface shall be primed in accordance with the manufacturer's instructions and two coats of damp-proofing compound shall be applied. Allow the compound to dry thoroughly after priming and in between coats. Do not backfill until the final coat has dried hard.
 - c. Before backfilling and compacting, make sure covers are in place and secured. Layer 6" to 8" of backfill material around the manhole or handhole. Tamp each individual layer of backfill material. Continue the layering and "tamping" until final grade is achieved.
 - d. Caulk manhole and handhole seams after the unit is assembled using a good quality silicone compound material.
 - e. The base of the manhole or handhole shall be placed level, and form work is constructed between the underside of the frame and top side of the manhole or handhole using duct tape, wood strips, cardboard, etc. Some manholes have adjustable frames that are raised to finish grade and secured in position. All voids created during the installation shall be filled with mortar mix, concrete or slurry and allowed to set. Strip forms after sufficient strength has developed. This is especially important where manholes or handholes may be subject to any vehicular traffic.
5. Ducts ending in manholes or handholes shall be terminated with junior end bells. End bells, terminators or ducts shall be flush to inside wall surfaces; duct extension into boxes is not acceptable. All ducts entering manholes or handholes shall be grouted between conduits and sidewall, inside and out. Verify requirements, complement and arrangement of ducts entering each manhole or handhole and location of duct entrance with the respective utility company and Sandwich Isles Communications, Inc. prior to fabrication and installation of the respective manhole or handhole.

- a. All Sandwich Isles Communications conduits shall enter the manholes and handholes on the property side at all times unless otherwise specified by the Engineer. Conduits shall enter handholes at 90 degree angle.
- b. Stubout conduits from Sandwich Isles Communications handholes to individual residential lots shall be Schedule 40 PVC, 1" diameter and shall be extend 5' beyond property line. Cap and seal end and mark locations with above ground marker.

F. Electrical Equipment Pads:

1. Slope of lots/area for concrete equipment pads shall not exceed one-inch rise in one foot run.
2. Grade sufficiently around equipment pad area to prevent future filling of lot/area.
3. Transformer pads may be precast or cast-in-place reinforced concrete as indicated on Drawings.
4. Concrete equipment pads shall be installed level. Pad elevation shall be 2" above the highest grade fronting the pad.

G. Street Lighting Systems:

1. Street lighting materials and installation shall be in accordance with the Standard Specifications of the City & County of Honolulu, and as specified herein and on the Drawings.
2. Street lighting system shall provide illumination along length of project roadways. System shall be provided complete, and be completely tested and ready for use. Furnish computerized footcandle arrays to show illumination levels and distribution along all project roadways.
 - a. Street light fixtures shall be mounted with bracket arms oriented 90 degrees to center line of road. Shaft shall be field adjusted for vertical alignment.
 - b. Prior to trenching or excavating, structural outlines and center lines of ductlines and street light foundation shall be clearly staked, and approval received from Engineer, City inspectors and utility companies. Staking shall be with steel or wood pegs or paint.
 - c. Base foundation for street light standards shall consist of cast-in-place reinforced concrete complete with anchor bolts, sized and placed in accordance with pole manufacturer's requirements and installation template. Length of base shown on Drawings shall be considered as minimum and shall be lengthened to suit the soil conditions and to adequately support the pole and lighting fixture assembly.
 - d. After pole is set, grease (or bituminous coat) ends of all anchor

bolts, bottom of the anchor plate and all screws and bolts.

3. Provide duct seal in duct entries into handholes and pullboxes to prevent moisture from entering light fixtures.

- H. Structural Steel And Miscellaneous Metal Work: Structural steel work including bolts, nuts, anchors, pulling-in irons, etc. shall be galvanized by hot-dipped process after fabrication into largest practical sections.

