

City Of West Park



Technical Specifications For SW 21st Street Improvements From SR-7 to SW 40th Avenue

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TABLE OF CONTENTS

SECTION 102..... 1
SECTION 104..... 14
SECTION 105..... 20
SECTION 120 (PART I) 30
SECTION 120 (PART II)..... 31
SECTION 125..... 41
SECTION 160 51
SECTION 320..... 56
SECTION 330 65
SECTION 331..... 76
SECTION 346..... 95
SECTION 425 116
SECTION 430..... 119
SECTION 443..... 128
SECTION 449..... 130
SECTION 520..... 132
SECTION 522..... 135
SECTION 523..... 137
SECTION 526..... 139
SECTION 527 141
SECTION 570 143
SECTION 700 145
SECTION 706..... 147
SECTION 710..... 148
SECTION 711 152
SECTION 911..... 156
SECTION 916..... 157
SECTION 921..... 166
SECTION 923..... 168
SECTION 925..... 169
SECTION 970..... 171
SECTION 971 172
SECTION 983..... 183
SECTION 990..... 183
SECTION 994..... 195

**SPECIAL PROVISIONS
FOR
SW 21 STREET ROADWAY IMPROVEMENTS**

**SECTION 102
MAINTENANCE OF TRAFFIC**

102-1 Description.

Maintain traffic within the limits of the project for the duration of the construction period, including any temporary suspensions of the work. Construct and maintain detours. Provide facilities for access to residences, businesses, etc., along the project. Furnish, install and maintain traffic control and safety devices during construction. Furnish and install work zone pavement markings for maintenance of traffic (MOT) in construction areas. Provide any other special requirements for safe and expeditious movement of traffic specified in the Plans. MOT includes all facilities, devices and operations as required for safety and convenience of the public within the work zone.

Do not maintain traffic over those portions of the project where no work is to be accomplished or where construction operations will not affect existing roads. Do not obstruct or create a hazard to any traffic during the performance of the work, and repair any damage to existing pavement open to traffic.

Include the cost of any work that is necessary to meet the requirements of the Contract Documents under the MOT pay item, when there is not a pay item provided.

102-2 Materials.

Meet the following requirements:

- Bituminous Adhesive.....Section 970
- Temporary Retroreflective Pavement Markers...Section 990
- PaintSection 971
- Removable TapeSection 990
- Glass Spheres.....Section 971
- Temporary Traffic Control Device Materials.....Section 990
- Retroreflective and Non-Reflective Sheeting
For Temporary Traffic Control Devices.....Section 994

102-2.1 Temporary Traffic Control Devices: Use only the materials meeting the requirements of Section 990, Section 994, the FDOT Design Standards and the Manual on Uniform Traffic Control Devices (MUTCD).

102-2.2 Detour: Provide all materials for the construction and maintenance of all detours.

102-2.3 Commercial Materials for Driveway Maintenance: Provide materials of the type typically used for base, including recycled asphalt pavement material, and having stability and drainage properties that will provide a firm surface under wet conditions.

102-3 Specific Requirements.

102-3.1 Beginning Date of Contractor's Responsibility: Maintain traffic starting the day work begins on the project or on the first day Contract time is charged, whichever is earlier.

102-3.2 Worksite Traffic Supervisor: Provide a worksite traffic supervisor in accordance with Section 105. Provide the worksite traffic supervisor with all equipment and materials needed to set up, take down, maintain traffic control, and handle traffic-related situations.

Ensure that the worksite traffic supervisor performs the following duties:

1. Performs on site direction of all traffic control on the project.
2. Is on site during all set up and take down, and performs a drive through inspection immediately after set up.
3. Is on site during all nighttime operations to ensure proper MOT.
4. Immediately corrects all safety deficiencies and does not permit minor deficiencies that are not immediate safety hazards to remain uncorrected for more than 24 hours.
5. Is available on a 24 hour per day basis and present within 45 minutes after notification of an emergency situation and is prepared to positively respond to repair the work zone traffic control or to provide alternate traffic arrangements.
6. Conducts daily daytime and weekly nighttime inspections of projects with predominately daytime work activities, and daily nighttime and weekly daytime inspections of projects with predominantly nighttime work activities of all traffic control devices, traffic flow, pedestrian, bicyclist, and business accommodations.

Advise the project personnel of the schedule of these inspections and give them the opportunity to join in the inspection as is deemed necessary. Include assurances in the inspection report that pedestrians are accommodated with a safe, accessible travel path around work sites separated from mainline traffic in compliance with the Americans with Disabilities Act (ADA) Standards for Transportation Facilities, that existing or detoured bicyclist paths are being maintained satisfactorily throughout the project limits, and that existing businesses in work areas are being provided with adequate entrances for vehicular and pedestrian traffic during business hours. Have the worksite traffic supervisor sign the report and certify that all of the above issues are being handled in accordance with the Contract Documents. When deficiencies are found, the worksite traffic supervisor is to note such deficiencies and include the proposed corrective actions, including the date corrected.

The Owner may disqualify and remove from the project a worksite traffic supervisor who fails to comply with the provisions of this Section. The Owner may temporarily suspend all activities, except traffic, erosion control and such other activities that are necessary for project maintenance and safety, for failure to comply with these provisions.

102-4 Alternative Traffic Control Plan.

The Contractor may propose an alternative traffic control plan (TCP) if a plan is presented in the Contract Documents. Have the Contractor's Engineer of Record sign and seal the alternative plan. Prepare the TCP in conformance with the requirements of the jurisdictional authority. Indicate in the plan a TCP for each phase of activities. Take responsibility for identifying and assessing any potential impacts to a utility that may be caused by the alternate TCP proposed by the Contractor, and notify the Owner in writing of any such potential impacts to utilities.

Engineer's approval of the alternate TCP does not relieve the Contractor of sole responsibility for all utility impacts, costs, delays or damages, whether direct or indirect, resulting from Contractor initiated changes in the design or construction activities from those in the original Contract Specifications, Design Plans (including TCPs) or other Contract Documents and which effect a change in utility work different from that shown in the Utility Plans, joint project agreements or utility relocation schedules.

The Owner reserves the right to reject any alternative TCP. Obtain the Engineer's written approval before beginning work using an alternate TCP. The Engineer's written approval is required for all modifications to the TCP. The Engineer will only allow changes to the TCP in an emergency without the proper documentation.

102-5 Traffic Control.

102-5.1 Standards: FDOT Design Standards are the minimum standards for the use in the development of all TCPs. The MUTCD, Part VI is the minimum national standard for traffic control for highway construction, maintenance, and utility operations. Follow the basic principles and minimum standards contained in these documents for the design, application, installation, maintenance, and removal of all traffic control devices, warning devices and barriers which are necessary to protect the public and workers from hazards within the project limits.

102-5.2 Maintenance of Roadway Surfaces: Maintain all lanes that are being used for the MOT, including those on detours and temporary facilities, under all weather conditions. Keep the lanes reasonably free of dust, potholes and rutting. Provide the lanes with the drainage facilities necessary to maintain a smooth riding surface under all weather conditions.

102-5.3 Number of Traffic Lanes: Maintain one lane of traffic in each direction. Maintain two lanes of traffic in each direction at existing four (or more) lane cross roads, where necessary to avoid undue traffic congestion. Construct each lane used for MOT at least as wide as the traffic lanes existing in the area before commencement of construction. Do not allow traffic control and warning devices to encroach on lanes used for MOT. The Engineer may allow the Contractor to restrict traffic to one-way operation for short periods of time provided that the Contractor employs adequate means of traffic control and does not unreasonably delay traffic. When a construction activity requires restricting traffic to one-way operations, locate the flaggers within view of each other when possible. When visual contact between flaggers is not possible, equip them with 2-way radios, official, or pilot vehicles, or use traffic signals.

102-5.4 Crossings and Intersections: Provide and maintain adequate accommodations for intersecting and crossing traffic. Do not block or unduly restrict any road or street crossing the project unless approved by the Engineer. Before beginning any construction, provide the Engineer the names and phone numbers of persons that can be contacted when signal operation malfunctions.

102-5.5 Access for Residences and Businesses: Provide continuous access to all residences and all places of business.

102-5.6 Protection of the Work from Injury by Traffic: Where traffic would be injurious to a base, surface course, or structure constructed as a part of the work, maintain all traffic outside the limits of such areas until the potential for injury no longer exists.

102-5.7 Flagger: Provide trained flaggers in accordance with Section 105.

102-5.8 Conflicting Pavement Markings: Where the lane use or where normal vehicle or pedestrian paths are altered during construction, remove all pavement markings (paint, tape, thermoplastic, raised pavement markers, etc.) that will conflict with the adjusted vehicle or pedestrian paths. Use of paint to cover conflicting pavement markings is prohibited. Remove conflicting pavement markings using a method that will not damage the surface texture of the pavement and which will eliminate the previous marking pattern regardless of weather and light conditions.

Remove all pavement markings that will be in conflict with “next phase of operation” vehicle pedestrian paths as described above, before opening to vehicle traffic or use by pedestrians. Cost for removing conflicting pavement markings (paint, tape, thermoplastic, raised pavement markers, etc.) to be included in Maintenance of Traffic, Lump Sum.

102-5.9 Vehicle and Equipment Visibility: Equip all pickups and automobiles used on the project with a minimum of one Class 2 warning light that meets the Society of Automotive Engineers Recommended Practice SAE J595, dated November 1, 2008, or SAE J845, dated December 1, 2007, and incorporated herein by reference. Existing lights that meet SAE J845, dated March, 1992, or SAE J1318, dated April, 1986, may be used to their end of service life. The warning lights shall be a high intensity amber or white rotating, flashing, oscillating or strobe light. Lights shall be unobstructed by ancillary vehicle equipment such as ladders, racks or booms. If the light is obstructed, additional lights will be required. The lights shall be operating when a vehicle is in a work area where a potential hazard exists, when operating the vehicle at less than the average speed for the facility while performing work activities, making frequent stops or called for in the Plans or FDOT Design Standards. Equip all other vehicles and equipment with a minimum of 4 square feet of retroreflective sheeting or warning lights.

102-5.10 No Waiver of Liability: Conduct operations in such a manner that no undue hazard results due to the requirements of this Article. The procedures and policies described herein in no way acts as a waiver of any terms of the liability of the Contractor or his surety.

102-6 Detours.

102-6.1 General: Construct and maintain detour facilities wherever it becomes necessary to divert traffic from any existing roadway or bridge, or wherever construction operations block the flow of traffic.

102-6.2 Construction: Plan, construct, and maintain detours for the safe passage of traffic in all conditions of weather. Provide the detour with all facilities necessary to meet this requirement. Where pedestrian facilities are detoured, blocked or closed during the work, provide safe alternate accessible routes through or around the work zone meeting the requirements of the ADA Standards for Transportation Facilities.

102-6.3 Construction Methods: Select and use construction methods and materials that provide a stable and safe detour facility. Construct the detour facility to have sufficient durability to remain in good condition, supplemented by maintenance, for the entire period that the detour is required.

102-6.4 Removal of Detours: Remove detours when they are no longer needed and before the Contract is completed. Take ownership of all materials from the detour and dispose of them.

102-6.5 Detours over Existing Roads and Streets: When the Owner specifies that traffic be detoured over roads or streets outside the project area, do not maintain such roads or streets. However, maintain all signs and other devices placed for the purpose of the detour.

102-7 Traffic Control Officer.

Provide uniformed law enforcement officers, including marked law enforcement vehicles, to assist in controlling and directing traffic in the work zone when the following types of work is necessary on projects:

1. Directing traffic/overriding the signal in a signalized intersection.
2. When FDOT Design Standards, Index No. 619 is used on freeway facilities (Interstates, toll roads, and expressways) at nighttime for work within the travel lane.
3. When Design Standards, Index No. 655 Traffic Pacing for overhead work is called for in the Plans or approved by the Engineer.
4. When pulling conductor/cable above an open traffic lane on limited access facilities, when called for in the Plans or approved by the Engineer.
5. When FDOT Design Standards, Index No. 625 Temporary Road Closure 5 Minutes or Less is used.

102-8 Driveway Maintenance.

102-8.1 General: Ensure that each residence and business has safe, stable, and reasonable access.

102-8.2 Construction Methods: Place, level, manipulate, compact, and maintain the material, to the extent appropriate for the intended use.

As permanent driveway construction is accomplished at a particular location, the Contractor may salvage and reuse previously placed materials that are suitable for reuse on other driveways.

102-9 Temporary Traffic Control Devices.

102-9.1 Installation and Maintenance: Install and maintain temporary traffic control devices as detailed in the Plans, Index 600 of the FDOT Design Standards and when applicable, in accordance with the approved vendor drawings. Erect the required temporary traffic control devices to prevent any hazardous conditions and in conjunction with any necessary traffic re-routing to protect the traveling public, workers, and to safeguard the work area. Use only those devices that are on the APL. Immediately remove or cover any devices that do not apply to existing conditions.

All temporary traffic control devices must meet the requirements of National Cooperative Highway Research Program Report 350 (NCHRP 350) or the Manual for Assessing Safety Hardware 2009 (MASH) and current FHWA directives. Manufacturers seeking evaluation must furnish certified test reports showing that their product meets all test requirements set forth by NCHRP 350 or the MASH. Manufacturers seeking evaluation of Category I devices for inclusion on the APL shall include the manufacturer's self-certification letter. Manufacturer's seeking evaluation of Category II and Category III devices for inclusion on the APL shall include the FHWA WZ numbered acceptance letter with attachments and vendor drawings of the device in sufficient detail to enable the Engineer to distinguish between this and similar devices. For devices requiring field assembly or special site preparation, vendor drawings shall include all field assembly details and technical information necessary for proper application and installation and must be signed and sealed by a Professional Engineer registered in the State of Florida. Manufacturers seeking evaluation of Category IV devices for inclusion on the APL must comply with the requirements of Section 990 and include detailed vendor drawings of the device along with technical information necessary for proper application, field assembly and installation. Ensure that the APL number is permanently marked on the device at a readily visible location. Sheeting used on devices is exempt from this marking requirement.

Notify the Engineer of any scheduled operation which will affect traffic patterns or safety sufficiently in advance of commencing such operation to permit his review of the plan for the proposed installation of temporary traffic control devices.

Ensure an employee is assigned the responsibility of maintaining the position and condition of all temporary traffic control devices throughout the duration of the Contract. Keep the Engineer advised at all times of the identification and means of contacting this employee on a 24 hour basis.

Keep temporary traffic control devices in the correct position, properly directed, clearly visible and clean, at all times. Ensure that all traffic control devices meet acceptable standards as outlined in American Traffic Safety Services Association (ATSSA) "Quality Guidelines for Temporary Traffic Control Devices and Features". Immediately repair, replace or clean damaged, defaced or dirty devices.

102-9.2 Work Zone Signs: Provide signs in accordance with the Plans and FDOT Design Standards. Meet the requirements of 700-1.2.4 and 990-8. Use only approved systems, which includes sign support posts or stands and attachment hardware (nuts, bolts, clamps, brackets, braces, etc.), meeting the vendor requirements specified on the APL drawings.

Attach the sign to the sign support using hardware meeting the manufacturer's recommendations and as specified in the FDOT Design Standards.

Provide Federal Highway Administration's (FHWA) accepted sign substrate for use with accepted sign stands on the National Highway System (NHS) under the provisions of the NCHRP Report 350 "Recommended Procedures for the Safety Performance Evaluation of Highway Features."

102-9.3 Business Signs: Provide and place signs in accordance with the Plans and FDOT Design Standards, Index No. 600 series. Furnish signs having retroreflective sheeting meeting the requirements of Section 990.

102-9.4 High Intensity Flashing Lights: Furnish Type B lights in accordance with the Plans and FDOT Design Standards.

102-9.5 Warning/Channelizing Devices: Furnish warning/channelizing devices in accordance with the Plans and FDOT Design Standards.

102-9.5.1 Retroreflective Collars for Traffic Cones: Use collars for traffic cones listed on the APL that meet the requirements of Section 990. Use cone collars at night designed to properly fit the taper of the cone when installed. Place the upper 6 inch collar a uniform 3-1/2 inches distance from the top of the cone and the lower 4 inch collar a uniform

2 inches distance below the bottom of the upper 6 inch collar. Ensure that the collars are capable of being removed for temporary use or attached permanently to the cone in accordance with the manufacturer's recommendations. Provide a white sheeting having a smooth outer surface and that has the property of a retroreflector over its entire surface.

102-9.5.2 Barrier Wall (Temporary): Furnish, install, maintain, remove and relocate a temporary barrier wall in accordance with the Plans. Ensure that temporary concrete barrier wall for use on roadway sections, complies with FDOT Design Standards, Index Nos. 412, 415 or 414 as specified in the Plans. Ensure that temporary concrete barrier wall for use on bridge and wall sections, complies with FDOT Design Standards, Index No 414 as specified in the Plans. Ensure that temporary water filled barrier wall used on roadway sections meets the NCHRP Report 350 criteria or the MASH and is listed on the APL. Barriers meeting the requirements of FDOT Design Standards, Index Nos. 412, 415 or temporary water filled barriers on the APL will not be accepted as an alternate to barriers meeting the requirements of FDOT Design Standards, Index No. 414.

102-9.5.3 Glare Screen (Temporary): Use temporary glare screens listed on the APL that meet the requirements of Section 990. Furnish, install, maintain, remove and relocate glare screen systems in conjunction with temporary barrier wall at locations identified in the Plans. Ensure the anchorage of the glare screen to the barrier is capable of safely resisting an equivalent tensile load of 600 pounds per foot of glare screen, with a requirement to use a minimum of three fasteners per barrier section.

When glare screen is utilized on temporary barrier wall, barrier delineators will not be required.

102-9.6 Temporary Crash Cushion (Redirective/Gating): Furnish, install, maintain and subsequently remove temporary crash cushions in accordance with the details and notes shown in the Plans, the FDOT Design Standards, and requirements of the pre-approved alternatives listed on the APL. Maintain the crash cushions until their authorized removal. Repair all attachment scars to permanent structures and pavements after crash cushion removal. Make necessary repairs due to defective material, work, or Contractor operations at no cost to the Owner. Restore crash cushions damaged by the traveling public within 24 hours after notification as authorized by the Engineer.

102-9.7 Guardrail (Temporary): Furnish guardrail (temporary) in accordance with the Plans and FDOT Design Standards. Meet the requirements of Section 536.

102-9.8 Arrow Board: Furnish arrow boards that meet the requirements of Section 990 as required by the Plans and FDOT Design Standards to advise approaching traffic of lane closures or shoulder work. Type B arrow boards may be used on low to intermediate speed (0 mph to 50 mph) facilities or for maintenance or moving operations on any speed facility. Type C arrow boards shall be used for all other operations on high-speed (50 mph and greater) facilities and may be substituted for Type B arrow boards on any speed facility.

102-9.9 Portable Changeable Message Sign (PCMS): Furnish PCMSs or truck mounted changeable message signs that meet the requirements of Section 990 as required by the Plans and FDOT Design Standards to supplement other temporary traffic control devices used in work zones.

102-9.10 Portable Regulatory Signs (PRS): Furnish PRSs that meet the requirements of Section 990 as required by the Plans and FDOT Design Standards. Activate portable regulatory signs only during active work activities and deactivate when no work is being performed.

102-9.11 Radar Speed Display Unit (RSDU): Furnish RSDUs that meet the requirements of Section 990 as required by the Plans and FDOT Design Standards to inform motorists of the posted speed and their actual speed. Activate the radar speed display unit only during active work activities and deactivate when no work is being performed.

102-9.12 Temporary Signalization and Maintenance: Provide temporary signalization and maintenance at existing, temporary, and new intersections including but not limited to the following:

- (1) Installation of temporary poles and span wire assemblies as shown in the Plans,
- (2) Temporary portable traffic signals as shown in the Plans,
- (3) Adding or shifting signal heads,
- (4) Trouble calls,
- (5) Maintaining intersection and coordination timing and preemption devices,

Restore any loss of operation within 12 hours after notification. Provide traffic signal equipment

that meets the requirements of the FDOT Design Standards and 603-2. The Engineer may approve used signal equipment if it is in acceptable condition. Replacement components for traffic signal cabinet assemblies will be provided by the maintaining agency.

102-9.13 Temporary Traffic Detection and Maintenance: Provide temporary traffic detection and maintenance at existing, temporary, and new signalized intersections. Provide temporary traffic detection equipment listed on the APL. Restore any loss of detection within 12 hours. Ensure 90% accuracy per signal phase, measured at the initial installation and after any lane shifts, by comparing sample data collected from the detection system with ground truth data collected by human observation. Collect the sample and ground truth data for a minimum of five minutes during a peak and five minutes during an off-peak period with a minimum three detections for each signal phase. Perform the test in the presence of the Engineer.

102-9.14 Truck Mounted Attenuators and Trailer Mounted Attenuators: Furnish, install and maintain only those attenuators that meet the requirements of NCHRP 350 or the MASH. Use truck mounted attenuators or trailer mounted attenuators, when called for in the FDOT Design Standards. Use attenuators listed on the APL. When attenuators are called for, use either a truck mounted attenuator or a trailer mounted attenuator system designed and installed in accordance with the manufacturers recommendations.

Equip the attenuator cartridge with lights and reflectors in compliance with applicable Florida motor vehicle laws, including turn signals, dual tail lights, and brake lights. Ensure that lights are visible in both the raised and lowered positions if the unit is capable of being raised. Ensure that the complete unit is painted DOT yellow (Fed. Std. 595 b, No. 13538). Stripe the rear facing of the cartridge in the operating position with the alternating

6 inch white and 6 inch safety orange 45 degree striping to form an inverted “V” at the center of the unit and slope down and toward the outside of the unit, in both directions from the center. In the raised position, place at least the same square footage of striping on the bottom of the cartridge as placed on the rear facing cartridge in the open position. Use Type III retro-reflectorized sheeting for striping. Attenuators will not be paid for separately. Include the cost of the truck with either a truck mounted attenuator or a trailer mounted attenuator in MOT Lump Sum. Payment includes all costs, including furnishing, maintaining and removal when no longer required, and all materials, labor, tools, equipment and incidentals required for attenuator maintenance.

102-9.15 Temporary Raised Rumble Strip Set: Furnish, install, maintain, remove, and reinstall temporary raised rumble strips per the manufacturer’s recommendations and in accordance with FDOT Design Standards, Index No. 600. The temporary raised rumble strip may be either a removable polymer striping tape or a molded engineered polymer material.

102-9.16 Automated Flagger Assistance Devices (AFAD): Furnish, install, maintain, remove and relocate AFADs in accordance with the Plans and FDOT Design Standards. Position AFADs where they are clearly visible to oncoming traffic and out of the lane of traffic. The devices may be operated either by a single flagger at one end of the traffic control zone, from a central location, or by a separate flagger near each device’s location. AFADs may be either a remotely controlled Stop/Slow AFAD mounted on either a trailer or a movable cart system, or a remotely controlled Red/Yellow Lens AFAD. AFADs will not be paid for separately. AFADs may be used as a supplement or an alternate to flaggers in accordance with Index 603. Include the cost for AFADs in MOT Lump Sum.

102-9.17 Temporary Lane Separator: Furnish, install, maintain, remove and relocate temporary lane separator in accordance with the Plans and FDOT Design Standards, Index No 600. Anchor the portable temporary lane separator with a removable anchor bolt. Use epoxy on bridge decks where anchoring is not allowed. Remove the epoxy from the bridge deck by hydro-blasting or other method approved by the Engineer.

102-10 Work Zone Pavement Marking.

102-10.1 Description: Furnish and install work zone pavement markings for MOT in construction areas and in close conformity with the lines and details shown in the Plans and FDOT Design Standards.

Centerlines, lane lines, edge lines, stop bars and turn arrows will be required in work zones prior to opening the road to traffic.

The most common types of work zone pavement markings are painted pavement markings and removable tape. Other types of work zone pavement markings may be identified in the Plans.

102.10.2 Painted Pavement Markings:

102-10.2.1 General: Use painted pavement markings meeting the requirements of Section 710. Use standard waterborne paint unless otherwise identified in the Plans or approved by the Engineer.

102-10.3 Removable Tape:

102-10.3.1 General: Use removable tape listed on the APL and meeting the requirements of 990-4.

102-10.3.2 Application: Apply removable tape with a mechanical applicator to provide pavement lines that are neat, accurate and uniform. Equip the mechanical applicator with a film cut-off device and with measuring devices that automatically and accumulatively measure the length of each line placed within an accuracy tolerance of plus or minus 2%. Ensure removable tape adheres to the road surface. Removable tape may be placed by hand on short sections, 500 feet or less, if it is done in a neat accurate manner.

102-10.3.3 Retroreflectivity: Apply white and yellow traffic stripes and markings that will attain an initial retroreflectivity of not less than $300 \text{ mcd/lx}\cdot\text{m}^2$ for white and contrast markings and not less than $250 \text{ mcd/lx}\cdot\text{m}^2$ for yellow markings. Black portions of contrast tapes and black masking tapes must be non-reflective and have a reflectance of less than $5 \text{ mcd/lx}\cdot\text{m}^2$. At the end of the six month service life, the retroreflectance of white and yellow removable tape shall not be less than $150 \text{ mcd/lx}\cdot\text{m}^2$.

102-10.3.4 Removability: Provide removable tape capable of being removed from bituminous concrete and Portland cement concrete pavement intact or in substantially large strips, either manually or by a mechanical roll-up device, at temperatures above 40°F, without the use of heat, solvents, grinding or blasting.

102-10.4 Temporary Retroreflective Pavement Markers (RPM's): Use markers listed on the APL and meeting the requirements of 990-5. Apply all markers in accordance with the FDOT Design Standards, Index No. 600, prior to opening the road to traffic. Replace markers any time after installation when more than three consecutive markers fail or are missing, at no expense to the Owner, in a timely manner, as directed by the Engineer.

102-11 Method of Measurement.

102-11.1 General: Devices installed/used on the project on any calendar day or portion thereof, within the allowable Contract Time, including time extensions which may be

granted, will be paid for at the Contract unit price for the applicable pay item, except those paid for as Lump Sum.

102-11.2 Traffic Control Officers: The quantity to be paid for will be at the Contract unit price per hour (4 hour minimum) for the actual number of officers certified to be on the project site, including any law enforcement vehicles and all other direct and indirect costs. Payment will be made only for those traffic control officers specified in the Plans and authorized by the Engineer.

102-11.3 Special Detours: When a detour facility is specifically detailed in the Plans, or is otherwise described or detailed as a special item, and an item for separate payment is included in the proposal, the work of constructing, maintaining, and subsequently removing such detour facilities will be paid for separately. Otherwise, all traffic control devices, warning devices, barriers, signing, and pavement markings for each special detour will be included in the Lump Sum Maintenance of Traffic item.

102-11.4 Commercial Material for Driveway Maintenance: The quantity to be paid for will be the certified volume, in cubic yards, of all materials authorized by the Engineer, acceptably placed and maintained for driveway maintenance. The volume, which is authorized to be reused, and which is acceptably salvaged, placed, and maintained in other designated driveways will be included again for payment.

102-11.5 Work Zone Signs: The number of temporary post-mounted signs (temporary regulatory, warning and guide) certified as installed/used on the project will be paid for under Lump Sum MOT. Temporary portable signs (excluding mesh signs) and vehicular mounted signs will be included for payment under work zone signs, only if used in accordance with the FDOT Design Standards.

102-11.6. Business Signs: The number of business signs certified as installed/used on the project will be paid for under Lump Sum MOT.

102-11.7 High Intensity Flashing Lights: The number of high intensity flashing lights (Type B) certified as installed/used on the project will be paid for under Lump Sum MOT.

102-11.8 Channelizing Devices: The number of Type I, Type II, direction indicator barricade, Type III, vertical panel, drum and longitudinal channelizing devices certified as installed/used on the project meeting the requirements of the FDOT Design Standards, Index No. 600 and have been properly maintained will be paid for under Lump Sum MOT.

102-11.9 Barrier Wall (Temporary): The Contract unit price for barrier wall (temporary) will be full compensation for furnishing, installing, maintaining, and removing the barrier wall. When called for, the Contract unit price for barrier wall (temporary/relocate) will be full compensation for relocating the barrier. The certified quantity to be paid for will be determined by the number of sections times the nominal length of each section.

102-11.10 Barrier Delineators: The number of barrier delineators, installed on top of barrier wall, used on the project, meeting the requirements of the FDOT Design Standards and Section 705.

102-11.11 Arrow Board: Will be paid for under Lump Sum MOT.

102-11.12 Portable Changeable Message Sign: Will be paid for under Lump Sum MOT.

102-11.13 Portable Regulatory Signs: Will be paid for under Lump Sum MOT.

102-11.14 Radar Speed Display Unit: Will be paid for under Lump Sum MOT if applicable.

102-11.15 Temporary Signalization and Maintenance: For existing intersections, the quantity will be paid for under Lump Sum MOT.. No separate payment will be made for temporary signalization and maintenance at new intersections.

102-11.16 Temporary Traffic Detection and Maintenance: For existing intersections, the quantity to be paid for will be the number of signalized intersections per day beginning the day Contract Time begins and ending the day the permanent detection is operational and the final lane configuration is in place. For temporary and new intersections, the quantity to be paid for will be the number of signalized intersections per day beginning the day the temporary detection is functional and ending the day: the permanent detection is operational and the final lane configuration is in place for a new intersection; or, when the detection is removed for a temporary intersection.

102-11.17 Work Zone Pavement Markings: The quantities, furnished and installed, to be paid for will be the length of skip and solid pavement markings, and the area of pavement markings placed as follows(if applicable):

- (a) The total transverse distance, in feet, of skip pavement marking authorized and acceptably applied. The length of actual applied line will depend on the skip ratio of the material used. Measurement will be the distance from the beginning of the first stripe to the end of the last stripe with proper deductions made for unpainted intervals as determined by plan dimensions or stations, subject to 9-1.3.
- (b) The net length, in feet, of solid pavement marking authorized and acceptably applied.
- (c) The number of directional arrows or pavement messages authorized and acceptably applied.
- (d) The number of temporary RPM's authorized and acceptably applied.

102-11.18 Temporary Raised Rumble Strips: If applicable, the quantity to be paid for will be the number of calendar days, or portions thereof, that temporary raised rumble strips are certified as installed/used on the project within the Contract Time. The number of strips used must meet the requirements of the FDOT Design Standards, Index No. 600. No adjustment will be made to the "per day" measurement for the number of strips or sets used, or for the number of times the sets are relocated.

102-11.19 Temporary Lane Separator: If applicable, The quantity of temporary lane separator to be paid for will be plan quantity, in feet, including drainage gaps, completed and accepted.

102-12 Submittals.

102-12.1 Submittal Instructions: Prepare a certification of quantities, using the Owner's current approved form, for certified MOT payment items for each project in the Contract. Submit the certification of quantities to the Engineer. The Owner will not pay for any disputed items until the Engineer approves the certification of quantities.

102-12.2 Contractor's Certification of Quantities: Request payment by submitting a certification of quantities as directed by the Engineer, based on the amount of work done or completed. Ensure the certification consists of the following:

- (a) Contract Number, Certification Number, Certification Date and the period that the certification represents.
- (b) The basis for arriving at the amount of the progress certification, less payments previously made and less an amount previously retained or withheld. The basis will include a detail breakdown provided on the certification of items of payment in accordance with 102-13. After

the initial setup of the MOT items and counts, the interval for recording the counts will be made weekly on the certification sheet unless there is a change. This change will be documented on the day of occurrence. Some items may necessitate a daily interval of recording the counts.

