SPECIFICATIONS
INDEX

DIVISION 2 - SITE WORK

SECTION 02100 –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 the Department and at no extra cost to the Department. 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 GRUBBING

A. The Contractor shall grub the ground surface within the roadways that were mass graded under the "East Kapolei II Portion of Lot 6A Mass Grading Plans". Grubbing shall include removal of tree roots, shrubbery roots and organics including roots and organics below 4" of existing grade.

B. No roadway excavation or trench excavation shall be undertaken until area has been 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

DIVISION 2 SITEWORK

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.

1.03 RELATED WORK IN OTHER SECTIONS

Temporary Soil Erosion Control.....Section 02270

1.04 SUBSURFACE SOIL DATA: Subsurface soil investigations have been made at the project site. A copy of the complete report entitled "Revised Preliminary Geotechnical Exploration Report – Proposed East Kapolei Phase II Development Study Area I, Honouliuli, Ewa, Oahu, Hawaii," dated June 2009, prepared by PSC Consultants LLC is available with these bid documents. Test pit and boring logs are shown in the soils report.

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.

1.05 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 Department 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: All finished grades shall be kept moist until chemically stabilized. Where shrinkage cracks are noted after compaction of the finished grade, 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 Department. 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 Department.

PART 2 – PRODUCTS

2.01 MATERIALS

A. General Fill: On-site material excavated from within the project limits and meeting the requirements for embankment may be utilized as fills unless otherwise recommended by the Geotechnical Engineer during construction. This excavated material shall be used as general fill under the required non-expansive select material as shown on the plans.

B. Imported Borrow: Additional general fill material needed for general filling shall consist of imported borrow materials that have the same general properties as on-site material described above. Borrow material shall be tested by the geotechnical engineer to evaluate its stability for use as general fill. and shall be approved by the Construction Manager.

C. Non-Expansive Select Material: Non-expansive select material to be used for this project shall consist of crushed coral, basalt gravel, or cinder sand. The non-expansive select material shall be well-graded from coarse to fine with no particles larger than 3 inches in largest dimension. It shall have a plasticity index not exceeding 15 as determined by ASTM D-4318-84; and have maximum 20 percent particles passing the No. 200 sieve. The material shall have a laboratory CBR value of 25 or higher. Free draining materials and highly permeable materials shall not be used as select material. Select material shall be tested by the geotechnical engineer for conformance with these requirements prior to delivery to the project site for the intended use.

D. Rocks: Rocks greater than 6 inches in diameter may be used at the bottom of deep fills or may be placed in areas suitable for rock disposal in accordance with the recommendations of the geotechnical engineer. Rocks not used in an engineered fill shall be disposed of as directed by the Construction Manager.

PART 3 – EXECUTION

3.01 GRADING

A. Notification of Schedule: The Construction Manager shall be notified by the Contractor 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 Construction Manager 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 Department, who shall approve all subgrade preparation, fill material, methods of placing and compaction and perform field density tests during the grading. No deviation from these specifications shall be made except upon the written approval of the Engineer and/or other public agencies having jurisdiction.

C. Preparation of Subgrades for Areas to Receive Fill:

1. Firm Competent Soils: The area shall be proof rolled to locate soft and yielding spots. The surface to receive fill shall be scarified to a depth of 6 inches until free of large clods, moisture-conditioned to at least 2 to 3 percent above the optimum moisture content and compacted to at least 90 percent of the maximum dry density established by ASTM D1557-91.

2. Soft Wet Soils: Soft, yielding or pumping areas shall be over excavated to firm natural material and stabilized by backfilling with select material placed in 8-inch thick level lifts, moisture-conditioned at least 2 to 3 percent above optimum moisture content and compacted to 90 percent relative compaction.

D. Soil Fill Placement and Compaction: After completion of the subgrade preparation, general fills or imported borrow materials shall be brought to at least 2 percent above the optimum moisture content, placed in level lifts not exceeding 8 inches in loose thickness, and compacted to a minimum of 90 percent of the maximum dry density established by ASTM D1557-91. The minimum degree of compaction within the upper 2.5 feet of the finished grade should be 95 percent.

Each lift of non-expansive select material shall be brought to above the optimum moisture content, placed in level lifts not exceeding 8 inches in loose thickness, and compacted to a minimum of 95 percent of the maximum dry density established by ASTM D1557-91.

Each lift of fill shall be thoroughly compacted complete to the edge before the next layer is laid thereon. Compaction shall be obtained with the use of conventional compaction equipment designed for the intended purpose. The incidental compaction achieved by the passage of hauling units over the fill will not be considered adequate.

Each lift of fill material shall be brought to at least 2 to 3 percent above the optimum moisture content to permit compacting to the specified requirements. If the soil moisture content is too high or too low, the soil moisture content shall be adjusted by suitable means before placement. Compaction of each lift of fill (including slopes, berms, etc.) shall be continued until the density as determined by field tests reaches a value of at least 90 percent of the maximum indicated by the aforementioned methods. In lieu of compacting of the slope faces, embankments may be overfilled past the design slope and then cut back.

In all cases where the existing ground surface is steeper than five horizontal to one vertical, the existing ground shall be keyed and benched into the underlying stiff soils when fill is placed on the sloping ground surface.

E. 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 deeper excavation, he shall direct the necessary modifications to be made.

Suitable material from excavation shall be placed at designated fill location.

F. Slopes: For fill slopes consisting of granular materials (six inches or less in size) and cut slopes, maximum slopes of two horizontal to one vertical (2:1) shall be used. Fill slopes shall be constructed by overfilling and cutting back to the required slope ratio.

G. 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 or drainage swales. Runoff diversion by ditches shall be completed in the time specified in the Proposal.

H. Field Testing: The Construction Manager shall be notified seven (7) 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 Department.

I. 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 Construction Manager in carrying out the work. Any instructions given to him by Construction Manager shall be considered to have been given to the Contractor personally.

J. 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.

K. 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 Construction Manager. 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.

3.03 MAINTENANCE OF CHEMICALLY STABILIZED GRADED AREA

A. Maintenance shall include, but is not limited to:

1. Protect areas susceptible to traffic by erecting barricades immediately after stabilization.

2. Maintain chemically stabilized area per manufacturer's specifications.

3. Keep stabilized area free of weeds and undesirable grasses through daily weeding, if required. Remove the entire root system. Dispose of all weeds in appropriate trash containers.

4. Inspect area for disease or insect damage weekly. Treat affected material immediately.

END OF SECTION

DIVISION 2 SITEWORK

SECTION 02230 – FINE GRADING OF ROADWAY PRISM

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 and grade the roadway prism necessary to install curbs, gutters, sidewalks and pavement structure. Work shall be governed by Section 12, Roadway Excavation, and Section 30, Select Borrow for Subbase Course, of the Standard Specifications.

1.03 RELATED WORK IN OTHER SECTIONS

Temporary Soil Erosion Control.....Section 02270

1.04 SUBSURFACE SOIL DATA: Subsurface soil investigations have been made at the project site. A copy of the complete report entitled "Revised Preliminary Geotechnical Exploration Report – Proposed East Kapolei Phase II Development Study Area I, Honouliuli, Ewa, Oahu, Hawaii," dated June 2009, prepared by PSC Consultants LLC is available with these bid documents. Test pit and boring logs are shown in the soils report.

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.

1.05 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 Department 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 Department. 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 causes 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 Department.

PART 2 – PRODUCTS

2.01 MATERIALS

A. General Fill: On-site material excavated from within the project limits and meeting the requirements for embankment may be utilized as fills unless otherwise recommended by the Geotechnical Engineer during construction.

PART 3 – EXECUTION

3.01 GRADING ROADWAY PRISM

A. Notification of Schedule: The Construction Manager shall be notified by the Contractor at least two weeks in advance before grading operations are scheduled to begin. Further, the Contractor shall advise the Construction Manager of the proposed overall schedule for the grading operations.

B. General: All cuts and fills to be constructed shall be monitored by a licensed geotechnical consultant (soils engineer) retained by the Department, who shall approve all subgrade preparation, fill material, methods of placing and compaction and perform field density tests during the grading. Written approval shall be issued upon completion of cuts and fills.

C. Preparation of Subgrades for Areas to Receive Fill: Firm Competent Soils: The surface to receive fill shall be scarified to a depth of about 6 inches until free of large clods, moisture-conditioned to at least 2 percent above the optimum moisture content and compacted to at least 95 percent of the maximum dry density established by ASTM D1557-91.

D. Soil Fill Placement and Compaction: After completion of the subgrade preparation, select granular fill materials shall be brought to at least 2 percent above the optimum moisture content, placed in level lifts not exceeding 8 inches in loose thickness, and compacted to a minimum of 95 percent of the maximum dry density established by ASTM D1557-91.

Each lift of fill shall be thoroughly compacted complete to the edge before the next layer is laid thereon. Compaction shall be obtained with the use of conventional compaction equipment designed for the intended purpose. The incidental compaction achieved by the passage of hauling units over the fill will not be considered adequate.

Each lift of fill material shall be brought to at least 2 percent above the optimum moisture content (above the optimum moisture content for the capping fill) to permit compacting the specified requirements. If the soil moisture content is too high or too low, the soil moisture content shall be adjusted by suitable means before placement. Compaction of each lift of fill shall be continued until the density as determined by field tests reaches a value of at least 95 percent of the maximum indicated by the aforementioned methods. In lieu of compacting the slope faces, embankments may be overfilled past the design slope and then cut back.