3.03 EXISTING UNDERGROUND UTILITIES:

Underground utilities indicated on plans are approximate in location. It is not the intention of plans to imply that all existing utilities are drawn and located. It shall be the responsibility of Contractor to coordinate locations of existing utilities prior to doing any excavation work. Any damage to existing utilities shall be repaired by Contractor at no cost to the Department.

3.04 CLEANING AND REPAIRING:

- A. During the progress of work, all rubbish, waste lumber, displaced materials, etc. shall be removed as soon as possible and upon completion of the work, Contractor shall remove from Owner's property and from all public and private property, at his own expense, all temporary structures, rubbish and waste material resulting from his operations.
- B. The Contractor shall restore all removed or damaged pavement, gutters, curbs, sidewalks, sign posts, trees and landscape damaged by his operations to as near their original condition or better. Materials used for restoration work shall be equal to or better in quality than the materials the Contractor will replace, and matching in thickness, texture, and color whenever applicable. The grades of the restored surfaces shall conform to the existing grades.

3.05 TESTS:

- A. Ground Resistance: Ground resistance measurements of each ground rod shall be taken and certified by the Contractor. Ground resistance measurements shall be made in normally dry weather, not less than 48 hours after rainfall, and with the ground under test isolated from other grounds. Upon completion of the project, the Contractor shall submit in writing to the Engineer, the measured ground resistance of each ground rod and grounding system, as well as the resistance and soil conditions at the time the measurements were made.
- B. Test all 600 volt class conductors to verify that no short circuits or accidental grounds exist. Make tests using an instrument which applies a voltage of approximately 500 volts to provide a direct reading in resistance, and measure the insulation resistance from phase to phase and phase to neutral. All test results shall be recorded and submitted.
- C. Wherever test or inspection reveals faulty materials or installation, Contractor shall take corrective action, at his own expense, repairing or replacing materials or installation as directed. The materials or installation shall then be retested.

END OF SECTION

SECTION 16501 – OVERHEAD STREET LIGHT SYSTEM

PART 1 - GENERAL

1.01 GENERAL CONDITIONS:

- A. The General Conditions and Special Provisions preceding this Specification shall govern this section.
- B. Specification and Plans complement each other and what is specified, scheduled or mentioned by one shall be binding as if called for by both. Specification and Plans are intended to specify nature, quantity and quality of electrical work.
- C. Before bidding, visit project site, carefully review each section of the Specification and all Drawings of this Contract, and obtain from utility companies their standards, drawings and specifications for the work to be provided. Verify details, report any error, conflicts or omissions to the Owner's representative (hereafter referred to as Engineer) at least 10 calendar days before submission of bids for interpretation or clarification. If errors or omissions are not reported, Contractor shall provide necessary work at no cost to the Department to properly complete intent of Specification and Drawings.

By submitting a proposal of the work included in this contract, the Contractor shall be deemed to have made such examination and to be familiar with and accept all conditions of the job site.

1.02 WORK INCLUDED:

- A. In general, provide complete overhead street lighting system as indicated on the drawings within project boundaries. The work shall include but not necessarily be limited to:
 - 1. Complete overhead street lighting system.
 - 2. Coordinate work and arrange for periodic inspections by Hawaiian Electric Co., City & County Inspectors, and Engineer.
 - 3. Immediately report and pay for damages to existing equipment.
- B. Obtain and pay for electrical permits, arrange for periodic inspection by local authorities and deliver certificate of final inspection to Engineer.
- C. Contractor shall check and test the installation for completeness and functional operation as described by the Drawings and specified herein. Final test shall be in the presence of Engineer and representatives of the utility companies, and the City. Contractor shall arrange and pay for all testing costs.

1.03 SPECIAL CONDITIONS:

- A. Contractor shall schedule the utility work and install and schedule the street lighting work within the timetable set by the General Contractor.