102-13 Basis of Payment (Where applicable).

102-13.1 Maintenance of Traffic (General Work): When an item of work is included in the proposal, price and payment will be full compensation for all work and costs specified under this Section except as may be specifically covered for payment under other items.

102-13.2 Traffic Control Officers: Price and payment will be full compensation for the services of the traffic control officers.

102-13.3 Special Detours: Price and payment will be full compensation for providing all detour facilities shown in the Plans and all costs incurred in carrying out all requirements of this Section for general MOT within the limits of the detour, as shown in the Plans.

102-13.4 Commercial Materials for Driveway Maintenance: Price and payment will be full compensation for all work and materials specified for this item, including specifically all required shaping and maintaining of driveways.

102-13.5 Work Zone Signs: Price and payment will be full compensation for all work and materials for furnishing signs, supports and necessary hardware, installation, relocating, maintaining and removing signs.

102-13.6. Business Signs: Price and payment will be full compensation for all materials and labor required for furnishing, installing, relocating, maintaining, and removing the signs as well as the cost of installing any logos provided by business owners.

102-13.7 High Intensity Warning Lights: Price and payment will be full compensation for furnishing, installing, operating, relocating, maintaining and removing high intensity flashing lights (Type B).

102-13.8 Channelizing Devices: Prices and payment will be full compensation for furnishing, installing, relocating, maintaining and removing the channelizing devices, including the costs associated with attached warning lights as required.

102-13.9 Barrier Wall (Temporary): Price and payment will be full compensation for furnishing, installing, maintaining, and removing the barrier. When called for, barrier wall (temporary) (relocate) will be full compensation for relocating the barrier.

102-13.10 Barrier Delineators: No separate payment will be made for barrier delineators installed on top of temporary barrier wall. The cost of furnishing, installing and maintaining the barrier delineators will be included in the cost of the temporary barrier wall.

102-13.11 Glare Screen (Temporary): NA

102-13.12 Temporary Crash Cushion (Redirective/Gating): Price and payment will be full compensation for furnishing, installing, maintaining and subsequently removing such crash cushions.

102-13.13 Temporary Guardrail: Price and payment will be full compensation for furnishing all materials required for a complete installation, including end anchorage assemblies and any end connections to other structures and for installing, maintaining and removing guardrail.

102-13.14 Arrow Board: Price and payment will be full compensation for

furnishing, installing, operating, relocating, maintaining and removing arrow boards.

102-13.15 Portable Changeable Message Sign: Price and payment will be full compensation for furnishing, installing, operating, relocating, maintaining and removing portable changeable message signs.

102-13.16 Portable Regulatory Signs: Price and payment will be full compensation for furnishing, installing, relocating, maintaining and removing a completely functioning system as described in these Specifications portable regulatory signs. Price and payment will be full compensation for furnishing, installing, operating, relocating, maintaining and removing portable regulatory signs. Payment will include all labor, materials, incidentals, repairs and any actions necessary to operate and maintain the unit at all times that work is being performed or traffic is being affected by construction and/or MOT operations.

102-13.17 Radar Speed Display Unit: Price and payment will be made only for a completely functioning system as described in these specifications. Payment will include all labor, hardware, accessories, signs, and incidental items necessary for a complete system. Payment will include any measurements needed to insure that the unit conforms to all specification requirements.

Payment will include all labor, materials, incidentals, repairs and any actions necessary to operate and maintain the unit at all times that work is being performed or traffic is being affected by construction and/or MOT operations. Price and payment will be full compensation for furnishing, installing, operating, relocating, maintaining and removing radar speed display unit.

102-13.18 Temporary Signalization and Maintenance: Price and payment will constitute full compensation for furnishing, installing, operating, maintaining and removing temporary traffic control signals including all equipment and components necessary to provide an operable traffic signal. Payment will be withheld for each day at each intersection where the temporary signalization is not operational within 12 hours after notification.

102-13.19 Temporary Traffic Detection and Maintenance: Price and payment will constitute full compensation for furnishing, installing, operating, maintaining and removing temporary traffic detection including all equipment and components necessary to provide an acceptable signalized intersection. Take ownership of all equipment and components. Payment will be withheld for each day at each intersection where the temporary detection is not operational within 12 hours after notification.

102-13.20 Temporary Raised Rumble Strips: Price and payment will be full compensation for all work and materials described in this Section, including all cleaning and preparing of surfaces, disposal of all debris, furnishing of all materials, application, curing, removal, reinstalling and protection of all items, protection of traffic, furnishing of all tools, machines and equipment, and all incidentals necessary to complete the work.

102-13.21 Work Zone Pavement Markings: Price and payment will be full compensation for all work specified including, all cleaning and preparing of surfaces, furnishing of all materials, application, curing and protection of all items, protection of traffic, furnishing of all tools, machines and equipment, and all incidentals necessary to complete the work. Final payment will be withheld until all deficiencies are corrected. Removable tape may be substituted for work zone paint at no additional cost to the Owner. Payment for temporary RPMs used to supplement line markings will be paid for under temporary retroreflective pavement markers. Install these markers as detailed in the FDOT Design Standards.

102-13.22 Temporary Lane Separator: Price and payment will be full compensation for all work specified in this Section.

SECTION 104
PREVENTION, CONTROL, AND ABATEMENT OF EROSION AND WATER
POLLUTION

104-1 Description.

Provide erosion control measures on the project and in areas outside the right-of-way where work is accomplished in conjunction with the project, so as to prevent pollution of water, detrimental effects to public or private property adjacent to the project right-of-way and damage to work on the project. Construct and maintain temporary erosion control features or, where practical, construct and maintain permanent erosion control features as shown in the Plans or as may be directed by the Engineer.

104-2 General.

Coordinate the installation of temporary erosion control features with the construction of the permanent erosion control features to the extent necessary to ensure economical, effective, and continuous control of erosion and water pollution throughout the life of the Contract. Due to unanticipated conditions, the Engineer may direct the use of control features or methods other than those included in the original Contract.

104-3 Control of Contractor's Operations Which May Result in Water Pollution.

Prevent pollution of streams, canals, lakes, reservoirs, and other water impoundments with fuels, oils, bitumens, calcium chloride, or other harmful materials. Also, conduct and schedule operations to avoid or otherwise minimize pollution or siltation of such water impoundments, and to avoid interference with movement of migratory fish. Do not dump any residue from dust collectors or washers into any live stream.

Restrict construction operations in rivers, streams, lakes, tidal waters, reservoirs, canals, and other water impoundments to those areas where it is necessary to perform filling or excavation to accomplish the work shown in the Plans and to those areas which must be entered to construct temporary or permanent structures. As soon as conditions permit, promptly clear rivers, streams, and impoundments of all obstructions placed therein or caused by construction operations.

Do not frequently ford live streams with construction equipment. Wherever an appreciable number of stream crossings are necessary at any one location, use a temporary bridge or other structure.

Except as necessary for construction, do not deposit excavated material in rivers, streams, canals, or impoundments, or in a position close enough thereto, to be washed away by high water or runoff.

Where pumps are used to remove highly turbid waters from enclosed construction areas such as cofferdams or forms, treat the water by one or more of the following methods prior to discharge into State waters: pumping into grassed swales or appropriate vegetated areas or sediment basins, or confined by an appropriate enclosure such as turbidity barriers when other methods are not considered appropriate.

Do not disturb lands or waters outside the limits of construction as staked, except as authorized by the Engineer.

Obtain the Engineer's approval for the location of, and method of operation in, borrow pits, material pits, and disposal areas furnished for waste material from the project (other than commercially operated sources) such that erosion during and after completion of the work will not result in probability of detrimental siltation or water pollution.

104-4 Materials for Temporary Erosion Control.

The Engineer will not require testing of materials used in construction of temporary erosion control features other than as provided for geotextile fabric in 985-3 unless such material is to be incorporated into the completed project. When no testing is required, the Engineer will base acceptance on visual inspection.

The Contractor may use new or used materials for the construction of temporary silt fence, staked turbidity barriers, and floating turbidity barrier not to be incorporated into the completed project, subject to the approval of the Engineer.

104-5 Preconstruction Requirements.

At the Preconstruction Conference, provide to the Owner an Erosion Control Plan meeting the requirements or special conditions of all permits authorizing project construction. If no permits are required or the approved permits do not contain special conditions or specifically address erosion and water pollution, the project Erosion Control Plan will be governed by 7-1.1, 7-2.2, 7-8.1, 7-8.2, and Section 104.

When a DEP generic permit is issued, the Contractor's Erosion Control Plan shall be prepared to accompany the required Stormwater Pollution Prevention Plan (SWPPP). Ensure the Erosion Control Plan includes procedures to control off-site tracking of soil by vehicles and construction equipment and a procedure for cleanup and reporting of non-storm water discharges, such as contaminated groundwater or accidental spills. Do not begin any soil disturbing activities until Owner approval of the Contractor's Erosion Control Plan, including required signed certification statements.

Failure to sign any required documents or certification statements will be considered a default of the Contract. Any soil disturbing activities performed without the required signed documents or certification statements may be considered a violation of the DEP Generic Permit.

When the SWPPP is required, prepare the Erosion Control Plan in accordance with the planned sequence of operations and present in a format acceptable to the Owner. The Erosion Control Plan shall describe, but not be limited to, the following items or activities:

(1) For each phase of construction operations or activities, supply the following information:

- (a) Locations of all erosion control devices
- (b) Types of all erosion control devices
- (c) Estimated time erosion control devices will be in operation
- (d) Monitoring schedules for maintenance of erosion control devices
- (e) Methods of maintaining erosion control devices
- (f) Containment or removal methods for pollutants or hazardous wastes

(2) The name and telephone number of the person responsible for monitoring and maintaining the erosion control devices.

(3) Submit for approval the Erosion Control Plans meeting paragraphs 3a, 3b, or 3c below:

(a) Projects permitted by the South Florida Water Management District or require the following:

Obtain the Engineer's approval of the Erosion Control Plan. Do not begin construction activities until the Erosion Control Plan receives written approval from the Engineer.

104-6 Construction Requirements.

104-6.1 Limitation of Exposure of Erodible Earth:

The Engineer may limit the surface areas of unprotected erodible earth exposed by the construction operation and may direct the Contractor to provide erosion or pollution control measures to prevent contamination of any river, stream, lake, tidal waters, reservoir, canal, or other water impoundments or to prevent detrimental effects on property outside the project right-of-way or damage to the project. Limit

the area in which excavation and filling operations are being performed so that it does not exceed the capacity to keep the finish grading, turf, sod, and other such permanent erosion control measures current in accordance with the accepted schedule.

Do not allow the surface area of erodible earth that clearing and grubbing operations or excavation and filling operations expose to exceed 750,000 square feet without specific prior approval by the Engineer. This limitation applies separately to clearing and grubbing operations and excavation and filling operations.

The Engineer may increase or decrease the amount of surface area the Contractor may expose at any one time.

104-6.2 Incorporation of Erosion and Sediment Control Features:

Incorporate permanent erosion control features into the project at the earliest practical time. Use temporary erosion and sediment control features found in the State of Florida Erosion and Sediment Control Designer and Reviewer Manual (E&SC Manual) to correct conditions that develop during construction which were not foreseen at the time of design, to control erosion and sediment prior to the time it is practical to construct permanent control features, or to provide immediate temporary control of erosion and sediment that develops during normal construction operations, which are not associated with permanent erosion control features on the project. An electronic version of the E&SC Manual can be found at the following URL:

<http://www.dot.state.fl.us/specificationsoffice/Implemented/URLinSpecs/Files/FLERosio nSedimentManual.pdf>

Install all sediment control devices in a timely manner to ensure the control of sediment and the protection of lakes, streams, gulf or ocean waters, or any wetlands associated therewith and to any adjacent property outside the right-of-way as required.

At sites where exposure to such sensitive areas is prevalent, complete the installation of any sediment control device prior to the commencement of any earthwork.

After installation of sediment control devices, repair portions of any devices damaged at no expense to the Owner. The Engineer may authorize temporary erosion and sediment control features when finished soil layer is specified in the Contract and the limited availability of that material from the grading operations will prevent scheduled progress of the work or damage the permanent erosion control features.

104-6.3 Scheduling of Successive Operations:

Schedule operations such that the area of unprotected erodible earth exposed at any one time is not larger than the minimum area necessary for efficient construction operations, and the

duration of exposure of uncompleted construction to the elements is as short as practicable. Schedule and perform clearing and grubbing so that grading operations can follow immediately thereafter. Schedule and perform grading operations so that permanent erosion control features can follow immediately thereafter if conditions on the project permit.

104-6.4 Details for Temporary Erosion and Sediment Control Features.

104-6.4.1 General: Use temporary erosion, sediment and water pollution control features found in the E&SC Manual. These features consist of, but are not limited to, temporary turf, rolled erosion control products, sediment containment systems, runoff control structures, sediment barriers, inlet protection systems, silt fences, turbidity barriers, and chemical treatment. For design details for some of these items, refer to the FDOT Design Standards and E&SC Manual.

104-6.4.2 Temporary Turf: The Engineer may designate certain areas of turf or sod as temporary erosion control features. For areas not defined as sod, constructing temporary turf by seeding only is not an option for temporary erosion control under this Section.

104-6.4.3 Runoff Control Structures: Construct runoff control structures in accordance with the details shown in the Plans, the E&SC Manual, or as may be approved as suitable to adequately perform the intended function.

104-6.4.4 Sediment Containment Systems: Construct sediment containment systems in accordance with the details shown in the Plans, the E&SC Manual, or as may be approved as suitable to adequately perform the intended function. Clean out sediment containment systems as necessary in accordance with the Plans or as directed.

104-6.4.5 Sediment Barriers: Provide and install sediment barriers according to details shown in the Plans, as directed by the Engineer, or as shown in the E&SC Manual to protect against downstream accumulation of sediment. Sediment Barriers include, but are not limited to synthetic bales, silt fence, fiber logs and geosynthetic barriers. Reusable barriers that have had sediment deposits removed may be reinstalled on the project as approved by the Engineer.

104-6.4.6 Silt Fence.

104-6.4.6.1 General: Furnish, install, maintain, and remove silt fences, in accordance with the manufacturer's directions, these Specifications, the details as shown in the Plans, the FDOT Design Standards, and the E&SC Manual.

104-6.4.6.2 Materials and Installation: Use a geotextile fabric made from woven or nonwoven fabric, meeting the physical requirements of Section 985 according to those applications for erosion control.

Choose the type and size of posts, wire mesh reinforcement (if required), and method of installation. Do not use products which have a separate layer of plastic mesh or netting. Provide a durable and effective silt fence that controls sediment comparable to the FDOT Design Standards and the E&SC Manual.

Erect silt fence at upland locations, across ditch lines and at temporary locations shown in the Plans or approved by the Engineer where continuous construction activities change the natural contour and drainage runoff. Do not attach silt fence to existing trees unless approved by the Engineer.

104-6.4.6.3 Inspection and Maintenance: Inspect all silt fences immediately after each rainfall and at least daily during prolonged rainfall. Immediately correct any deficiencies. In addition, make a daily review of the location of silt fences in areas where

construction activities have changed the natural contour and drainage runoff to ensure that the silt fences are properly located for effectiveness. Where deficiencies exist, install additional silt fences as directed by the Engineer.

Remove sediment deposits when the deposit reaches approximately 1/2 of the volume capacity of the silt fence or as directed by the Engineer. Dress any sediment deposits remaining in place after the silt fence is no longer required to conform to the finished grade, and prepare and seed them in accordance with Section 570.

104-6.4.7 Floating Turbidity Barriers and Staked Turbidity Barriers:

Install, maintain, and remove turbidity barriers to contain turbidity that may occur as the result of dredging, filling, or other construction activities which may cause turbidity to occur in the waters of the State. The Contractor may need to deploy turbidity barriers around isolated areas of concern such as seagrass beds, coral communities, etc. both within as well as outside the right-of-way limits. The Engineer will identify such areas. Place the barriers prior to the commencement of any work that could impact the area of concern. Install the barriers in accordance with the details shown in the Plans or as approved by the Engineer.

Ensure that the type barrier used and the deployment and maintenance of the barrier will minimize dispersion of turbid waters from the construction site. The Engineer may approve alternate methods or materials. Operate turbidity barriers in such a manner to avoid or minimize the degradation of the water quality of the surrounding waters and minimize damage to areas where floating barriers installed.

104-6.4.8 Inlet Protection System: Furnish and install inlet protection systems as shown in the Plans, FDOT Design Standards and the E&SC Manual.

104-6.4.9 Rolled Erosion Control Products (RECPs):

104-6.4.9.1 General: Install RECPs in locations where temporary protection from erosion is needed. Two situations occur that require artificial coverings. The two situations have differing material requirements, which are described below.

(1) Use RECPs composed of natural or synthetic fiber mats, plastic sheeting, or netting as protection against erosion, when directed by the Engineer, during temporary pauses in construction caused by inclement weather or other circumstances. Remove the material when construction resumes.

(2) Use RECPs as erosion control blankets, at locations shown in the Plans, to facilitate plant growth while permanent grassing is being established. For the purpose described, use non-toxic, biodegradable, natural or synthetic woven fiber mats. Install erosion control blankets capable of sustaining a maximum design velocity of 6.5 ft. /sec as determined from tests performed by Utah State University, Texas Transportation Institute or an independent testing laboratory approved by the Owner. Furnish to the Engineer, two certified copies of manufacturers test reports showing that the erosion control blankets meet the requirements of this Specification. Certification must be attested, by a person having legal authority to bind the manufacturing company. Also, furnish two 4 by 8 inch samples for product identification. The manufacturers test records shall be made available to the Owner upon request. Leave the material in place, as installed, to biodegrade.

104-6.4.10 Chemical Treatment: Provide chemical treatment in accordance with the E&SC Manual. Chemical treatment may be used to clarify turbid or sediment laden water that does not yet meet state water quality standards or as an amendment to other erosion prevention and sediment control products to aid in their performance. The contractor must provide all of the required toxicity testing information in accordance with the E&SC Manual to

the Engineer for review and acceptance prior to using any chemical treatment on the project site.

104-6.5 Removal of Temporary Erosion Control Features: In general, remove or incorporate into the soil any temporary erosion control features existing at the time of construction of the permanent erosion control features in an area of the project in such a manner that no detrimental effect will result. The Engineer may direct that temporary features be left in place.

104-7 Maintenance of Erosion and Sediment Control Features.

104-7.1 General: Provide routine maintenance of permanent and temporary erosion and sediment control features, at no expense to the Owner, until the project is complete and accepted. If reconstruction of such erosion and sediment control features is necessary due to the Contractor's negligence or carelessness or, in the case of temporary erosion and sediment control features, failure by the Contractor to install permanent erosion control features as scheduled, the Contractor shall replace such erosion control features at no expense to the Owner.

Inspect all erosion and sediment control features at least once every seven calendar days and within 24 hours of the end of a storm of 0.50 inches or greater. Maintain all erosion control features as required in the Stormwater Pollution Prevention Plan, Contractor's Erosion Control Plan and as specified in the State of Florida Department of Environmental Protection Generic Permit for Stormwater Discharge from Large and Small Construction Activities.

104-8 Protection during Suspension of Contract Time.

If it is necessary to suspend the construction operations for any appreciable length of time, shape the top of the earthwork in such a manner to permit runoff of rainwater, and construct earth berms along the top edges of embankments to intercept runoff water. Provide temporary slope drains to carry runoff from cuts and embankments that are in the vicinity of rivers, streams, canals, lakes, and impoundments. Locate slope drains at intervals of approximately 500 feet, and stabilize them by paving or by covering with waterproof materials. Should such preventive measures fail, immediately take such other action as necessary to effectively prevent erosion and siltation. The Engineer may direct the Contractor to perform, during such suspensions of operations, any other erosion and sediment control work deemed necessary.

104-9 Method of Measurement.

When separate items for temporary erosion control features are included in the Contract, the quantities to be paid for will be: (1) the area, in square yards, of rolled erosion control products; (2) the length, in feet, of runoff control structures, measured along the surface of the work constructed; (3) the number of sediment containment systems constructed and accepted; (4) the number of sediment containment system cleanouts accomplished and accepted; (5) the length, in feet, of sediment barriers; (6) the length, in feet, of floating turbidity barrier; (7) the length, in feet, of staked turbidity barrier; (8) the number of inlet protection systems; (9) the area, in square yards, of chemical treatment. (10) the number of floc logs or drums of product for chemical treatment.

Upon acceptance by the Engineer, the quantity of floating turbidity barriers, sediment barriers, staked turbidity barriers, and inlet protection devices will be paid for regardless of whether materials are new, used, or relocated from a previous installation on the project.

104-10 Basis of Payment.

Include in overall project cost all work specified in this Section, including construction and routine maintenance of temporary erosion control features. Separate payment will not be made. Any additional costs resulting from compliance with the requirements of this Section, other than construction, routine maintenance, and removal of temporary erosion control features, will be included in the Contract unit prices for the item or items to which such costs are related.

SECTION 105 CONTRACTOR QUALITY CONTROL GENERAL REQUIREMENTS.

105-1 General.

105-1.1 Quality Control Documentation.

105-1.1.1 Submission of Materials Certification and Reporting Test Results:

Provide certifications prior to placement of materials. Report test results at completion of the test and meet the requirements of the applicable Specifications.

105-1.1.2 Worksheets: Make available to the Owner, when requested, worksheets used for collecting test information. Ensure the worksheets at a minimum contain the following:

1. Project Identification Number,
2. Time and Date,
3. Laboratory Identification and Name,
4. Training Identification Numbers (TIN) and initials,
5. Record details as specified within the test method.

105-1.2 Inspections to Assure Compliance with Acceptance Criteria.

105-1.2.1 General: The Owner is not obligated to make an inspection of materials at the source of supply, manufacture, or fabrication. Provide the Engineer with unrestricted entry at all times to such parts of the facilities that concern the manufacture, fabrication, or production of the ordered materials. Bear all costs incurred in determining whether the material meets the requirements of these Specifications.

105-1.2.2 Quality Control Inspection: Provide all necessary inspection to assure effective Quality Control of the operations related to materials acceptance. This includes but is not limited to sampling and testing, production, storage, delivery, construction and placement. Ensure that the equipment used in the production and testing of the materials provides accurate and precise measurements in accordance with the applicable Specifications. Maintain a record of all inspections, including but not limited to, date of inspection, results of inspection, and any subsequent corrective actions taken. Make available to the Owner the inspection records, when requested.

105-1.2.3 Notification of Placing Order: Order materials sufficiently in advance of their incorporation in the work to allow time for sampling, testing and inspection. Notify the Engineer, prior to placing orders for materials. Submit to the Engineer a fabrication schedule for all items requiring commercial inspection, before or at the preconstruction meeting. Notify the Engineer at least 30 days before beginning any production and include a production schedule.

105-2 Quality Control Program.

105-2.1 General: Certain operations require personnel with specific qualifications. Certain materials require production under an approved Quality Control (QC) Plan to ensure that these materials meet the requirements of the Contract Documents. Applicable materials include hot mix asphalt, Portland cement concrete (Structural), earthwork, cementitious materials, timber, steel and miscellaneous metals, galvanized metal products, prestressed and/or precast concrete products and drainage products. For all applicable materials included in the Contract, submit a QC Plan prepared in accordance with the requirements of this Section to the Engineer. Do not incorporate any of these materials into the project prior to the Engineer's approval of the QC Plan.

Steel and Miscellaneous Metal products, including aluminum, are defined as the metal components of bridges, including pedestrian and moveable bridges, overhead and cantilevered sign supports, ladders and platforms, bearings, end wall grates, roadway gratings, drainage items, expansion joints, roadway decking, shear connectors, handrails, galvanized products, fencing, guardrail, light poles, high mast light poles, standard mast arm assemblies and monotube assemblies, stay in-place forms, casing pipe, strain poles, fasteners, connectors and other hardware. When accreditation or certification is required, make supporting documents from the two previous inspections performed by the accrediting or certifying agency available to the Owner upon request.

105-2.2 Compliance with the Materials Manual.

Producers of Flexible Pipe shall meet the requirements of Section 6.1, Volume II of the FDOT's Materials Manual, which may be viewed at the following URL:

<http://www.dot.state.fl.us/specificationoffice/Implemented/URLinSpecs/Files/section61.pdf>.

Producers of Precast Concrete Pipe shall meet the requirements of Section 6.2, Volume II of the FDOT's Materials Manual, which may be viewed at the following URL:

<http://www.dot.state.fl.us/specificationoffice/Implemented/URLinSpecs/Files/section62.pdf>.

Producers of Precast Concrete Drainage Structures shall meet the requirements of Section 6.3, Volume II of the FDOT's Materials Manual, which may be viewed at the following URL:

<http://www.dot.state.fl.us/specificationoffice/Implemented/URLinSpecs/Files/section63.pdf>.

Producers of Precast/Prestressed Concrete Products shall meet the requirements of Sections 8.1 and 8.3 of the FDOT's Materials Manual, which may be viewed at the following URLs:

<http://www.dot.state.fl.us/specificationoffice/Implemented/URLinSpecs/Files/section81.pdf>.

<http://www.dot.state.fl.us/specificationoffice/Implemented/URLinSpecs/Files/section83.pdf>.

Producers of Precast Prestressed Concrete Products using Self Consolidating Concrete shall meet the requirements of Section 8.4, Volume II of the FDOT's Materials Manual, which may be viewed at the following URL:

<http://www.dot.state.fl.us/specificationoffice/Implemented/URLinSpecs/Files/section84.pdf>

Producers of Incidental Precast/Prestressed Concrete Products shall meet the requirements of Section 8.2, Volume II of the FDOT's Materials Manual, which may be viewed at the following URL:

<http://www.dot.state.fl.us/specificationoffice/Implemented/URLinSpecs/Files/section82.pdf>.

Producers of Portland Cement Concrete shall meet the requirements of Section 9.2, Volume II of the FDOT's Materials Manual, which may be viewed at the following

URL:

<http://www.dot.state.fl.us/specificationoffice/Implemented/URLinSpecs/Files/section92.pdf>.

Producers of Structural Steel and Miscellaneous Metal Components shall meet the requirements of Sections 11.1, 11.2, 11.3, 11.4 and 11.5 of the FDOT's Materials Manual, which may be viewed at the following URLs:

<http://www.dot.state.fl.us/specificationoffice/Implemented/URLinSpecs/Files/section111.pdf>

<http://www.dot.state.fl.us/specificationoffice/Implemented/URLinSpecs/Files/section112.pdf>

<http://www.dot.state.fl.us/specificationoffice/Implemented/URLinSpecs/files/section113.pdf>

<http://www.dot.state.fl.us/specificationoffice/Implemented/URLinSpecs/files/Section114.pdf>

<http://www.dot.state.fl.us/specificationoffice/Implemented/URLinSpecs/files/Section115.pdf>

Producers of Fiber Reinforced Polymer Composites shall meet the requirements of Section 12-1, Volume II of the FDOT's Materials Manual, which may be viewed at the following URL:

<http://www.dot.state.fl.us/specificationoffice/Implemented/URLinSpecs/files/section121.pdf>

105-2.3 Hot Mix Asphalt, Portland Cement Concrete (Structural), Earthwork, Cementitious Materials, Timber, Steel and Miscellaneous Metals, Galvanized Metal Products, Prestressed and/or Precast Concrete Products and Drainage Products Quality

Control Program: Have an accepted Quality Control Program, developed in accordance with this Section, during the production of materials to be used on this project.

105-2.4 Prestressed Concrete Quality Control Program: Ensure that prestressed concrete plants are qualified.

105-2.5 Steel and Miscellaneous Metals Quality Control Program: Ensure that the fabricators of Steel and miscellaneous metal products are qualified. Obtaining qualification requires an accepted Quality Control Plan, developed in accordance with this Section. A current American Institute for Steel Construction (AISC) certification is a requirement for the Quality Control Acceptance Program of the steel and miscellaneous metal fabricators, provided that AISC certification program is available for the category of the fabrication products.

105-2.6 Producers Quality Control Plan Submittal: Depending on the type of products, the producers shall submit their proposed Quality Control Plans to the State Materials Office or to the District Materials Office, as described below:

105-2.6.1 State Materials Office: Producers of cementitious materials, steel and miscellaneous metals, galvanized metal products, and aggregates must submit their proposed Quality Control Plan to the State Materials Office for review and acceptance.

105-2.6.2 District Materials Office: Producers of hot mix asphalt, Portland cement concrete (Structural), earthwork, timber, prestressed and/or precast concrete products and drainage products must submit their proposed Quality Control Plan to the local District Materials Office for acceptance. Producers located outside the State must contact the State Materials Office for address information of the District Materials Office responsible for the review of the proposed Quality Control Program.

105-2.7 Contractor's Quality Control Plan: Have an approved Quality Control Plan meeting the requirements of this Section for the transportation, storage, placement, and other related construction operations required by the Contract Documents.

105-2 Contractor Certification of Compliance.

Provide the Engineer with a notarized monthly certification of compliance with the requirements of this Section, to accompany each progress estimate, on a form provided by the Engineer. The Owner may not authorize payment of any progress estimate not accompanied by an executed certification document.

Final payment in accordance with 9-8 will not be made until a final notarized certification summarizing all QC exceptions has been submitted.

105-3 Guidelines for Development of the Quality Control Plan.

105-4.1 General: Use the following guidelines for developing the QC Plan. Provide detailed policies, methods and procedures to ensure the specified quality of all applicable materials and related production and field operations. Include other items in addition to these guidelines as necessary.

105-4.2 Personnel:

105-4.2.1 Qualifications: Submit the Training Identification Numbers (TINs) or any other information which will be traceable to the certification agency's training location and dates for all technicians performing sampling, testing and inspection for both field and laboratory tests. Provide the names of the CTQP certifications and other pertinent certifications held and the expiration dates for each certification for each technician. Include employed and subcontracted technicians.

105-4.2.2 Level of Responsibility: Identify the primary contact for the Owner. Identify roles and responsibilities of various personnel involved in the QC process.

105-5. Raw Materials:

105-5.1 Source: Identify the sources of raw materials. Provide locations and plant or mine numbers when applicable.

105-5.1.1 Certification: Describe methods of verifying compliance of certification with the specifications.

105-5.1.2 Disposition of Failing Materials: Describe the system for controlling non-conforming materials, including procedures for identification, isolation and disposition.

105-5.2 Storage Facilities for Raw Materials: Describe measures and methods, including bedding details, for preventing segregation, contamination and degradation.

Describe methods of identifying individual materials. Where applicable, submit a site plan showing the locations of various materials.

105-5.3 Production Equipment: Describe calibration frequencies, maintenance schedule and procedures for production equipment.

105-5.4 Plant Requirements:

105-5.4.1 Plant Identification: For those facilities producing materials listed in Article 105-3, provide the mailing address, physical address including county and X-Y (Latitude and Longitude) coordinates of the plant, telephone and fax numbers, E-mail address, primary contact at the plant, responsible person in charge, Owner information and Vendor Number and other information as required.

105-5.4.2 Process Control System: Describe the methods and measures established to ensure Contract compliance for the produced materials that are supplemental to the

QC sampling and testing program described in the Contract Documents. These methods and measures will include, but are not limited to, inspection schedule, additional sampling and testing, maintenance schedule, etc.