The finished subgrade below areas to receive asphalt concrete base course for pavements shall be scarified to a depth of 6 inches, moisture-conditioned to above the optimum moisture content, and compacted to at least 95 percent of the maximum dry density established by ASTM D1557-91.

E. 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.

F. 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 or drainage swales.

G. Field Testing: The Construction Manager 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 Department.

H. 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 Construction Manager in carrying out the work. Any instructions given to him by the Construction Manager shall be considered to have been given to the Contractor personally.

I. 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 Construction Manager indicate that conditions will permit satisfactory results.

3.02 UNSUITABLE EXCAVATED MATERIAL: The Contractor shall remove from the site all unsuitable excavated material unless specified otherwise by the Construction Manager. 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 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

Fine Grading of Roadway Prism.....Section 02230

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.

C. Catch Basin Inlet Filters: "True Dam" sediment filter (by Dandy Products, Inc.) or approved equal.

PART 3 – EXECUTION

3.01 TEMPORARY EROSION CONTROL

A. The Construction Manager 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 Construction Manager may also direct the Contractor to provide immediate, permanent, or temporary pollution control measures to prevent contamination of streams, 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 Construction Manager.

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 to 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 02480 - LANDSCAPE PLANTING

PART 1 - GENERAL

1.01 GENERAL PROVISIONS: The General Instructions to Bidders, the General Conditions of Construction Contracts, and Special Provisions preceding these specifications shall govern this section of the work.

1.02 WORK INCLUDED: Work includes all labor, materials, equipment and incidentals required to complete the landscaping by a licensed landscape contractor as shown on the plans and as herein specified. Grass restoration for trenches (12" or less in width) for sewers, drains, culverts, electrical ducts, potable water lines, irrigation lines and related appurtenances shall not be required to be done by a licensed landscape contractor.

1.03 REFERENCE: DPR Standard Specifications for Landscaping.

1.04 EXPLANATION AND PRECEDENCE OF DRAWINGS:

A. For purposes of clarity or legibility, drawings are essentially diagrammatic and although the locations and areas of plant material are drawn to scale, Contractor shall make use of all data in all contract documents and shall verify this information at the site.

B. All work called for on the drawings by notes shall be furnished and installed whether or not specifically mentioned in the specifications.

1.05 WORK SPECIFIED IN OTHER SECTIONS:

A. Stripping surface, stockpiling and spreading of existing on-site soil and/or furnishing and spreading of imported screened soil in all planting areas except for trees and shrubs.

B. Submission of samples of the existing on-site soil and/or imported screened soil and the soil analysis.

1.06 SOIL PREPARATION (For grass and ground cover planting):

A. General:

1. These specifications shall supersede Sections 50 and 51 "Standard Specifications for Public Works Construction," September 1986, City and County of Honolulu.

2. Soil Testing: Complete soil testing and soil analysis shall be done on all existing on-site soil and/or imported screened soil to be used for landscaping on the site. Soil testing shall be done by the University of Hawaii Cooperative Extension Service or an independent soil engineering laboratory. Soil samples shall be tested for pH and "available" phosphorous, potassium, calcium and magnesium. A test for salinity may be requested upon inspection by the Engineer. Contractor shall bear all cost of soil testing.

B. Materials:

1. Commercial fertilizer shall be of the analysis 10-30-10, or as determined by the Engineer.

2. Lime (Calcium Carbonate) shall be agricultural type acceptable to the Engineer.

3. Gypsum (calcium sulfate) shall be agricultural type acceptable to the Engineer.

4. Organic Nutrient soil conditioner (humus) shall be Ferto (6-4-2) or Gro-Power Plus (5-3-1) or equal acceptable to the Engineer.

5. Organic non-nutrient-soil conditioner shall be “Menehune Mulch” or Big "R" Redwood soil conditioner or equal acceptable to the Engineer.

C. Soil Amending Application Rates:

1. Organic nutrient soil conditioner shall be applied at the rate of l50 lbs. per l000 square feet or as specified on plans.

2. Organic non-nutrient-soil conditioner shall be applied as specified on plans.

3. Addition of Amendments: Addition of commercial fertilizer and amendments shall be in strict accordance to specifications and as determined by the Engineer after submission of soil test report.

4. Contractor shall submit copies of all purchase and delivery receipts to the Engineer for all amendments ordered and used on this project.

D. Soil Preparation Procedure:

1. After site grading operations have been completed, shape and fine grade to a smooth fine surface the entire site in accordance with the grading plan. In ballfield areas, grade to a maximum 2% slope ground plane to insure proper drainage.

2. Spread amendments on ground in even layers at rates specified in 1.05c, 1, and 2 and incorporate to a depth of 4 inches by rotary hoe method, working over all areas in alternate directions. ALL AMENDMENTS SHALL BE SPREAD OVER THE SITE IN THE PRESENCE OF AND ACCEPTED BY THE ENGINEER BEFORE INCORPORATION. This soil amending and acceptance procedure shall not be deleted, substituted nor amended in any manner.

3. Drag all areas by mechanical means to break up clods. Remove debris and rocks over 1 inch in diameter by use of a spring tooth harrow with debris screen container. Fine grade to a smooth continuous surface and roll with a lightweight disc roller prior to planting.

1.07 LANDSCAPE PLANTING - TREES, SHRUBS, GROUND COVERS AND GRASS:

A. General: Plant trees, shrubs, ground covers and grass where indicated on the drawings and specified herein.

B. Materials:

1. Imported screened soil: Shall be screened, (1/2-inch screen), natural, fertile, friable soil free of stones, noxious seeds, roots, sticks, weeds, (especially nutgrass), subsoil in any quantity. Red Humic latosol soils or types known as "Palolo Clay" or "Lualualei Clay" are unacceptable. Soil should have satisfactory loam characteristics, and it shall not be screened subsoil.

2. Commercial Fertilizer: Shall be slow release Agriform (20-10-5) tablets or Osmocote (18-6-12) polymeric capsules, unless otherwise detailed on plans.

3. Organic nutrient-soil conditioner (humus): shall be Ferto (6-4-2) or Gro-Power Plus (5-3-1) or equal acceptable to the Engineer.

4. Organic non-nutrient-soil conditioner: shall be Burnt Bagasse Mix or Big "R" Redwood soil conditioner or equal acceptable to the Engineer.

5. Stakes for container stock trees shall be 2" x 2" x 8'-0" rough construction grade redwood or treated Douglas Fir; stakes for field grown trees shall be #5 reinforcing bars, 3 feet long minimum or as detailed on drawings.

6. Tree Ties shall be new or used reinforced rubber or plastic hose inserted with #12 gauge pliable galvanized iron wire or commercial ties acceptable to the Engineer.

C. Plant Materials:

1. Nomenclature: The names of plants required shall conform to "Gardens of Hawaii" by Marie C. Neal. Names of plants not included therein shall conform to names generally accepted in the local nursery trade. The Engineer shall be the final arbiter in decisions regarding plant identification and nomenclature.

2. Quality and Size: All plant materials shall be uniform and have a habit of growth that is normal for the species and shall be sound, healthy, vigorous and free from insect pests, plant disease and injuries. Trees and shrubs in containers of the size specified shall have sufficient roots to hold earth together intact after removal from containers without being rootbound.

Trees will be straight of uniform shape without damaged, crooked or multiple leader, unless otherwise specified. Trees shall be free of bark abrasions, sunscalds, disfiguring knots or fresh cuts of limbs over 3/4 inch which have not completely calloused.

All materials shall equal or exceed the measurements specified in the drawings which are minimum acceptable sizes. Caliper measurements for trees shall be taken at a point 6 inches above natural ground line for trees up to 4 inches in caliper and at a point 12 inches above natural ground line for trees over 4 inches in caliper. Materials shall be measured before pruning with branches in normal condition.

D. Trees, Shrubs and Ground Cover Procedure

1. Planting Pits: Reasonable care shall be exercised to have tree and shrub pits dug and soil prepared prior to moving plants to their respective locations for planting to ensure that they will not be unnecessarily exposed to drying elements or to physical damage. The diameter of all plant pits shall be at least twice the diameter of the container. The depth of pits for trees and shrubs shall be sufficient to accommodate the rootball depths when the plant is set plus at least 12 inches clearance for trees and 6 inches clearance for shrubs for prepared soil at the bottom of the pit.

2. Setting Trees: All trees shall be set at such a level that after settlement, the top of rootball shall be approximately 4-6 inches below the finished grade of the surrounding ground. Each shall be set upright and faced to provide the best appearance possible.

3. Planting: Trees shall be planted in the specified backfill which shall be thoroughly settled by watering and tamping. Backfill mix for all trees shall consist of organic non-nutrient-soil conditioner, organic nutrient-soil (humus) and screened soil in proportions detailed on plans. MagAmp (7-40-6) shall be mixed in bottom of pits in proportions detailed on plans. All soil amendments and screened top soil shall be thoroughly mixed together before being placed in the plant pit. If the on-site soil available from the excavation of planting pits, as herein specified, is insufficient in quantity or of poor quality for backfill, the Contractor shall provide the necessary additional imported screened top soil. Backfill shall not be packed.