- B. Obtain copies of Hawaiian Electric Company's service drawings and details for the project prior to construction and coordinate the proposed pole locations with the civil site improvements and required site work for installation and access purposes.
- C. Contractor shall make detailed arrangements for work by utility companies pertaining to this Contract. Payment to utility companies for their work shall be by the Department.
- D. Arrange for the General Contractor to identify the locations of all civil site utilities (i.e. drain, water and sewer lines, etc.) and driveways prior to layout of street light system.
- E. Contractor and General Contractor shall closely supervise and coordinate all electrical work with the utility companies to ensure that proper roadway drainage is maintained during construction. Should damage and erosion occur during construction, the Contractor or General Contractor shall repair all damage and restore existing grade at no additional cost to the Department.

1.04 RELATED WORK BY OTHERS:

- A. Connection of street light circuits to utility company power source shall be by Hawaiian Electric Company.
- B. Electric and CATV utility cables and equipment shall be by respective utility companies.

1.05 SUBMITTALS:

- A. Shop Drawings: Within four weeks of award of Contract and prior to installation, submit complete shop drawings and manufacturer's literature for Engineer's review before any work is fabricated. Submit six sets of manufacturer's literature and/or fabrication drawings for the following:
 - 1. Complete street light fixtures and accessories, including computerized footcandle arrays showing illumination levels for all project roadways..
 - 2. Utility companies' drawings.
- B. Prequalification: Brand names, manufacturer's names and catalog numbers indicate standard of design and quality required. Where materials or products specified herein are designated by manufacturer's name, any request to substitute materials or products other than those specified shall be approved by the Engineer. Burden of proof of equality of proposed substitutions will be the responsibility of the Contractor. List of substitute material together with qualifying data shall be submitted for approval at least ten days before bid opening.

Submission shall be as follows:

EXAMPLE:

<u>Item</u>	<u>Manufacturer and Catalog Number Specified</u>	<u>Substitute Manufacturer And Catalog Number</u>
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- C. Shop drawings and catalogue cuts for substitute materials shall clearly specify compliance with and/or deviation from specified material. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; and "achieve the same end use and results as materials formulated in accordance with the referenced publications". Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance. Review of shop drawings and catalogue cuts shall not release Contractor from complying with intent of Drawings and Specifications.
- D. Intent of Shop Drawing and Catalog Cut Review:
1. Shop drawing and catalog cut submittals processed by the Engineer are not Change Orders. The purpose of the submittals by the Contractor is to demonstrate to the Engineer that he understands the design concept, that he demonstrates his understanding by indicating which equipment and material he intends to furnish and install and by detailing the fabrication and installation methods he intends to use;
 2. If deviations, discrepancies or conflicts between shop drawings and Specifications are discovered either prior to or after shop drawing submittals are processed by the Engineer, the design drawings and specifications shall control and shall be followed;
 3. The fact that a manufacturer does not offer a specific option or meet a minimum guaranteed performance specification, called for herein or in a formal bid specification, is not deemed proprietary when such is available from one or more manufacturers.
- E. Approvals rendered on shop drawings shall not be considered as a guarantee of measurements or site conditions. Where drawings are approved, said approval does not relieve the Contractor from his responsibility for furnishing material or performing work as required by the Contract Drawings and Specifications.

1.06 GUARANTEE AND CERTIFICATE:

Defective materials and workmanship shall be removed and replaced at no cost to the Department. For period of one year after acceptance of work by the Department, materials and workmanship developing defects and malfunctions shall be repaired and/or replaced, to conform to intent of the Specification and Drawings at no additional cost to the Department.

PART 2 - PRODUCTS

2.01 GENERAL:

- A. All materials shall be new, except as specifically noted, and shall bear the label of Underwriters's Laboratories whenever standards have been established and label

service is normally and regularly furnished by the agency.