105-5.4.3 Loading and Shipping Control: Describe the methods and measures for preventing segregation, contamination and degradation during loading and shipping operations. Describe the methods established for materials to be in compliance with the specifications at the point of use.

105-5.5 Types of Products Generated: Describe the products the plant is approved to produce under applicable guidelines.

105-5.6 Other Requirements.

105-5.6.1 Copy of Certification: Attach examples of certifications issued by the plant/Contractor for the products supplied.

105-5.6.2 Statement of Compliance: Include a statement of compliance with all quality requirements set forth in the Contract Documents.

105-5.6.3 Information on Producers with Accepted Quality Control Programs: Identify the Producers of materials listed in 105-2.1 for the project.

105-5.6.4 Describing Documentation Procedure: Identify location of document storage to enable review. Include QC charts, qualification/accreditation records, inspection reports, and other pertinent/supporting documents for an approved QC Plan.

105-5.7 Final Manufactured Product - Plant Operations: Describe inspection schedule and methods for identifying defects and non-compliance with the specifications. Describe corrective actions and methods to resolve them.

105-5.7.1 Storage: When storage of the produced materials is required and it is not defined in the Contract Documents, describe the methods and duration for storage. Include measures and methods for preventing segregation, contamination and degradation during storage.

105-5.7.2 Disposition of Failing Materials: When not described in the specifications, describe the methods and measures for identifying and controlling the failing materials. Include preventive and corrective measures. Describe disposition of failing materials.

105-5.8 Final Manufactured Product - Field Operations:

105-5.8.1 Transportation: Describe the method of delivery from the point of production/storage to the point of placement.

105-5.8.2 Storage: When storage of the produced materials is required and it is not defined in the Contract Documents, describe the methods and duration for storage. Include measures and methods for preventing segregation, contamination and degradation during storage.

105-5.8.3 Placement: Describe the methods and identify the type of equipment used in incorporation of the materials into the project.

105-5.8.4 Disposition of Failing Materials: When not described in the specifications, describe the methods and measures for identifying and controlling the failing materials. Include preventive and corrective measures. Describe disposition of failing materials.

105-5.9 Testing Laboratories: Identify the laboratories performing testing. Ensure that the testing laboratories comply with the Laboratory Qualification Program requirements of this Section.

105-5.9.1 Lab Qualification Program.

Testing Laboratories must have one of the following:

1. Current AASHTO (AAP) accreditation.

2. Inspected on a regular basis per ASTM D 3740 for earthwork, ASTM D 3666 for asphalt and ASTM C 1077 for concrete for test methods used in the Acceptance Program, with all deficiencies corrected, and under the supervision of a Specialty Engineer.

3. Current Construction Materials Engineering Council (CMEC) program accreditation or other independent inspection program accreditation acceptable to the Engineer and equivalent to a. or b. above.

Should any qualified laboratory falsify records, the laboratory qualification will be subject to revocation by the Engineer. Falsification of project-related documentation will be subject to further investigation and penalty under state and federal laws.

It is prohibited for any contract laboratory or staff to perform Contractor Quality Control testing and any other Acceptance Program testing on the same contract.

105-6 Quality Control Plan Submittal.

Submit the QC Plan to the Engineer for approval within 21 calendar days after the Contract Award. The Engineer will review the QC Plan and respond to the Contractor within 21 calendar days of receipt.

If at any time the Contractor is not in compliance with the approved QC Plan, or a part thereof, affected portions of the plan will be disapproved. Cease work in the affected operation(s) and submit a revision to the Engineer. If the QC Plan, or a part thereof, must be revised, submit the revision to the Engineer. The Engineer will review the revision and respond within seven calendar days of receipt. Continue to work on operations that are still in compliance with the approved sections of the QC Plan.

105-7 Personnel Qualifications.

105-7.1 General: Provide qualified personnel for sampling, testing and inspection of materials and construction activities. Ensure that qualifications are maintained during the course of sampling, testing and inspection.

Construction operations that require a qualified technician must not begin until the Owner verifies that the technician is on the CTQP list of qualified technicians. The CTQP lists are subject to satisfactory results from periodic Independent Assurance evaluations.

105-7.2 QC Manager: Designate a QC Manager who has full authority to act as the Contractor's agent to institute any and all actions necessary for the successful implementation of the QC Plan. The QC Manager must speak and understand English. The QC Manager must be on-site at the project on a daily basis or always available upon four hours' notice to administer the QC Plan. This includes administering, implementing, monitoring, and as necessary, adjusting the processes to ensure compliance with the Contract Documents. Ensure that the QC Manager is qualified as such through the Construction Training/Qualification Program.

Under the direction of the QC Manager, and using standard forms provided by the Engineer, summarize the daily QC activities including testing and material sampling. Since erasures are strictly prohibited on all reports and forms, use blue or colored ink. Do not use black ink. If manual corrections to original data are necessary, strike through, correct, and date the entry, including the initials of the person making the correction.

105-7.3 Worksite Traffic Supervisor: Provide a Worksite Traffic Supervisor who is responsible for initiating, installing, and maintaining all traffic control devices as described in Section 102 and in the Contract Documents. Use approved alternate Worksite Traffic Supervisors when necessary.

105-7.4 Flagger: Provide trained flaggers to direct traffic where one-way operation in a single lane is in effect and in other situations as required. The Worksite Traffic Supervisor or others will provide training for flaggers.

105-7.5 Earthwork Quality Control Personnel:

105-7.5.1 Earthwork Level I: Ensure the technician who samples soil and earthwork materials from the roadway project, takes earthwork moisture and density readings, and records those data in the Density Log Book holds a Construction Training and Qualification Program (CTQP) Earthwork Construction Inspection Level I qualification.

105-7.5.2 Earthwork Level II: Ensure the technician responsible for determining the disposition of soil and earthwork materials on the roadway, and for interpreting and meeting Contract Document requirements holds a CTQP Earthwork Construction Inspection Level II qualification.

105-7.6 Asphalt Quality Control Personnel:

105-7.6.1 Plant Technicians: For asphalt plant operations, provide a QC technician, qualified as a CTQP Asphalt Plant Level II technician, available at the asphalt plant at all times when producing mix. Perform all asphalt plant related testing with a CTQP Asphalt Plant Level I technician. As an exception, measurements of temperature may be performed by someone under the supervision of a CTQP Plant Level II technician.

105-7.6.2 Paving Technicians: For paving operations (with the exception of miscellaneous or temporary asphalt), **keep a qualified CTQP Asphalt Paving Level II technician on the roadway at all times when placing asphalt mix, and perform all testing with a CTQP Asphalt Paving Level I technician.** As an exception, measurements of cross-slope, temperature, and yield (spread rate) can be performed by someone under the supervision of a CTQP Paving Level II technician at the roadway.

105-7.6.3 Mix Designer: Ensure all mix designs are developed by individuals who are CTQP qualified as an Asphalt Hot Mix Designer.

105-7.6.4 Documentation: Document all QC procedures, inspection, and all test results and make them available for review by the Engineer throughout the life of the Contract. Identify in the asphalt producer's Quality Control Plan the Quality Control Manager(s) and/or Asphalt Plant Level II technician(s) responsible for the decision to resume production after a quality control failure.

105-8. Concrete QC Personnel:

105-8.1.1 Concrete Field Technician - Level I: Ensure technicians performing plastic property testing on concrete for materials acceptance are qualified CTQP Concrete Field Technicians Level I. Plastic property testing will include but not be limited to slump, temperature, air content, water-to-cementitious materials ratio calculation, and making and curing concrete cylinders. Duties will include initial sampling and testing to confirm specification compliance prior to beginning concrete placements, ensuring timely placement of initial cure and providing for the transport of compressive strength samples to the designated laboratories.

105-8.1.2 Concrete Field Inspector - Level II: Ensure field inspectors responsible for the quality of concrete being placed on major bridge projects are qualified CTQP

Concrete Field Inspectors Level II. A Level II Inspector must be present on the jobsite during all concrete placements. Prior to the placement of concrete, the inspector will inspect the element to be cast to ensure compliance with Contract Documents. A Level II Inspector's duties may include ensuring that concrete testing, inspection, and curing in the field are performed in accordance with the Contract Documents. The QC Inspector will inform the Verification Inspector of anticipated concrete placements and LOT sizes.

105-8.1.3 Concrete Laboratory Technician – Level I: Ensure technicians testing cylinders and recording concrete strength for material acceptance are qualified CTQP Concrete Laboratory Technicians Level I. Duties include final curing, compressive strength testing, and the recording/reporting of all test data.

105-8.2 Supervisory Personnel – Post-Tensioned and Movable Bridge Structures:

105-8.2.1 General: Provide supervisory personnel meeting the qualification requirements only for the post-tensioned and movable bridge types detailed in this Article. Submit qualifications to the Engineer at the pre-construction conference. Do not begin Construction until the qualifications of supervisory personnel have been approved by the Engineer.

105-8.2.2 Proof of License or Certification: Submit a copy of the Professional Engineer license current and in force issued by the state in which registration is held. The license must be for the field of engineering that the construction work involves such as Civil, Electrical or Mechanical. Under certain circumstances Florida registration may be required.

Submit a copy of the license issued by the State of Florida for tradesmen that require a license indicating that the license is in force and is current. Submit a copy of the certification issued by the Instrumentation, Systems and Automation Society of America for each Certified Control Systems Technician.

105-8.2.3 Experience Record: Submit the following information for supervisory personnel to substantiate their experience record. The supervisor (project engineer, superintendent/manager or foreman) seeking approval must provide a notarized certification statement attesting to the completeness and accuracy of the information submitted. Provide the following experience information for each individual seeking approval as a supervisor:

Project owner's name and telephone number of an owner's representative, project identification number, state, city, county, highway number and feature intersected.

Provide a detailed description of each bridge construction experience, and the level of supervisory authority during that experience. Report the duration in weeks, as well as begin and end dates, for each experience period.

Provide the name, address and telephone number of an individual that can verify that the experience being reported is accurate. This individual should have been an immediate supervisor unless the supervisor cannot be contacted in which case another individual with direct knowledge of the experience is acceptable.

105-8.3 Pipe and Precast Concrete Products Manufacturing Facilities Quality Control Personnel:

105-8.3.1 General: Obtain personnel certifications from accredited training provider.

105-8.3.2 Precast Concrete Drainage Structures, Precast Concrete Box Culvert, Precast Concrete Pipe, Incidental Precast Concrete, and Flexible Pipe Manufacturing Facilities Quality Control Personnel:

105-8.3.2.1 Level I Quality Control Inspectors: Ensure that the Level I Inspectors have completed a minimum of a 12-hour, approved, Level I QC Inspector training course in the respective work area. As an exception to this, ensure Flexible Pipe Level I QC Inspectors have completed a minimum of an 8-hour, approved, Level I QC Flexible Pipe Inspector training course. For Incidental Precast Concrete, as an alternative to the completion of the 12-hour training course, the Owner will accept QC personnel meeting the requirements of 105-8.11.2.4.1 and CTQP Concrete Field Technician level I certification or Precast/Prestressed Concrete Institute (PCI) Quality Control Technician/Inspector Level II certification.

105-8.3.2.2 Level II Quality Control Inspectors: Ensure that Level II Inspectors have completed approved Level I QC Inspector training and a minimum of a 5-hour, approved Level II QC Inspector training course in the respective work areas. For Incidental Precast Concrete, as an alternative to the completion of the 5-hour training course, the Owner will accept CTQP Concrete Field Technician Level II or PCI Quality Control Level III certifications.

105-8.3.2.3 Plant Quality Control Manager: Ensure that QC Manager has completed approved Level II QC Inspector training and has a minimum of 2 years construction related experience in the specific work area.

105-8.3.2.4 Additional Requirements for Quality Control Personnel of Precast Concrete Drainage, Precast Concrete Box Culvert, and Incidental Precast Concrete Manufacturing Facilities(if applicable):

105-8.3.2.4.1 Testing Personnel: Ensure the personnel performing plastic property tests have ACI Concrete Field Testing Technician-Grade I certification. Ensure the personnel performing laboratory compressive strength testing have ACI Concrete Laboratory Testing Technician-Grade 1 certification or ACI Concrete Strength Testing Technician certification.

105-8.3.2.4.2: Batch Plant Operator: Ensure the concrete batch plant operator is qualified as a CTQP Concrete Batch Plant Operator. As an alternative to CTQP qualification, the Owner will accept the completion of a minimum of a 6-hour, approved, Batch Plant Operator training course.

105-8.4 Structural Steel and Miscellaneous Metals Fabrication Facility Quality Control Personnel: Ensure each fabrication facility has an onsite production manager, an onsite facility manager for QC, a plant engineer, and on site QC inspectors/technicians to provide complete QC inspections and testing.

Ensure that the Facility Manager for QC and QC inspectors/technicians meet the certification requirements set forth in the latest version of AASHTO/NSBA Steel Bridge Collaboration S 4.1, Steel Bridge Fabrication QC/QA Guide Specification, including the years of experience required in Table 105-5 below. The Facility Manager for QC must meet the requirements of Table 105-5 for every Structural Steel Member Type produced by a plant with QC being managed by the Facility Manager for QC. The Facility Manager for QC will report directly to the plant manager or plant engineer and must not be the plant production manager nor report to or be the subordinate of the plant production manager. QC inspectors/technicians must be the employees of, and must report directly to the Facility Manager for QC.

TABLE 105-5 Experience Requirements for QC Inspectors/Technicians And Facility Manager for Quality Control		
Structural Steel Member Type	Minimum Years of Experience Required	
	QC Inspector/Technician	Facility Manager for QC
Rolled beam bridges	1 year	3 years
Welded plate girders (I sections, box sections, etc.)	2 years	4 years
Complex structures, such as trusses, arches, cable stayed bridges, and moveable bridges	3 years	5 years
Fracture critical (FC) members	3 years	5 years

SECTION 120 (PART I) EXCAVATION AND BACKFILL

120-0 Description.

120-0.1 Work Included: This Section covers the work necessary for the trench excavation and backfill, as well as any regular excavation and backfill required to complete the work as per the contract documents and specifications.

120-0.2 Submittals: Submittals shall be made for all products listed in accordance with the requirements specified.

120-0.3 Settlement: Any settlement noted adjacent to or in backfill, fill, or in structures built over the backfill or fill within the warranty period in accordance with the General Conditions will be considered to be caused by improper stabilization or compaction methods and shall be corrected at no cost to the Owner. Structure damaged by settlement shall be restored to their original condition by the Contractor at no cost to the Owner.

120-0.4 General.

a. See CONDITIONS OF THE CONTRACT and GENERAL REQUIREMENTS, Supplementary Conditions which contain information and requirements that apply to the work specified herein and are mandatory for this project.

b. Contractor shall provide Quality Control for this project as per the requirements of FDOT STANDARD SPECIFICATIONS SECTION 105.

c. A pre-construction video is required for this project prior to mobilization of equipment. Contractor is responsible for the quality of this video. Provide CD or flash drive capable of viewing on windows media player. Video shall extend at minimum 200 LF outside the limits of Construction. Cost of video to be included in overall project cost.

120-0.1 Standard Specifications / Local Agency Specifications.

a. If the term "Standard Specifications" is used, or if there is a reference to any section of the FDOT Standard Specification not included within this section, or if there is a reference to any section of the FDOT Standard Specification not included within this section; such reference shall mean the most current edition of Florida Department of Transportation Standard Specification for Road and Bridge Construction. The Standard Specifications shall be considered as part of this section of the Specifications; below are Listed references for the contractor's convenience; the contractor shall be responsible for obtaining and incorporation in the contract all of the Standard Specification's and the most current revisions that apply to this contract scope of work. The contractor shall document in his daily reports the required Standard Specifications that are used.

b. Any reference of the following "Jurisdictional Authority", "Agency", "Local Agency" in the ATTACHED; SECTION 120 EARTHWORK AND RELATED OPERATIONS FOR LOCAL AGENCIES, shall be considered to be the Owner (City of West Park) for this contract.

c. Any reference of the following “Engineer” in the ATTACHED; SECTION 120 EARTHWORK AND RELATED OPERATIONS FOR LOCAL AGENCIES, shall be considered to be the Construction Engineer for this contract.

d. ATTACHED; SECTION 120 EARTHWORK AND RELATED OPERATIONS FOR LOCAL AGENCIES

SECTION 120 (PART II) EARTHWORK AND RELATED OPERATIONS FOR LOCAL AGENCIES

120-1 Description.

120-1.1 General: Perform Earthwork and Related Operations based on the type of work specified in the Contract and the Earthwork Categories as defined below. Meet the applicable requirements for materials, equipment and construction as specified.

Earthwork and Related Operations consists of excavation for the construction of the roadway, excavation for structures and pipe, constructing backfill around structures and pipe, and constructing embankments as required for the roadway, ditches, and channel changes.

120-1.2 Earthwork Categories: Performance of Earthwork Operations will fall into one of the following Earthwork Categories:

120-1.2.1 Earthwork Category 1: Includes the earthwork and related operations associated with the construction of sidewalks and bike paths along with any drainage structures associated with these facilities.

120-1.2.2 Earthwork Category 2: Includes the earthwork and related operations associated with the construction of turn lanes and other non-mainline traffic lanes, widening, roadway shoulders, concrete box culverts, retaining walls, and other drainage structures on the non-mainline pavement.

120-1.2.3 Earthwork Category 3: Includes the earthwork and related operations associated with the construction of new mainline pavement, along with concrete box culverts, retaining walls, and other drainage structures on the mainline pavement.

120-2 Classes of Excavation.

120-2.1 Excavation of Unsuitable Material: Excavation of unsuitable material consists of the removal of muck, clay, rock or any other material that is unsuitable in its original position and that is excavated below the finished grading template. For stabilized bases and sand bituminous road mixes, the finished grading template is the top of the finished base, shoulders and slopes. For all other bases and rigid pavement, the finished grading template is the finished shoulder and slope lines and bottom of completed base or rigid pavement.

120-2.2 Lateral Ditch Excavation: Lateral Ditch Excavation consists of all excavation of inlet and outlet ditches to structures and roadway, changes in channels of streams, and ditches parallel to the roadway right-of-way. Dress lateral ditches to the grade and cross-section shown in the plans.

120-2.3 Channel Excavation: Channel Excavation consists of the excavation and satisfactory disposal of all materials from the limits of the channel as shown in the plans.

120-2.4 Excavation for Structures and Pipe: Excavation for Structures consists of the excavation for bridge foundations, box culverts, pipe culverts, storm sewers and all other pipe

lines, retaining walls, headwalls for pipe culverts and drains, catch basins, drop inlets, manholes, and similar structures.

120-3 Excavation Requirements.

120-3.1 Excavation and Replacement of Unsuitable Materials: Where rock, muck, clay, or other material within the limits of the roadway is unsuitable in its original position, excavate such material to the cross-sections shown in the plans or indicated by the Engineer, and backfill with suitable material. Shape backfill materials to the required cross-sections. Where the removal of plastic soils below the finished earthwork grade is required, meet a construction tolerance of ± 0.2 foot in depth and ± 6 inches (each side) in width.

120-3.2 Lateral Ditch Excavation: Excavate inlet and outlet ditches to structures and roadway, changes in channels of streams and ditches parallel to the roadway. Dress lateral ditches to the grade and cross-section shown in the plans.

120-3.3 Channel Excavation: Excavate and dispose of all materials from the limits of the channel as shown in the plans. Excavate for bridge foundations, box culverts, pipe culverts, storm sewers and all other pipe lines, retaining walls, headwalls for pipe culverts and drains, catch basins, drop inlets, manholes, and similar structures.

120-3.4 Excavation for Structures and Pipe.

120-3.4.1 Requirements for all Excavation: Excavate foundation pits to permit the placing of the full widths and lengths of footings shown in the plans, with full horizontal beds. Do not round or undercut corners or edges of footings. Perform all excavation to foundation materials, satisfactory to the Engineer, regardless of the elevation shown on the plans. Perform all excavation in stream beds to a depth at least 4 feet below the permanent bed of the stream, unless a firm footing can be established on solid rock before such depth is reached, and excavate to such additional depth as may be necessary to eliminate any danger of undermining. Wherever rock bottom is secured, excavate in such manner as to allow the solid rock to be exposed and prepared in horizontal beds for receiving the masonry. Remove all loose and disintegrated rock or thin strata. Have the Engineer inspect and approve all foundation excavations prior to placing masonry.

120-3.4.2 Earth Excavation:

120-3.4.2.1 Foundation Material other than the Rock: When masonry is to rest on an excavated surface other than rock, take special care to avoid disturbing the bottom of the excavation, and do not remove the final foundation material to grade until just before placing the masonry. In case the foundation material is soft or mucky, the Engineer may require excavation to a greater depth and to backfill to grade with approved material.

120-3.4.2.2 Foundation Piles: Where foundation piles are used, complete the excavation of each pit before driving the piles. After the driving is completed, remove all loose and displaced material, leaving a smooth, solid, and level bed to receive the masonry.

120-3.4.2.3 Removal of Obstructions: Remove boulders, logs, or any unforeseen obstacles encountered in excavating.

120-3.4.3 Rock Excavation: Clean all rock and other hard foundation material, remove all loose material, and cut all rock to a firm surface. Either level, step vertically and horizontally, or serrate the rock, as may be directed by the Engineer. Clean out all seams, and fill them with concrete or mortar.

120-3.4.4 Pipe Trench Excavation: Excavate trenches for pipe culverts and storm sewers to the elevation of the bottom of the pipe and to a width sufficient to provide adequate working room. Remove soil not meeting the classification specified as suitable backfill

material in 120-8.3.2.2 to a depth of 4 inches below the bottom of the pipe elevation. Remove rock, boulders or other hard lumpy or unyielding material to a depth of 12 inches below the bottom of the pipe elevation. Remove muck or other soft material to a depth necessary to establish a firm foundation. Where the soils permit, ensure that the trench sides are vertical up to at least the mid-point of the pipe.

For pipe lines placed above the natural ground line, place and compact the embankment, prior to excavation of the trench, to an elevation at least 2 feet above the top of the pipe and to a width equal to four pipe diameters, and then excavate the trench to the required grade.

120-4 Disposal of Surplus and Unsuitable Material.

120-4.1 Ownership of Excavated Materials: Dispose of surplus and excavated materials as shown in the plans or, if the plans do not indicate the method of disposal, take ownership of the materials and dispose of them outside the right-of-way.

120-4.2 Disposal of Muck on Side Slopes: As an exception to the provisions of 120-4.1, when approved by the Engineer, muck (A-8 material) may be placed on the slopes, or stored alongside the roadway, provided there is a clear distance of at least 6 feet between the roadway grading limits and the muck, and the muck is dressed to present a neat appearance. In addition, this material may also be disposed of by placing it on the slopes where, in the opinion of the Engineer, this will result in an aesthetically pleasing appearance and will have no detrimental effect on the adjacent developments. Where the Engineer permits the disposal of muck or other unsuitable material inside the right-of-way limits, do not place such material in a manner which will impede the inflow or outfall of any channel or of side ditches. The Engineer will determine the limits adjacent to channels within which such materials may be disposed.

120-4.3 Disposal of Paving Materials: Unless otherwise noted, take ownership of paving materials, such as paving brick, asphalt block, concrete slab, sidewalk, curb and gutter, etc., excavated in the removal of existing pavements, and dispose of them outside the right-of-way. If the materials are to remain the property of the Agency, place them in neat piles as directed. Existing limerock base that is removed may be incorporated in the stabilized portion of the subgrade. If the construction sequence will allow, incorporate all existing limerock base into the project as allowed by the Contract Documents.

120-4.4 Disposal Areas: Where the Contract Documents require disposal of excavated materials outside the right-of-way, and the disposal area is not indicated in the Contract Documents, furnish the disposal area without additional compensation.

Provide areas for disposal of removed paving materials out of sight of the project and at least 300 feet from the nearest roadway right-of-way line of any road. If the materials are buried, disregard the 300 foot limitation.

120-5 Materials for Embankment.

120-5.1 General Requirements for Embankment Materials: Construct embankments using suitable materials excavated from the roadway or delivered to the jobsite from authorized borrow pits.

Construct the embankment using maximum particle sizes (in any dimension) as follows:

In top 12 inches: 3 1/2 inches (in any dimension).

12 to 24 inches: 6 inches (in any dimension).

In the depth below 24 inches: not to exceed 12 inches (in any dimension) or the compacted thickness of the layer being placed, whichever is less.

Spread all material so that the larger particles are separated from each other to minimize voids between them during compaction. Compact around these rocks in accordance with 120-7.2.

When and where approved by the Engineer, larger rocks (not to exceed 18 inches in any dimension) may be placed outside the one to two slope and at least 4 feet or more below the bottom of the base. Compact around these rocks to a firmness equal to that of the supporting soil. Where constructing embankments adjacent to bridge end bents or abutments, do not place rock larger than 3 1/2 inches in diameter within 3 feet of the location of any end-bent piling.

120-5.2 Use of Materials Excavated from the Roadway and Appurtenances: Assume responsibility for determining the suitability of excavated material for use on the project in accordance with the applicable Contract Documents. Consider the sequence of work and maintenance of traffic phasing in the determination of the availability of this material.

120-5.3 Authorization for Use of Borrow: Use borrow only when sufficient quantities of suitable material are not available from roadway and drainage excavation, to properly construct the embankment, subgrade, and shoulders, and to complete the backfilling of structures and pipe. Do not use borrow material until so ordered by the Engineer, and then only use material from approved borrow pits.

120-5.3.1 Haul Routes for Borrow Pits: Provide and maintain, at no expense to the Agency, all necessary roads for hauling the borrow material. Where borrow area haul roads or trails are used by others, do not cause such roads or trails to deteriorate in condition.

Arrange for the use of all non-public haul routes crossing the property of any railroad. Incur any expense for the use of such haul routes. Establish haul routes which will direct construction vehicles away from developed areas when feasible, and keep noise from hauling operations to a minimum. Advise the Engineer in writing of all proposed haul routes.

120-5.3.2 Borrow Material for Shoulder Build-up: When so indicated in the plans, furnish borrow material with a specific minimum bearing value, for building up of existing shoulders. Blend materials as necessary to achieve this specified minimum bearing value prior to placing the materials on the shoulders. Take samples of this borrow material at the pit or blended stockpile.

120-5.4 Materials Used at Pipes, Culverts, etc.: Construct embankments over and around pipes, culverts, and bridge foundations with selected materials.

120-6 Embankment Construction.

120-6.1 General: Construct embankments in sections of not less than 300 feet in length or for the full length of the embankment.

120-6.2 Dry Fill Method.

120-6.2.1 General: Construct embankments to meet compaction requirements in 120-7 and in accordance with the acceptance program requirements in 120-9. Restrict the compacted thickness of the last embankment lift to 6 inches maximum.

As far as practicable, distribute traffic over the work during the construction of embankments so as to cover the maximum area of the surface of each layer.

Construct embankment in the dry whenever normal dewatering equipment and methods can accomplish the needed dewatering.

120-6.2.1.1 For A-3 and A-2-4 Materials with up to 15% fines: Construct the embankment in successive layers with lifts up to a maximum compacted thickness of 12 inches. Ensure the percentage of fines passing the No. 200 US Standard sieve in the A-2-4 material does not exceed 15%.

120-6.2.1.2 For A-1 Plastic materials (As designated in FDOT Design Standard Index 505) and A-2-4 Materials with greater than 15% fines: Construct the embankment in successive layers with lifts up to a maximum compacted thickness of 6 inches.

120-6.2.1.3 Equipment and Methods: Provide normal dewatering equipment including, but not limited to, surface pumps, sump pumps and trenching/digging machinery. Provide normal dewatering methods including, but not limited to, constructing shallow surface drainage trenches/ditches, using sand blankets, sumps and siphons.

When normal dewatering does not adequately remove the water, the Engineer may require the embankment material to be placed in the water or in low swampy ground in accordance with 120-7.2.4.

120-6.2.2 Placing in Unstable Areas: Where depositing the material in water, or in low swampy ground that will not support the weight of hauling equipment, construct the embankment by dumping successive loads in a uniformly distributed layer of a thickness not greater than necessary to support the hauling equipment while placing subsequent layers. Once sufficient material has been placed so that the hauling equipment can be supported, construct the remaining portion of the embankment in layers in accordance with the applicable provisions of 120-7.2.4 and 120-7.2.6.

120-6.2.3 Placing on Steep Slopes: When constructing an embankment on a hillside sloping more than 20 degrees from the horizontal, before starting the fill, deeply plow or cut into steps the surface of the original ground on which the embankment is to be placed.

120-6.2.4 Placing Outside Standard Minimum Slope: Where material that is unsuitable for normal embankment construction is to be used in the embankment outside the standard minimum slope (approximately one to two), place such material in layers of not more than 18 inches in thickness, measured loose. The Contractor may also place material which is suitable for normal embankment, outside such standard minimum slope, in 18 inch layers. Maintain a constant thickness for suitable material placed within and outside the standard minimum slope, unless placing in a separate operation.

120-6.3 Hydraulic Method:

120-6.3.1 Method of Placing: When the hydraulic method is used, as far as practicable, place all dredged material in its final position in the embankment by such method. Place and compact any dredged material that is re-handled, or moved and placed in its final position by any other method, as specified in 120-7.2. The Contractor may use baffles or any form of construction he may select, provided the slopes of the embankments are not steeper than indicated in the plans. Remove all timber used for temporary bulkheads or baffles from the embankment, and fill and thoroughly compact the holes thus formed. When placing fill on submerged land, construct dikes prior to beginning of dredging, and maintain the dikes throughout the dredging operation.

120-6.3.2 Excess Material: Do not use excess material placed outside the prescribed slopes, below the normal high-water level, to raise the fill. Remove only the portion of this material required for dressing the slopes.

120-6.3.3 Protection of Openings in Embankment: Leave openings in the embankments at the bridge sites. Remove any material which invades these openings or existing channels without additional compensation to provide the same depth of channel as existed before the construction of the embankment. Do not excavate or dredge any material within 200 feet of the toe of the proposed embankment.

120-7 Compaction Requirements.

120-7.1 Moisture Content: Compact the materials at a moisture content such that the specified density can be attained. If necessary to attain the specified density, add water to the material, or lower the moisture content by manipulating the material or allowing it to dry, as is appropriate.

120-7.2 Compaction of Embankments.

120-7.2.1 Earthwork Category 1 and 2 Density Requirements: Reduce the minimum required density from 100% to 95% of AASHTO T99 Method C for all earthwork items requiring densities.

120-7.2.2 Earthwork Category 3 Density Requirements: Except for embankments constructed by the hydraulic method as specified in 120-6.3, and for the material placed outside the standard minimum slope as specified in 120-6.2.4, and for other areas specifically excluded herein, compact each layer of the material used in the formation of embankments to a density of at least 100% of the maximum density as required by AASHTO T 99, Method C. Uniformly compact each layer using equipment that will achieve the required density, and as compaction operations progress, shape and manipulate each layer as necessary to ensure uniform density throughout the embankment.

120-7.2.3 Compaction over Unstable Foundations: Where the embankment material is deposited in water or on low swampy ground, and in a layer thicker than 12 inches (as provided in 120-6.2.2), compact the top 6 inches (compacted thickness) of such layer to the density as specified in 120-9.5.