   After backfilling, 6" below the rootcrown, soak pit with water and place the required number of Agriform tablets or amount of Osmocote fertilizer evenly around the rootball, approximately 2 inches from root tips. Slow release fertilizer shall be applied to trees and shrubs at rates detailed on plans.

   Backfill rest of hole with specified backfill mixture. Firm down backfill, but do not pack. Immediately after planting, thoroughly soak planting pit with water.

4. Staking: Trees shall be supported immediately after planting.

   Container-grown trees shall be secured with stakes as detailed on plans.

5. Pruning: Pruning of trees shall be limited to the minimum necessary to remove injured twigs and branches and to compensate for the loss of roots during transplanting but never to exceed one-half of the branching structure.

6. Ground Cover Planting: Plant ground cover in prepared soil only, refer to 1.06. Soil Preparation. Plants shall be spaced equally and uniformly at the distance indicated on the plan. Spacings shown on the drawings are triangular, unless noted otherwise. Finish grade shall be smooth and uniform, and drainage patterns and tree water basins shall not be altered. Water and soak ground immediately after planting.

E. Grass Planting:

1. General:

   a. The work covered under this section shall include the furnishing of all labor, equipment, materials and incidentals necessary for grass planting or grass restoration, complete in place, in strict accordance with this section of the specifications and applicable drawings.

b. Grass planting shall commence immediately after the soil preparation has been completed and accepted by Engineer

c. The Contractor may elect to plant grass by either seeding, stolonizing or hydromulching, unless otherwise indicated on the drawings.

2. Materials:

a. Grass shall be common Bermuda, Cynodon dactylon, unless otherwise indicated on the drawings.

b. Grass seed shall be fresh hulled and meet the following requirements:

Pure Seed.....95.0% minimum
Crop Seed..... 1.0% maximum
Weed..... 0.5% maximum
Inert Material..... 5.0% maximum
Germination.....85.0% minimum

Grass seeds shall be delivered to the site in unopened, sealed container, labeled with brand name and percent purity. Labeling shall indicate that the seeds passed a certified germination test no more than 12 months prior to use.

c. Grass stolons shall be healthy, living runners 2 inches to 4 inches long with a well developed root system. They shall be freshly cut and free from weeds. Immediately following harvesting, the stolons shall be thoroughly watered then covered and kept moist during storage and transportation until planted.

3. Procedure:

a. Preparation of Planting Area: Refer to 1.06. Soil Preparation.

b. Planting by Seed: Ground surface shall be raked to a smooth even plane, broadcast seeds uniformly by mechanical sower at a minimum rate of 5 lbs. per 1000 square feet. Sow one-half the seeds in one direction and the remainder at right angles to the first direction. The seeds shall be incorporated into the top 1/4 inch to 1/2 inch of soil. After sowing, the seeded area shall be compacted by hand or a cultipacker or mechanical roller weighing 60 to 90 pounds per lineal foot of roller. The area shall be thoroughly and gently watered and kept moist during the germination period.

c. Planting by Stolons: After ground surfaces have been raked to a smooth and even plane, broadcast stolons uniformly by hand at a minimum rate of 6 bushels per 1000 square feet. The stolons shall be incorporated into the top 1/4 inch to 1/2 inch of soil. After broadcasting, the planted area shall then be disked and rolled by a mechanical roller weighing 60 to 90 lbs. per lineal foot of roller to insure close contact of the soil and stolons. Do not roll on wet soil.

d. Planting by Hydromulching:

(1) Description: This work shall consist of furnishing and applying by hydromulching, seeds or stolons, and mulch to areas designated on the plans or ordered by the Engineer and shall include continuous care and maintenance in accordance with these specifications. Such areas shall include those damaged or made barren by construction operations or equipment. All steep banks 3 to 1 slope or more shall be hydromulched for erosion control.

(2) Materials:

(a) Seeds: Seeds shall be hulled common Bermuda (Cynodon dactylon), certified, meeting the following requirements:

Pure Seed.....95.0% minimum
Crop Seed..... 1.0% maximum
Weed..... 0.5% maximum
Inert Material..... 5.0% maximum
Germination.....85.0% minimum

The seeds shall be applied at the rate of 50 pounds per acre (minimum) and within 12 months of the date of the certified germination test.

(b) Stolons: Shall be healthy, living, well developed runners, 1 inch to 2-1/2 inches in length, freshly dug up and free from weeds. Immediately following harvesting, the stolons shall be thoroughly watered then kept moist during storage and transportation until planted. Stolons shall be applied at the rate of 8 bushels per 1000 square feet (minimum).

(c) Mulch: Mulch shall be specifically processed fiber containing no growth or germination inhibiting factors. It shall be such that after addition and agitation in the hydraulic equipment with seeds, fertilizer, water and other additives not detrimental

to plant growth, the fibers will form a homogeneous slurry. When hydraulically sprayed on the soil, the fibers shall form a blotter-like ground cover which readily absorbs water and allows infiltration to the underlying soil. In every application, complete coverage of the soil shall be attained. Mulch shall be applied at the minimum rate of 1700 pounds per acre.

(3) Procedure:

(a) The Contractor shall notify the Engineer not less than 24 hours in advance of any hydromulching operation and shall not begin work until area for hydromulching has been prepared and accepted by Engineer. Acceptance shall include inspection of fine grading to provide for the collection and disposal of surface and subsurface water to protect planting areas against unnecessary erosion. Acceptance shall not relieve the Contractor of his responsibility to restore any damage to the grade until the planted areas are accepted. Following the Engineer's acceptance, hydromulching of the approved planting areas shall begin promptly.

The hydromulch equipment shall be capable of mixing all the necessary ingredients to a uniform mixture and to apply the slurry to provide uniform coverage. Seeds, fertilizer and mulch mix shall be applied in one operation by approved hydraulic equipment. The equipment shall have a built-in agitation system with an operating capacity sufficient to keep the mix in uniform distribution until pumped from the tank. Distribution and discharge lines shall be large enough to prevent stoppage and shall be equipped with hydraulic discharge spray nozzles which provide a uniform distribution of the slurry. Areas inaccessible to hydromulching application shall be stolonized or seeded by hand broadcast method acceptable to Engineer and fertilized.

Water shall be applied immediately following mulching in such quantities as to moisten the soil and mulch. Watering shall be continued in such manner, quantity and frequency to insure proper germination and growth and shall be done in a way that will prevent erosion. Watering equipment shall

be of a type that will not cause erosion or runoff. If method is deemed unacceptable by the Engineer, it shall be corrected by the Contractor. Should the slope erode or silt be transported to pose as potential pollutants, it shall be immediately removed and prevented from entering into water channels. All eroded areas shall be restored to the original grade as soon as possible.

1.08 PLANTING MAINTENANCE, INSPECTION AND ACCEPTANCE:

A. General: This item of work shall consist of the maintenance of all plants and planted areas in optimum growing condition and appearance and the inspection and acceptance of landscape planting.

B. Pre-Maintenance Inspection:

1. A pre-maintenance inspection shall be held at the completion of all planting operations and prior to the beginning of the formal maintenance period.

2. All deficiencies shall be corrected and all plantings accepted by the Engineer before the issuance of a commencement date of the formal maintenance period.

C. Period of Maintenance:

1. Maintenance shall begin immediately after completion and acceptance of all planting and shall continue for 60 calendar days thereafter, unless otherwise specified in the Proposal or on the drawings. The care of plants prior to completion of all planting, including relocated trees, shall not be considered as part of the maintenance period but only as an incidental to landscape work.

2. Maintenance shall include watering, weeding, fertilizing, topdressing with amended imported screened soil acceptable to Engineer, mowing, pruning, repairing stakes, guys and ties, spraying for diseases and insects, replanting and any other work necessary to maintain all plants in a healthy growing condition. The contractor shall irrigate all planting areas as required to insure active growth keeping areas moist but not saturated. Regulate irrigation as necessary to avoid erosion and gullying. The Contractor shall be responsible for the protection of all plants and planting areas during the maintenance period and shall pay for all water required during the maintenance period unless otherwise specified. All dead plant materials shall be replaced immediately. During the last week of the maintenance period, the Contractor shall fertilize the entire planting areas as follows:

a. Organic nutrient-soil conditioner (humus) at the rate of 25 lbs. per 1000 square feet. Ferto (6-4-2) or Gro-Power Plus (5-3-1) shall be applied in the presence of the Engineer.

D. Final Inspection and Acceptance:

1. At the completion of all planting operations and the maintenance period, an inspection shall be performed.

2. The Contractor shall request the inspection in writing to the Engineer 7 calendar days prior to the completion of the maintenance period in order that a mutually agreeable time for inspection may be arranged.

3. The Contractor and the Engineer, or their representatives, shall be present at the inspection.

4. Any plant material found not to be in healthy growing condition shall be immediately replaced by the Contractor.

5. Acceptance of the grass planting after the maintenance period shall be contingent upon the following:

   a. 95% coverage of the overall area shall be required for grass planting.

   b. All germinated areas shall be healthy and living at the end of maintenance period.

   c. Weeds shall not exceed an area greater than 10% of the overall grass area.

   d. Grass shall be mowed and not taller than 1 inch in height. All clippings shall be removed.

   e. All depressions shall be filled to proper grade and area regrassed as required.