2.02 MATERIALS:

- A. Plastic Conduits: Conduits for electric and street lighting systems shall be round bore, PVC (polyvinyl chloride) Schedule 80 plastic or approved equal.
- B. Metal Raceways: (for above grade use)
 - 1. Conduits: galvanized rigid steel.
 - 2. Flexible conduit: Zinc-coated inside and outside; for wet or moist areas -- liquid-tight with factory fittings.
- C. Conduit and Duct Accessories: Couplings, plugs, and accessories shall be as recommended by the manufacturer of conduits and ducts and shall be of the same schedule as the ducts which are connected to it, unless indicated otherwise.
- D. Ground Rods: Diameter shall be adequate to permit driving to full length of the rod, but not less than 5/8" in diameter unless otherwise indicated. Ground rods for street light standards shall be 5/8" x 10'-0" copper-clad steel core.
- E. Wires and Cables: Conductors shall be copper, No. 12 AWG minimum; No. 10 AWG and smaller, solid and round; No. 8 AWG and larger, 7 or 19 strands concentric.
 - 1. Conductors No. 6 and smaller shall be type THW, THHN or RHW, except that ground wire may be type TW. Conductors No. 4 AWG and larger shall be type RHW, or THW with neoprene jacket. For street light circuits, exterior and below-grade locations, conductors shall be type RHW-USE.
 - 2. Grounding conductors shall be 1/c - #4 bare copper unless indicated otherwise.
 - 3. Wires and cables for locations and uses not specified above shall be suitable for the purpose and in accordance with the NEC.
- F. Connectors and Terminals: Connectors and terminals shall be designed and approved for use with the associated conductor material, and shall provide a uniform compression over the entire contact surface. Solderless terminal lugs shall be used on all stranded conductors. Crimp type connectors will be acceptable, however, the type which makes only one indentation will not be acceptable. The crimping tool shall make a minimum of four indentations around the circumference of the cable. In addition, crimp type connectors to be used on 250 MCM and larger conductors shall have adequate length for two sets of indentations on each half of the connector.
 - 1. Gaskets shall be of neoprene or Buna N rubber, and shall be a resilient, heat-resistant and oil-resistant grade having low compression set and high tear strength.
 - 2. Cap screws shall be of a cadmium or zinc-coated steel or of copper-silicon alloy, and shall be of extra-large size and closely spaced so as to maintain a tight joint.

- G. Street lighting materials including wiring shall be in accordance with Standard Specifications, and as specified herein and on the Drawings.
1. Lamps: Provide types, numbers, and wattages indicated. Lamps shall be low mercury content type, and TCLP-compliant, passing the EPA's Toxic Characteristic Leaching Procedure test for non-hazardous waste.
 2. Provide wood poles machine trimmed by turning, Douglas Fir conforming to ANSI 05.1. Poles must be gained, bored and roofed before treatment. Poles shall be full length pressure treated with coal-tar creosote preservative conforming to AWWA C4. Poles shall be branded by the manufacturer with his mark and date of treatment, height and class of pole, wood species, preservation code, and retention..
 3. Pole line hardware shall be hot dip galvanized conforming to ASTM A153.
- H. Nameplates: Laminated plastic nameplates shall be provided for each cabinet. Nameplates shall be 1/8-inch thick Melamine plastic, black with white center core, 1-inch high by 2-1/2 inches wide, minimum. Lettering shall be minimum 1/4-inch high normal block lettering . Equipment designations shall be as indicated on the Drawings.
- I. Hardware, Supports, Backing, Etc.: All hardware, supports, backing and other accessories necessary to install electrical equipment shall be provided. Wood materials shall be "wolmanized" treated against termites, iron or steel materials shall be galvanized for corrosion protection, and non-ferrous materials shall be brass or bronze.