120-7.2.4 Compaction Where Plastic Material Has Been Removed: Where unsuitable material is removed and the remaining surface is of the A-4, A-5, A-6, or A-7 Soil Groups, as determined by the Engineer, compact the surface of the excavated area by rolling with a sheepsfoot roller exerting a compression of at least 250 psi on the tamper feet, for the full width of the roadbed (subgrade and shoulders). Perform rolling before beginning any backfill, and continue until the roller feet do not penetrate the surface more than 1 inch. Do not perform such rolling where the remaining surface is below the normal water table and covered with water. Vary the procedure and equipment required for this operation at the discretion of the Engineer.

120-7.2.5 Compaction of Material to Be Used in Base, Pavement, or Stabilized Areas: Do not compact embankment material which will be incorporated into a pavement, base course, or stabilized subgrade, to be constructed as a part of the same Contract.

120-7.2.6 Compaction of Grassed Shoulder Areas: For the upper 6 inch layer of all shoulders which are to be grassed, since no specific density is required, compact only to the extent directed.

120-7.2.7 Compaction of Grassed Embankment Areas: For the outer layer of all embankments where plant growth will be established, do not compact. Leave this layer in a loose condition to a minimum depth of 6 inches for the subsequent seeding or planting operations.

120-7.3 Compaction of Subgrade: If the plans do not provide for stabilizing, compact the subgrade in both cuts and fills to the density specified in 120-9.5. For undisturbed soils, do not apply density requirements where constructing narrow widening strips or paved shoulders 5 feet or less in width.

Where trenches for widening strips are not of sufficient width to permit the use of standard compaction equipment, perform compaction using vibratory rollers, trench rollers, or other type compaction equipment approved by the Engineer.

Maintain the required density until the base or pavement is placed on the subgrade.

120-8 Backfilling around Structures and Pipe.

120-8.1 Requirements for all Structures:

120-8.1.1 General: Backfill around structures and pipe in the dry whenever normal dewatering equipment and methods can accomplish the needed dewatering.

120-8.1.2 Equipment and Methods: Provide normal dewatering equipment including, but not limited to, surface pumps, sump pumps, well points and header pipe and trenching/digging machinery. Provide normal dewatering methods including, but not limited to, constructing shallow surface drainage trenches/ditches, using sand blankets, perforated pipe drains, sumps and siphons.

120-8.1.3 Backfill Materials: Backfill to the original ground surface or subgrade surface of openings made for structures, with a sufficient allowance for settlement. The Engineer may require that the material used for this backfill be obtained from a source entirely apart from the structure.

Do not allow heavy construction equipment to cross over culvert or storm sewer pipes until placing and compacting backfill material to the finished earthwork grade or to an elevation at least 4 feet above the crown of the pipe.

120-8.1.4 Use of A-7 Material: In the backfilling of trenches, A-7 material may be used from a point 12 inches above the top of the pipe up to the elevation shown on the FDOT Design Standards as the elevation for undercutting of A-7 material.

120-8.1.5 Time of Placing Backfill: Do not place backfill against any masonry or concrete abutment, wingwall, or culvert until the Engineer has given permission to do so, and in no case until the masonry or concrete has been in place seven days or until the specified 28-day compressive strength occurs.

120-8.1.6 Placement and Compaction: Place the material in horizontal layers not exceeding 6 inches compacted thickness, in depth above water level, behind abutments, wingwalls and end bents or end rest piers, and around box culverts and all structures including pipe culverts. When the backfill material is deposited in water, compact per 120-8.2.5 and 120-8.3.4.

The Contractor may elect to place material in thicker lifts of no more than 12 inches compacted thickness outside the soil envelope if he can demonstrate with a successful test section that density can be achieved. Notify the Engineer prior to beginning construction of a test section. Construct a test section of 500 feet in length. Perform five tests at random locations within the test section. All five tests must meet the density required by 120-7.2. Identify the test section with the compaction effort and soil classification in the Agency Logbook. In case of a change in compaction effort or soil classification, construct a new test section. When a test fails the requirements of 120-7.2, construct a new test section. The Contractor may elect to place material in 6 inches compacted thickness at any time.

120-8.2 Additional Requirements for Structures Other than Pipe:

120-8.2.1 Density: Where the backfill material is deposited in water, obtain a 12 inch layer of comparatively dry material, thoroughly compacted by tamping, before verifying the layer and density requirements. Meet the requirements of the density Acceptance Criteria.

120-8.2.2 Box Culverts: For box culverts over which pavement is to be constructed, compact around the structure to an elevation not less than 12 inches above the top of the structure, using rapid-striking mechanical tampers.

120-8.2.3 Other Limited Areas: Compact in other limited areas using mechanical tampers or approved hand tampers, until the cover over the structure is at least 12 inches thick. When hand tampers are used, deposit the materials in layers not more than 4 inches thick using hand tampers suitable for this purpose with a face area of not more than 100 in². Take special precautions to prevent any wedging action against the masonry, and step or terrace the slope bounding the excavation for abutments and wingwalls if required by the Engineer.

120-8.2.4 Culverts and Piers: Backfill around culverts and piers on both sides simultaneously to approximately the same elevation.

120-8.2.5 Compaction Under Wet Conditions: Where wet conditions do not permit the use of mechanical tampers, compact using hand tampers. Use only A-3 material for the hand tamped portions of the backfill. When the backfill has reached an elevation and condition such as to make the use of the mechanical tampers practical, perform mechanical tamping in such manner and to such extent as to transfer the compaction force into the sections previously tamped by hand.

120-8.3 Additional Requirements for Pipe 15 Inches Inside Diameter or Greater:

120-8.3.1 General: Trenches for pipe may have up to four zones that must be backfilled.

Lowest Zone: The lowest zone is backfilled for deep undercuts up to within 4 inches of the bottom of the pipe.

Bedding Zone: The zone above the Lowest Zone is the Bedding Zone. Usually it will be the backfill which is the 4 inches of soil below the bottom of the pipe. When rock or other hard material has been removed to place the pipe, the Bedding Zone will be the 12 inches of soil below the bottom of the pipe.

Cover Zone: The next zone is backfill that is placed after the pipe has been laid and will be called the Cover Zone. This zone extends to 12 inches above the top of the pipe. The Cover Zone and the Bedding Zone are considered the Soil Envelope for the pipe.

Top Zone: The Top Zone extends from 12 inches above the top of the pipe to the base or final grade.

120-8.3.2 Material:

120-8.3.2.1 Lowest Zone: Backfill areas undercut below the Bedding Zone of a pipe with coarse sand, or other suitable granular material, obtained from the grading operations on the project, or a commercial material if no suitable material is available.

120-8.3.2.2 Soil Envelope: In both the Bedding Zone and the Cover Zone of the pipe, backfill with materials classified as A-1, A-2, or A-3. Material classified as A-4 may be used if the pipe is concrete pipe.

120-8.3.2.3 Top Zone: Backfill the area of the trench above the soil envelope of the pipe with materials allowed on FDOT Design Standard, Index No. 505.

120-8.3.3 Compaction:

120-8.3.3.1 Lowest Zone: Compact the soil in the Lowest Zone to approximately match the density of the soil in which the trench was cut.

120-8.3.3.2 Bedding Zone: If the trench was not undercut below the bottom of the pipe, loosen the soil in the bottom of the trench immediately below the approximate middle third of the outside diameter of the pipe.

If the trench was undercut, place the bedding material and leave it in a loose condition below the middle third of the outside diameter of the pipe. Compact the outer portions to meet the density requirements of the Acceptance Criteria. Place the material in lifts no greater than 6 inches (compacted thickness).

120-8.3.3.3 Cover Zone: Place the material in 6 inches layers (compacted thickness), evenly deposited on both sides of the pipe, and compact with mechanical tampers suitable for this purpose. Hand tamp material below the pipe haunch that cannot be reached by mechanical tampers. Meet the requirements of the density Acceptance Criteria.

120-8.3.3.4 Top Zone: Place the material in layers not to exceed 12 inches in compacted thickness. Meet the requirements of the density Acceptance Criteria.

120-8.3.4 Backfill Under Wet Conditions: Where wet conditions are such that dewatering by normal pumping methods would not be effective, the procedure outlined below may be used when specifically authorized by the Engineer in writing.

Granular material may be used below the elevation at which mechanical tampers would be effective, but only material classified as A-3. Place and compact the material using timbers or hand tampers until the backfill reaches an elevation such that its moisture content will permit the use of mechanical tampers. When the backfill has reached such elevation, use normally acceptable backfill material. Compact the material using mechanical tampers in such manner and to such extent as to transfer the compacting force into the material previously tamped by hand.

120-9 Acceptance Program.

120-9.1 Density over 105%: When a computed dry density results in a value greater than 105% of the applicable Proctor maximum dry density, perform a second density test within 5 feet. If the second density results in a value greater than 105%, investigate the compaction methods, examine the applicable Maximum Density and material description. If necessary, test an additional sample for acceptance in accordance with AASHTO T 99, Method C.

120-9.2 Maximum Density Determination: Determine the maximum density and optimum moisture content by sampling and testing the material in accordance with the specified test method listed in 120-9.3.

120-9.3 Density Testing Requirements: Ensure compliance with the requirements of 120-9.5 by Nuclear Density testing in accordance with FDOT Florida Method FM 1-T 238. Determine the in-place moisture content for each density test. Use Florida Method FM 1-T 238, FM 5-507 (Determination of Moisture Content by Means of a Calcium Carbide Gas Pressure Moisture Tester), or ASTM D 4643 (Laboratory Determination of Moisture Content of Granular Soils by Use of a Microwave Oven) for moisture determination.

120-9.4 Soil Classification: Perform soil classification tests in accordance with AASHTO T-88. Classify soils in accordance with AASHTO M-145 in order to determine compliance with embankment utilization requirements.

120-9.5 Acceptance Criteria: Obtain a minimum density in accordance with 120-7.2 with the following exceptions:

- 1) Embankment constructed by the hydraulic method as specified in 120-6.3;
- 2) Material placed outside the standard minimum slope as specified in 120-6.2.4;
- 3) Other areas specifically excluded herein.

120-9.6 Frequency: Conduct sampling and testing at a minimum frequency listed in the table below.

Test Name	Frequency
Maximum Density	One per soil type
Density	1 per 500' RDWY (Alt Lift)
Soil Classification	One per Maximum Density

120-10 Maintenance and Protection of Work.

While construction is in progress, maintain adequate drainage for the roadbed at all times. Maintain a shoulder at least 3 feet wide adjacent to all pavement or base construction in order to provide support for the edges.

Maintain and protect all earthwork construction throughout the life of the Contract, and take all reasonable precautions to prevent loss of material from the roadway due to the action of wind or water. Repair any slides, washouts, settlement, subsidence, or other mishap which may occur prior to final acceptance of the work. Maintain all channels excavated as a part of the Contract work against natural shoaling or other encroachments to the lines, grades, and cross-sections shown in the plans, until final acceptance of the project.

120-11 Construction.

120-11.1 Construction Tolerances: Shape the surface of the earthwork to conform to the lines, grades, and cross-sections shown in the plans. In final shaping of the surface of earthwork, maintain a tolerance of 0.3 foot above or below the plan cross-section with the following exceptions:

1. Shape the surface of shoulders to within 0.1 foot of the plan cross-section.
2. Shape the earthwork to match adjacent pavement, curb, sidewalk, structures, etc.
3. Shape the bottom of ditches so that the ditch impounds no water.
4. When the work does not include construction of base or pavement, shape the entire roadbed (shoulder point to shoulder point) to within 0.1 foot above or below the plan cross-section.

Ensure that the shoulder lines do not vary horizontally more than 0.3 foot from the true lines shown in the plans.

120-11.2 Operations Adjacent to Pavement: Carefully dress areas adjacent to pavement areas to avoid damage to such pavement. Complete grassing of shoulder areas prior to placing the final wearing course. Do not manipulate any embankment material on a pavement surface.

When shoulder dressing is underway adjacent to a pavement lane being used to maintain traffic, exercise extreme care to avoid interference with the safe movement of traffic.

120-12 Method of Measurement.

120-12.1 Excavation: Excavation will be paid for by volume, in cubic yards, calculated by the method of average end areas, unless the Engineer determines that another method of calculation will provide a more accurate result. The material will be measured in its original position by field survey or by photogrammetric means as designated by the Engineer. Measurement for payment will include the excavation of unsuitable material, lateral ditch excavation, channel excavation, and excavation for structures and pipe. Payment will not be

made for excavation or embankment beyond the limits shown in the plans or authorized by the Engineer.

120-12.2 Embankment: Measurement will be made on a loose volume basis, as measured in trucks or other hauling equipment at the point of dumping on the road. Payment will not be made for embankment beyond the limits shown in the plans or authorized by the Engineer.

120-12.3 Swale Re-Grading: Measurement will be made on the number of square yards graded to match the required cross slope for swale areas adjacent to asphalt pavement. Payment will not be made for swale grading beyond the limits shown in the plans or authorized by the Engineer.

120-13 Basis of Payment.

120-13.1 General: Prices and payments for the work items included in this Section will be full compensation for all work described herein, including excavating, dredging, hauling, placing, and compacting; dressing the surface of the earthwork; and maintaining and protecting the complete earthwork.

120-13.2 Excavation: The total quantity of all excavation specified under this Section will be paid for at the Contract unit price for Excavation. No payment will be made for the excavation of any materials which are used for purposes other than those shown in the plans or designated by the Engineer. No payment will be made for materials excavated outside the lines and grades given by the Engineer, unless specifically authorized by the Engineer.

120-13.3 Embankment: The total quantity of embankment specified in this Section will be paid for at the Contract unit price for embankment. No payment will be made for materials which are used for purposes other than those shown in the plans or designated by the Engineer. Includes the total quantity of re-grading specified for re-grading of existing swale. No payment will be made for materials placed outside the lines and grades given by the Engineer, unless specifically authorized by the Engineer.

SECTION 125 EXCAVATION FOR STRUCTURES AND PIPE

125-1 Description.

Excavate for box culverts, pipes, retaining walls, headwalls for pipes and drains, catch basins, drop inlets, manholes, and similar structures. Construct and remove cofferdams, sheeting, bracing, etc.; pump or otherwise dewater foundations; remove and dispose of any existing structures or portions of structures not covered by other items in the Contract, including foundations, abutments, piers, wings, and all other materials, obstructions, etc., found necessary to clear the site for the proposed work; backfill, dispose of surplus material, and perform final cleaning, as may be necessary for the proper execution of the work. This Section does not include excavation for bases or pavements, curbs, curb and gutter, valley gutter, ditch pavement, or rubble gutter. Perform work in accordance with an approved Quality Control (QC) Plan meeting the requirements of 105-3.

125-1.1 Trench Excavation Safety System and Shoring, Special (Trench Excavation): When performing trench excavation in excess of 5 feet in depth, comply with the Occupational Safety and Health Administration's (OSHA) trench safety standards, 29 CFR,

1926, Subpart P, and all subsequent revisions or updates adopted by the Department of Labor and Employment Security. Ensure that trench boxes are wide enough to accommodate compaction and density testing.

Submission of bid and subsequent execution of the Contract will serve as certification that all trench excavation in excess of 5 feet in depth will be in compliance with Section 553.62, Florida Statutes.

Consider all available geotechnical information when designing the trench excavation safety system.

Consider these and any more stringent trench safety standards as minimum Contract requirements.

125-2 Classification.

Consider all materials excavated as unclassified and as excavation regardless of the material encountered.

125-3 Cofferdams.

125-3.1 Construction:

125-3.1.1 Methods: Construct all foundations by open excavation, and shore, brace, or protect the foundation openings with cofferdams. Provide cofferdams or cribs for foundation construction below the bottom of the footings. Provide sufficient clearance in the cofferdam interiors to permit construction of forms and inspection of their exteriors, and for pumping equipment.

125-3.1.2 Protection of Concrete: Construct cofferdams to protect green concrete against damage from a sudden rising of the water and to prevent damage by erosion. Do not leave timber or bracing in cofferdams or cribs that extend into the substructure masonry except where permitted in writing by the Engineer.

125-3.1.3 Placing in the Dry: For placing footings in the dry, the Engineer may require cofferdam sheeting to be driven to an elevation 6 feet below the elevation of the bottom of the footings and require sufficient pumping equipment to dewater and maintain the cofferdam in a comparatively dry condition.

125-3.1.4 Working Drawings: For substructure work, submit drawings showing the proposed method of cofferdam construction and other details left to choice or not fully shown

in the Plans. Obtain the Engineer's approval of the type and clearance of cofferdams, insofar as such details affect the character of the finished work. For other details of design that do not affect the character of the finished work, assume responsibility for the successful construction of the work. Retain a Professional Engineer, registered in the State of Florida, to prepare the above construction drawing, and keep a signed and sealed copy on hand at the site at all times.

125-3.2 Removal: Unless otherwise provided, remove cofferdams or cribs, with all sheeting and bracing, after completion of the substructure without disturbing or marring the finished masonry.

125-4 Excavation.

125-4.1 Requirements for all Excavation: Perform all excavation to foundation materials, satisfactory to the Engineer, regardless of the elevation shown in the Plans. Remove rock, boulders or other hard lumpy or unyielding material to a depth of 12 inches

below the bottom of pipes and box culverts elevations. Remove muck or other soft material to the depth indicated in the Plans or as directed by the Engineer.

125-4.2 Earth Excavation:

125-4.2.1 Foundation Material other than the Rock: When masonry is to rest on an excavated surface other than rock, take special care to avoid disturbing the bottom of the excavation, and do not remove the final foundation material to grade until just before placing the masonry. In case the foundation material is soft or mucky, the Engineer may require excavation to a greater depth and to backfill to grade with approved material.

125-4.2.2 Foundation Piles: Where foundation piles are used, complete the excavation of each pit before driving the piles. After the driving is completed, remove all loose and displaced material, leaving a smooth, solid, and level bed to receive the masonry.

125-4.2.3 Removal of Obstructions: Remove boulders, logs, or any unforeseen obstacles encountered in excavating. Compensation will be in accordance with the requirements of 4-3.

125-4.3 Rock Excavation: Clean all rock and other hard foundation material, remove all loose material, and cut all rock to a firm surface. Either level, step vertically and horizontally, or serrate the rock, as may be directed by the Engineer. Clean out all seams, and fill them with concrete or mortar.

125-4.4 Pipe Trench Excavation: Excavate trenches for pipes to the elevation of the bottom of the pipe and to a width sufficient to provide adequate working room. Remove soil not meeting the classification specified as suitable backfill material in 125-8.3.2.2, to a depth of 4 inches below the bottom of the pipe elevation. Where the soils permit, ensure that the trench sides are vertical up to at least the mid-point of the pipe.

For pipe lines placed above the natural ground line, place and compact the embankment, prior to excavation of the trench, to an elevation at least 2 feet above the top of the pipe and to a width equal to four pipe diameters, and then excavate the trench to the required grade.

For pipe trenches utilizing trench boxes, ensure that the trench box used is of sufficient width to permit thorough tamping of bedding material under and around the pipes as specified in 125-8.1.6.

Do not disturb the installed pipe and its embedment when moving trench boxes. Move the trench box carefully to avoid excavated wall displacement or damage. As the trench box is moved, fill any voids left by the trench box and continuously place and compact the backfill material adjacent to and all along the side of the trench box walls to fill any voids created by the trench box.

125-5 Preservation of Channel.

125-5.1 General: Unless shown in the Plans, do not excavate outside of caissons, cribs, cofferdams, or sheet piling, and do not disturb the natural stream bed adjacent to the structure. If excavating or dredging at the site of the structure before sinking caissons, cribs, or cofferdams, complete the foundation and backfill all such excavations to the original ground surface or other required elevation, with material satisfactory to the Engineer.

125-5.2 Removal of Excavated Materials: Do not allow materials that are deposited adjacent to the stream area to infiltrate the water areas. Leave the stream in its original condition.

125-6 Disposal of Surplus.

Use suitable excavated materials for backfilling over or around the structure. Dispose of unsuitable materials. Meet the disposal requirements pertaining to water pollution contained in Section 104 and in 7-1.1.

125-7 Pumping.

Pump from the interior of any foundation enclosure in such manner as to preclude the possibility of any portion of the concrete materials being carried away. Do not pump while placing concrete, or for a period of at least 24 hours thereafter, unless using a suitable pump separated from the concrete work by a watertight wall.

125-8 Backfilling.

125-8.1 General Requirements for Structures and Pipe:

125-8.1.1 General: Backfill in the dry whenever normal dewatering equipment and methods can accomplish the needed dewatering. A LOT is defined as one lift of backfill material placement, not to exceed 500 feet in length or a single run of pipe connecting two successive structures, whichever is less. Backfill for structures and pipe compacted in one operation will be considered as one LOT within the cover zone. Backfill around structures compacted separately from the pipe will be considered as separate LOTs. Backfill on each side of the pipe for the first lift will be considered a separate LOT. Backfill on opposite sides of the pipe for the remaining lifts will be considered separate LOTs, unless the same compactive effort is applied. Same compactive effort is defined as the same type of equipment (make and model) making the same number of passes on both sides of the pipe. For multiple phase backfill, a LOT shall not extend beyond the limits of the phase.

When placing backfill within trench box each lift of backfill is considered a LOT. Placement of backfill within trench box limits will be considered a complete operation before trench box is moved for next backfill operation. When the trench box is moved for next backfill operation this will start new LOTs for each lift. Follow the density testing frequency in 125-9.3.1.

125-8.1.2 Equipment and Methods: Provide normal dewatering equipment including, but not limited to, surface pumps, sump pumps, wellpoints and header pipe and trenching/digging machinery. Provide normal dewatering methods including, but not limited to constructing shallow surface drainage trenches/ditches, using sand blankets, perforated pipe drains, sumps and siphons.

125-8.1.3 Backfill Materials: Backfill to the original ground surface or subgrade surface of openings made for structures, with a sufficient allowance for settlement. The Engineer

may require that the material used for this backfill be obtained from a source entirely apart from the structure. Use only material accepted by the Engineer.

Do not allow heavy construction equipment to cross over culvert or storm sewer pipes until placing and compacting backfill material to the finished earthwork grade or to an elevation at least 4 feet above the crown of the pipe.

125-8.1.4 Use of A-7 Material: In the backfilling of trenches, A-7 material may be used from a point 12 inches above the top of the pipe up to the elevation shown in the FDOT Design Standards as the elevation for undercutting of A-7 material.

125-8.1.5 Time of Placing Backfill: Do not place backfill against any masonry or concrete abutment, wingwall, or culvert until the Engineer has given permission to do so, and in no case until the masonry or concrete has been in place seven days or until the specified 28 day compressive strength occurs.

125-8.1.6 Placement and Compaction: Place the material in horizontal layers not exceeding 6 inches compacted thickness, in depth above water level, behind abutments, wingwalls and end bents or end rest piers, under the haunches of the pipes and around box culverts and all structures including pipe culverts. When the backfill material is deposited in water, compact as specified in 125-8.2.5 and 125-8.3.4.

The Contractor may elect to place material in thicker lifts of no more than 12 inches compacted thickness above the Soil Envelope if he can demonstrate with a successful test section that density can be achieved. Notify the Engineer prior to beginning construction of a test section. Construct a test section of the length of one LOT. Perform five QC tests at random locations within the test section. All five tests must meet the density required by 125-9.2 and be verified by the Owner. Identify the test section with the compaction effort and soil classification in the Logbook. In case of a change in compaction effort or soil classification, construct a new test section. When a QC test fails the requirements of 125-9.2 or when the QC tests cannot be verified, construct a new test section. The Contractor may elect to place material in 6 inches compacted thickness at any time.

125-8.2 Additional Requirements for Structures Other than Pipe:

125-8.2.1 Density: Where the backfill material is deposited in water, obtain a 12 inch layer of comparatively dry material, thoroughly compacted by tamping, before verifying the layer and density requirements. Meet the requirements of 125-9.2.

125-8.2.2 Box Culverts: For box culverts over which pavement is to be constructed, compact around the structure to an elevation not less than 12 inches above the top of the structure, using rapid-striking mechanical tampers.

125-8.2.3 Other Limited Areas: Compact in other limited areas using mechanical tampers or approved hand tampers, until the cover over the structure is at least 12 inches thick. When hand tampers are used, deposit the materials in layers not more than 4 inches thick using hand tampers suitable for this purpose with a face area of not more than 100 square inches. Take special precautions to prevent any wedging action against the masonry, and step or terrace the slope bounding the excavation for abutments and wingwalls if required by the Engineer.

125-8.2.4 Culverts and Piers: Backfill around culverts and piers on both sides simultaneously to approximately the same elevation.

125-8.2.5 Compaction Under Wet Conditions: Where wet conditions do not permit the use of mechanical tampers, compact using hand tampers. Use only A-3 material for the hand tamped portions of the backfill. When the backfill has reached an elevation and condition such as to make the use of the mechanical tampers practical, perform mechanical tamping in such manner and to such extent as to transfer the compaction force into the sections previously tamped by hand.

125-8.3 Additional Requirements for Pipe 15 Inches inside Diameter or Greater: 125-

8.3.1 General:

Trenches for pipe may have up to four zones that must be backfilled.

Lowest Zone: The lowest zone is backfilled for deep undercuts up to within 4 inches of the bottom of the pipe.

Bedding Zone: The zone above the lowest zone is the bedding zone. Usually it will be the backfill which is the 4 inches of soil below the bottom of the pipe. When rock or other hard material has been removed to place the pipe, the bedding zone will be the 12 inches of soil below the bottom of the pipe.

Cover Zone: The next zone is backfill that is placed after the pipe has been laid and will be called the cover zone. This zone extends to 12 inches above the top of the pipe. The cover zone and the bedding zone are considered the Soil Envelope for the pipe.

Top Zone: The top zone extends from 12 inches above the top of the pipe to the base or final grade.

125-8.3.2 Material:

125-8.3.2.1 Lowest Zone: Backfill areas undercut below the bedding zone of a pipe with coarse sand, or other suitable granular material, obtained from the grading operations on the project, or a commercial material if no suitable material is available.

125-8.3.2.2 Soil Envelope: In both the bedding zone and the cover zone of the pipe, backfill with materials classified as A-1, A-2, or A-3. Material classified as A-4 may be used if the pipe is concrete pipe.

125-8.3.2.3 Top Zone: Backfill the area of the trench above the soil envelope of the pipe with materials allowed on FDOT Design Standards, Index No. 505.

125-8.3.3 Compaction:

125-8.3.3.1 Lowest Zone: Compact the soil in the lowest zone to approximately match the density of the soil in which the trench was cut.

125-8.3.3.2 Bedding Zone: If the trench was not undercut below the bottom of the pipe, loosen the soil in the bottom of the trench immediately below the approximate middle third of the outside diameter of the pipe.

If the trench was undercut, place the bedding material and leave it in a loose condition below the middle third of the outside diameter of the pipe. Compact the outer portions to meet the density requirements of the acceptance criteria. Place the material in lifts no greater than 6 inches (compacted thickness).

125-8.3.3.3 Cover Zone: Before placing the cover zone material, lay pipe according to Section 430. Excavate for pipe bells before laying pipe. Place the material in 6 inch layers (compacted thickness), evenly deposited on both sides of the pipe, and compact with mechanical tampers suitable for this purpose. Hand tamp material below the pipe haunch that cannot be reached by mechanical tampers. Meet the requirements of in 125-9.2.

125-8.3.3.4 Top Zone: Place the material in layers not to exceed 12 inches in compacted thickness. Meet the requirements of the density acceptance criteria.

125-8.3.4 Backfill Under Wet Conditions: Where wet conditions are such that dewatering by normal pumping methods would not be effective, the procedure outlined below may be used when specifically authorized by the Engineer in writing.

The Owner will permit the use of granular material below the elevation at which mechanical tampers would be effective, but only material classified as A-3. Place and compact the material using timbers or hand tampers until the backfill reaches an elevation such that its moisture content will permit the use of mechanical tampers. When the backfill has reached such elevation, use normally acceptable backfill material. Compact the material using

mechanical tampers in such manner and to such extent as to transfer the compacting force into the material previously tamped by hand.

The Owner will permit the use of coarse aggregate below the elevation at which mechanical tampers would be effective. Use coarse aggregate as specified in Section 901 for Aggregate Size Number 89, 8, 78, 7, 68, 6, or 57. Place the coarse aggregate such that it will be stable and firm. Fully wrap the aggregate with a layer of Type D-4 filter fabric, as specified in Section 985. Do not place coarse aggregate within 4 feet of the ends of the trench or ditch. Use normally accepted backfill material at the ends.

125-9 Acceptance Program.

125-9.1 General Requirements: Meet the requirements of 120-10, except replace the requirements of 120-10.1.6 with 125-9.1.1, 120-10.2 with 125-9.2, 120-10.3 with 125-9.3, and 120-10.4 with 125-10.

125-9.1.1 Reduced Testing Frequency: When no resolution testing is required for six consecutive LOTs, or if required, the QC test data was upheld, reduce the QC density testing to one test every two LOTs or one every four LOTs for trench box operations. Identify the substantiating tests in the Density Log Book and notify the Engineer in writing prior to starting reduced frequency of testing. Generate random numbers for selecting test locations for the LOTs under consideration. When QC test frequency is reduced to one every two LOTs, obtain the Engineer's approval to place more than one LOT over an untested LOT. Assure similar compaction efforts for the untested sections. If the Verification test fails, and QC test data is not upheld by Resolution testing the QC testing will revert to the original frequency.

125-9.2 Acceptance Criteria:

125-9.2.1 Density: Obtain a minimum QC density in any LOT of 100% of the Standard Proctor maximum density as determined by AASHTO T99, Method C, or the requirements of 125-8.3.3.1 when applicable. When the cover height below the bottom of base under asphalt pavement, below concrete pavement, or below unpaved ground, exceeds 15 inches, compact the pipe backfill in the cover zone to a density of at least 95% of the Standard Proctor maximum density as determined by AASHTO T99, Method C.

For density requirements around drainage structures, obtain a minimum Quality Control (QC) density in any LOT of 100% of the Standard Proctor maximum density as determined by AASHTO T99 for a distance of one pipe diameter but not less than 3 feet from the outside face of the structure.

125-9.2.2 Exceptions to Structures and Pipe Density Requirements: Compact the backfill to a firmness approximately equal to that of the soil next to the pipe trench in locations outside the plane described by a two (horizontal) to one (vertical) slope downward from the roadway shoulder line or the gutter line as applicable. Apply 125-9.2.1 when compacting side-drain pipe backfill under driveways serving a property that is not a single residential lot.

125-9.3 Additional Requirements:

125-9.3.1 Frequency: Conduct QC Standard Proctor maximum density sampling and testing at a minimum frequency of one test per soil type. The verification test will be at a minimum of one test per soil type:

Test Name	Quality Control	Verification
Standard Proctor Maximum Density	One per soil type	One per soil type
Density	One per LOT	One per four consecutive LOTs and for wet conditions, the first lift not affected by water
Soil Classification	One per Standard Proctor Maximum density	One per Standard Proctor Maximum density

125-10 Verification Comparison Criteria and Resolution Procedures.

125-10.1 Standard Proctor Maximum Density Determination: The Engineer will verify the QC results if the results compare within 4.5 PCF of the verification test result. Otherwise, the Engineer will take one additional sample of material from the soil type in question. The State Materials Office or an AASHTO accredited laboratory designated by the State Materials Office will perform resolution testing. The material will be sampled and tested in accordance with AASHTO T99, Method C.