6. Acceptance of the ground cover planting after the maintenance period shall be contingent upon an 80% coverage.

7. If at the final inspection, the Engineer is of the opinion that all or certain portions of the work is not acceptable as to the intent of the drawings and specifications, an additional 30 days maintenance period shall be extended at no cost to the owner. During this period, the Contractor shall meet all requirements and correct all deficiencies, including any additional mowing and fertilizing. After the 30 days, if the work is still unacceptable or does not meet the conditions as specified under Section 1.08.d.4) & 5), Planting

Maintenance, Inspection and Acceptance, the Contractor shall be charged with liquidated damages for each and every calendar day thereafter and shall be based on the amount bid in the Proposal and as specified in the Schedule of Liquidated Damages.

8. If all plant materials are accepted at this inspection by the Engineer, the Contractor shall be relieved of further maintenance.

9. All trees and palms shall be guaranteed for one year. If any tree or palm fails to survive by the end of one year, it shall be replaced with the same size and species by the Contractor at no cost to the owner. Contractor shall not be held liable for any loss due to lack of proper maintenance, vandalism or accident.

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 Construction 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 12
Subgrade .....Section 29
Aggregate Subbase Course .....Section 30
Aggregate Base Course.....Section 31
Asphalt Surface Treatments.....Section 33
Asphalt Concrete Pavement, Mix No. 3 or 4.....Section 34
Standard Street Survey Monuments.....Section 49

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 Construction Manager 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 Department. 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 33 of the Standard Specifications.

3.04 ADJUSTMENT OF EXISTING UTILITY STRUCTURES TO FINISHED GRADE: Adjust existing utility structures to finished grade in accordance with Section 36 of 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 34 of the Standard Specifications.

END OF SECTION

SECTION 02501 – ASPHALT CONCRETE BASE

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, one or more courses of plant mixed asphalt concrete base course or plant mixed glassphalt concrete base course on a prepared subbase and subgrade in accordance with the requirements of these specifications and in conformity with the dimensions, profiles, sections and details shown on the plans.

1.03 SUBMITTALS: The Contractor shall submit for review the job mix formula for the Asphalt Concrete Base/Glassphalt Concrete Base (with crushed glass and/or virgin material) to be supplied. The job mix formula shall indicate the source of the aggregates, grades of bituminous material and proportion of the crushed glass to be used in the mix. The total amount of bituminous binder in the mix shall be between 4.0% to 6.0% for Asphalt Concrete Base. 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 submitted for review 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	Asphalt Concrete Base
Number of Blows	75
Stability, lb. (minimum number)	2,000
Flow, 0.01 in.	8 – 16
Percent air voids	3 – 8
Percent air voids in mineral aggregate (min.)	13

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. Pavement Samples. At the discretion of the Engineer, the Contractor shall obtain pavement samples and/or test the samples and restore the affected areas at no extra cost to the City.

1. Quantity. Two (2) core or cut samples shall be obtained per street.

2. Size. The size of the samples will be directed by the Engineer. Core samples shall be minimum 4 inches in diameter. Cut samples shall be minimum 12 inches by 12 inches. Samples shall be taken to the full depth of the course.

3. Location. The location of the samples will be directed by the Engineer.

4. Testing. Samples shall be tested to determine thickness and density of the completed pavements. A nuclear gauge shall be used for the final determination of density.

5. Restoration. Place and compact the sampled area with new materials to conform with the surrounding area.

D. All data for the control and the acceptance testing shall be submitted.

E. Tests necessary to determine the conformance with requirements may be performed by the Engineer without cost to the Contractor.

Availability of Cullet (Crushed Glass) for Glassphalt Concrete Base:

A. Aggregate base course shall include mixture of aggregate and cullet. When cullet is not produced on the project island, or material unit price of cullet is greater than material unit price of aggregate for untreated base, cullet may be excluded. Before excluding cullet, submit availability and pricing documentation.

PART 2 – PRODUCTS

2.01 MATERIALS: Plant Mix Asphalt Concrete Base and Plant Mixed Glassphalt Concrete Base shall conform to the following:

A. The asphalt cement grade shall be PG 64-16.

B. Aggregate shall conform to the requirements of Section 34.2B of the Standard Specifications, and shall meet the following grading requirements:

Sieve Size	Percent Passing by Weight
1.25 Inch	100
1 Inch	85 – 100
0.75 Inch	73 - 92
0.5 Inch	60 – 80
0.375 Inch	52 - 72
#4	36 – 55
#8	25 – 42
#16	18 - 33
#30	12 – 24
#50	7 - 18
#100	4 – 12
#200	1 - 8

C. Blending Sand and Mineral Filler shall conform to the requirements of Section 34.2C of the Standard Specifications.

D. Glassphalt (Concrete Base). If available, glassphalt shall be used.

Crushed glass shall be supplied by the City's Department of Environmental Services Division of Refuse Collection and Disposal (Refuse). Contact person for Refuse is Ms. Suzanne Jones, telephone 768-3420.

"Glassphalt" means asphaltic concrete for street paving made from crushed glass as a partial substitute for the aggregate (sand or crushed stone) in the mix.

1. Crushed Glass shall be processed to provide a uniform gradation from fine to coarse with 100 percent of the material passing the 3/8-inch sieve and be relatively free of foreign materials (bottle caps, plastics, and paper). The blend of crushed glass and virgin aggregate shall produce a combined mixture of acceptable gradation.

2. The Glassphalt Concrete Base shall be a uniform mixture of crushed glass, virgin aggregate, and asphalt cement. The proportion of crushed glass to virgin aggregate shall not exceed 10% crushed glass to 90% virgin aggregate by weight. Once established, the proportion shall not be

changed. The Contractor shall submit for review any changes to the proportion.

3. Should the supply of glass provided by the City be exhausted, only then is the Contractor to use virgin asphalt concrete base.

However, as glass becomes available to the Contractor from the City, the Contractor is required to revert back to using Glassphalt. This process may occur more than once during the duration of the contract.

Once the job mix is established, the Contractor shall maintain controls to produce a uniform product as established in the job mix.

PART 3 – EXECUTION

3.01 PLACING ROAD BASE COURSE: Plant mixed asphalt concrete base/glassphalt concrete base mixture shall be placed on the approved moistened subgrade in a uniform layer by an approved self-propelled mechanical spreader ready for compaction without further shaping. Dumping of the mixture in piles or windrows will not be permitted.

3.02 COMPACTING AND FINISHING: The mixture shall be spread in one lift if the required thickness is 6 inches or less and in tow or more equal lifts if the required thickness is grater than 6 inches. Compact the mixture immediately upon completion of spreading operations to a density of 91 percent of the maximum theoretical specific gravity according to AASHTO T 209 (ASTM D 2041) modified by deletion of Section 8 supplemental procedure. Tamp places not accessible to the roller with mechanical tampers.

The combined thickness of the asphalt concrete base course/glassphalt concrete base course and the asphaltic concrete pavement shall be within 0.02 foot of the planned thickness.

A tack coat shall be applied to all layers of asphalt concrete base course/glassphalt concrete base course upon which a subsequent layer of asphalt concrete base course/glassphalt concrete base course or asphaltic concrete pavement is to be placed. Tack coat shall conform to Section 33, Asphalt Surface Treatments of the DPW Standard Specifications.

3.03 MEASUREMENT AND PAYMENT: The Engineer will measure plant mix asphalt concrete base/plant mixed glassphalt concrete base by the square yard. Payment at the unit price bide shall be full compensation for furnishing the material, equipment, tools, labor, and any incidental work necessary to construct the work in place.

END OF SECTION

SECTION 02520 – CONCRETE CURBS, GUTTERS, SIDEWALKS 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 39
Curb and Gutter.....Section 41
Sidewalk.....Section 42
Reinforced Concrete Driveways .....Section 46
Reinforcing Steel .....Section 48

PART 2 – PRODUCTS

2.01 MATERIALS: Materials shall conform to the sections of the Standard Specifications noted hereinbefore, or as listed below:

A. Detectable warning material shall be pre-mold, thermoplastic meeting the requirements of TopMark by Flint Trading, Inc. or approved equal.

B. Adhesive shall be as recommended by the manufacturer.

PART 3 – EXECUTION

3.01 INSTALLATION: The Contractor shall be responsible for precisely laying out the curbs, gutters, sidewalks 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.

Detectable warning devices shall be installed per the manufacturer's installation instructions.

3.03 MEASUREMENT AND PAYMENT FOR CURB RAMPS: The Construction Manager will not measure curb ramps.

The Construction Manager will not pay for the accepted curb ramps separately. The Construction Manager will consider the price for curb ramps included in the contract price for reinforced concrete sidewalks including curb ramps and detectable warning strips.

The price includes full compensation for excavating; backfilling; installing reinforcing steel, concrete expansion joint materials, construction joints, special drop curbs, and bed course material; and furnishing 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," 2003, the "Traffic Standards Manual" of the Department of Transportation Services, July 1976, 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 Construction Manager.

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 reticule 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:

Purity ..... 76 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.

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

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 0.2l 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°F ± 3°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°F ± 3°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°F ± 3°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

[1]Viscosity, 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.