PART 3 - EXECUTION

3.01 GENERAL:

- A. Rules and Permit: The entire installation shall conform to ordinances of the City and County of Honolulu; General Order No. 10, Public Utilities Commission, State of Hawaii; and shall be made in strict accordance with the latest rules and regulations of the National Board of Fire Underwriters, the currently adopted edition of the National Electrical Code (NEC) and the local Electrical Bureau. The Contractor shall obtain and pay for the electrical permit as required by local laws and rules. All work shall be inspected by the proper local authorities as it progresses. The Contractor shall pay all inspection fees and shall deliver certificates of completion and inspection to the Engineer before final payment will be made. Costs of permits and inspection fees shall be included in the Contractor's bid price.
- B. Materials and Workmanship: All labor and materials of every kind shall be subject to the approval of the Engineer who shall be afforded every facility for ascertaining the competence of such labor and examining such materials as he may deem necessary. Concealed work shall be reopened at random as directed during formal inspection by Engineer or Electrical or Utility Inspector.
- C. Qualification of Installers: For actual fabrication, installation and testing of the Work of this section, use only thoroughly trained and experienced workmen completely familiar with items required and with manufacturers' recommended methods of

installation. In acceptance or rejection of installed work, no allowance will be made for lack of skill on part of workmen.

- D. Construction Methods: Construction shall conform to construction practices as recommended by the American Electricians Handbook by Croft (latest edition), American National Standards Institute (ANSI), Edison Electric Institute, National Board of Fire Underwriters (NBFU), National Electrical Code (NEC), National Electrical Manufacturer's Association (NEMA), National Electrical Safety Code (NESC), National Fire Protection Association (NFPA), Underwriters' Laboratories, Inc. (UL) and applicable instructions of manufacturers of equipment and material supplied for this project.
- E. Inspection: Skill and competency of workmanship shall be subject to the approval of the Engineer, inspectors of the utility companies, and the City and County of Honolulu. Notification for inspection shall be given to the respective companies or agencies three working days in advance of work.
- F. Record Drawings: The Contractor shall maintain an accurate and adequate record of each change as it occurs, regardless of how ordered. As-built drawings shall be prepared in accordance with project requirements.
- G. Plans and Specification: This specification is intended to cover all labor, materials and standards of workmanship to be employed in the work indicated on the plans and called for in the specification or reasonably implied therein. The plans and specification supplement one another. Any part of the work mentioned in one and not represented in the other, shall be done the same as if it has been mentioned in both. The Contractor shall not make alterations in the drawings and specification.
- H. Discrepancies and Interpretations:
 - 1. Should the Contractor find any discrepancies in or omissions from any of the documents or be in doubt as to their meaning, he shall advise the Engineer who will issue any necessary clarification within a time period which does not disrupt the progress of the work.
 - 2. All interpretation and supplemental instructions will be in the form of a written addenda to the Contract Documents.
 - 3. Should any discrepancy arise from the failure of the Contractor to notify the Engineer, the higher quality or larger quantity of item shall prevail. Engineer shall make the final interpretation and judgement.
 - 4. In the event of a discrepancy between small scale drawings and large scale details, or between drawings and specification, on which is in violation of any regulations, ordinances, laws or codes, the discrepancy, if known by the Contractor, shall be immediately brought to the attention of the Engineer for a decision before proceeding with the particular work involved. Work carried out disregarding these instructions will be subject to removal and replacement at the Contractor's expense.
- I. Symbols: The standard electrical symbols together with the special symbols, notes and instructions shown on the drawings indicate the work and outlets required and are all to be included as a part of this specification.