The Engineer will compare the resolution test result with the QC test results. If the resolution test result is within 4.5 PCF of the corresponding QC test results, the Engineer will use the QC test results for material acceptance purposes for each LOT with that soil type. If the resolution test result is not within 4.5 PCF of the Contractor’s QC test, the verification test result will be used for material acceptance purposes.

125-10.2 Density Testing: When a verification or independent verification density test fails the acceptance criteria, retest the site within a 5 feet radius and the following actions will be taken:

1. If the QC retest meets the acceptance criteria and compares favorably with the verification or independent verification test, the Engineer will accept those LOTs.
2. If the QC retest does not meet the acceptance criteria and compares favorably with the verification or independent verification test, rework and retest the LOT. The Engineer will re-verify those LOTs.
3. If the QC retest and the verification or independent verification test do not compare favorably, complete a new equipment-comparison analysis as defined in 120-10.1.2. Once acceptable comparison is achieved, retest the LOTs. The Engineer will perform new verification testing. Acceptance testing will not begin on a new LOT until the Contractor has a gauge that meets the comparison requirements.

125-10.3 Soil Classification: Meet the requirements of 120-10.4.3.

125-11 Site Restoration.

Wherever the existing site is disturbed solely for the purpose of constructing or removing box culverts, pipes, inlets, manholes, etc., completely replace and restore the site to the Engineer's satisfaction, without additional compensation.

125-12 Cleaning Up.

Upon completion of the work, leave the structure and all adjacent areas in a neat and presentable condition, clear up all temporary structures, rubbish and surplus materials and

leave the space under the structure unobstructed and in such shape that drift will not collect nor scour or be induced. Pile all material from existing structures that have been removed neatly on the bank, unless otherwise directed by the Engineer. Pull false work piling unless the Engineer permits it to be cut or broken off in which case it will be cut or broken off at least 2 feet below the ground line or stream bed.

125-13 Method of Measurement.

When direct payment for excavation for structures is provided in the proposal, and such payment is on a unit basis, such excavation will be measured in its original position by the cross-section method to determine the amount of material. The cubic yard volume of excavation used as a basis of payment will then be that material actually removed below the original ground line or stream bed, but not including that shown in the Plans to be paid for either as regular excavation, subsoil excavation, lateral ditch excavation or channel excavation, or which is included in the item for grading, and except that no payment will be made for material removed in excavating for footings or foundations outside of an area which is bounded by vertical planes 12 inches outside of the limits of the footing and parallel thereto. For pipe trenches the width used to be in the calculation shall be the diameter of the pipe, plus 24 inches.

125-14 Basis of Payment.

125-14.1 When No Direct Payment Provided: When direct payment for excavation for structures is not provided for in the proposal, all work specified in this Section, other than as specified in 125-14.3 through 125-14.7, shall be included in the Contract price for the concrete or for other items covering the applicable structure.

125-14.2 Direct Payment: When direct payment for work under this Section is provided, the Contract price per cubic yard (measured as provided in 125-13), as shown in the proposal, shall be full compensation for all the work specified in this Section, except such work as is specifically stipulated to be paid for separately, in 125-14.3 through 125-14.7.

125-14.3 Excavation Below Plan Grade: When excavation of material below plan grade is called for in the Plans or authorized by the Engineer, and payment for Excavation for Structures is on a cubic yard basis, the material excavated below plan grade will be included in the measurement for this item.

Payment for the material used for the backfill will be made as specified in

125-14.7.

125-14.4 Strengthening Foundations: The work of strengthening the foundations (as provided in 125-4.2) shall be paid for as provided in 4-4, unless such work is covered by a bid item.

125-14.5 Backfilling for Additional Support: The work of providing additional support by backfilling with sand or other satisfactory material, where called for by the Engineer (as specified in 125-8), shall be paid for as provided in 4-4.

125-14.6 Removal and Replacement of Existing Pavement: For pavement, curb, etc., which is removed only in order to construct pipe culverts or storm sewers, as specified in 125-11, all costs of such removal and replacement shall be included in the costs of the pipe or other structure for which it is removed, unless otherwise provided for in the contract.

125-14.7 Removal and Replacement of Material Unsuitable for Backfill: When it cannot reasonably be anticipated from information contained in the Plans, that material excavated for the structure will be unsuitable for use as backfill, and such material proves to be unsuitable for this use, the work of disposing of such material away from the site will be paid for as Unforeseeable Work, and the work of bringing in substitute material for the backfill will be paid for as specified for the particular case shown below:

1. No additional payment will be made for backfill materials obtained from surplus material available from the normal excavation or grading operations.
2. When the necessary material is not available from the normal excavation or grading operations, and the Contract includes an item for borrow excavation, backfill material authorized to be obtained from designated borrow areas will be included in the volume of borrow excavation to be paid for.
3. When the necessary material is not available from the normal excavation or grading operations and no separate item for borrow excavation is included in the Contract, any backfill material obtained by increasing the volume of excavation within the roadway right of way will be measured and paid for as regular excavation subject to the provisions of 9-3.2.2.
4. When authorization is given for obtaining the material from outside the right of way and from other than designated borrow areas, such excavation will be paid for as unforeseeable work.
5. Where pipe bedding is provided, as specified in 125-8, by the use of select granular material, the quantity of such select material obtained either as commercial material or from material from the grading operations other than in the immediate vicinity of the pipe to be bedded, as authorized by the Engineer, will be paid for at the Contract price per cubic yard for select bedding material. No payment for this material will be made for material available from the excavation for the pipe culvert or from other material available from the grading operations at a location not sufficiently remote as to require loading on trucks.

125-14.8 Pay Items: Payment for the work under this Section, when provided for directly.

SECTION 160 STABILIZING

160-1 Description.

Stabilize designated portions of the roadbed to provide a firm and unyielding subgrade, having the required bearing value specified in the Plans. Perform work in accordance with an approved Quality Control (QC) Plan meeting the requirements of Section 105.

160-2 Materials.

160-2.1 Commercial Material: Meet the requirements of Section 914.

160-2.2 Local Material: Meet the requirements of Section 914. Test material from each source, or if authorized by the Engineer, test blended materials. Submit test results to the Engineer at least 14 days prior to the stabilization operation.

160-2.3 Existing Base: When the material from an existing base is used as all, or a portion, of the stabilizing additives, no further testing is required unless directed by the Engineer.

160-2.4 Granular Subbase: If applicable, the Engineer may allow, at no additional cost to the Owner, the substitution of 6 inches of granular subbase meeting the requirements of 290-2 and 290-3, when 12 inches of stabilization requiring a limerock bearing ratio (LBR) value of 40 is specified.

160-3 Construction Methods.

160-3.1 General: Prior to the beginning of stabilizing operations, construct the area to be stabilized to an elevation such that, upon completion of stabilizing operations, the completed stabilized subgrade will conform to the lines, grades, and cross-section shown in the Plans. Prior to spreading any additive stabilizing material, bring the surface of the roadbed to a plane approximately parallel to the plane of the proposed finished surface.

Construct mainline pavement lanes, turn lanes, ramps, parking lots, concrete box culverts and retaining wall systems meeting the requirements of 120-8.1, except replace “embankment” with “subgrade”.

Construct shoulder-only areas, sidewalk, and shared use path areas meeting the requirements of 120-8.1 except replace “embankment” with “subgrade” and meet the acceptance criteria of 160-4.2.

Isolated mixing operations will be considered as separate LOTs. Curb pads and shoulders compacted separately shall be considered separate LOTs. Isolated compaction operations will be considered as separate LOTs. For multiple phase construction, a LOT shall not extend beyond the limits of the phase.

160-3.2 Application of Stabilizing Material: After substantially completing the roadbed grading operations, determine the type and quantity (if any) of stabilizing material necessary for compliance with the bearing value requirements. Before using any Fossil Fuel Combustion Products (FFCPs), provide documentation, at the preconstruction meeting or no later than 30 days prior to delivery of FFCP’s to the project, signed and sealed by the Specialty Engineer that these materials meet the requirements of 403.7047 F.S. Notify the Engineer of the approximate quantity to be added before spreading. When additive stabilizing materials are required, spread the material uniformly over the area to be stabilized.

160-3.2.1 Sampling and Testing of Local Material: Randomly select locations for sampling using a random number generator approved by the Engineer in accordance with FM 1-T 267 and test at the minimum frequency listed in the table below before mixing. The Engineer will reject the material for failing QC test results. The Engineer will sample for

Verification and Resolution testing at the minimum frequency listed in the table below. The Engineer will perform Verification tests at the minimum frequency listed in the table below.

Test Name	Quality Control	Verification	Resolution
Liquid Limit (LL), Plastic Index (PI), and Organic Content	One per two LOTs	One per eight LOTs	One per eight LOTs

160-3.2.1.1 Verification Comparison Criteria and Resolution

Procedures: If the QC and the Verification tests meet the requirements of Section 914 then the Engineer will accept the corresponding LOTs. Otherwise, the Engineer will submit the Resolution sample to the State Materials Office (SMO) or an AASHTO accredited laboratory designated by SMO to perform Resolution testing.

If the Resolution Test results meet the requirements of Section 914 then the Engineer will accept the LOTs in question. Otherwise remove the material and apply new material meeting the requirements of Section 914 and retest in accordance with 160-3.2.

160-3.3 Mixing: Perform mixing using rotary tillers, a plant or other equipment meeting the approval of the Engineer. The subgrade may be mixed in one course if the equipment and method of construction provides the uniformity, particle size limitation, compaction and other desired results of 160-4. Thoroughly mix the area to be stabilized throughout the entire depth and width of the stabilizing limits.

Perform the mixing operations, as specified, (either in place or in a plant) regardless of whether the existing soil, or any select soils placed within the limits of the stabilized sections, have the required bearing value without the addition of stabilizing materials.

160-3.4 Maximum Particle Size of Mixed Materials: At the completion of the mixing, ensure that the gradation of the material within the limits of the area being stabilized is such that 97% will pass a 3 1/2 inch sieve and that the material does not have a plasticity index greater than eight or liquid limit greater than 30. Remove any materials not meeting the plasticity requirements from the stabilized area. Break down or remove from the stabilized area materials, including clay lumps or lumps made of clay-size particles (any particle size 2 microns or less), not meeting the gradation requirements.

160-3.5 Bearing Value: Meet the bearing value requirements for the subgrade in accordance with 160-4.

160-3.6 Compaction: After completing the mixing operations and satisfying the requirements for bearing value, uniformity, and particle size. Compact the materials at a moisture content permitting the specified compaction in 160-4.2.3. If the moisture content of the material is improper for attaining the specified density, either add water or allow the material to dry until reaching the proper moisture content for the specified compaction.

160-3.7 Finish Grading: Shape the completed stabilized subgrade to conform to the finished lines, grades, and cross-section indicated in the Plans. Check the subgrade using elevation stakes or other means approved by the Engineer.

160-3.8 Requirements for Condition of Completed Subgrade: After completing the stabilizing and compacting operations, ensure that the subgrade is firm and substantially unyielding to the extent that it will support construction equipment and will have the bearing value required by the Plans.

Remove all soft and yielding material, and any other portions of the subgrade which will not compact readily, and replace it with suitable material so that the whole subgrade is brought to line and grade, with proper allowance for subsequent compaction.

160-3.9 Maintenance of Completed Subgrade: After completing the subgrade as specified above, maintain it free from ruts, depressions, and any damage resulting from the hauling or handling of materials, equipment, tools, etc. The Contractor is responsible for maintaining the required density until the subsequent base or pavement is in place including any repairs, replacement, etc., of curb and gutter, sidewalk, etc., which might become necessary in order to re-compact the subgrade in the event of underwash or other damage occurring to the previously compacted subgrade. Perform any such re-compaction at no expense to the Owner. Construct and maintain ditches and drains along the completed subgrade section.

160-4 Acceptance Program.

160-4.1 General Requirements: Meet the requirements of 120-10, except use 160-4.2 instead of 120-10.2, 160-4.3 instead of 120-10.3, and 160-4.4 instead of 120-10.4.

160-4.2 Acceptance Criteria:

160-4.2.1 Bearing Value Requirements:

160-4.2.1.1 General: Within the entire limits of the width and depth of the areas to be stabilized, obtain the required minimum bearing value for each LOT. For any area where the bearing value obtained is deficient from the value indicated in the Plans, in excess of the tolerances established herein, spread and mix additional stabilizing material in accordance with 160-3.3. Perform this reprocessing for the full width of the roadway being stabilized and longitudinally for a distance of 50 feet beyond the limits of the area in which the bearing value is Deficient. Determine the quantity of additional stabilizing material to be used in reprocessing.

160-4.2.1.2 Under-tolerances in Bearing Value Requirements: The under-tolerances are allowed for the following specified Bearing Values:

Specified Bearing Value	Under-tolerance
LBR 40	5.0
LBR 35	4.0
LBR 30 (and under)	2.5

The following unsoaked bearing value requirement is based on tests performed on samples obtained after completing mixing operations:

Specified Bearing Value	Unsoaked Bearing Value Required	Under-tolerance
LBR 40	LBR 43	0.0

160-4.2.2 Mixing Depth Requirements: Do not exceed individual plan depth thickness by more than 2 inches or exceed LOT-average depth thickness by more than 1 inch measured to the nearest 0.25 inch. No under-tolerance of mixing depth is allowed.

As an exception to the above mixing requirements, where the subgrade is of rock, the Engineer may waive the mixing operations (and the work of stabilizing), and the Owner will not pay for stabilization for such sections of the roadway.

160-4.2.3 Density Requirements:

160-4.2.3.1 General: Within the entire limits of the width and depth of the areas to be stabilized, other than as provided in 160-4.2.3.2, obtain a minimum density at any location of 98% of the Modified Proctor maximum density as determined by FM 1-T 180,

Method D.

160-4.2.3.2 Exceptions to Density Requirements: The Contractor need not obtain the minimum density specified in 160-4.2.3.1 if within the following limits:

(a) The width and depth of areas which are to be subsequently incorporated into a base course under the same contract.

(b) The upper 6 inches of areas to be grassed under the same contract. Compact these areas to a reasonably firm condition as directed by the Engineer.

160-4.2.4 Frequency: Conduct QC sampling and testing at a minimum frequency listed in the table below. The Engineer will perform Verification sampling and tests at a minimum frequency listed in the table below.

Test Name	Quality Control	Verification	Verification for Shoulder-Only, Shared Use Path and Sidewalk Construction
Modified Proctor Maximum Density	One per two consecutive LOTs	One per eight consecutive LOTs	One per four LOTs
Density	One per LOT	One per four LOTs	One per two LOTs
Stabilizing Mixing Depth	Three per 500 feet	Witness one per LOT	Witness one per LOT
LBR	One per two consecutive LOTs	One per eight consecutive LOTs	One per four LOTs
Gradation, LL/PI & Soil Classification (Local materials)	Not Required	One per eight consecutive LOTs	One per four LOTs

160-4.3 Additional Requirements:

160-4.3.1 Quality Control Testing:

160-4.3.1.1 Bearing Values: Test the stabilized subgrade sample collected in 160-4.3.1.3. Determine the LBR in accordance with FM 5-515 and 160-4.2.4.

160-4.3.1.1.1 Unsoaked LBR: If unsoaked LBR is desired, submit request for approval to the Engineer. Upon approval by the Engineer to consider the use of unsoaked LBR, randomly sample and test from three locations in the initial Lot for both soaked and unsoaked LBR in accordance with FM 5-515. Ensure all of the tests demonstrate the material achieves the LBR values in 160-4.2.1.2. Continue testing unsoaked LBR at the frequency shown in 160-4.2.4. Discontinue unsoaked LBR testing if any unsatisfactory QC LBR test result is obtained or resolution determines an unsatisfactory LBR.

160-4.3.1.2 Mixing Depths: Meet required plan mixing-depths by measuring from the proposed final grade line. Determine test locations, including stations and offsets. Notify the Engineer a minimum of 24 hours before checking mixing depths.

160-4.3.1.3 Modified Proctor Maximum Density Requirement: Collect enough material to split and create three separate samples. Determine test locations, including stations and offsets for the two LOTs under consideration. Retain the Verification and Resolution samples until the Engineer accepts the LOTs represented by the samples.

160-4.3.2 Verification Tests:

160-4.3.2.1 Bearing Value & Soil Classification: The Engineer will collect a sample at a location other than the location where the sample was collected in 160-4.3.1.3, and test the stabilized subgrade for determination of the LBR in accordance with FM 5-515. The Engineer will select test locations, including stations and offsets, using a

Random Number generator, based on the LOTs under consideration.

If local material is used for stabilizing, the Engineer will determine compliance with embankment utilization requirements and 160-3.4 by testing and classifying the stabilized subgrade in accordance with AASHTO T88 and AASHTO M 145 at the frequency shown in 160-4.2.4.

160-4.3.2.1.1 Unsoaked LBR: The Engineer will sample and test the initial LOT for one soaked and one unsoaked LBR if consideration of the unsoaked LBR has been approved.

160-4.3.2.2 Mixing Depth: The Engineer will witness the Contractor's mixing depth checks to ensure compliance with 160-4.2.2. The Engineer will select test locations, including stations and offsets, using a Random Number generator.

160-4.3.2.3 Modified Proctor Maximum Density: The Engineer will randomly select one of the retained split samples and test in accordance with FM 1-T 180, Method D.

160-4.4 Verification Comparison Criteria and Resolution Procedures:

160-4.4.1 Bearing Value & Soil Classification: If the Verification test meets the requirements of 160-4.2.1 and embankment utilization requirements, the Engineer will accept the corresponding LOTs. Otherwise, the Engineer will collect an additional sample in the same LOT the Verification sample was obtained. SMO or an AASHTO accredited laboratory designated by SMO will perform Resolution testing on the additional sample. The material will be sampled and tested in accordance with FM 5-515. If local material is used for stabilization, the sample will be tested in accordance with AASHTO T-88, and AASHTO M-145.

If the Resolution Testing results meet the requirements of 160-4.2.1 and embankment utilization requirements then the Engineer will accept the LOTs in question. Otherwise reprocess the corresponding LOTs in accordance with 160-3 and retest in accordance with 160-4.3.1.1.

160-4.4.2 Mixing Depth Thickness: The Owner will witness the mixing depth checks.

1. If the depth checks meet the requirements of 160-4.2.2 the Engineer will accept that 500-foot section.
2. If the depth checks confirm shallow depth, re-mix the 500-foot section to an appropriate depth and re-measure in accordance with 160-4.3.1.2. The Engineer will repeat the witness process.
3. If the depth checks confirm extra deep mixing, conduct an additional QC density test after compaction for the bottom 12 inches of the subgrade for that 500-foot section in addition to a QC density test for the top 12 inches. The additional density test must meet the requirements of 160-4.2.3.

160-4.4.3 Modified Proctor Maximum Density Determination: The Engineer will compare the Verification test results of 160-4.3.2.3 to the corresponding Quality Control test results. If the test result is within 4.5 lb/ft^3 of the QC test result, the LOTs will be verified. Otherwise, the Engineer will collect the Resolution split sample corresponding to the Verification sample tested. SMO or an AASHTO accredited laboratory designated by SMO will perform Resolution testing. The material will be sampled and tested in accordance with FM 1-T 180, Method D.

The Engineer will compare the Resolution Test results with the QC test results. If the Resolution Test result is within 4.5 lb/ft^3 of the corresponding QC test result, the Engineer will use the QC test results for material acceptance purposes for each corresponding pair of LOTs. If the Resolution test result is not within 4.5 lb/ft^3 of the corresponding QC test, the Engineer will collect the remaining Verification split samples for testing. Verification Test results will be used for material acceptance purposes for the LOTs in question.

160-4.4.4 Density: When a Verification or Independent Verification density test does not meet 160-4.2.3 (Acceptance Criteria), retest at a site within a 5 feet radius of the Verification test location and observe the following:

1. If the QC retest meets the Acceptance Criteria and compares favorably with the Verification or Independent Verification test, the Engineer will accept the LOTs in question.
2. If the QC retest does not meet the Acceptance Criteria and compares favorably with the Verification or Independent Verification test, rework and retest the material in that LOT. The Engineer will re-verify the LOTs in question.
3. If the QC retest and the Verification or Independent Verification test do not compare favorably, complete a new equipment-comparison analysis as defined in 120-10.1.2. Once acceptable comparison is achieved, retest the LOTs. The Engineer will perform new verification testing. Acceptance testing will not begin on a new LOT until the Contractor has a gauge that meets the comparison requirements.

160-5 Method of Measurement.

The quantity to be paid for will be the plan quantity, in square yards, completed and accepted.

160-6 Basis of Payment.

Price and payment will constitute full compensation for all work and materials specified in this Section, including furnishing, spreading and mixing, compacting of all stabilizing material required and any reprocessing of stabilization areas necessary to attain the specified bearing value. The Owner will make full payment for any areas where the existing subgrade materials meet the design bearing value requirements without the addition of stabilizing additives, as well as areas where the Contractor may elect to place select high-bearing materials from other sources within the limits of the stabilizing.

If the item of borrow excavation is included in the Contract, any stabilizing materials obtained from designated borrow areas will be included in the pay quantity for borrow excavation.

**SECTION 320
HOT MIX ASPHALT -
PLANT METHODS AND EQUIPMENT**

320-1 General.

This Section specifies the basic equipment and operational requirements for hot mix asphalt (including warm mix asphalt) production facilities used in the construction of asphalt pavements and bases. Establish and maintain a quality control system that provides assurance that all materials and products submitted for acceptance meet Contract requirements.

320-2 Quality Control (QC) Requirements.

320-2.1 Minimum Producer QC Requirements: Perform as a minimum the following activities:

1. Stockpiles:
 - a. Assure materials are placed in the correct stockpile;
 - b. Assure good stockpiling techniques;
 - c. Inspect stockpiles for separation, contamination, segregation, and other

similar items;

- d. Properly identify and label each stockpile.
- 2. Incoming Aggregate:
 - a. Obtain gradations and bulk specific gravity (G_{sb}) values from aggregate supplier for reference;
 - b. Determine the gradation of all component materials and routinely compare gradations and G_{sb} values to mix design.
- 3. Cold Bins:
 - a. Calibrate the cold gate/feeder belt for each material;
 - b. Determine cold gate/feeder belt settings;
 - c. Observe operation of cold feeder for uniformity;
 - d. Verify accuracy of all settings;
 - e. Verify that the correct components are being used, and that all modifiers or additives or both are being incorporated into the mix.
- 4. Batch Plants:
 - a. Determine percent used and weight to be pulled from each bin to assure compliance with the mix design;
 - b. Check mixing time;
 - c. Check operations of weigh bucket and scales.
- 5. Drum Mixer Plants:
 - a. Determine aggregate moisture content;
 - b. Calibrate the weigh bridge on the charging conveyor.
- 6. Control Charts: Maintain QC data and charts (updated daily) for all QC Sampling and Testing and make available upon demand. Provide the following charts:
 - a. All components used to determine the composite pay factor (No. 8 sieve, No. 200 sieve, asphalt binder content, air voids, and density);
 - b. Gradation of incoming aggregate;
 - c. Gradation, asphalt binder content and maximum specific gravity (G_{mm}) of RAP;
 - d. Any other test result or material characteristic (as determined by the Contractor) necessary for process control.

The above listed minimum activities are to be considered normal activities necessary to control the production of hot mix asphalt at an acceptable quality level. Depending on the type of process or materials, some of the activities listed may not be necessary and in other cases, additional activities may be required. The frequency of these activities will also vary with the process and the materials. When the process varies from the defined process average and variability targets, the frequency of these activities will be increased until the proper conditions have been restored.

320-2.2 Minimum Process Control Testing Requirements: Perform, as a minimum, the following activities at the testing frequencies provided in Table 320-1. QC tests used in the acceptance decision may be used to fulfill these requirements.

Table 320-1		
Asphalt Plant - Materials Testing Frequencies		
Material	Property	Minimum Testing Frequency

Aggregate	Gradation	Once per 1,000 tons of incoming aggregate
Asphalt Mix	Asphalt Binder Content	If daily production > 100 tons, once per day; If daily production > 1,000 tons, twice per day. *
Asphalt Mix	Bulk Specific Gravity (G_{mb})	If daily production > 100 tons, once per day; If daily production > 1,000 tons, twice per day. *
Asphalt Mix	Gradation	If daily production > 100 tons, once per day; If daily production > 1,000 tons, twice per day. *
Asphalt Mix	Maximum Specific Gravity (G_{mm})	If daily production > 100 tons, once per day; If daily production > 1,000 tons, twice per day. *
Asphalt Mix	Temperature	Each of first 5 loads, then once every 5 loads thereafter, per day per mix design.
RAP	Asphalt Binder Content	Once per 1,000 tons RAP
RAP	Gradation	Once per 1,000 tons RAP
RAP	Maximum Specific Gravity (G_{mm})	Once per 5,000 tons RAP
*If less than 100 tons of mix is produced on each of successive days of production, resulting in a cumulative quantity of greater than 100 tons, then perform the indicated test.		

320-2.3 Personnel Qualifications: Provide QC Technicians in accordance with Section 105.

320-2.4 Hot Mix Asphalt Testing Laboratory Requirements: The laboratory shall meet the following requirements:

1. Area - The effective working area of the laboratory shall be a minimum of 180 square feet, with a layout of which will facilitate multiple tests being run simultaneously by two technicians. This area does not include the space for desks, chairs and file cabinets. Any variations shall be approved by the Engineer.

2. Lighting - The lighting in the lab must be adequate to illuminate all areas of the

work.

3. Temperature Control - Equip the lab with heating and air conditioning units that provide a satisfactory working environment.

4. Ventilation - Equip the lab with exhaust fans that will remove all hazardous fumes from within the laboratory in accordance with OSHA requirements.

5. Equipment and Supplies - Furnish the lab with the necessary sampling and testing equipment and supplies for performing contractor QC and Owner Verification Sampling and Testing. A detailed list of equipment and supplies required for each test is included in the appropriate FDOT, AASHTO, or ASTM Test Method. In the event testing equipment goes out of service during production, the Contractor may elect to use replacement equipment at another laboratory qualified, as described in Section 105, for up to 72 hours upon notification of the Engineer.

6. Personal Computer - Provide a personal computer capable of running a Microsoft Excel™ spreadsheet program, along with a printer.

7. Communication - Provide a telephone and fax machine (with a private line) for the use of the testing facility's QC personnel.

320-3 Requirements for All Plants.

320-3.1 General: Design, manufacture, coordinate, and operate the asphalt plant in a manner that will consistently produce a mixture within the required tolerances and temperatures specified.

320-3.2 Electronic Weigh Systems: Equip the asphalt plant with an electronic weigh system that: 1) has an automatic printout, 2) is certified every six months by an approved certified scale technician, and 3) meets monthly comparison checks with certified truck scales as specified in 320-3.2.4. Weigh all plant produced hot mix asphalt on the electronic weigh system, regardless of the method of measurement for payment.

Include, as a minimum, the following information on the printed delivery ticket:

- (a) Sequential load number
- (b) Project number
- (c) Date
- (d) Name and location of plant
- (e) Mix design number
- (f) Place for hand-recording mix temperature
- (g) Truck number
- (h) Gross, tare, and net tonnage per truck (as applicable)
- (i) Daily total tonnage of mix for the mix design

Print the delivery ticket with an original and at least one copy. Furnish the original to the Engineer at the plant and one copy to the Engineer at the paving site.

Utilize any one of the following three electronic weigh systems.

320-3.2.1 Electronic Weigh System on the Truck Scales: Provide an electronic weigh system on all truck scales, which is equipped with an automatic recordation system that is

approved by the Engineer. Use scales of the type that directly indicate the total weight of the loaded truck. Use scales meeting the requirements for accuracy, condition, etc., of the Bureau of Weights and Measures of the Florida Department of Agriculture, and re-certify such fact

every six months, either by the Bureau of Weights and Measures or by a registered scale technician.

320-3.2.2 Electronic Weigh System on Hoppers Beneath a Surge or Storage

Bin: Provide an electronic weigh system on the hopper (hopper scales or load cells) beneath the surge or storage bin, which is equipped with an automatic recordation system approved by the Engineer.

320-3.2.3 Automatic Batch Plants with Printout: For batch plants, provide an approved automatic printer system which will print the individual or cumulative weights of aggregate and liquid asphalt delivered to the pugmill and the total net weight of the asphalt mix measured by hopper scales or load cell type scales. Use the automatic printer system only in conjunction with automatic batching and mixing control systems that have been approved by the Engineer.

320-3.2.4 Monthly Electronic Weigh System Comparison Checks: Check the accuracy of the electronic weighing system at the commencement of production and thereafter at least every 30 days during production by one of the following two methods and maintain a record of the weights in the Scale Check Worksheet.

320-3.2.4.1. Electronic Weigh System on Truck Scales:

(a) The Engineer will randomly select a loaded truck of asphalt mix, a loaded aggregate haul truck, or another vehicle type approved by the Engineer and record the truck number and gross weight from the Contractor's delivery ticket.

(b) Weigh the selected truck on a certified truck scale, which is not owned by the Contractor and record the gross weight for the comparison check. If another certified truck scale is not available, the Engineer may permit another set of certified truck scales owned by the Contractor to be used. The Engineer may elect to witness the scale check.

(c) The gross weight of the loaded truck as shown on the Contractor's delivery ticket will be compared to the gross weight of the loaded truck from the other certified truck scale. The maximum permissible deviation is 8 pounds per ton of load, based on the certified truck scale weight.

(d) If the distance from the asphalt plant to the nearest certified truck scale is enough for fuel consumption to affect the accuracy of the comparison checks, a fuel adjustment may be calculated by using the truck odometer readings for the distance measurement, and 6.1 miles per gallon for the fuel consumption rate, and 115 ounces per gallon for fuel weight.

(e) During production, when an additional certified truck scale is not available for comparison checks, the Engineer may permit the Contractor to weigh the truck on his certified scales used during production and then weigh it on another certified truck scale, as soon the other scale is available for the comparison checks.

In addition to the periodic checks as specified above, check the scales at any time the accuracy of the scales becomes questionable. When such inaccuracy does not appear to be sufficient to seriously affect the weighing operations, the Engineer will allow a period of two calendar days for the Contractor to conduct the required scale check. However, in the event the indicated inaccuracy is sufficient to seriously affect the mixture, the Engineer may require immediate shut-down until the accuracy of the scales has been checked and necessary

corrections have been made. Include the cost of all scale checks in the bid price for asphalt concrete, at no additional cost to the Owner.

320-3.2.4.2. Electronic Weigh System on Hoppers Beneath a Surge or Storage Bin and Automatic Batch Plants with Printout:

(a) The Engineer will randomly select a loaded truck of asphalt mix and record the truck number, and the net weight of the asphalt mix from the Contractor's delivery ticket.

(b) Weigh the selected truck on a certified truck scale, which is not owned by the Contractor and record the gross weight for the comparison check. If another certified truck scale is not available, the Engineer may permit another set of certified truck scales owned by the Contractor to be used. The Engineer may elect to witness the scale check.

(c) Deliver the asphalt mix to the project, then weigh the selected empty truck on the same certified truck scales. Record the tare weight of the truck.

(d) Compare the net weight of the asphalt mix from the delivery ticket to the calculated net weight of the asphalt mix as determined by the certified truck scale weights. The maximum permissible deviation is 8 pounds per ton of load, based on the certified truck scale weight.

(e) Use the fuel adjustment as specified in 320-3.2.4.1(d), when the distance from the asphalt plant to the nearest certified truck scale is enough for fuel consumption to affect the accuracy of the comparison checks.