[2]Specific 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.

[3]Percent 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.

[4]Color (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.

[5]Color (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 livering. 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 Morest 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 reparable 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 graduation:

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 oviate 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 oviate 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 Department, that part of the pavement markings installed under this contract which, in the opinion of the Construction Manager, 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 Construction Manager.

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 Construction Manager.

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 at the contract lump sum price 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 Construction Manager.

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

END OF SECTION

SECTION 02609 – ELECTRONIC MARKERS FOR POTABLE WATER SYSTEMS

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 and equipment necessary for the installation and testing of electronic markers over plastic pipe and concrete jackets for "locating" purposes.

Electronic markers shall be installed in lieu of copper toning wire along all new mains 4-inches and larger including fire hydrant and meter laterals.

PART 2 – PRODUCTS

2.01 MATERIALS: Electronic markers shall be the "Omni Marker," manufactured by Tempo, or approved equal.

Application	Color	Frequency	Model Number	UPC Number
Potable Water Main	Blue	145.7 kHz	161	60766
Non-Potable Water Main	Purple	66.35 kHz	168	11050

PART 3 – EXECUTION

3.01 PLACEMENT: The electronic markers shall be hand placed in the trench, centered over the pipe and covered with sufficient base course material to prevent shifting prior to backfilling of the trench. Installation shall be at a minimum depth of 2 feet and a maximum depth of 3 feet from finish grade.

3.02 LOCATION: Installation of electronic markers shall be in accordance with the following:

A. One marker at all changes in horizontal alignment (e. g., bends, deflection couplings and deflections at joints).

B. One marker 10 feet prior to and one marker 10 feet after a change in horizontal alignment unless markers are required within the 10-foot distance.

C. On straight runs, markers shall be placed at a maximum distance of 40 feet.

D. One marker at the end of all mains and at all permanent cleanouts.

E. Markers at the beginning and ending of all concrete jackets.

3.03 TESTING: Contractor shall test the electronic markers prior to installation to verify proper operation. Construction Manager shall verify the number and locations of placed electronic markers before final paving of the project. Contractor shall record marker locations on the "as-built" drawings.

3.04 PAYMENT: Payment for electronic markers will be made at a lump sum price.

The lump sum price for electronic markers shall be full compensation for all labor, materials, tools and equipment necessary for furnishing and installing electronic markers and all other incidentals required to complete the work.

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.

Brass fittings shall conform to the BWS Standards amendment letter regarding "lead-free" fittings, found at the end of this section.

2.02 Electronic markers as specified in Section 02609 - Electronic Markers for Potable and Non-Potable Water Systems.

PART 3 – EXECUTION

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

The Construction Manager 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 Construction Manager 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 Construction Manager. The Contractor shall inform the Construction Manager 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.

3.02 Install electronic markers as specified in Section 02609 – Electronic Markers for Potable and Non-Potable Water Systems.

BOARD OF WATER SUPPLY

CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA STREET
HONOLULU, HI 96843

October 22, 2013

TO: WHOM IT MAY CONCERN

FROM: ERNEST Y. W. LAU, P.E.
MANAGER AND CHIEF ENGINEER

SUBJECT: 2002 WATER SYSTEM STANDARDS AMENDMENTS

All waterworks brass fittings shall be in compliance with the amended Section 1417 of the Safe Drinking Water Act (SDWA) which takes effect on January 4, 2014. The amendment includes a change to the definition of "lead-free" by reducing lead content from 8% to a weighted average of not more than 0.25% in the wetted surface material. All waterworks brass fittings installed for potable water service on January 4, 2014 and beyond shall conform to the amended definition of "lead-free".

As indicated in Section 211 – Brass Products, all brass fitting shall conform to NSF Standard 61 and Section 1417 of the SDWA. In addition, for Oahu only, all brass fittings shall conform to NSF Standard 372. Until conforming brass products are approved for inclusion on the Approved Materials List, brass products must be submitted for review and approval on a project-to-project basis.

If you have any questions, please contact Michael Domion at (808)748-5740.

cc: Kauai, Maui and Hawaii Dept. of Water Supply

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 in conformity with the dimensions, profiles, sections, and details shown on the plans. Work relating to drainpipes and drainage structures shall be governed by the following sections of the Standard Specifications:

Trench Excavation and Backfill	Section 11
Drainpipes	Section 24
Drain Manholes	Section 25
Catch Basins and Storm Water Inlets	Section 26
Portland Cement Concrete	Section 39
Concrete Structures	Section 40

1.03 CONTRACTOR SUBMITTALS: Shop drawings shall be submitted for precast manholes, catch basins and storm water inlets.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Drainpipe: Reinforced Concrete Pipe, Class III, AASHTO M170.

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

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 storm drain 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 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 sewer system shall be governed by the following sections of the DPW Standard Specifications:

PVC Sewer Pipe and Appurtenances	Section 21
Connection to Existing Sewer and Connecting Cesspool in Direct Line of Sewer	Section 22
Sewer Manholes	Section 23
Portland Cement Concrete	Section 39
Concrete Blocks, Cradles and Concrete Jackets	Section 43
Reinforcing Steel	Section 48

PART 2 – PRODUCTS

2.01 MATERIALS

A. Sewer Pipe: Polyvinyl Chloride Pipe, C-900, Class 150 (DR 18).

B. Sewer Manholes: As specified in Section 23 - Sewer Manholes 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 preceding these specifications shall govern this section of the work.

1.02 WORK INCLUDED: Furnish all materials, labor and equipment required 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 material 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

DIVISION 5 - METALS

SECTION 05500 - STEEL FABRICATIONS

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: This Section includes but is not limited to:

A. Miscellaneous steel angles, plates, pipes, bars and tubing not specified elsewhere.

B. Ferrous metal anchors, bolts, expansion shields, and other accessories indicated and/or required for the complete installation of all work.

1.03 GENERAL REQUIREMENTS

A. Reference Specifications: Unless otherwise indicated, the "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings" of the American Institute of Steel Construction (AISC) and the American Welding Society (AWS) Standard Code shall govern the work.

B. Coordinate with other trades so that all inserts and attachments are properly set and that adequate provision is made for embedding this work, where required, in the concrete and rough stone work.

C. Submittals: Submit the following in accordance with the Special Provisions.

1. Prequalification of "or approved equal" materials.
2. Shop Plans: Submit shop plans for approval.

PART 2 - PRODUCTS

2.01 MATERIALS: All new, with physical and chemical characteristics equal to or better than those required herein.

A. Steel: ASTM A36 and A283, new, straight and true; manufactured by reputable mills.

B. Bolts, Nuts, and Washers: ASTM A307, Grade "A", hot-dipped galvanized. High strength bolts: ASTM A325.

C. Expansion Bolts: Star Expansion Industries Corp. or approved equal lead sleeve

type.

D. Paint for Shop Priming and Field Touch-Up of Non-Galvanized Steel: Zinc Chromate-Iron Oxide Primer, Fuller #621-04, Sinclair #15, or approved equal.

E. Cold Galvanizing Compound for Shop and Field Touch-Up of Galvanized Ferrous Metal Work: The ZRC Chemical Products Co. "ZRC Compound", applied in strict accordance with manufacturer's specifications.

F. Fill for Embedment of Perimeter Fence Posts, Anchors, and for Similar Uses: Sonneborn "Sonogrout", Anti-Hydro Co. "Axpandcrete S-Hi-Flow", Thoro System Products "Thorogrip", or approved equal non-metallic grout, premixed, specially manufactured for this purpose, with mix and setting characteristics as recommended by the manufacturer for the purpose intended. Mix and place in strict accordance with manufacturer's instructions.

2.02 FABRICATION AND WORKMANSHIP

A. Insofar as possible, fit and shop assemble the work, ready for installation. Fabricate and erect all work square, plumb, straight and true. Provide all supports and anchors required for proper installation. Perimeter fence shall be fabricated in as large sections as possible and hot-dip galvanized after fabrication.

B. Connections: Weld, blindrivet, or attach with screws, countersink and finish flush where exposed, unless otherwise indicated. Make joints and intersections accurately in true planes; tightly fit and draw up, with end threads nicked to prevent loosening.

C. Welding: Use the referenced AWS Standards for general procedure, with all welders certified for the classification of work involved. Grind all exposed welds smooth.

D. Connections: Provide holes and connections for the work of other trades and connect thereto as required.

1. Isolate metals from contact with concrete and stone work, and different metals from contact with each other, where necessary to prevent corrosion.

2. Bolting: Use proper size bolts. Draw nuts tight with end threads upset. Metal shall be clean and free from mill-scale, rust and/or pitting.

E. Painting

1. Shop paint all ferrous metal work except zinc-coated surfaces and work to

be embedded in concrete or mortar. Do not coat surfaces to be welded closer than three inches from the weld, prior to welding. Thoroughly dry and clean surfaces; then paint in a workmanlike manner, with all joints and crevices coated thoroughly. Prior to assembly, paint all surfaces which will be concealed or inaccessible after assembly.

a. Cleaning: Remove all scale, rust, dirt, grease and other deleterious materials prior to coating.

b. Priming: As soon as possible after cleaning, prime coat all exposed surfaces to a uniform dried film thickness of not less than 1.5 mil, Damaged coating shall be promptly repaired with the primer.