- J. Coordination: This specification is accompanied by plans, sections and elevations, and site plans indicating locations of all outlets, controls, service runs, and other electrical apparatus. These locations are approximate and, before installing, the Contractor shall study the adjacent civil utility and landscaping details and actually make the installation in the most logical manner. Any outlet may be relocated within ten feet before installation at the direction of the Engineer. The circuit routing is typical only and may be varied in any logical manner.
- K. Before installation, verify all dimensions, conditions and sizes of equipment at job site. Installation shall be complete in every detail as specified and ready for use.
- L. Work shall conform to ordinances of City and County of Honolulu; latest edition of National Electrical Code (NEC); General Order No. 10, Public Utilities Commission, State of Hawaii; and Regulations and Standard Practices of Hawaiian Electric Company, Inc., Hawaiian Telcom, Inc. and Sandwich Isles Communications, Inc.
- M. Applicable rules, standards and specifications of following associations shall apply to materials and workmanship:
- American National Standards Institute (ANSI)
Illumination Engineer Society (IES)
National Board of Fire Underwriters (NBFU)
National Electrical Manufacturer's Association (NEMA)
National Fire Protection Association (NFPA)
Underwriters' Laboratories, Inc. (UL)
- Applicable instructions of manufacturers of equipment and material supplied for this project.
- N. All metallic materials shall be protected against corrosion. Exposed metallic parts of outdoor apparatus shall be given a rust-inhibiting treatment and standard finish by the manufacturer. All such parts as boxes, bodies, fittings, guards and miscellaneous parts made of ferrous metals but not of corrosion-resistant steel, shall be zinc-coated in accordance with ASTM A153. The Contractor shall not join dissimilar metals that will result in deterioration due to galvanic corrosion.

3.02 CONSTRUCTION REQUIREMENTS:

- A. Installation of Conduits:
1. Saw cut, ream and taper conduits with manufacturers' approved tool.
 2. Conduits shall be clean and free from debris and rubbish.
 3. After each day's work, provide temporary conduit plugs at the end of conduits to prevent entry of dirt, rubbish, debris or concrete.
 4. Swab all conduits and dry before installing wires.
 5. Pullwires shall be placed in all empty conduit for ten feet in length and as indicated.
 6. Install insulating bushings and two locknuts on each end of every conduit run at enclosures and boxes. Provide grounding bushings as required.

B. Street Lighting Systems:

1. Street lighting materials and installation shall be in accordance with Standard Specifications, and as specified herein and on the Drawings..
2. Street lighting system shall provide illumination along length of project roadways. System shall be completely tested and ready for use.
 - a. Street light fixtures shall be mounted with bracket arms oriented 90 degrees to center line of road.
 - b. Prior to trenching or excavating, structural outlines and center lines of street light pole shall be clearly staked, and approval received from the utility companies and inspectors. Staking shall be with steel or wood pegs or paint.
 - c. Wood poles shall be placed so that the bottom of the brand or disc is 10 feet from the pole butt.

C. Structural Steel And Miscellaneous Metal Work: Structural steel work including bolts, nuts, anchors, etc. shall be galvanized by hot-dipped process after fabrication into largest practical sections.

D. Installation of Wiring System:

1. Secondary electrical system materials and installation shall be in accordance with Standard Specifications, and as specified herein and on the Drawings.
2. Splicing or Wiring System:
 - a. Splices made according to NEC Article 110.
 - b. Splices for 600 Volt Class Cables: The conductors shall be joined securely both mechanically and electrically by the use of solderless or crimp type connectors with properly sized tools
 1. Splices for cables No. 10 AWG and smaller shall be made only in accessible locations using a compression connector on the conductor, taped watertight.
 2. Splices for cables No. 8 AWG and larger shall be made only in accessible locations using a compression connector on the conductor and by insulating and waterproofing suitable for continuous submersion in water.
3. Cable Terminations: Protect terminations of insulated power and lighting cables from accidental contact, deterioration of coverings and moisture by the use of terminating devices and materials.
 - a. Install all terminations of insulated power and lighting cables in accordance with the manufacturer's requirements.
 - b. Make terminations using materials and methods as indicated or

specified herein or as designated by the written instruction of the cable manufacturer and termination kit manufacturer.