(f) During production, when an additional certified truck scale is not available for comparison checks, the Engineer may permit the Contractor to load a truck with aggregate from the pugmill, surge or storage bin, and follow the above procedures to conduct the comparison checks as soon as certified truck scale is available.

If the check shows a greater difference than the tolerance specified above, then recheck on a second set of certified scales. If the check and recheck indicate that the printed weight is out of tolerance, have a certified scale technician check the electronic weigh system and certify the accuracy of the printer. While the system is out of tolerance and before its adjustment, the Engineer may allow the Contractor to continue production only if provisions are made to use a set of certified truck scales to determine the truck weights.

320-3.3 Asphalt Binder: Meet the following requirements:

320-3.3.1 Transportation: Deliver the asphalt binder to the asphalt plant at a temperature not to exceed 370°F, and equip the transport tanks with sampling and temperature sensing devices meeting the requirements of 300-3.2.

320-3.3.2 Storage: Equip asphalt binder storage tanks to heat the liquid asphalt binder to the temperatures required for the various mixtures. Heat the material in such a manner that no flame comes in contact with the binder. Heat or insulate all pipe lines and fittings. Use a circulating system of adequate size to ensure proper and continuous circulation during the entire operating period. Locate a thermometer, reading from 200 to 400°F, either in the storage tank or in the asphalt binder feed line. Maintain the asphalt binder in storage within a range of 230 to 370°F in advance of mixing operations. Locate a sampling device on the discharge piping exiting the storage tank or at a location as approved by the Engineer.

320-3.4 Aggregate: Meet the following requirements:

320-3.4.1 Stockpiles: Place each aggregate component in an individual stockpile, and separate each from the adjacent stockpiles, either by space or by a system of

bulkheads. Prevent the intermingling of different materials in stockpiles at all times. Identify each stockpile, including RAP, as shown on the mix design.

Form and maintain stockpiles in a manner that will prevent segregation. If a stockpile is determined to be segregated, discontinue the use of the material on the project until the appropriate actions have been taken to correct the problem.

320-3.4.2 Blending of Aggregates: Stockpile all aggregates prior to blending or placing in the cold feed bins. If mineral filler or hydrated lime is required in the mix, feed or weigh it in separately from the other aggregates.

320-3.4.2.1 Cold Feed Bin: Provide a separate cold feed bin for each component of the fine and coarse aggregate required by the mix design. Equip the cold feed bins with accurate mechanical means for feeding the aggregate uniformly into the dryer in the proportions required for the finished mix to maintain uniform production and temperature. When using RAP as a component material, prevent any oversized RAP from being incorporated into the completed mixture by the use of: a grizzly or grid over the RAP bin; in-line roller or impact crusher; screen; or other suitable means. If oversized RAP material appears in the completed recycled mix, take the appropriate corrective action immediately. If the appropriate corrective actions are not immediately taken, stop plant operations.

Use separate bin compartments in the cold aggregate feeder that are constructed to prevent any spilling or leakage of aggregate from one cold feed bin to another. Ensure that each cold feed bin compartment has the capacity and design to permit a uniform flow of aggregates. Mount all cold feed bin compartments over a feeder of uniform speed, which will deliver the specified proportions of the separate aggregates to the drier at all times. If necessary, equip the cold feed bins with vibrators to ensure a uniform flow of the aggregates at all times.

320-3.4.2.2 Gates and Feeder Belts: Provide each cold feed bin compartment with a gate and feeder belt, both of which are adjustable to assure the aggregate is proportioned to meet the requirements of the mix design.

320-3.4.3 Screening Unit: Remove any oversized pieces of aggregate by the use of a scalping screen. Do not return this oversized material to the stockpile for reuse unless it has been crushed and reprocessed into sizes that will pass the scalping screen. Ensure that the quantity of aggregates being discharged onto the screens does not exceed the capacity of the screens to actually separate the aggregates into the required sizes.

320-3.5 Dryer: Provide a dryer of satisfactory design for heating and drying the aggregate. Use a dryer capable of heating the aggregate to within the specified temperature range for any mix, and equip the dryer with an electric pyrometer placed at the discharge chute to automatically register the temperature of the heated aggregates.

320-3.6 Asphalt Binder Control Unit: Provide a satisfactory means, either by weighing, metering, or volumetric measuring, to obtain the proper amount of asphalt binder material in the mix, within the tolerance specified for the mix design.

320-3.7 Contractor's Responsibilities: Acceptance of any automatic delivery ticket printout, electronic weight delivery ticket, other evidence of weight of the materials or approval of any particular type of material or production method will not constitute agreement by the Owner that such matters are in accordance with the Contract Documents and it shall be the Contractor's responsibility to ensure that the materials delivered to the project are in accordance with the Contract Documents.

320-4 Additional Requirements for Batch Plants.

320-4.1 Heating and Drying: Heat and dry the aggregate before screening. Control the temperature of the aggregate so the temperature of the completed mixture at the plant falls within the permissible range allowed by this Section.

320-4.2 Gradation Unit: Provide plant screens capable of separating the fine and coarse aggregates and of further separating the coarse aggregate into specific sizes. In addition, equip the gradation unit with a scalping screen to restrict the maximum size of the aggregates. In the event that the plant is equipped with cold feed bins that are capable of adequately controlling the gradation of the mixture, the use of plant screens is optional.

320-4.3 Hot Bins: Provide storage bins of sufficient capacity to supply the mixer when it is operating at full capacity. Provide hot bins with divided compartments to ensure separate and adequate storage of the appropriate fractions of the aggregate. Equip each compartment with an overflow chute of suitable size and location to prevent any backing up of material into other bins.

320-4.4 Weigh Box or Hopper: Equip the batch plant with a means for accurately weighing each bin size of aggregate and the mineral filler into the weigh box or hopper.

320-4.5 Pugmills: Utilize a pugmill capable of mixing the aggregate and the asphalt binder.

320-5 Additional Requirements for Drum Mixer Plants.

320-5.1 Weight Measurements of Aggregate: Equip the plant with a weigh-in-motion scale capable of measuring the quantity of aggregate (and RAP) entering the dryer.

320-5.2 Synchronization of Aggregate Feed and Asphalt Binder Feed: Couple the asphalt binder feed control with the total aggregate weight device, including the RAP feed, in such a manner as to automatically vary the asphalt binder feed rate as necessary to maintain the required proportions.

320-5.3 Hot Storage or Surge Bins: Equip the plant with either a surge bin or storage silo that is capable of storing an adequate amount of material to assure a uniform and consistent product.

320-6 Preparation of the Mixture.

320-6.1 Mixing: After the aggregate is dried and properly proportioned, mix the aggregate, along with any other components, with the asphalt binder to produce a thoroughly and uniformly coated mixture.

320-6.2 Storage: If necessary, store the asphalt mixture in a surge bin or hot storage silo for a maximum of 72 hours. For FC-5 mixtures, store the asphalt mixture in a surge bin or hot storage silo for a maximum of one hour.

320-6.3 Mix Temperature: Produce the mixture with a temperature within the master range as defined in Table 320-2.

320-6.3.1 Test Requirements: Determine the temperature of the completed mixture using a quick-reading thermometer through a hole in the side of the loaded truck immediately after loading. Contractor shall also provide a thermometer on-site for comparison purposes. Locate a 1/4 inch hole on both sides of the truck body within the middle third of the length of the body, and at a distance from 6 to 10 inches above the surface supporting the mixture. If a truck body already has a hole located in the general vicinity of the specified location, use this hole. At the Engineer’s discretion, the Contractor may take the temperature of the load over the top of the truck in lieu of using the hole in the side of the truck.

320-6.3.2 Test Frequency: The normal frequency for taking asphalt mix temperatures will be for each day, for each design mix on the first five loads and one out of every

five loads thereafter. Take the temperature of the asphalt mix at the plant and at the roadway before the mix is placed at the normal frequency. Record the temperature on the front of the respective delivery ticket. The Engineer shall review the plant and roadway temperature readings and may take additional temperature measurements at any time.

If any single load at the plant or at the roadway is within the master range shown in Table 320-2 but does not meet the criteria shown in Table 320-3 (for single measurements or the average of five consecutive measurements), the temperature of every load will be monitored until the temperature falls within the specified tolerance range in Table 320-3; at this time the normal frequency may be resumed. For warm mix asphalt, the Contractor may produce the first five loads of the production day and at other times when approved by the Engineer, at a hot mix asphalt temperature not to exceed **330°F** for purposes of heating the asphalt paver. For this situation, the upper tolerances of Tables 320-2 and 320-3 as applied to the warm mix asphalt mix design do not apply.

320-6.3.3 Rejection Criteria: Reject any load or portion of a load of asphalt mix at the plant or at the roadway with a temperature outside of its respective master range shown in Table 320-2. Notify the Engineer of the rejection immediately.

Table 320-2	
Mix Temperature Master Range Tolerance	
Location	Acceptable Temperature Tolerance
Plant	Mixing Temperature ± 30 F
Roadway	Compaction Temperature ± 30 F

Table 320-3	
Mix Temperature Tolerance From Verified Mix Design	
Any Single Measurement	$\pm 25^{\circ}$ F
Average of Any Five Consecutive Measurements	$\pm 15^{\circ}$ F

320-7 Transportation of the Mixture.

Transport the mix in trucks of tight construction, which prevents the loss of material and the excessive loss of heat and previously cleaned of all foreign material. After cleaning, thinly coat the inside surface of the truck bodies with soapy water or an asphalt release agent as needed to prevent the mixture from adhering to the beds. Do not allow excess liquid to pond in the truck body. Do not use a release agent that will contaminate, degrade, or alter the characteristics of the asphalt mix or is hazardous or detrimental to the environment. Petroleum derivatives (such as diesel fuel), solvents, and any product that dissolves asphalt are prohibited. Provide each truck with a tarpaulin or other waterproof cover mounted in such a manner that it can cover the entire load when required. When in place, overlap the waterproof cover on all sides so that it can be tied down. Cover each load during cool and cloudy weather and at any time it appears rain is likely during transit with a tarpaulin or waterproof cover. Cover and tie down all loads of friction course mixtures.

SECTION 330

HOT MIX ASPHALT - GENERAL CONSTRUCTION REQUIREMENTS

330-1 Description.

This Section specifies the basic equipment and construction requirements for hot mix asphalt (including warm mix asphalt) pavements and bases. Establish and maintain a quality control system that provides assurance that all materials, products and completed construction submitted for acceptance meet Contract requirements.

330-2 Quality Control (QC) Requirements.

330-2.1 Minimum QC Requirements: In addition to the requirements set forth in Section 105, describe in the Quality Control Plan (QCP) how the following attributes will be monitored: pavement density, mix temperature, pavement smoothness, pavement cross-slope, mix spread rate, and pavement texture, including methods for monitoring pavement segregation and the corrective actions that will be taken to resolve any identified problems. Perform as a minimum, the following activities necessary to maintain process control and meet Specification requirements:

1. **Pavement Density:** Monitor the pavement temperature with an infrared temperature device so that compaction is completed before the surface temperature of the pavement drops to the extent that effective compaction may not be achieved or the rollers begin to damage the pavement. Monitor the roadway density with either 6 inch diameter roadway cores, a nuclear density gauge, or other density measuring device, at a minimum frequency of once per 1,500 feet of pavement.

2. **Mix Temperature:** Determine the mix temperature at the roadway for the first five loads and one out of every five loads thereafter.

3. **Mix Spread Rate:** Monitor the mix spread rate at the beginning of each day's production, and as needed to control the operations, at a minimum of once per 5 truck loads placed. When determining the spread rate, use, at a minimum, an average of five truckloads of mix.

4. **Pavement Texture:** Monitor the pavement texture to minimize pavement segregation. Use density gauges, infrared temperature measurement devices, or roadway cores at the beginning of each day's production, and as necessary, both at truck exchanges and during normal paving operations.

5. **Reporting:** Ensure the accuracy of the Quality Control Roadway Reports on the approved form to reflect the actual surface area of the finished work and be in compliance with the requirements of the Contract Documents.

330-2.2 Personnel Qualifications: Provide QC Technicians in accordance with Section 105.

330-3 Limitations of Operations.

330-3.1 Weather Limitations: Do not transport asphalt mix from the plant to the roadway unless all weather conditions are suitable for the paving operations.

330-3.2 Limitations of Paving Operations:

330-3.2.1 General: Place the mixture only when the surface upon which it is to be placed has been previously prepared, is intact, firm, dry, clean, and the tack or prime coat, with acceptable spread rate, is properly broken or cured. Do not place friction course until the adjacent shoulder area has been dressed and grassed.

330-3.2.2 Ambient Air Temperature: Place the mixture only when the air temperature in the shade and away from artificial heat meets requirements of Table 330-1. The

minimum ambient temperature requirement may be reduced by 5°F when using warm mix technology, if mutually agreed to by both the Engineer and the Contractor.

Table 330-1	
Ambient Air Temperature Requirements for Paving	
Layer Thickness or Asphalt Binder Type	Minimum Temperature (°F)
≤ 1 inch	50
Any mixture > 1 inch containing a PG asphalt binder having a high temperature designation ≥ 76°C	45
Any mixture > 1 inch containing a PG asphalt binder having a high temperature designation < 76°C	40
FC-5 ⁽¹⁾	65
⁽¹⁾ As an exception, place the mixture at temperatures no lower than 60°F, only when approved by the Engineer based on the Contractor's demonstrated ability to achieve a satisfactory surface texture and appearance of the finished surface. The minimum ambient temperature may be further reduced to 55°F when using warm mix technology, if agreed to by both the Engineer and the Contractor.	

330-3.2.3 Rain and Surface Conditions: Immediately cease transportation of asphalt mixtures from the plant when rain begins at the roadway. Do not place asphalt mixtures while rain is falling, or when there is water on the surface to be covered. Once the rain has stopped and standing water has been removed from the tacked surface to the satisfaction of the Engineer and the temperature of the mixture caught in transit still meets the requirements as specified in 320-6.3, the Contractor may then place the mixture caught in transit.

330-3.2.4 Wind: Do not place the mixture when the wind is blowing to such an extent that proper and adequate compaction cannot be maintained or when sand, dust, etc., are being deposited on the surface being paved to the extent that the bond between layers will be diminished.

330-4 Surface Preparation.

330-4.1 Cleaning: Prior to placing the mixture, clean the surface of the base or underlying pavement of all loose and deleterious material by the use of power brooms or blowers, supplemented by hand brooming where necessary.

330-4.1.1 Application over Asphalt Rubber Membrane Interlayer (ARMI): Where an asphalt mix is to be placed over a newly constructed ARMI, do not sweep or otherwise disturb the cover material prior to placing the asphalt mix, unless directed by the Engineer.

330-4.2 Tacking: Apply a tack coat on all existing pavement surfaces that are to be overlaid with an asphalt mix as specified in Section 300 and between successive layers of all asphalt mixes. Apply a tack coat on freshly primed bases only when so directed by the Engineer.

330-5 Paving Equipment.

330-5.1 General Requirements: Use equipment that is mechanically sound and capable of consistently meeting the requirements of these Specifications.

330-5.2 Asphalt Paver:

330-5.2.1 General: Provide an asphalt paver that is self-propelled, can be steered, and is equipped with a receiving and distribution hopper and a mechanical screed. Use a mechanical screed capable of adjustment to regulate the depth of material spread and to produce the desired cross-section.

330-5.2.2 Automatic Screed Control: For all asphalt courses placed with an asphalt paver, equip the paver with automatic longitudinal screed controls of either the skid type,

traveling stringline type, or non-contact averaging ski type with a minimum length of 25 feet. On the final layer of asphalt base, overbuild, and structural courses, and for friction courses, use the joint matcher in lieu of the skid, traveling stringline, or non-contact averaging ski on all passes after the initial pass. Equip the asphalt paver with electronic cross slope controls.

330-5.2.3 Screed Width: Provide an asphalt paver having a screed width greater than 8 feet when required to pave full width lanes. Do not use extendable screed strike-off devices that do not provide preliminary compaction of the mat in place of fixed screed extensions. Use a strike-off device only on irregular areas that would normally be done by hand and on shoulders 5 feet or less in width. When using the strike-off device on shoulders in lieu of an adjustable screed extension, demonstrate the ability to obtain an acceptable texture, density, and thickness.

When using an extendable screed device to extend the screed's width on the full width lane or shoulder by 24 inches or greater, the Engineer will require an auger extension, paddle, or kicker device unless written documentation from the manufacturer is provided that these are not necessary.

330-5.3 Rollers:

330-5.3.1 Steel-Wheeled Rollers: Provide compaction equipment capable of meeting the density requirements described in these Specifications. In the event that density testing is not required, and the standard rolling pattern is used, provide a tandem steel-wheeled roller weighing 5 to 15 tons for breakdown rolling. For finish rolling, use a separate roller with a weight of 5 to 15 tons. Variations from these requirements shall be approved by the Engineer.

330-5.3.2 Traffic Rollers: Provide compaction equipment capable of meeting the density requirements described in the Specifications. In the event that density testing is not required, and the standard rolling pattern is used, provide a self-propelled, pneumatic-tired traffic roller equipped with at least seven smooth-tread, low pressure tires, equipped with pads or scrapers on each tire. Maintain the tire pressure between 50 and 55 psi or as specified by the manufacturer. Use rollers with a minimum weight of 6 tons. Do not use wobble-wheeled rollers. Variations from these requirements shall be approved by the Engineer.

330-5.3.3 Prevention of Adhesion: Do not allow the mixture to adhere to the wheels of any rollers. Do not use fuel oil or other petroleum distillates to prevent adhesion. Do not use any method which results in water being sprinkled directly onto the mixture.

330-5.4 Coring Equipment: Furnish a suitable saw or drill for obtaining the required density cores.

330-5.5 Hand Tools: Provide the necessary hand tools such as rakes, shovels, and other similar tools, and a suitable means for keeping them clean. Do not use diesel fuel or other petroleum based solvents contained in an open container for cleaning purposes on the paver.

330-6 Placing Mixture.

330-6.1 Requirements Applicable to All Pavement Types:

330-6.1.1 Alignment of Edges: Place all asphalt mixtures by the stringline method to obtain an accurate, uniform alignment of the pavement edge. As an exception, pavement edges adjacent to curb and gutter or other true edges do not require a

stringline. Control the unsupported pavement edge to ensure that it will not deviate more than plus or minus 1.5 inches from the stringline.

330-6.1.2 Paving Width: If necessary due to the traffic requirements, place the mixture in strips in such a manner as to provide for the passage of traffic. As an option, where

the road is closed to traffic, place the mixture to the full width with machines traveling in echelon.

330-6.1.3 Mix Temperature: Maintain the temperature of the mix at the time of paving within the master range as defined in 320-6.3. The minimum frequency for taking mix temperatures on the roadway will be as indicated in 320-6.3. Any load or portion of a load of asphalt mix on the roadway with a temperature outside of the master range shall be rejected for use on the project. Immediately notify the Engineer of the rejection.

330-6.1.4 Speed of Paver: Establish the forward speed of the asphalt paver based on the rate of delivery of the mix to the roadway but not faster than the optimum speed needed to adequately compact the pavement.

330-6.1.5 Thickness and Spread Rate of Layers: Construct each layer as defined in the following table:

Table 330-2	
Thickness and Target Spread Rate Requirements	
Mix Type	Specification Section and Article
Type SP	334-1
Type FC	337-8
Type B	234-8
ATPB	287-8

330-6.1.5.1 Thickness Control: Ensure the spread rate is within 5% of the target spread rate. When determining the spread rate, use, at a minimum, an average of five truckloads of mix. When the average spread rate is beyond plus or minus 5% of the target spread rate, monitor the thickness of the pavement layer closely and adjust the construction operations.

If the Contractor fails to maintain an average spread rate within plus or minus 5% of the target spread rate for two consecutive days, the Engineer may elect to stop the construction operation at any time until the issue is resolved.

330-6.1.5.2 Maximum Spread Rate Tolerances: When the average spread rate for the total structural or friction course pavement thickness measured in accordance with 330-6.1.5.1 exceeds the maximum spread rate tolerances shown in Table 330-3, address the unacceptable pavement in accordance with 330-9.5.

Table 330-3		
Maximum Spread Rate Tolerances		
Course	Design Thickness	Spread Rate Tolerance
Structural	≥ 2.5 inches	± 50 lbs per sy
Structural	< 2.5 inches	± 25 lbs per sy
Friction (dense)	-	± 25 lbs per sy
Friction (open)	-	± 15 lbs per sy

As an exception, the Engineer may allow the Contractor to leave areas in place if it is determined by the Engineer that the deficiency is not a significant detriment to the pavement quality. A reduction to the pay item quantity will be made in accordance with 330-9.5.2.

330-6.1.6 Correcting Defects: Before starting any rolling, check the surface; correct any irregularities; remove all drippings, sand accumulations from the

screed, and fat spots from any source; and replace them with satisfactory material. Do not skin patch. When correcting a depression while the mixture is hot, scarify the surface and add fresh mixture.

330-6.1.7 Hand Work: In limited areas where the use of the paver is impossible or impracticable, the Contractor may place and finish the mixture by hand.

330-7 Compacting Mixture.

330-7.1 General Requirements: When density testing for acceptance is required, select equipment, sequence, and coverage (number of times the roller passes over a given area of pavement) of rolling to meet the specified density requirement. Regardless of the rolling procedure used, complete the final rolling before the surface temperature of the pavement drops to the extent that effective compaction may not be achieved or the rollers begin to damage the pavement.

330-7.2 Standard Rolling Procedure: When density testing for acceptance is not required, propose an alternative rolling pattern to be approved by the Engineer or use the following standard rolling procedure:

1. Breakdown rolling: Provide two static coverages with a tandem steel-wheeled roller, following as close behind the paver as possible without pick-up, undue displacement, or blistering of the material.
2. Intermediate rolling: Provide five static coverages with a pneumatic-tired roller, following as close behind the breakdown rolling operation as the mix will permit.
3. Finish rolling: Provide one static coverage with a tandem steel-wheeled roller, after completing the breakdown rolling and intermediate rolling, but before the surface pavement temperature drops to the extent that effective compaction may not be achieved or the rollers begin to damage the pavement.

330-7.3 Rolling Procedures: Utilize procedures that will uniformly compact the pavement layer to the desired density level, while meeting the appropriate smoothness requirements, without damaging the pavement surface, crushing aggregate or leaving excessive roller marks, roller heads, or ripples. While rolling is in progress, monitor the surface continuously, and adjust the compaction operations to comply with the surface requirements.

330-7.4 Compaction of Areas Inaccessible to Rollers: Use hand tamps or other satisfactory means to compact areas which are inaccessible to a roller, such as areas adjacent to curbs, gutters, bridges, manholes, etc.

330-7.5 Correcting Defects: Do not allow the compaction equipment to deposit contaminants onto the pavement surface. Remove and replace any areas damaged by such deposits as directed by the Engineer. Correct any depressions that develop before completing the rolling by loosening the mixture and adding new mixture to bring the depressions to a true surface. Should any depression remain after obtaining the final compaction, remove the full depth of the mixture, and replace it with sufficient new mixture to form a true and even surface. Correct all defects prior to laying the subsequent course.

330-7.6 Use of Traffic Roller: *Use a traffic roller on the first overbuild course. Use a traffic roller or vibratory roller (unless restricted by the Contract Documents) on the first structural layer placed on an ARMI.*

330-7.7 Compaction at Bridge Structures: Compact asphalt mixtures placed over bridge decks and approach slabs using static compaction only. Utilize the standard rolling procedure described in 330-7.2 or an alternative procedure approved by the Engineer.

330-8 Joints.

330-8.1 General: When laying fresh mixture against the exposed edges of joints, place it in close contact with the exposed edge to produce an even, well-compacted joint after rolling.

330-8.2 Transverse Joints: Place the mixture as continuously as possible to minimize transverse joints. When constructing permanent transverse joints, meet the surface requirements as defined in 330-9. Construct temporary transverse joints in such a manner to allow traffic to pass over it. When resuming the paving operation, construct a transverse joint by cutting back on the previously placed pavement at a location where the straightedge requirements are met. At the project limits, tie into the adjoining pavement layers as shown in the Plans.

330-8.3 Longitudinal Joints: Place each layer of pavement so that all longitudinal construction joints are offset 6 to 12 inches laterally between successive layers. Plan offsets in advance so that longitudinal joints of the friction course are not in wheel path areas. The longitudinal joints for friction course layers should be within 6 inches of the lane edge or at the center of the lane. The Engineer may waive this requirement where offsetting is not feasible due to the sequence of construction.

330-8.4 Placing Asphalt Next to Concrete Pavement: When placing asphalt next to concrete pavement, construct the joint as shown in the Plans.

330-9 Surface Requirements.

330-9.1 General: Construct a smooth pavement with good surface texture and the proper cross-slope.

330-9.2 Texture of the Finished Surface of Paving Layers: Produce a finished surface of uniform texture and compaction with no pulled, torn, raveled, crushed or loosened portions and free of segregation, bleeding, flushing, sand streaks, sand spots, or ripples. Address any pavement not meeting the requirements of this specification in accordance with 330-9.5. For dense graded structural and friction course mixtures, in areas not defined to be a density testing exception per 334-5.1.2, obtain for the Engineer six 6 inch diameter roadway cores at locations visually identified by the Engineer to be segregated. The Engineer will determine the density of each core in accordance with FM 1-T 166 and calculate the percent G_{mm} of the segregated area using the average G_{mb} of the roadway cores and the QC subplot G_{mm} for the questionable material. If the average percent G_{mm} is less than 90.0, address the segregated area in accordance with 330-9.5.

Do not use asphalt concrete mixtures containing aggregates that cause a different color appearance in the final wearing surface unless the section is greater than or equal to one mile in length and across the full width of the pavement, including shoulders and turn lanes. Exceptions to these requirements will be permitted if approved by the Engineer.

330-9.3 Cross Slope: Construct a pavement surface with cross slopes in compliance with the requirements of the Contract Documents. Furnish an electronic level with a length of 4 feet and an accuracy of 0.1 degree, approved by the Engineer for the control of cross slope. Make this electronic level available at the jobsite at all times during paving operations.

330-9.3.1 QC Requirements: Calibrate the electronic levels a minimum of once per day before paving operations begin, in accordance with manufacturer's instructions.

Compare the QC level with the Verification level before paving operations begin, and at any time as directed by the Engineer. If the comparison between the QC and Verification levels is within the comparison tolerance of plus or minus 0.2%, the QC level is considered to compare favorably and can be used for measurement and acceptance of cross slopes. If the levels do not compare favorably, perform a second comparison using another calibrated electronic level (FDOT or Contractor) for resolution. If this resolution level compares favorably with the QC level, the QC level is considered to be verified. If the second level does not compare favorably with the QC level, discontinue the use of the QC electronic level and obtain another approved electronic level that meets the requirements of this specification. Regardless of the comparison analysis outcome, the Contractor assumes all risk associated with placing the pavement at the correct cross slope.

Measure the cross slope of the compacted pavement surface by placing the level at the center location of a lane and perpendicular to the roadway centerline. Record all measurements to the nearest 0.1% on the Cross Slope Measurement Data Form and submit to the Engineer for documentation.

1. Tangent Sections: Measure the cross slope at a minimum frequency of one measurement every 100 feet per lane. Calculate the absolute deviation of each cross slope measurement and then average the absolute deviations of ten consecutive cross slope measurements. (The absolute deviation is the positive value of a deviation) When the average absolute deviation cross slope is consistently within the acceptance tolerance as shown in Table 330-4 and upon the approval of the Engineer, the frequency of cross slope measurements can be reduced to one measurement every 200 feet during paving operations.

2. Superelevated Sections: Measure the cross slope every 100 feet per lane within the length of the full superelevation. Calculate the absolute deviation of each measurement and then average the absolute deviations of ten consecutive cross slope measurements. For the transition sections, measure the cross slope at control points identified in the Plans, or if not shown in the Plans, at a control point at the location of 0.0% cross slope and calculate the absolute deviation. For curves where the length of full superelevation is less than 250 feet, measure the cross slope at the beginning point, midpoint and ending point of the fully superelevated sections, calculate the absolute deviation, and average. When the number of measurements is less than ten and the length of full superelevation is greater than 250 feet, average the absolute deviation of all measurements.

If the average absolute deviation of the cross slope measurements falls outside the acceptance tolerance, as shown in Table 330-4, stop the paving operation and make adjustments until the problem is resolved to the satisfaction of the Engineer. If an individual cross slope deviation falls outside the acceptance tolerance as shown in Table 330-4, make corrections at no cost to the Owner in accordance with 330-9.5 to address the deficient area of the structural course. Complete all corrections before placement of the final pavement surface layer, unless stated otherwise in the Plans, or as determined by the Engineer. For pavement with multiple layers, the deficient areas for the structural course may be left in place, upon the approval of the Engineer.

The limits of deficient areas requiring correction may be verified and adjusted with more accurate measurement methods, including survey instruments, upon approval by the Engineer at no cost to the Owner.

Should the Contractor wish to have any corrections waived, submit a request to the Engineer for approval. The Engineer may waive the corrections at no reduction in payment if the deficiencies are sufficiently separated so as not to affect the overall traffic safety, surface drainage and ride quality characteristics of the pavement and the corrective action would unnecessarily mar the appearance of the finished pavement.

For intersections, tapers, crossovers, transitions at the beginning and end of the project, bridge approaches and similar areas, adjust the cross slope to match the actual site conditions, or as directed by the Engineer.

Table 330-4 Cross Slope Acceptance Tolerance		
Roadway Feature	Individual Absolute Deviation	Average Absolute Deviation
Tangent section (including turn	0.4%	0.2%
Superelevated lane curve	0.4%	0.2%
Shoulder	0.5%	0.5%

In the event that the distance between two edges of deficient areas is less than 100 feet, the correction work shall include the area between the deficient sections.

330-9.3.2 Verification: The Engineer will verify the Contractor’s cross slope measurements by randomly taking a minimum of ten cross slope measurements per lane per mile in tangent sections, control points in transition sections, and a minimum of three cross slope measurements on fully superelevated sections over a day’s production. The Engineer will measure the cross slope of the compacted pavement surface by placing the level at the center location of a lane and perpendicular to the roadway centerline. If the average absolute deviation or an individual cross slope deviation falls outside of the acceptance tolerance as shown in Table 330-4, immediately make a comparison check at the QC test locations to verify the QC measurements in the section. If the comparisons are beyond the acceptable comparison tolerance in accordance with 330-9.3.1, stop the paving operations until the issue is resolved to the satisfaction of the Engineer. Correct any cross slope not meeting the individual deviation acceptance tolerance in accordance with 330-9.5 at no cost to the Owner. The Engineer reserves the right to check the pavement cross slope at any time by taking cross slope measurements at any location.

330-9.4 Pavement Smoothness: Construct a smooth pavement meeting the requirements of this Specification.

330-9.4.1 General: Furnish a 15 foot manual and a 15 foot rolling straightedge meeting the requirements of FM 5-509. Obtain a smooth surface on all pavement courses placed, and then straightedge all layers as required by this Specification.

330-9.4.2 Test Method: Perform all straightedge testing in accordance with FM 5-509 in the outside wheel path of each lane. The Engineer may require additional testing at other locations within the lane.