2. Field Painting: After installation, clean welds, bolts, and abraded portions and give an additional spot coat of the same materials. Leave the entire work in condition to receive the finish paint, or to provide complete protection of exposed metal if finish painting is not required.

F. Galvanizing: Where so specified, galvanize ferrous metal items using ASTM A123 hot dip process, to an average weight of not less than 2.0 ounces per square foot of surface (coating thickness 0.0034") with no individual specimen having less than 1.8 ounces (coating thickness 0.0030").

1. In the event of doubt of compliance with the weight of zinc coating, test the weight of the coating using test method ASTM A90.

2. Repair of Galvanizing: Where damaged by welding after galvanizing, or by any other cause in shop or field, clean surfaces thoroughly by wire brushing or other approved means, then touch up with the specified cold galvanizing compound. Prepare surfaces, apply material and fuse onto the surface in accordance with manufacturer's instructions. Repair shall provide protection equal to the original coating.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Assemble and install shop fabricated work plumb, square and unwarped. Movable parts shall operate smoothly upon completion. Galvanizing repaired after welding as specified above.

B. Secure anchor bolts with cinch anchors set in holes drilled under this section, in concrete and stone work. At the Contractor's option, attachments may be made with bolts installed in the forms and embedded in the concrete, wherever

practical.

C. Protect finish metal surfaces installed in contact with stone, concrete or non-compatible metals with a heavy coat of asphalt or zinc chromate paint, unless specified otherwise.

D. Finished work shall be complete in every detail, strong and rigid, neat in appearance, free from defects, and acceptable to Engineer.

E. Clean all surfaces after installation and leave free of all oil, grease and dirt.

3.02 CLEANUP: 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.

END OF SECTION

DIVISION 10 - SPECIALTIES

SECTION 10552 – CONCRETE PAD FOR MAIL BOXES

PART 1 – GENERAL

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

WORK INCLUDED: Furnish all labor, materials, tools, and equipment necessary for the installation of mail boxes, including concrete pads and anchor bolts, in conformity with the dimensions, profiles, sections, and details shown in this section.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Mail Boxes shall be "Vital Type III Cluster Box Units (CBUs), Model #1570-16PG" by Florence Manufacturing Company, or approved equal.

B. Concrete Pad

1. Concrete shall have a compressive strength of 3000 psi @ 28 days, contain 4% minimum to 6% maximum air entrainment and be placed with a 3.50 to 4.50 slump in accordance with ACI 301.

2. Reinforcing steels rods shall conform to ASTM A615, Grade 60.

3. Anchor Bolts shall conform to ASTM A193, Grade B8M, Type 316 Stainless Steel.

PART 3 – EXECUTION

3.01 INSTALLATION:

CBUs shall not be installed until the local USPS representative has conducted an on-site visit to ensure compliance with the official specifications. **The Contractor shall contact the local USPS representative at 423-3653 to have the pads inspected prior to pouring the concrete.**

CBUs shall be installed facing the correct direction. CBU installed on concrete pads poured behind the sidewalk shall face the sidewalk.

CBUs shall not be installed so close to an intersection or traffic lane that they block visibility for approaching traffic or could be struck by a passing motor vehicle.

CBUs shall not be located on dead-end streets where there is no safe turnaround for Postal delivery vehicles.

The Contractor shall notify the local USPS representative immediately upon completion of the CBU installation so that USPS can install the arrow lock and secure the unit.

All CBU compartment keys shall be distributed by the DHHL at the time of move in. The local USPS representative shall be contacted by the DHHL for the box address assignments. Each homeowner shall receive a copy of the Mode of Delivery Agreement at the time of move in.

Any deviation from the USPS designated location of the CBU shall not occur without first receiving authorization from the local USPS representative.

CBUs shall be level and mounted firmly in concrete, using one of the following methods.

1. The J-bolt method is the preferred method of installation of CBUs on concrete pads; however, the J-bolt pattern shall be accurate with the CBU pedestal plate. When using J-bolts, in order to prevent any damage or accidents that could result from the exposed bolts, consideration shall be given as to the time lapse between pouring the concrete and the actual installation. Expansion anchors shall be installed in accordance with the manufacturer's instructions.

2. The use of anchor bolts for the installation of CBUs on concrete pads is also acceptable as long as the methods described below are followed.

    a. Hilti Kwik bolt II, ½" diameter X 5-1/2" overall length
    Catalog Number: 000-453-696, KB II 12-512
    Stainless Steel Catalog Number: 000-454-744
    Minimum embedment in concrete shall be no less than 3-1/2"

    b. ITW Ramset Redhead Trubolt, galvanized, 1/2" diameter X 7" overall length.

    c. Rawl Stud, 1/2" diameter X 5-1/2" overall length, galvanized.
    Catalog Number: 7324
    Minimum embedment in concrete shall be no less than 4"

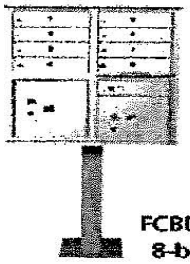
CLUSTER BOX UNIT (CBU)
CONCRETE PAD REQUIREMENTS

- ALL FREE STANDING PADS MUST BE 8" THICK -

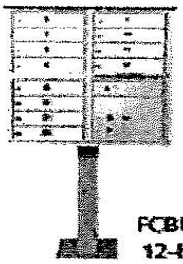
1 Box	Single Pad	4' X 4' (C&C HNL 4'X6')
2 Boxes	Double Pad	4' X 7'
3 Boxes	Triple Pad	4' X 10'
4 Boxes	Quad Pad	4' X 13'

WHEN PLACING A PARCEL LOCKER AT ANY CBU LOCATION, INCREASE THE PAD SIZE BY AN ADDITIONAL 4' X 4'