4. **Protection of Wire and Cable Ends:** The ends of wire and cables that are not to be spliced or connected to equipment shall be protected from moisture and other damage.
 - a. The ends of wires and cables shall be protected by applying not less than six half-lapped wraps of electrical insulating tape beginning three inches from the end of the wire of cable and continuing over the exposed conductor to form a watertight seal.
 - b. The ends of wires and cables that are to be left unspliced or unconnected temporarily during construction shall be protected to prevent moisture from getting into the cable.
5. **Finishing:**
 - a. All cutting that may be required for complete installation of the electrical work shall be carefully performed, and all patching shall be finished in first-class condition by the Contractor.
 - b. Wipe clean all exposed raceways and enclosures with rag and solvent. Unfinished raceways and enclosures shall be prime-painted and finished to blend into the background. (Do not cover nameplates). Factory finished enclosures shall not be painted.
6. **Miscellaneous Details:**
 - a. Cut, drill and patch as required to install electrical system. Repair any surface damaged or marred by notching, drilling or any other process necessary for installation of electrical work. Cutting, repairs and refinishing subject to the approval of the Engineer. Need for remedial work determined by the Engineer as attributable to poor coordination and workmanship shall be cause for reconstruction to the satisfaction of the Department.
 - b. Attachment of electrical equipment to wood by non-ferrous wood screws. Attachment to concrete by expansion anchors. Powder-charge-driven studs and anchors permitted only with prior approval.
 - c. Furnish necessary test equipment and make all test necessary to check for unspecified grounding, shorts and wrong connections. Correct faulty conditions, if any.
7. **Concrete Brick and Hollow Concrete Block Work:**
 - a. Concrete brick and hollow block shall be laid in full bed of mortar, both horizontally and vertically.
 - b. Mortar shall be one part (by volume) cement and three parts (by volume) fine aggregate, thoroughly mixed and used when fresh. Retampering will not be allowed. Mortar shall have a minimum 28 days strength of 2,500 psi.

- c. Setting bed shall be of depth required to bring top of blocks flush with finish line.

3.03 EXISTING UNDERGROUND UTILITIES:

- A. Underground utilities indicated on plans are approximate in location. It is not the intention of plans to imply that all existing utilities are drawn and located. It shall be the responsibility of Contractor to coordinate locations of existing utilities prior to doing any excavation work. Any damage to existing utilities shall be repaired by Contractor at no cost to the Department.

3.04 CLEANING AND REPAIRING:

- A. During the progress of work, all rubbish, waste lumber, displaced materials, etc. shall be removed as soon as possible and upon completion of the work, Contractor shall remove from Owner's property and from all public and private property, at his own expense, all temporary structures, rubbish and waste material resulting from his operations.
- B. The Contractor shall restore all removed or damaged pavement, gutters, curbs, sidewalks, sign posts, trees and landscape damaged by his operations to as near their original condition or better. Materials used for restoration work shall be equal to or better in quality than the materials the Contractor will replace, and matching in thickness, texture, and color whenever applicable. The grades of the restored surfaces shall conform to the existing grades.

3.05 TESTS:

- A. Ground Resistance: Ground resistance measurements of each ground rod shall be taken and certified by the Contractor. Ground resistance measurements shall be made in normally dry weather, not less than 48 hours after rainfall, and with the ground under test isolated from other grounds. Upon completion of the project, the Contractor shall submit in writing to the Engineer, the measured ground resistance of each ground rod and grounding system, as well as the resistance and soil conditions at the time the measurements were made.
- B. Test all 600 volt class conductors to verify that no short circuits or accidental grounds exist. Make tests using an instrument which applies a voltage of approximately 500 volts to provide a direct reading in resistance, and measure the insulation resistance from phase to phase and phase to neutral. All test results shall be recorded and submitted.
- C. Contractor shall arrange with Hawaiian Electric Company to energize street lights a minimum of six hours for final inspection and acceptance. Contractor shall assume all costs.
- D. Wherever test or inspection reveals faulty materials or installation, Contractor shall take corrective action, at his own expense, repairing or replacing materials or installation as directed. The materials or installation shall then be retested.

END OF SECTION