330-9.4.3 Traffic Control: *Provide traffic control in accordance with Section 102 and the FDOT Design Standards Index Nos. 607 or 619 during all testing. When traffic control cannot be provided in accordance with Index Nos. 607 or 619, submit an alternative Traffic Control Plan as specified in 102-4. Include the cost of this traffic control in the Contract bid prices for the asphalt items.*

330-9.4.4 Process Control Testing: Assume full responsibility for controlling all paving operations and processes such that the requirements of these Specifications are met at all times.

330-9.4.5 QC Testing:

330-9.4.5.1 General: Straightedge the final Type SP structural layer and friction course layer in accordance with 330-9.4.2, with the exception that if the method of acceptance is by laser profiler, then straightedging of the friction course layer is not required. Test all pavement lanes and ramps where the width is constant and document all deficiencies in excess of 3/16 inch on a form approved by the Engineer.

330-9.4.5.2 Straightedge Exceptions: Straightedge testing will not be required in the following areas: shoulders, intersections, tapers, crossovers, sidewalks, shared use paths, parking lots and similar areas, or in the following areas when they are less than 250 feet in length: turn lanes, acceleration/deceleration lanes and side streets. The limits of the intersection will be from stop bar to stop bar for both the mainline and side streets.

As an exception, in the event the Engineer identifies a surface irregularity in the above areas that is determined to be objectionable, straightedge and address all deficiencies in excess of 3/8 inch in accordance with 330-9.5.

The Engineer may waive straightedge requirements for transverse joints at the beginning and end of the project, at the beginning and end of bridge structures, at manholes, and at utility structures if the deficiencies are caused by factors beyond the control of the Contractor, as determined by the Engineer. In addition, the Engineer may also waive the straightedging requirements on ramps and superelevated sections where the geometrical orientation of the pavement results in an inaccurate measurement with the rolling straightedge.

330-9.4.5.3 Intermediate Layers and Temporary Pavement: When the design speed is 55 mph or greater and the intermediate Type SP layer or temporary pavement is to be opened to traffic, if the Engineer identifies a surface irregularity that is determined to be objectionable, straightedge and address all deficiencies in excess of 3/8 inch within 72 hours of placement in accordance with 330-9.5.

330-9.4.5.4 Final Type SP Structural Layer: Straightedge the final Type SP structural layer in accordance with 330-9.4.2, either behind the final roller of the paving train or as a separate operation. Notify the Engineer of the location and time of straightedge testing a minimum of 48 hours before beginning testing. The Engineer will verify the straightedge testing by observing the QC straight edging operations. Address all deficiencies in excess of 3/16 inch in accordance with 330-9.5.

When the final structural course is to be opened to traffic and the design speed is 55 mph or greater, if any defect is 3/8 inch or greater, the Engineer may require deficiencies to be corrected within 72 hours after opening to traffic.

330-9.4.5.5 Friction Course Layer: Where required per 330-9.4.5.1, straightedge the friction course layer in accordance with 330-9.4.2, either behind the final roller of the paving train or a separate operation upon completion of all paving operations. Notify the Engineer of the location and time of straightedge testing a minimum of 48 hours before as beginning testing. The Engineer will verify the straightedge testing by observing the QC

straightedging operations. Address all deficiencies in excess of 3/16 inch in accordance with 330-9.5.

330-9.4.6 Acceptance:

330-9.4.6.1 Straightedge Acceptance: For areas of roadways where the design speed is less than 55 miles per hour, acceptance for pavement smoothness of the friction course will be based on verified QC measurements using the straightedge as required by 330-9.4.5. The Engineer will verify the straightedge testing by observing the QC straightedging operations.

330-9.5 Unacceptable Pavement:

330-9.5.1 Corrections: Address all areas of unacceptable pavement at no cost to the Owner. Retest all corrected areas and assure the requirements of these Specifications are met.

330-9.5.1.1 Structural Layers: Correct all deficiencies, as defined in these Specifications, in the Type SP structural layers by removing and replacing the full depth of the layer, extending a minimum of 50 feet on both sides (where possible) of the defective area for the full width of the paving lane.

As an option, for high straightedge deficiencies only, mill the pavement surface the full lane width to a depth and length that is adequate to remove the deficiency. This option only applies if the structural layer is not the final surface layer.

330-9.5.1.2 Friction Course: Correct deficiencies in the friction course or final surface layer by removing and replacing the full depth of the layer, extending a minimum of 50 feet on both sides (where possible) of the defective area for the full width of the paving lane. As an exception, the Engineer may allow the Contractor to leave these areas in place if it is determined by the Engineer that the deficiency is not a significant detriment to the pavement quality. A reduction to the pay item quantity will be made in accordance with 330-9.5.2.

330-9.5.2 Reduction in Pay Item Quantity: When the Engineer elects to waive corrections, the Owner will reduce the pay quantity for the pay item in question by the amount of material that the Contractor would have removed and replaced had the correction been made. When the pay quantity is in tons, the Owner will base the reduction on the volume of material that the Contractor would have removed (the length by the lane width by layer thickness) multiplied by the maximum specific gravity of the mix as determined through the following equation:

$$\text{Quantity (tons)} = L \times W \times t \times G_{\text{mm}} \times 0.0024$$

Where: L = Lane length (ft.)

W = Lane width (ft.)

t = Layer thickness (in.)

G_{mm} = Maximum specific gravity from verified mix design

For FC-5 open-graded friction course, the Owner will base the reduction on the area that the Contractor would have removed (the length by lane width) multiplied by a spread rate of 80 lb/yd² as determined through the following equation:

$$\text{Quantity (tons)} = L \times W \times 0.0044$$

Where: L = Lane length

(ft.) W = Lane width (ft.)

330-10 Protection of Finished Surface.

Keep sections of newly compacted asphalt concrete, which are to be covered by additional courses, clean until the successive course is laid.

Do not dump embankment or base material directly on the pavement. Dress shoulders before placing the friction course on adjacent pavement.

Equip blade graders operating adjacent to the pavement during shoulder construction with a 2 inch by 8 inch or larger board, or other attachment providing essentially the same results, attached to their blades in such manner that it extends below the blade edge in order to protect the pavement surface from damage by the grader blade.

To prevent rutting or other distortion, protect sections of newly finished dense- graded friction course and the last structural layer prior to the friction course from traffic until the surface temperature has cooled below 160°F.

**SECTION 331
TYPE S ASPHALT CONCRETE, QUALITY ASSURANCE AND ACCEPTANCE
PROCEDURES**

331-1 Description.

331-1.1 General: Construct a Type S Asphalt Concrete course (using the Quality Assurance acceptance system) using the type of mixture specified in the Contract, or when offered as alternates, as selected. If offered as alternates, meet the layer thickness criteria specified in 331-1.2. Type S mixes are identified as Type S-I, Type S-II, or Type S-III. The composition and physical test properties for all mixes including Type S Asphaltic Concrete are shown in Tables 331-1 and 331-2. This Section establishes Acceptance Procedures for materials and work performed under Sections 280, 290, 331, 332, 333, 335, and 337.

Where Type S Asphalt Concrete is specified in the Contract, if approved by the Engineer, the equivalent fine Type SP Asphalt Concrete mixture (Traffic Level C) meeting the requirements of Section 334 may be selected as an alternate at no additional cost to the Owner. The equivalent mixes are as follows:

- Type S-I..... Type SP-12.5
- Type S-II..... Type SP-19.0
- Type S-III..... Type SP-9.5

Meet the requirements for plant and equipment specified in Section 320. Meet the general construction requirements specified in Section 330.

Table 331-1 Bituminous Concrete Mixtures								
Type	Total Aggregate Passing Sieves ¹							
	3/4 inch [19.0]	1/2 inch [12.5 mm]	3/8 inch [9.5 mm]	No. 4	No. 10	No. 40	No. 80	No. 200 [75 μm]
S-I ⁵	100	88-98	75-93	47-75	31-53	19-35	7-21	2-6
S-II ²	83-98	71-87	62-78	47-63	33-49	19-35	9-18	2-6
S-III ⁵		100	88-98	60-90	40-70	20-45	10-30	2-6
Type II		100	90-100	80-100	55-90			2-12
Type III		100	80-100	65-100	40-75	20-45	10-30	2-10
SAHM		100						0-12

ABC-1		100						0-12
ABC-2		100			55-90			0-12
ABC-3 ³	70-100			30-70	20-60	10-40		2-10
FC-2 ⁴		100	85-100	10-40	4-12			2-5
FC-3 ⁵		100	88-98	60-90	40-70	20-45	10-30	2-6

¹ In inches [mm] or sieves [μm].

Table 331-1
Bituminous Concrete
Mixtures

Type	Total Aggregate Passing Sieves ¹							
	3/4 inch [19.0]	1/2 inch [12.5 mm]	3/8 inch [9.5 mm]	No. 4	No. 10	No. 40	No. 80	No. 200 [75 μm]

² 100% passing 1 1/4 inch [31.5 mm] sieve and 94 to 100% passing 1 inch [25.0 mm] sieve.

³ 100% passing 1 1/2 inch [37.5 mm] sieve.

⁴ The Engineer may increase the design range for the No. 10 [2.00 mm] sieve for lightweight aggregates.

⁵ The Engineer may retain up to 1% on the maximum sieve size.

Table 331-2 Non SI Units
Marshall Design Properties For Bituminous Concrete

Mix Type	Minimum Marshall Stability	Flow* (0.01 in.)	Minimum VMA (%)	Air Voids (%)	Minimum Effective Asphalt Content (%)	VFA Voids Filled with Asphalt (%)
S-I	1,500*	8-13	14.5	4-5	***	65-75
S-II	1,500*	8-13	13.5	4-5	***	65-75
S-III	1,500*	8-13	15.5	4-6	***	65-75
Type	500-750	7-15	18	5-16	6.0	-
Type III	750-1,000	7-15	15	5-12	5.5	-
SAH	300-500	7-15	15	5-16	6.0	-
ABC-	500	7-15	15	5-16	6.0	-
ABC-	750	7-15	15	5-14	5.5	-
ABC-	1,000	8-13	14	4-7	***	65-78
FC-2	-	-	-	-	-	-
FC-3	1,500	8-13	15.5	4-6	***	65-75

*The minimum Marshall Stability for Type S mixes used on limited access facilities (Interstate, Turnpike, and Expressways) shall be 1,800 lbs.

**The maximum Flow value during production shall not exceed one point more than shown in the Table.

***The ratio of the percentage by weight of total aggregate passing the No. 200 sieve to the effective asphalt content expressed as a percentage by weight of total mix shall be in the range of 0.6 to 1.2.

Table 331-2 SI Units
Marshall Design Properties For Bituminous Concrete

Mix	Minimum Marshall Stability	Flow*	Minimum VMA	Air Voids (%)	Minimum Effective Asphalt Content	VFA Voids Filled with Asphalt (%)
S-I	6.7*	2.0-3.3	14.5	4-5	***	65-75
S-II	6.7*	2.0-3.3	13.5	4-5	***	65-75
S-III	6.7*	2.0-3.3	15.5	4-6	***	65-75

Type II	2.2-3.3	1.8-3.8	18	5-16	6.0	-
Type III	3.3-4.4	1.8-3.8	15	5-12	5.5	-
SAHM	1.3-2.2	1.8-3.8	15	5-16	6.0	-
ABC-1	2.2	1.8-3.8	15	5-16	6.0	-

ABC-2	3.3	1.8-3.8	15	5-14	5.5	-
ABC-3	4.4	2.0-3.3	14	4-7	***	65-78
FC-2	-	-	-	-	-	-
FC-3	6.7	2.0-3.3	15.5	4-6	***	65-75

*The minimum Marshall Stability for Type S mixes used on limited access facilities (Interstate, Turnpike, and Expressways) shall be 8.0 kN.

**The maximum Flow value during production shall not exceed 0.25 mm more than shown in the Table.

***The ratio of the percentage by weight of total aggregate passing the 75µm sieve to the effective asphalt content expressed as a percentage by weight of total mix shall be in the range of 0.6 to 1.2.

The Engineer will accept the work on a LOT to LOT basis in accordance with the applicable requirements of Sections 5, 6, and 9. The size of the LOT will be as specified in 331-6 for the bituminous mixture produced at the plant and as stipulated in 331-7 for the material placed on the roadway.

331-1.2 Layer Thicknesses:

331-1.2.1 Structural Layers: The allowable layer thicknesses for Type S Asphalt Concrete mixtures used in structural and overbuild applications is as follows:

Type S-III..... 3/4 – 1 1/4 inches [20 – 30 mm]

Type S-I 1 1/4 – 2 1/2 inches [30 – 60 mm]

Type S-II..... 2 – 2 3/4 inches [50 – 70 mm]

In addition to the minimum and maximum thickness requirements, the following restrictions are placed on Type S mixtures when used as a structural course:

Type S-III – Limited to the final (top) structural layer, one layer only.

Type S-I – May not be used in the first layer of courses over 3 1/2 inches [90 mm] thick, nor in the first layer of courses over 2 3/4 inches [70 mm] thick on limited access facilities.

Type S-II – May not be used in the final (top) structural layer.

331-1.2.2 Additional Requirements: The following requirements also apply to Type S Asphalt Concrete mixtures:

1. A minimum 1 1/2 inch [40 mm] initial lift is required over an Asphalt Rubber Membrane Interlayer (ARMI).

2. When construction includes the paving of adjacent shoulders (#5 feet [#1.5 m] wide), the layer thickness for the upper pavement layer and shoulder shall be the same and paved in a single pass, unless shown differently in the plans.

3. All overbuild layers shall be Type S asphalt concrete. Use the minimum and maximum layer thicknesses as specified in 331-1.2.1 unless shown differently in the plans. On variable thickness overbuild layers, the minimum allowable thickness may be reduced by 1/2 inch [13 mm], and the maximum allowable thickness may be increased 1/2 inch [13 mm], unless shown differently in the plans. Other variations from these thicknesses must be approved by the Engineer.

331-2 Materials.

331-2.1 General Requirements: Meet the material requirements specified in Division III. Specific references are as follows:

Superpave PG Asphalt Binder or Recycling Agent	916-1, 916-2
Mineral Filler	917-1, 917-2
Coarse Aggregate, Stone, Slag or Crushed Gravel.....	Section 901
Fine Aggregate	Section 902

Asphalt concrete mixes containing crushed gravel as coarse aggregate component must show no potential for stripping during laboratory testing for mix design verification. Crushed Reclaimed Portland Cement Concrete Pavement may be used as a coarse aggregate or screenings component subject to meeting all applicable specifications.

331-2.2 Specific Requirements:

331-2.2.1 Condition of Aggregate: Use clean aggregate containing no deleterious substances. Do not use coarse or fine aggregate which contains more than 0.5% of phosphate.

331-2.2.2 Fine Aggregate and Mineral Filler: In laboratory tests, and for the purpose of proportioning the paving mixture, consider all material passing the No. 10 [2.00 mm] sieve and retained on the No. 200 [75 µm] sieve as fine aggregate, and the material passing the No. 200 [75 µm] sieve as mineral filler.

331-2.2.3 Screenings: Do not use any screenings in the combination of aggregates containing more than 15% of material passing the No. 200 [75 µm] sieve. When two screenings are blended to produce the screening component of the aggregate, one of such screenings may contain up to 18% of material passing the No. 200 [75 µm] sieve, as long as the combination of the two does not contain over 15% material passing the No. 200 [75 µm] sieve. Screenings may be washed to meet these requirements.

331-2.2.4 Use of Reclaimed Asphalt Pavement (RAP): Subject to certain requirements, Reclaimed Asphalt Pavement (RAP) may be used as a component material of the asphalt mixture if approved by the Engineer. RAP may be used as a component material of the bituminous mixture subject to the following:

4. Assume responsibility for the design of asphalt mixes which incorporate RAP as a component part.

5. Do not allow RAP to exceed 60% by weight of total aggregates for Asphalt Base Courses nor more than 50% by weight of total aggregates for Structural and Leveling Courses. Do not use RAP in Friction Courses.

6. Mount a grizzly or grid with openings of a sufficient size to prevent clogging of the cold feed over the RAP cold bin.

Use a grizzly or grid over the RAP cold bin, in-line roller crusher, screen, or other suitable means to prevent oversized RAP material from showing up in the completed recycled mixture.

If oversized RAP material appears in the completed recycled mix, cease plant operations and take appropriate corrective action.

7. Ensure that the RAP material as stockpiled is reasonably uniform in characteristics and contains no aggregate particles which are soft or conglomerates of fines.

8. Ensure that the RAP has a minimum average asphalt content of

4% by weight of total mix. The Owner reserves the right to sample the stockpile in order that this requirement is met.

When material milled from the project is used as a component of the asphalt mixture and a Composition of Existing Pavement is known, use the following procedures for obtaining representative samples for the mix design:

1. Cut ten 6-inch [150 mm] cores in area(s) approved by the Engineer. Fill the core holes immediately prior to opening to traffic.

2. Representative samples may also be obtained by milling the existing pavement to the full depth shown on the plans for pavement removal for a length of approximately 200 feet [60 m]. Immediately replace the pavement removed with the specified mix in the Contract.

3. Submit a request in writing to the Engineer for any variance from the above outlined methods of obtaining samples for mix designs.

When the composition of stockpiled RAP to be used as a component in a mix design is not known, design the mix as follows:

1. Submit a bag of RAP, composed of samples from several locations in the stockpile(s), to the Owner at least four weeks prior to the planned start of mix design. The Engineer will run viscosities on the reclaimed asphalt pavement and furnish the information to the Contractor.

2. Run a minimum of six extraction gradation analyses of the RAP. Take the samples at random locations around the stockpile(s).

3. Request the Engineer to make a visual inspection of the stockpile(s) of RAP. Based on visual inspection, the Engineer will determine the suitability of the stockpiled materials.

4. When the proposed mix design is submitted to the Owner for verification, submit the data from the extraction gradation analyses required above.

331-2.2.5 Binder for Mixes with RAP: Use a PG 67-22 where RAP is less than 20% by weight of total aggregate; use a PG 64-22 where RAP is 20% or greater but less than 30% by weight of total aggregate; use appropriate recycle agent where RAP is 30% or greater.

The Engineer reserves the right to change binder type and grade at design based on the characteristics of the RAP binder, and reserves the right to request reasonable changes during the production based on the requirements of 331-4.4.4.

331-2.2.6 Use of Recycled Crushed Glass: Recycled crushed glass may be used as a component of the bituminous mixture subject to the following:

1. Consider the recycled crushed glass a local material and meet all requirements specified in 902-6.

2. The percentage of recycled crushed glass in any bituminous mixture does not exceed 15% of the total aggregate weight.

3. The asphalt binder used with mixtures containing recycled crushed glass contains 0.5% anti-stripping agent from an approved source. The addition of the specified amount of anti-stripping agent must be certified by the supplier.

4. Test bituminous mixtures containing recycled crushed glass in accordance with AASHTO T 283 as part of the mix design approval. The minimum tensile strength ratio must not be less than 80%. An increase in the amount of anti-stripping agent may be necessary in order to meet this requirement.

Recycled crushed glass must not be used in friction course mixtures nor in structural course mixtures which are to be used as the final wearing course.

331-2 Permissible Variation for the Coarse Aggregate.

Size and uniformly grade or combine the aggregate or aggregates shipped to the job in such proportions that the resulting mixture meets the grading requirements of the mix design.

331-3 General Composition of Mixture.

331-4.1 General: Use a bituminous mixture composed of a combination of aggregate (coarse, fine or mixtures thereof), mineral filler, if required, and bituminous material. Ensure that not more than 20% by weight of the total aggregate used is silica sand or local materials as defined in Section 902. Consider the silica sand and local materials contained in any RAP material, if used in the mix, in this limitation. Size, grade and combine the several aggregate fractions in such proportions that the resulting mixture meets the grading and physical properties of the verified mix design.

RAP meeting the requirements of 331-2.2.4 may be approved as a substitution for a portion of the combination of aggregates, subject to all applicable specification requirements being met.

331-4.2 Grading Requirements: In all cases, use a mix design within the design ranges specified in Table 331-1.

331-4.3 Mix Design:

331-4.3.1 General: Prior to the production of any asphaltic paving mixture, submit a mix design and representative samples of all component materials to the Owner at least two weeks before the scheduled start of production. The Engineer will verify the mix design before use. Send a copy of the proposed mix design to the Engineer at the same time. (Open-graded mixes will be designed by the Engineer.) Furnish the following information:

9. The specific project on which the mixture will be used.
10. The source and description of the materials to be used.
11. The gradation and approximate proportions of the raw materials as intended to be combined in the paving mixture. The gradation of the component materials shall be representative of the material at the time of use.
12. A single percentage of the combined mineral aggregate passing each specified sieve. Degradation of the aggregate due to processing (particularly No. 200 [75 µm]) should be accounted for and identified for the applicable sieves.
13. A single percentage of asphalt by weight of total mix intended to be incorporated in the completed mixture, shown to the nearest 0.1%. For structural mixes (S-I, S-II and S-III) establish the optimum asphalt content at a level corresponding to a minimum of 4.5% air voids. For FC-3 mixes, establish optimum asphalt content at a level corresponding to a minimum of 5.0% air voids.
14. A single temperature at which the mixture is intended to be discharged from the plant.
15. The laboratory density of the asphalt mixture for all mixes except Open-Graded Friction Courses.
16. Evidence that the completed mixture will meet all specified physical requirements.

17. The name _____ of the individual responsible for the Quality Control of the mixture.

331-4.3.2 Revision of Mix Design: Submit all requests for revisions to approved mix designs, along with supporting documentation, in writing to the Engineer. In order to expedite the revision process, a verbal revision request or discussion of the possibility of a revision request may be made, but must be followed up with a written request. The verified mix design will remain in effect until a change is authorized by the Engineer. In no case will the effective date of the revision be established earlier than the date of the first communication with the Engineer regarding the revision. Provide a new mix design for any change in source of aggregate.

331-4.3.3 Resistance to Plastic Flow: Include with the submitted mix design test data showing that the material as produced will meet the requirements specified in Table 331-2 when tested in accordance with FM 1-T 245. Further, determine the bulk specific gravity of the laboratory compacted bituminous mixture in accordance with FM 1-T 166.

Determine the percent of unfilled voids and the percent of aggregate voids filled with asphalt using the maximum specific gravity of the bituminous mixture and on the asphalt content of each group of specimens prepared from the same sample. Determine maximum specific gravity of the bituminous mixture by FM 1-T 209.

331-4.3.4 Revocation of Mix Design: The Engineer will consider any marked variations from original test data for a mix design or any evidence of inadequate field

performance of a mix design as sufficient evidence that the properties of the mix design have changed, and the Engineer will no longer allow the use of the mix design.

331-4.4 Contractor's Quality Control:

331-4.4.1 Personnel: In accordance with the requirements of 331-5.2 provide the necessary quality control personnel. Ensure that the Quality Control Technician is certified and possesses a valid certificate of qualification.

331-4.4.2 Extraction Gradation Analysis: Sample the bituminous mixture at the plant in accordance with FM 1-T 168. Determine the percent bitumen content of the mixture in accordance with FM 5-563, and determine the percent passing the standard sieves in accordance with FM 1-T 030. In the event the calibration factor for the mix exceeds 0.50%, conduct the extraction and gradation analysis in accordance with FM 5-544 and FM 5-545, respectively. Show all test results to the nearest 0.01.

Run a minimum of one extraction gradation analysis of the mixture for each day's or part of a day's production and immediately following any change in the production process. Take the quality control sample of mixture for the extraction gradation analysis each day as soon as the plant operations have stabilized. Obtain the results in a timely manner (no later than the end of the day) so that adjustments can be made if necessary.

On initial use of a Type S or FC-3 mix design at a particular plant, as a minimum, run an additional extraction gradation analysis if more than 500 tons [450 metric tons] of mixture are produced on the first day of production.

Extraction gradation analysis will not be required on the days when mix production is less than 100 tons [90 metric tons]. However, when mix production is less than 100 tons [90 metric tons] per day on successive days, run the test when the accumulative tonnage on such days exceeds 100 tons [90 metric tons].

Use the target gradation and asphalt content as shown on the mix design. Any changes in target will require a change in the mix design in accordance with 331-4.3.2.

If the percentage of bitumen deviates from the optimum asphalt content by more than 0.55% or the percentage passing any sieve falls outside the limits shown in Table 331-3, make the necessary correction. If the results for two consecutive tests deviate from the optimum asphalt content by more than 0.55% or exceeds the limits as shown in Table 331-3 for any sieve, stop the plant operations until the problem has been corrected. In addition, if the results of two consecutive tests show an amount greater than 99.0% passing the 1/2 inch [12.5 mm] sieve for Type S-I, an amount greater than 99.0% passing the 3/4 inch [19.0 mm] sieve for Type S-II, or an amount greater than 99.0% passing the 3/8 inch [9.5 mm] sieve for Types S-III or FC-3, stop the plant operation until the problem has been corrected.

Maintain control charts showing the results of the extraction gradation analysis (bitumen content and sieve analysis).

Sieve	Percent
1 inch [25.0 mm]	7
3/4 inch [19.0 mm]	7
1/2 inch [12.5 mm]	7
3/8 inch [9.5 mm]	7
No. 4 [4.75 mm]	7

Sieve	Percent
No. 10 [2.00 mm]	5.5
No. 40* [*425 μm]	4.5
No. 80* [*180 μm]	3
No. 200 [75 μm]	2

*Does not apply to SAHM, ABC-1 or Type II.

331-4.4.3 Plant Calibration: At or before the start of mix production, perform a wash gradation on a set of hot bin samples for batch or continuous mix plants or belt cut for drum mix plants to verify calibration of the plant. When approved by the Engineer, extraction gradation analysis of the mix may be used to verify calibration of the plant. This extraction gradation analysis may also be used to fulfill the quality control requirements for the first day's production.

331-4.4.4 Viscosity of Asphalt in Mixes Containing RAP: When RAP is a component material, the viscosity of the asphalt material in the bituminous mixture, determined by the Engineer in accordance with ASTM D 2171, shall be $6,000 \pm 2,000$ poises [600 ± 200 Pa·s]. This determination will be made on samples obtained by the Owner on a random basis at a frequency of approximately one per 2,000 tons [1,800 metric tons] of mix.

If the viscosity determined by the Engineer is out of the specified range, adjust the binder formulation or blend of RAP in the mix to bring the viscosity within tolerance.

331-5 Acceptance Procedures.

. The Engineer is responsible for determining the acceptability of the construction and materials incorporated therein. The Contractor is responsible for the quality of construction and materials. Accomplish all quality control sampling and testing on a random basis in accordance with the approved Quality Control Plan. The Owner may will perform necessary sampling and testing for acceptance purposes on a random basis as specified herein, in addition to monitoring and observing the Contractor's quality control test procedures and results. Maintain effective quality control until final project acceptance.

A LOT is defined as an isolated quantity of a specified material produced from a single source or operation, or it is a measured amount of specified construction produced by the same process. In order to change the process, thereby necessitating the termination of the current LOT and starting a new LOT, submit a written request, with justification, to the Engineer for approval. Obtain the Engineer's approval prior to making the process change.

Perform all quality control sampling and testing of materials in strict conformance with the Florida Method of Sampling and Testing as found in the Field Sampling and Testing Manual.

331-5.1 Acceptance Plans:

331-5.1.1 Payment Based on Acceptance Results: The Owner will adjust the payment for each LOT of material, product, item of construction or completed construction on the basis of acceptance test results in accordance with the requirements specified hereinafter in the applicable Sections.

331-5.1.2 Resampling of LOTs: The Owner requires that LOTs of materials, products, items of construction or completed construction meet the requirements of these Specifications at the time of submission. The Owner will not take check samples for acceptance purposes.

331-5.2 Quality Control by the Contractor: Provide and maintain a quality control system that provides reasonable assurance that all materials, products and completed construction submitted for acceptance meet Contract requirements. Develop and maintain a quality control system in conformance with the following requirements:

CONTRACTOR QUALITY CONTROL SYSTEM

I. SCOPE

:

These Specifications establish minimum requirements and activities for a Contractor quality control system. These requirements pertain to the inspections and tests necessary to substantiate material and product conformance to Contract requirements and to all inspections and tests required by the Contract.

II. FUNCTIONS AND RESPONSIBILITIES:

1. . The Owner will verify the Contractor's design mixes, inspect plants and monitor control of the operations to ensure conformance with these Specifications. At no time will the Engineer issue instructions to the Contractor or producer as to the setting of dials, gauges, scales and meters. However, the Owner's representatives may question and warn the Contractor against the continuance of any operations or sequence of operations that obviously do not result in satisfactory compliance with the requirements of these Specifications.

2. The Contractor. Submit in writing the proposed Quality Control Plan for each asphalt plant for the Engineer's approval. Maintain the approved Quality Control Plan in effect for the plant to which it is assigned until the Engineer rejects it in writing. Include in the plan the sampling, testing, inspection and the anticipated frequencies of each to maintain process control. A recommended series of sampling, testing and inspecting activities are shown in Table 331-4.

Table 331-4
RECOMMENDATIONS FOR A CONTRACTOR QUALITY CONTROL PLAN

A. All Types of Plants

1. Stockpiles

- a. Place materials in the correct stockpile.
- b. Use good stockpiling techniques.
- c. Inspect stockpiles for separation, contamination, segregation, etc.

2. Incoming Aggregate

- a. Obtain gradations and bulk specific gravity (BSG) values from the aggregate supplier.
- b. Determine gradation of all component materials.
- c. Compare gradations and BSG to mix design.

3. Cold Bins

- a. Calibrate the cold gate/feeder belt settings.
- b. Observe operation of cold feed for uniformity.

4. Dryer

- a. Observe pyrometer for aggregate temperature control.
- b. Observe efficiency of the burner.

5. Hot Bins

- a. Determine gradation of aggregates in each bin.
- b. Determine theoretical combined grading.

6. Bituminous Mixture

- a. Determine asphalt content.
- b. Determine mix gradation.
- c. Check mix temperature.
- d. Verify modifier addition.

B. Batch Plants

1. For batch weights, determine percent used and weight to be pulled from each bin to ensure compliance with the mix design.

2. Check mixing time.

3. Check operations of weigh bucket and scales.

C. Continuous Mix Plant

1. Determine gate calibration chart for each bin.

2. Determine gate settings for each bin to ensure compliance with the mix design.

3. Determine gallons [cubic meters] per revolution or gallons [cubic meters] per minute to ensure compliance with the mix design.

D. Drum Mixer Plant

1. Calibrate the cold feed and prepare a calibration chart for each cold gate.

2. Develop information for the synchronization of the aggregate feed, reclaimed asphalt pavement (RAP) feed and the bituminous material feed.

3. Calibrate the weigh bridge on the changing conveyor.

The activities shown in Table 331-4 are the normal activities necessary to control the production of bituminous concrete at an acceptable quality level. The Owner recognizes, however, that depending on the type of process or materials, some of the activities listed may not be necessary and, in other cases, additional activities may be required. The frequency of these activities will also vary with the process and the materials. When the process varies from the defined process average and variability targets, increase the frequency of these activities until the proper conditions are restored. Take one sample and test for every 1,000 tons [900 metric tons] of incoming aggregate (including RAP) as it is stockpiled. Test RAP material for extracted gradation and asphalt content.

Plot and keep up-to-date control charts for all quality control sampling and testing. Provide control charts for the following:

- a. gradation of incoming aggregates
- b. gradation and asphalt content of RAP
- c. combined gradations of hot bins
- d. extracted asphalt content
- e. mix gradation
- f. gradation of cold feed (drum mixers)

Post all current control charts in the asphalt lab where they can be seen. Formulate all design mixes with the exception of open-graded friction mixes (FC-2 and FC-5). Submit design mixes to the Engineer for verification prior to their use. Provide process control of all materials during handling, blending, mixing and placing operations.