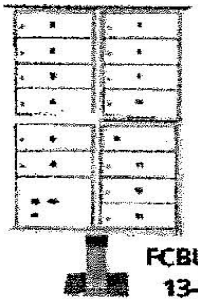
CLUSTER BOX UNITS
FOR OUTDOOR CENTRALIZED MAIL DELIVERY



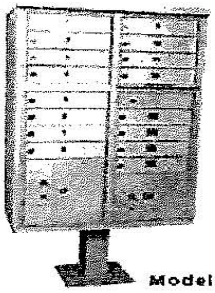
FCBU Type I
8-box Unit



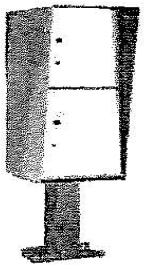
FCBU Type II
12-box Unit



FCBU Type IV
13-box Unit



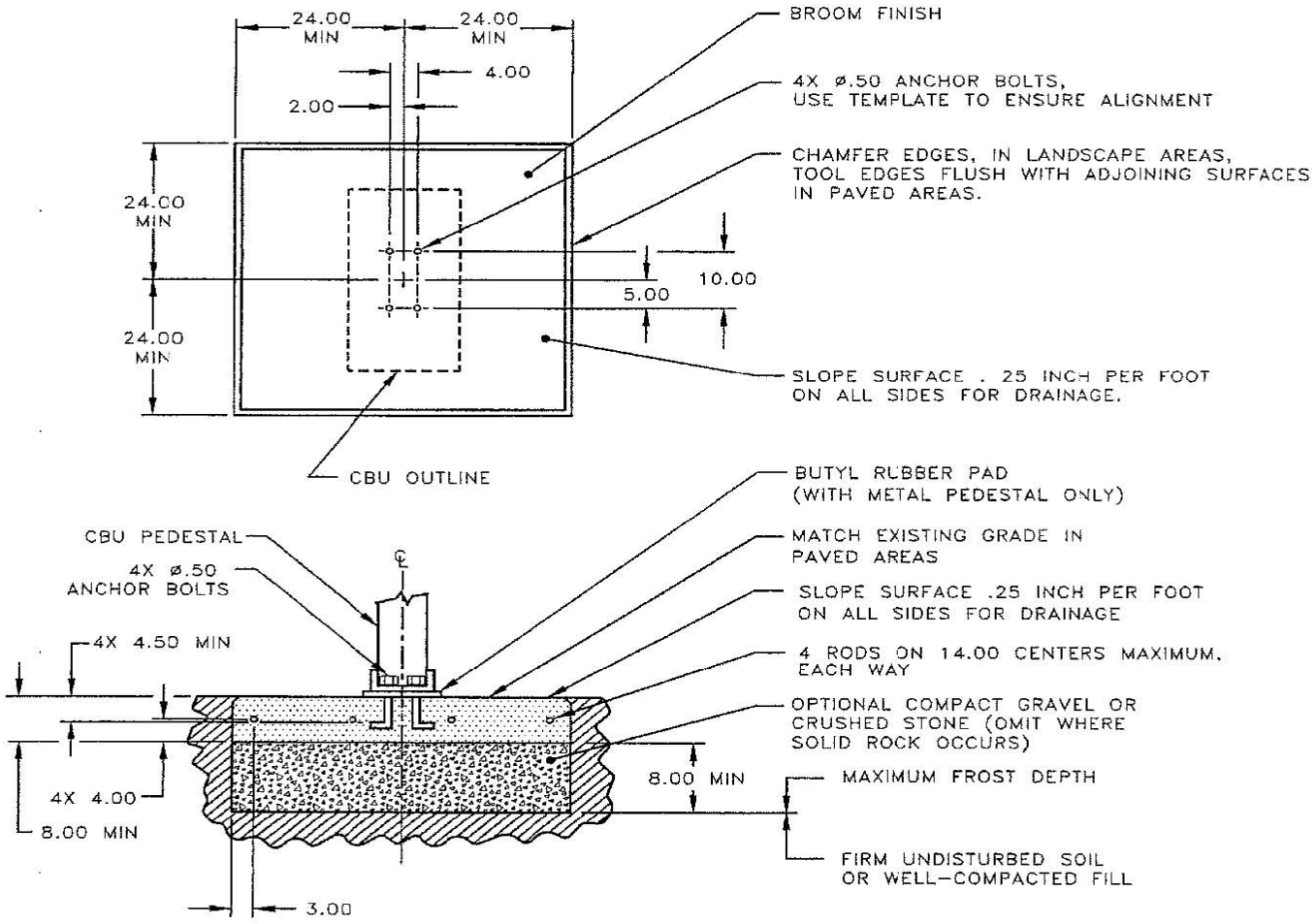
16-box Unit



Outdoor Parcel Locker

FCBU Type III

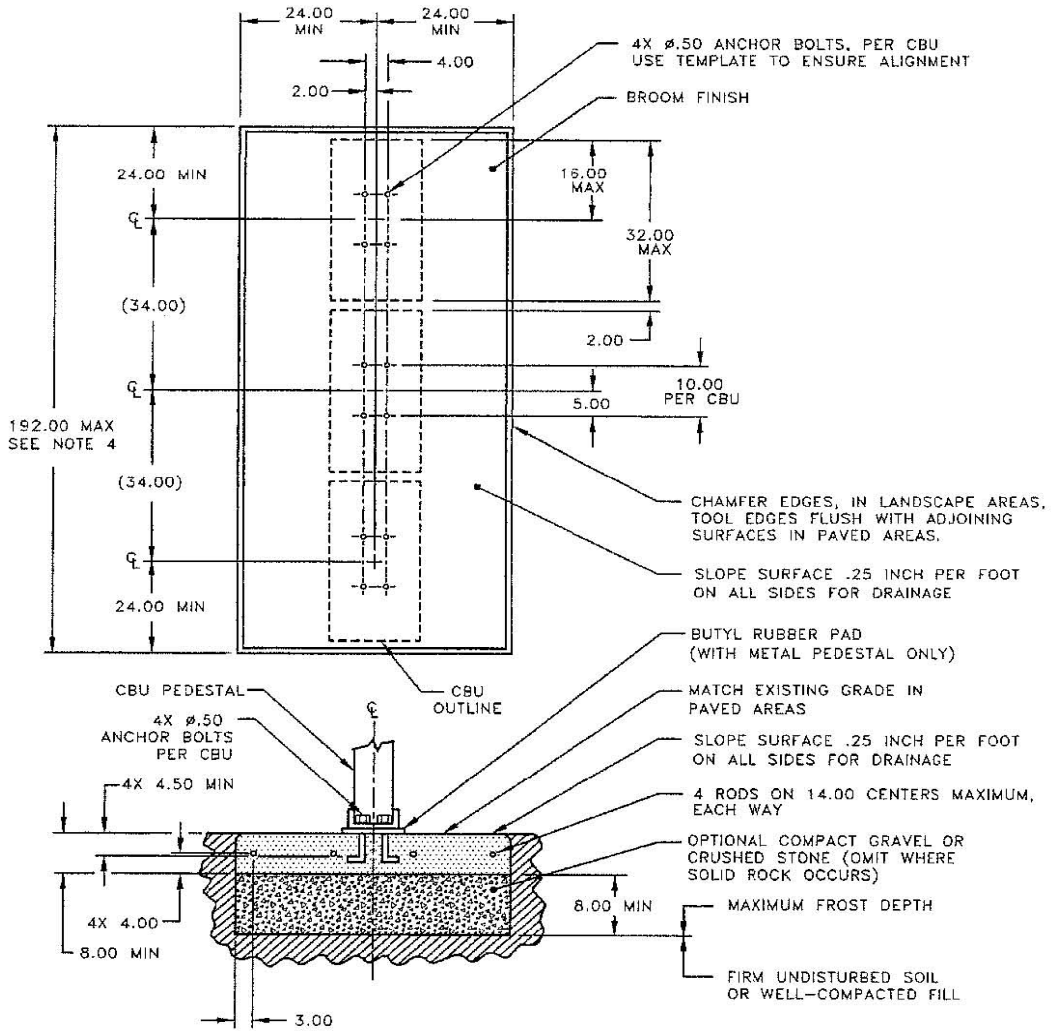
USPS APPROVED SPECIFICATIONS – CONCRETE PAD (SINGLE UNIT)



NOTES:

1. CONCRETE SHALL HAVE A COMPRESSIVE STRENGTH OF 3000 PSI @ 28 DAYS, CONTAIN 4% MIN – 6% MAX AIR ENTRAINMENT AND BE PLACED WITH A 3.50 – 4.50 SLUMP IN ACCORDANCE WITH ACI 301.
2. REINFORCING STEEL RODS SHALL CONFORM TO ASTM A615, GRADE 60.
3. ANCHOR BOLTS SHALL CONFORM TO ASTM A193, GRADE B8M, TYPE 316 STAINLESS STEEL.

USPS APPROVED SPECIFICATIONS – CONCRETE PAD (MULTIPLE UNIT)



NOTES:

1. CONCRETE SHALL HAVE A COMPRESSIVE STRENGTH OF 3000 PSI @ 28 DAYS, CONTAIN 4% MIN – 6% MAX AIR ENTRAINMENT AND BE PLACED WITH A 3.50 – 4.50 SLUMP IN ACCORDANCE WITH ACI 301.
2. REINFORCING STEEL RODS SHALL CONFORM TO ASTM A615, GRADE 60.
3. ANCHOR BOLTS SHALL CONFORM TO ASTM A193, GRADE B8M, TYPE 316 STAINLESS STEEL.
4. A 3 CBU CONFIGURATION IS DEPICTED. A 2 OR 4 CBU CONFIGURATION MAY BE USED AS LONG AS THEY ARE ARRANGED IN GROUPS SUCH THAT THE OVERALL DIMENSION OF THE CONCRETE BASE DOES NOT EXCEED 192 INCHES.

END OF SECTION

DIVISION 16 - ELECTRICAL

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 Drawings complement each other and what is specified, scheduled or mentioned by one shall be binding as if called for by both. Specification and Drawings 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 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, handholes, 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. (SIC) for their cables and equipment.

3. Complete underground raceway system including trenches, ducts, and boxes, to be used for communication system cables and equipment.

4. Complete street lighting system.

5. Complete private secondary power systems.

6. Coordinate work and arrange for periodic inspections by Hawaiian Electric Co., Sandwich Isles Communications, Inc., 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 line consisting of polypropelene cord in all empty ducts and conduits, unless indicated otherwise. Provide duct measuring/cable pulling tape in all Hawaiian Electric Company 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, and street 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, CATV, street light and communications 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.

2. Complete secondary power system, including cabinets, meter sockets, circuit breakers, and accessories.

3. 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.

4. 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:

Item	Manufacturer and Catalog Number Specified	Substitute Manufacturer And Catalog Number
Cable	John Doe - No. 3200	King - No. 2200

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' 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 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 40 plastic or approved equal.

2. Under Road Pavement or In 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 80 plastic or approved equal. Conduits for street lighting and secondary power systems shall be PVC (polyvinyl chloride) Schedule 80 plastic or approved equal.

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, 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 or approved equal.

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. 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 in accordance with Drawings.

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 as indicated on Drawings.

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 UH-35 assembly units shall be by Hawaii Precast, per master purchase agreement.

    e. Sandwich Isles Communications Handholes: Shall include 20K traffic load rated cover(s). Covers shall have the “SIC” logo. Handhole cover bolts shall be stainless steel 3/4" Pentahead, unless otherwise noted..

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 stainless steel type 304. The cable support hooks shall be of stainless steel type 304 and shall be of the removable type. Insulators shall be dry-process glazed porcelain. 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. Boxes and Cabinets:

1. Outlet and Small Junction Boxes: Exposed boxes and weather exposed boxes shall be cast iron, or ferrous alloy, prime painted and enamel finished, with threaded hubs for conduit connection. Steel City 600 series or approved equal.

2. Large Junction Boxes and Gutters: For dry interior location, the box shall be fabricated from NEC gauge galvanized steel with matching screw-on type cover, field punched knockouts. For exterior and wet locations, the box shall be galvanized cast iron with matching gasketed cover and threaded hubs for conduit connection. All screws shall be stainless steel. All boxes and gutters shall have minimum dimensions to accommodate pulling per NEC Article 370 requirements

3. Enclosures and Cabinets: Enclosures and cabinets for loadcenters, breakers, and switches shall be NEMA type, fabricated from stainless steel, or as indicated, prime painted and enamel finished according to NEMA specifications. Field painting shall be as specified hereinafter.

a. Enclosures for individually mounted circuit breakers shall include provisions for locking the enclosure closed and locking the breaker open. The cover of the enclosure shall be interlocked with the circuit breaker operating handle so that the cover cannot be opened unless the circuit breaker handle is in the "OFF" position.

P. Device and Cover Plates: Plates for exposed and weather exposed boxes (indicated WP on drawings) shall be cast metal with neoprene gasket for sealing against entry of water and moisture into box.

Q. Weatherproof Ground-Fault Circuit Interrupter (GFCI) Duplex Receptacle: Duplex receptacle, for mounting in a standard outlet box, 20 ampere, 125-volt, 3 wires, grounding type with test and reset buttons mounted on the device face. Device shall be capable of detecting a current leakage of 6 milliamperes or greater and tripping per requirements of UL-943 for Class A GFCI devices. Receptacles shall be UL rated for 20 amperes feed through, suitable for use as GFCI protection on a 20 ampere circuit. UL approved for "wet locations". Bryant Electric Co., Hubbell, Arrow Hart, General Electric, and Pass & Seymour equals.

R. Loadcenters: UL listed, surface-mounted 120/240V, 1-phase, 3WSN, copper bussing, with breaker complement as shown, complete with door, trim, 2-ply plastic nameplate, and typed

directory. Locks to be keyed alike. Cutler-Hammer, or Square D, General Electric, Siemens equal.

1. Single pole breakers shall be full module size; two poles shall not be installed in a single module.

2. Multi-Pole Breakers: Provide common-trip type with single operating handle. Breaker design shall be such that overload in one pole automatically causes all poles to open. Multi-pole breakers of frame sizes 100 amperes or less may consist of single-pole breakers permanently factory assembled into a multi-pole unit having an internal mechanical non-tamperable common-trip mechanism and external handle ties.

S. Individual Circuit Breaker: Shall consist of molded plastic case circuit breaker with toggle operated mechanism and thermal-magnetic overload trips, in enclosure, type as indicated. Enclosures shall include provisions for locking the enclosure closed and locking the breaker “open”. Interchangeable trip shall be provided when available. Toggle positions "On" and "Off", engraved or embossed on body.

T. Meter Sockets: Surface-mounted weatherproof type with ratings and provisions as indicated on the drawings. Meter sockets shall be submitted to and approved by Hawaiian Electric Company.

U. Equipment Disconnect and Fused Switch: Heavy-duty, horse-power rated when used as motor disconnect, lever-operated contacts, spring-loaded, NEC standard fuse rejection type holders when used with current limiting fuses. Include provisions for locking the switch enclosure "closed" and for locking the switch "open". The cover of the enclosure shall be interlocked with the switch operating handle so that the cover cannot be opened unless the switch handle is in the "Off" position. General Electric Co. type TH, or Westinghouse, Cutler-Hammer, Square D, Siemens equal.

V. 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 2½ inches wide, minimum. Lettering shall be minimum 1/4-inch high normal block lettering. Equipment designations shall be as indicated on Drawings.

W. Luminaires: Shall be cast aluminum, rear-entry with a tempered glass, cut-off refractor and have a photo-electric cell receptacle and weather-proof shorting cap, provided complete with all necessary mounting hardware and accessories, lamps, ballasts, drivers, etc., as specified herein and on the Drawings. Ballasts or drivers shall be constant wattage, high power factor type, designed to operate the LED lamp. Ballast or driver and starting aid shall protect itself against normal lamp failure modes, and shall operate with the lamp in an open-circuit or short-circuit condition for at least six months without significant loss of ballast or driver life. Lamp current crest factor shall not exceed 1.8 for a plus/minus line voltage variation at any lamp voltage, for the life of the lamp. Lamps shall be clear, mogul-base LED. Lamp wattage shall be as indicated on the Drawings. Where indicated, luminaire housing shall be provided with 3 wire twist lock receptacle mounted in the housing for individual photo electrical control.

X. 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.

Y. 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; Hawaii Administrative Rules 6-73, 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), National Electrical Safety Code (NESC) 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., 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., 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. Provide shoring where required.

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 boxes 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, 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 Isle 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 12" 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 Sandwich Isles Communications and communications conduits/ducts shall be constructed with 25-foot minimum radius curves unless indicated otherwise or approved by the respective 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 Sandwich Isles Communications 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 Tyco, Quadplex Jackmoon Duct Seals and Hole Plugs, Series 136. Duct tape is not acceptable.

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 ½" less than inside diameter of duct. Mandrel for Sandwich Isles Communications ducts shall be 12" long and shall have diameter of ¼" 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 polypropylene cord (pull line), having a breaking strength of at least 200 pounds, in each conduit after testing.

a. For HECO ducts, provide cable pulling tape (NEPTCO WP1800P Muletape or approved equal) in each new duct.

b. 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 Sandwich Isles Communications and/or communication company 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. Limit concrete jacket size to the nominal dimensions shown on the duct section details. Payment will not be made for excessive amounts of concrete used because of over excavation or providing excessive jacket thickness beyond what is shown on the duct sections.

19. Warning Tapes:

a. 3" 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. 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 and SIC 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. Re-tampering 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 box shall be determined after careful consideration has been given to the location of the driveway apron, other utilities, grades, and pavement. Boxes 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 ½ inch above the finished grade; Sandwich Isles Communications' handholes shall be set approximately ½ inch above the finished grade.

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. Sandwich Isles Communications Manholes, Handholes and Pullboxes:

   a. Provide a 5/8" diameter x 8-foot copper clad ground rod in all handholes and manholes, unless indicated otherwise.

   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 topside 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.

   f. UH-35 handholes are equipped with jack moon duct plugs to accommodate the UD (1x 3) configurations. All 4-inch duct plugs, however, are to be provided by the Contractor. This unit will accommodate six SDR-11 conduits; therefore, the Contractor is required to provide plugs for the vacant conduit holes in the jack moon.

4. 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 handholes on the property side at all times unless otherwise specified by the Engineer. Conduits shall enter handholes at 90 degree angle.

Any exceptions shall only be permitted when specified by the Engineer.

b. Stub-out 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.

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.

I. 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. Unless otherwise indicated or specified herein, wiring shall consist of single conductor cables installed in conduit/duct in areas where permitted by the NEC and NESC.

a. Below or in slab, use Schedule 80 PVC, unless indicated otherwise. For distribution feeder banks, provide Schedule 40 PVC with 3" concrete encasement.

b. Above grade where exposed to damage, use galvanized rigid steel conduit.

c. Above grade where not exposed to damage, use EMT with UL approved grounding connectors.

d. Conduit system shall be continuous from outlet to outlet or fitting to fitting so that electrical continuity is obtained between all conduits of the system.

e. Conduits cut square and inner edges reamed. Butt together evenly in couplings.

f. Changes in direction shall be made with symmetrical bends or cast metal fittings. Make bends and offsets with hickey or conduit-bending machine. Do not use vise or pipe tee. Flattened crushed or deformed conduit not acceptable. Trapped raceways shall be avoided.

g. Use of running threads not permitted. Where conduits cannot be joined by standard threaded couplings, approved water-tight conduit unions shall be used. Threadless fittings for electrical metallic tubing shall be of a type approved for the conditions encountered.

h. Cap conduits during construction with plastic or metal- capped bushings to prevent entrance of dirt or moisture. Swab all conduits

and dry before installing wires.

i. Pull wires shall be placed in all empty conduits for ten feet in length and as indicated.

j. Install insulating bushings and two locknuts on each end of every conduit run at enclosures and boxes. Provide grounding bushings as required.

3. Conductors:

a. Mechanical means for pulling shall be torque-limiting type and not used for #2 AWG and smaller wires.

b. Pulling tension shall not exceed wire manufacturer's recommendations.

c. Where necessary, powdered soapstone may be used as a lubricant for drawing wires through conduit. No other means of lubricating will be allowed.

d. Form neatly in enclosures and boxes for minimum of crossovers. Tag all feeders.

e. Thoroughly swab out existing ducts to remove foreign material before the pulling of cable.

4. Splicing of Wire and Cable:

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 in underground systems 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 in underground systems 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.

5. 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.

6. Protection of Wire and Cable Ends: The ends of wire and cables in handholes, pullboxes, and in other wet locations, as defined by the NEC, 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 or 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.

7. 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 background. (Do not cover nameplates). Factory finished enclosures shall not be painted.

8. 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 Engineer as attributable to poor coordination and workmanship shall be cause for reconstruction to the satisfaction of the Engineer.

   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.

   d. Provide nameplate for service equipment, loadcenters, enclosed circuit breakers, etc.

Tag all empty conduit in cabinets and boxes giving destination. Use fiber disc tags in bushing.

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:

Test complete installation and correct all defects of material and workmanship as well as all malfunctions of equipment and systems prior to final inspection at no increase in contract amount. All wiring shall be tested to ensure proper operation according to functions specified herein; and in other sections of these Specifications, on Drawings and conform to standard industry practices.

A. Ground-Impedance Measurements: Perform ground-impedance measurements of each ground rod utilizing the fall-of-potential method in accordance with IEEE Std 81. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod, perform tests before any wire is connected. 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.

Use a portable megohmmeter tester in accordance with manufacturer’s instructions to test each ground or group of ground rods. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test. Submit written results of each test to Engineer, and indicate location of rods as well as resistance and soil conditions at time

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