III. QUALITY CONTROL SYSTEM:

1. General Requirements. Furnish and maintain a quality control system that provides reasonable assurance that all materials and products submitted to the Engineer for acceptance meet the Contract requirements. Perform, or have performed, the inspection and tests required to substantiate product conformance to Contract requirements, and also perform, or have performed, all inspections and tests otherwise required by the Contract. Place a person in responsible charge of the paving operations who is qualified as a Qualified Asphalt Paving Technician (Paving Level II). Document the quality control procedures, inspection and tests,

and make that information available for review by the Engineer throughout the life of the Contract.

2. Documentation. Maintain adequate records of all inspections and tests. Record the nature and number of tests made, the number and type of deficiencies found, the quantities approved and rejected, and the nature of corrective action taken, as appropriate.

3. Charts and Forms. Record all conforming and nonconforming inspections and test results on approved forms and charts, and keep them up to date and complete and make them available at all times to the Engineer during the performance of the work. Prepare charts of test properties for the various materials and mixtures. Obtain the Engineer's approval of non-standard forms and charts prior to using them.

4. Corrective Actions. Take prompt action to correct any errors, equipment malfunctions, process changes or other problems that result or could result in the submission of materials, products or completed construction that do not meet the requirements of these Specifications.

5. Laboratories with Measuring and Testing Equipment. Furnish a fully equipped asphalt laboratory (permanent or portable) at the production site, and meeting the following requirements:

a. Area - Provide an effective working area for the laboratory that is a minimum of 180 ft² [17 m²]. This area does not include the space for desks, chairs and file cabinets.

b. Lighting - Provide lighting in the lab adequate to illuminate all areas of work.

c. Temperature Control - Equip the lab with heating and air conditioning units that provide a satisfactory working environment.

d. Ventilation - Equip the lab with fume hoods and exhaust fans that will remove all hazardous fumes from within the laboratory in accordance with OSHA requirements.

e. Equipment and Supplies - Furnish the lab with the necessary sampling and testing equipment, and supplies, for performing Contractor quality control. A detailed list of equipment and supplies required for each test is included in the Field Sampling and Testing Manual. When running plants at a high production rate, furnish additional testing equipment as necessary to allow the completion of the Contractor's quality control tests within the specified time frame.

6. Sampling and Testing. Use the sampling and testing methods and procedures to determine quality conformance of the materials and products. Include the sampling for other material characteristics on a random basis and the plotting of the test results on control charts in the Quality Control Plan.

7. Alternative Procedures. The Contractor may use alternative sampling methods, procedures and inspection equipment when such procedures and equipment provide, as a minimum, the quality assurance required by the Contract Documents. Prior to applying such alternative procedures, describe them in a written proposal and demonstrate for the Engineer's approval that their effectiveness is equal to or better than the Contract requirements. In case of dispute as to whether certain proposed procedures provide equal assurance, use the procedures stipulated by the Contract Documents.

8. Nonconforming Materials. Establish and maintain an effective and positive system for controlling nonconforming materials, including procedures for identification, isolation and disposition. Reclaim or rework nonconforming materials in accordance with procedures

acceptable to the Engineer. Discuss the details of this system at the preconstruction conference, and make these details a part of the record of the conference.

9. Owner Inspection at Subcontractor or Supplier Facilities. The Owner reserves the right to inspect materials not manufactured within the Contractor's facility. The Owner's inspection does not constitute acceptance and does not, in any way, replace the Contractor's inspection or otherwise relieve the Contractor of his responsibility to furnish an acceptable material or product. When the Owner inspects the subcontractor's or supplier's product, such inspection does not replace the Contractor's responsibility to inspect such subcontractor's or supplier's product.

331-5.3 Defective Materials:

331-5.3.1 Acceptance or Rejection: Following the application of the appropriate acceptance plan, the Engineer will make the final decision as to the acceptance, rejection or acceptance at an adjusted payment of the LOTs.

331-5.3.2 Disposition of LOTs: For nonconforming LOTs of materials, products, items of construction or complete construction that are not adaptable to correction by reworking, either remove and replace the nonconforming work, or accept no payment or an adjusted payment as stated in these Specifications, or, if not stated, as directed by the Engineer.

331-5.4 General Basis of Adjusted Payment For Deficiencies: When the Engineer determines that a deficiency exists, the Engineer will apply the applicable payment factor as shown in these Specifications to the entire LOT. When the Engineer determines that multiple deficiencies exist, the Engineer will apply an adjustment to the LOT of material that is identified by each deficiency. The Engineer will apply the adjustment for each deficiency separately as it occurs. The Engineer will not allow an adjustment to be affected by any other adjustment occurring for the same LOT. As an exception to the foregoing requirements, when there are two or more deficiencies in the gradation acceptance tests (% pass No. 4 [4.75 mm] sieve, % pass No. 10 [2.0 mm] sieve, % pass No. 40 [425 μm sieve], % pass No. 200 [75 μm] sieve) the Engineer will only apply the greater adjustment. The Engineer will express all reductions in payment in terms of equivalent pay items at no pay. When the item is measured by the ton [metric ton], the Engineer will convert the LOT in the field, which is measured in feet [meters], to equivalent tons [metric tons] and by using the average calculated spread for that LOT. When the pay item is measured by the square yard [square meter], the Engineer will convert the LOT at the production point, which is measured in tons [metric tons], to equivalent square yards [square meters] at the design thickness and by using the laboratory density as a conversion factor.

331-6 Acceptance of the Mixture at the Plant.

331-6.1 General: The Engineer will accept the bituminous mixture at the plant, with respect to gradation and asphalt content, on a LOT to LOT basis. The material will be tested for acceptance in accordance with the provisions of 331-5 and the following requirements. However, the Engineer will reject any load or loads of mixture which are unacceptable for reason of being excessively segregated, aggregates improperly coated, or of excessively high or low temperature for use in the work.

For initial use of a Type S or FC-3 mix design with a Florida limestone source north of the 28th parallel at a particular plant, limit the first day's production to a maximum of 300 tons [275 metric tons]. Resume production upon notification of acceptable Marshall properties as determined in accordance with 331-6.4

A standard size LOT at the asphalt plant will consist of 4,000 tons [3,600 metric tons] with four equal sublots of 1,000 tons [900 metric tons] each. As an exception, the first LOT for the initial use of a Type S or FC-3 mix design with a particular plant will consist of four sublots, the first sublot of 500 tons [450 metric tons] or the first day's production (300 tons [275 metric tons] maximum for mix design with a Florida limestone source north of the 28th parallel), the second sublot of 500 tons [450 metric tons], and the remaining two sublots of 1,000 tons [900 metric tons] each.

A partial LOT may occur due to the following:

- (1) The completion of a given mix type on a project.
- (2) An approved LOT termination by the Engineer due to a change in process, extended delay in production, or change in mix design.

If the partial LOT contains one or two sublots with their appropriate test results, then the previous full-size LOT will be redefined to include this partial LOT and the evaluation of the LOT will be based on either five or six sublot determinations. If the

partial LOT contains three sublots with their appropriate test results, this partial LOT will be redefined to be a whole LOT and the evaluation of it will be based on three sublot determinations.

When the total quantity of any mix is less than 3,000 tons [2,700 metric tons], the partial LOT will be evaluated for the appropriate number of sublots from n=1 to n=3. When the total quantity of any mix type is less than 500 tons [450 metric tons], the Owner will accept the mix on the basis of visual inspection. On multiple project contracts, the LOT(s) at the asphalt plant will carry over from project to project.

331-6.2 Acceptance Procedures: Control all operations in the handling, preparation, and mixing of the asphalt mix so that the percent bitumen and the percents passing the No. 4, No. 10, No. 4 and No. 200 [4.75 mm, 2.00 mm, 425 µm and 75 µm] sieves will meet the approved job mix formula within the tolerance shown in Table 331-6.

Table 331-6 Tolerances for Acceptance	
Characteristi	Tolerance
Asphalt Content (Extraction)	±0.55%
Asphalt Content (Printout)	±0.15%
Passing No. 4 [4.75 mm] sieve	±7.00%
Passing No. 10 [2.00 mm] sieve	±5.50%
Passing No. 40 [425 µm] sieve**	±4.50%

Table 331-6 Tolerances for Acceptance	
Characteristi	Tolerance
Passing No. 200 [75 µm] sieve	±2.00

*Tolerances for sample size of n=1. See Table 331-7 for other sample sizes n=2 through n=6.
 **Applies only to Types S-I, S-II, S-III, and FC-3.

Acceptance of the mixture will be on the basis of test results on consecutive random samples from each LOT. One random sample will be taken from each subplot. The bituminous mixture will be sampled and tested at the plant as specified in 331-4.4.2.

Calculations for the acceptance test results for bitumen content and gradation (percentages passing No. 4, No. 10, No. 40 and No. 200 [4.75 mm, 2.00 mm, 425 µm and 75 µm] sieves) will be shown to the nearest 0.01.

Payment will be made on the basis of Table 331-7, "Acceptance Schedule of Payment". The process will be considered out of control when the deviation of any individual test result from the mix design falls in the 80% pay factor for the "one test" column of Table 331-7. When this happens, the LOT will be automatically terminated and production stopped. The approval of the Engineer will be required prior to resuming production of the mix. Acceptance of the LOT will then be determined in accordance with Table 331-7.

All acceptance tests will be completed on the same day the sample was taken, when possible, and on no occasion will they be completed later than the following work day.

Table 331-7						
Average of Accumulated Deviations of the Acceptance Tests from the Mix Design.						
Pay	1-Test	2-Tests	3-Tests	4-Tests	5-Tests	6-Tests
Asphalt Cement Content (Extraction - FM 5-544 or 5-563)						
1.00	0.00-0.55	0.00-0.43	0.00-0.38	0.00-0.35	0.00-0.33	0.00-0.31
0.95	0.56-0.65	0.44-0.50	0.39-0.44	0.36-0.40	0.34-0.37	0.32-0.36
0.90	0.66-0.75	0.51-0.57	0.45-0.50	0.41-0.45	0.38-0.42	0.36-0.39
0.80*	over 0.75	over 0.57	over 0.50	over 0.45	over 0.42	over 0.39
Asphalt Cement Content (Printout)						
1.00	0.00-0.15	0.00-0.15	0.00-0.15	0.00-0.15	0.00-0.15	0.00-0.15
0.95	0.16-0.25	0.16-0.25	0.16-0.25	0.16-0.25	0.16-0.25	0.16-0.25
0.90	0.26-0.35	0.26-0.35	0.26-0.35	0.26-0.35	0.26-0.35	0.26-0.35
0.80*	over 0.35	over 0.35	over 0.35	over 0.35	over 0.35	over 0.35
No. 4 [4.75 mm] sieve**						
1.00	0.00-7.00	0.00-5.24	0.00-4.46	0.00-4.00	0.00-3.68	0.00-3.45
0.98	7.01-8.00	5.25-5.95	4.47-5.04	4.01-4.50	3.69-4.13	3.46-3.86
0.95	8.01-9.00	5.96-6.66	5.05-5.62	4.51-5.00	4.14-4.58	3.87-4.27
0.90	9.01-10.00	6.67-7.36	5.63-6.20	5.01-5.50	4.59-5.02	4.28-4.67
0.80*	over 10.00	over 7.36	over 6.20	over 5.50	over 5.02	over 4.67
No. 10 [2.00 mm] sieve**						
1.00	0.00-5.50	0.00-4.33	0.00-3.81	0.00-3.50	0.00-3.29	0.00-3.13
0.98	5.51-6.50	4.34-5.04	3.82-4.39	3.51-4.00	3.30-3.74	3.14-3.54
0.95	6.51-7.50	5.05-5.74	4.40-4.96	4.01-4.50	3.75-4.18	3.55-3.95
0.90	7.51-8.50	5.75-6.45	4.97-5.54	4.51-5.00	4.19-4.63	3.96-4.36

Table 331-7						
Average of Accumulated Deviations of the Acceptance Tests from the Mix Design.						
Pay	1-Test	2-Tests	3-Tests	4-Tests	5-Tests	6-Tests
0.80*	over 8.50	over 6.45	over 5.54	over 5.00	over 4.63	over 4.36

No. 40 [425 µm] sieve**						
1.00	0.00-4.50	0.00-3.91	0.00-3.65	0.00-3.50	0.00-3.39	0.00-3.32
0.98	4.51-5.50	3.92-4.62	3.66-4.23	3.51-4.00	3.40-3.84	3.33-3.72
0.95	5.51-6.50	4.63-5.33	4.24-4.81	4.01-4.50	3.85-4.29	3.73-4.13
0.90	6.51-7.50	5.34-6.04	4.82-5.39	4.51-5.00	4.30-4.74	4.14-4.54
0.80*	over 7.50	over 6.04	over 5.39	over 5.00	over 4.74	over 4.54
No. 200 [75µm] sieve**						
1.00	0.00-2.00	0.00-1.71	0.00-1.58	0.00-1.50	0.00-1.45	0.00-1.41
0.95	2.01-2.40	1.72-1.99	1.59-1.81	1.51-1.70	1.46-1.63	1.42-1.57
0.90	2.41-2.80	2.00-2.27	1.82-2.04	1.71-1.90	1.64-1.80	1.58-1.73
0.80*	over 2.80	over 2.27	over 2.04	over 1.90	over 1.80	over 1.73

*If approved by the Engineer based on an engineering determination that the material is acceptable to remain in place, the Contractor may accept the indicated partial pay. Otherwise, remove and replace the material at no cost to the Owner at any item.
**When there are two or more reduced payments for these items in one LOT of material, only the greatest reduction in payment will be applied. CAUTION: This rule applies only to these four gradation test results.

NOTES:
(1) The No. 40 [425 µm] sieve applies to Type S-I, S-II, S-III and FC-3.
(2) Deviations are absolute values with no plus or minus signs.

331-6.3 Automatic Batch Plant with Printout: Acceptance determinations for asphalt content for mixtures produced by automatic batch plants with printout will be based on the calculated bitumen content using the printout of the weights of asphalt actually used. Acceptance determinations for gradations (No. 4, No. 10, No. 40 and No. 200 [4.75 mm, 2.00 mm, 425 µm and 75 µm] sieves) will be based on the actual test results from extraction gradation analyses. Payment will be made based on the provisions of Table 331-7.

331-6.4 Additional Tests: The Engineer reserves the right to run any test at any time for informational purposes and for determining the effectiveness of the Contractor’s quality control.

331-6.4.1 Determination of Marshall and Volumetric Properties: The Engineer will determine the Marshall and Volumetric Properties of the mix at a minimum frequency of one set per LOT, to determine whether or not the produced mix is meeting the specification requirements. The Engineer will sample and prepare test specimens and test them in accordance with FM 5-511 for Marshall stability and flow, FM 1-T 209 for maximum specific gravity, and FM 1-T 166 for density. Volumetric properties will be determined for Type S and FC-3 mixes only.

331-6.4.2 Failing Marshall Properties: When the average value of the specimens fails to meet specification requirements for stability or flow, the Engineer may stop the plant operations until all specification requirements can be met or until another verified mix design has been approved. Make revisions to a mix design in accordance with 331-4.3.2. If the Lab Density of the mix during production differs from the value shown on the verified mix design by more than 2 lbs/ft³ [32 kg/m³] for two consecutive tests, the Engineer will revise the target value.

331-6.4.3 Failing Volumetric Properties (Type S and FC-3 mixes only):
When the Engineer determines the air void content to be less than 3.0%, or greater than 6.5%, make appropriate adjustments to the mix. When the air void content is determined to be less than 2.5% or greater than 7.0% on any one test, or less than 3.0% on two consecutive tests, cease operations until the problem has been resolved.

331-6.4.4 Resuming Production: In the event that plant operations are stopped due to a failure to meet specification requirements, obtain the Engineer’s approval before

resuming production of the mix. Limit production to a maximum of 300 tons [270 metric tons]. At this time, the Marshall and volumetric properties of the mix will be verified. After the Marshall and volumetric properties are verified, full scale production of the mix may be resumed.

331-6.5.5 Disposition of In-Place Material: Any material in-place that is represented by the failing test results (low stability, high flow, or less than 2.5% air voids) will be evaluated by the Engineer to determine if removal and replacement is necessary. Remove and replace any in-place material, if required, at no cost to the Owner.

331-7 Acceptance of the Mixture at the Roadway

331-7.1 Density Control Nuclear Method: Determine the in-place density of each course of asphalt mix construction using the Nuclear Density Backscatter Method as specified by FM 1-T 238 (Method B). For a completed course, obtain an average in-place LOT density of at least 98% of the valid control strip density.

Do not perform density testing on patching courses, leveling and intermediate courses less than 1 inch [25 mm] thick (or a specified spread rate less than 100 lb/yd² [55kg/m²]), overbuild courses where the minimum thickness is less than 1

inch [25 mm], projects less than 1,000 feet [300 m], sections with variable width, or open-graded friction courses. Compact these courses, with the exception of open-graded friction courses in accordance with 330-10.1.2.

331-7.2 Control Strips: In order to determine the density of compacted asphalt mixtures for the purpose of acceptance, may be required. Construct one or more control strips for the purpose of determining the control strip density if requested by the engineer. Construct a control strip at the beginning of asphalt construction and one thereafter for each successive course. Construct a new control strip for any change in the composition of the mix design, underlying pavement structure, compaction equipment, or procedures. The Engineer may require an additional control strip when the Engineer deems it necessary to establish a new control strip density or confirm the validity of the control strip density being used at that time. The Contractor may also request a confirmation of the control strip density. Construct the control strip as a part of a normal day's run.

Construct a control strip 300 feet [100 m] in length and of an adequately uniform width to maintain a consistent compactive effort throughout the section. When constructing the control strip, start it between 300 and 1,000 feet [100 and 300 m] from the beginning of the paving operation. Construct a control strip of a thickness that is the same as that specified for the course of which it is a part. Construct the control strip using the same mix, the same paving and rolling equipment, and the same procedures as those used in laying the asphalt course of which the control strip is to become a part. Leave every control strip in place to become a portion of the completed roadway.

In order to determine the acceptability of the control strip, make ten nuclear density determinations at random locations within the control strip after completing the compaction of the control strip. Do not make any determinations within 12 inches [300 mm] of any unsupported edge. Use the average of these ten determinations for the Control Strip Density. For purposes of determining the percent of laboratory density, as required in Table 331-8, the Engineer will develop a correction factor at four nuclear density locations from 6 inch [150 mm] diameter cores or by direct transmission nuclear determination where applicable. Cut the cores prior to opening the roadway to traffic. The Engineer will calculate the percent of lab density to

the nearest 0.01% and round it to the nearest 0.1%. Should the percent of lab density in a control strip exceed 99.0%, notify the Engineer immediately.

In the event that a control strip does not meet the minimum density requirements specified in Table 331-8, take appropriate corrective actions and construct a new control strip. If three consecutive control strips fail to meet specification requirements, the Engineer will limit production and placement of the mix to 800 to 1,000 feet [250 to 300 m], regardless of the thickness and width the Contractor is placing, until the Contractor obtains a passing control strip.

Once the Contractor has obtained a passing control strip after a failing control strip (for the same mix, layer, and project), the Engineer will use the passing control strip to accept all previously laid mix. In the event the Contractor does not

obtain a passing control strip, and this particular mix, layer, etc., is completed on the project, the Engineer will evaluate density in accordance with FM 5- 543.

Table 331- Roadway Requirements for Bituminous Concrete Mixes			
Mix Type	Density	Minimum Control Strip Density* (% of Lab Density)	Surface Tolerance
S-I, S-II, S-III, Type II, Type III, SAHM	per 331-7	96	per 330-12
ABC-1, ABC-2, ABC-3	per 280-8.6	96	per 200-7
FC-2	No density	N/A	per 330-12
FC-3	per 331-7	96	per 330-12

* The minimum control strip density requirement for shoulders is 95% of lab density.

331-7.3 LOTs: For the purpose of acceptance and partial payment, the Engineer will divide each day’s production into LOTs. The Engineer will close out all LOTs at the end of the day. The standard size of a LOT is 5,000 feet [1,500 m] of any pass made by the paving train regardless of the width of the pass or the thickness of the course. A subplot will be 1,000 feet [300 m] or less. The Engineer will consider pavers traveling in echelon as two separate passes. When at the end of a production day, the completion of a given course, layer, or mix, or at the completion of the project, and a LOT size is determined to be less than 5,000 feet [1,500 m], it will be considered a partial LOT. Handle partial LOTs as follows:

If the length of the partial LOT is 2,000 feet [600 m] or less, and a previous full-size LOT from the same day, mix, layer, and project is available, then the previous full-size LOT will be redefined to include this partial LOT and the number of tests required for the combined LOT will be as shown in Table 331-9.

If the partial LOT is 2,000 feet [600 m] or less, and a previous full-size LOT from the same day, mix, layer, and project is not available, the Engineer will evaluate the partial LOT separately and perform the number of tests required for the partial LOT as shown in Table 331-9.

If the partial LOT is greater than 2,000 feet [600 m] long, the Engineer will evaluate the partial LOT separately and perform the number of tests required for the partial LOT as shown in Table 331-9.

Table 331- Testing Requirements for Partial LOTs	
LOT Size	Number of Tests
Less than 3,000 feet [900 m]	3
3,001 to 4,000 feet [901 to 1,200 m]	4
4,001 to 5,000 feet [1,201 to 1,500 m]	5
5,001 to 6,000 feet [1,501 to 1,800 m]	6
6,001 to 7,000 feet [1,801 to 2,100 m]	7
Greater than 7,000 feet [2,100 m]	2

For each LOT and partial LOT, the Engineer will make density determinations at a frequency shown in Table 331-9 at random locations within the LOT, but will not take them within 12 inches [300 mm] of any unsupported edge. The Engineer will determine the random locations by the use of statistically derived stratified random number tables. For the Contractor to receive full payment for density,

the average density of a LOT shall be a minimum of 98.0% of the control strip density. Once the Engineer determines the average density of a LOT, do not provide additional compaction to raise the average. Notify the Engineer should the average density for two consecutive LOTs be greater than 102% of control strip density.

331-7.4 Acceptance: The Engineer will accept the completed pavement with respect to density on a LOT basis. The Owner will make partial payment for those LOTs that have an average density less than 98.0% of the Control Strip Density based on Table 331-10:

Table 331-10 Payment Schedule For Density	
Percent of Control Strip Density*	Percent of Payment
98.0 and above	100
97.0 to less than 98.0	95
96.0 to less than 97.0	90
Less than 96.0**	75

* In calculating the percent of control strip density, do not round off the final percentage.
 ** If approved by the Engineer, based on an engineering determination that the material is acceptable to remain in place, the Contractor may accept the indicated partial pay; otherwise, remove and replace the material at no expense to the Owner. The Contractor may remove and replace the material at no expense to the Owner at any time.

331-7.5 Density Requirements for Small Projects and Other Non-mainline Roadway Areas: For projects less than 1,000 feet [300 m] in length and bridge projects with approaches less than 1,000

feet [300 m] each side, do not apply the requirements for control strips and nuclear density determination. Use the standard rolling procedures as specified in 330-10.1.2. Do not apply the provisions for partial payment to these small projects.

In other non-mainline roadway areas where it is not practical to establish a control strip, such as parking areas, toll plazas, turn lanes, and acceleration/deceleration lanes,

the Contractor may use the standard rolling procedure to determine density requirements if so authorized in writing by the Engineer.

331-7.6 Surface Tolerance: The bituminous mixture will be accepted on the roadway with respect to surface tolerance in accordance with 330-12.

331-7 Method of Measurement.

The quantity to be paid for will be the weight of the mixture, in tons [metric tons], completed and accepted. The weight will be determined as provided in 320-2 (including the provisions for the automatic recordation system).

The bid price for the asphalt mix will include the cost of the liquid asphalt or the asphalt recycling agent. There will be no separate payment or unit price adjustment for the bituminous material in the asphalt mix.

331-8 Basis of Payment.

Price and payment will be full compensation for all the work specified under this Section, including the applicable requirements of Sections 320 and 330.

**SECTION 346
PORTLAND CEMENT CONCRETE**

346-1 Description.

Use concrete composed of a mixture of portland cement, aggregate, water, and, where specified, admixtures, pozzolan and ground granulated blast furnace slag. Deliver the portland cement concrete to the site of placement in a freshly mixed, unhardened state.

Obtain concrete from a plant that is currently on the list of Producers with Accepted Quality Control Programs. Producers seeking inclusion on the list shall meet the requirements of 105-3. If the concrete production facility's Quality Control Plan is suspended, the Contractor is solely responsible to obtain the services of another concrete production facility with an accepted Quality Control Plan or await the re-acceptance of the affected concrete production facility's Quality Control Plan prior to the placement of any further concrete on the project. There will be no changes in the contract time or completion dates. Bear all delay costs and other costs associated with the concrete production facility's Quality Control Plan acceptance or re-acceptance.

346-2 Materials.

346-2.1 General: Meet the following requirements:

Coarse Aggregate.....	Section 901
Fine Aggregate*	Section 902
Portland Cement.....	Section 921
Water	Section 923
Admixtures**	Section 924
Pozzolans and Slag	Section 929

*Use only silica sand except as provided in 902-5.2.3.

**Use products listed on the Owner's Approved Product List (APL).

Do not use materials containing hard lumps, crusts or frozen matter, or that is contaminated with dissimilar material in excess of that specified in the above listed

Sections.

346-2.2 Types of Cement: Unless a specific type of cement is designated elsewhere, use

Type I, Type IP, Type IS, Type II, Type II (MH) or Type III cement in all classes of concrete. Use Type II (MH) for all mass concrete elements.

Use only the types of cements designated for each environmental condition in structural concrete. A mix design for a more aggressive environment may be substituted for a lower aggressive environmental condition.

TABLE 1			
BRIDGE SUPERSTRUCTURES			
Component	Slightly Aggressive Environment	Moderately Aggressive Environment	Extremely Aggressive Environment
Precast Superstructure and Prestressed Elements	Type I or Type III	Type I, Type II, Type III, Type IP, or Type IS	Type II (MH)
Cast In Place	Type I	Type I, Type II, Type IP, or Type IS	Type II (MH)
BRIDGE SUBSTRUCTURE, DRAINAGE STRUCTURES AND OTHER STRUCTURES			

TABLE 1			
BRIDGE SUPERSTRUCTURES			
Component	Slightly Aggressive Environment	Moderately Aggressive	Extremely Aggressive
All Elements	Type I or Type III	Type I, Type II, Type IP, or Type IS	Environment Type II (MH)

346-2.3 Pozzolans and Slag: Fly ash or slag materials are required in all classes of concrete. Use fly ash or slag materials as a cement replacement, on an equal weight replacement basis with the following limitations:

(1) Mass Concrete:

a. Fly Ash - Ensure that the quantity of cement replaced with fly ash is 18% to 50% by weight, except where the core temperature is expected to rise above 165°F. In that case, ensure that the percentage of fly ash is 35% to 50% by weight.

b. Slag - Ensure that the quantity of cement replaced with slag is 50% to 70% by weight. Ensure that slag is 50% to 55% of total cementitious content by weight when used in combination with silica fume, ultrafine fly ash and/or metakaolin.

c. Fly Ash and Slag - Ensure that there is at least 20% fly ash by weight and 40% portland cement by weight for mixes containing portland cement, fly ash and slag.

(2) Drilled Shaft:

a. Fly Ash - Ensure that the quantity of cement replaced with fly ash is 33% to 37% by weight.

b. Slag - Ensure that the quantity of cement replaced with slag is 58% to 62% by weight.

c. Fly Ash and Slag (Ternary Blend) - Ensure that there is 10% to 20% fly ash, 50% to 60% slag by weight, and 30% portland cement by weight for mixes containing portland cement, fly ash and slag.

(3) Precast Concrete – Ensure that the precast concrete has a maximum of 25% fly ash or a maximum of 70% slag. In extremely aggressive environments, ensure that the precast concrete has a minimum of 18% fly ash or a minimum of 50% slag.

For fly ash and slag (ternary blend), ensure that there is 10% to 20% fly ash, 50% to 60% slag by weight, and 40% portland cement by weight for mixes containing portland cement, fly ash and slag.

(4) For all other concrete uses not covered in (1), (2) and (3) above,

a. Fly Ash - Ensure that the quantity of cement replaced with fly ash is 18% to 30% by weight.

b. Slag - Ensure that the quantity of cement replaced with slag is 25% to 70% for slightly and moderately aggressive environments and 50% to 70% by weight when used in extremely aggressive environments. Ensure that slag is 50% to 55% of total cementitious content by weight when used in combination with silica fume, ultra fine fly ash and/or metakaolin.

c. Fly Ash and Slag (Ternary Blend) - Ensure that there is 10% to 20% fly ash, 50% to 60% slag by weight, and 40% portland cement by weight for mixes containing portland cement, fly ash and slag.

(5) Blended Cements:

a. Type IS - Ensure that the quantity of slag in Type IS is less than or equal to 70% by weight.

b. Type IP - Ensure that the quantity of the pozzolan in Type IP is less than or equal to 40% by weight.

(6) Highly Reactive Pozzolans: Highly reactive pozzolans are considered to be silica fume, metakaolin and ultrafine fly ash. When silica fume, metakaolin or ultrafine fly ash is used, it must be used in combination with fly ash or slag and cured in accordance with the manufacturer's recommendations and approved by the Engineer.

a. Silica Fume - Ensure that the quantity of cement replaced with silica fume is 3% to 9% by weight of the total cementitious material.

b. Metakaolin - Ensure that the quantity of cement replaced with metakaolin is 8% to 12% by weight of the total cementitious material.

c. Ultrafine Fly Ash - Ensure that the quantity of cement replaced with ultrafine fly ash is 8% to 12% by weight of the total cementitious material.

346-2.4 Coarse Aggregate Gradation: Produce all concrete using Size No. 57, 67 or 78 coarse aggregate. With the Engineer's approval, Size No. 8 or Size No. 89 may be used either alone or blended with Size No. 57, 67 or 78 coarse aggregate. The Engineer will consider requests for approval of other gradations individually. Submit sufficient statistical data to establish production quality and uniformity of the subject aggregates, and establish the quality and uniformity of the resultant concrete. Furnish aggregate gradations sized larger than nominal maximum size of 1.5 inch as two components.

For Class I and Class II, excluding Class II (Bridge Deck), the coarse and fine aggregate gradation requirements set forth in Sections 901 and 902 are not applicable and the aggregates may be blended; however, the aggregate sources must be approved by the Owner. Do not blend the aggregate if the size is smaller than Size No. 78.

346-2.5 Admixtures: Use admixtures in accordance with the requirements of this subarticle. Chemical admixtures not covered in this subarticle may be approved by the Owner. Submit statistical evidence supporting successful laboratory and field trial mixes which demonstrate improved concrete quality or handling characteristics.

Use admixtures in accordance with the manufacturer's recommended dosage rate. Dosage rates outside of this range may be used with written recommendation from the admixture producer's technical representative. Do not use admixtures or additives containing calcium chloride (either in the raw materials or introduced during the manufacturing process) in reinforced concrete.

346-2.5.1 Water-Reducer/Water-Reducer Retardant Admixtures: When a water-reducing admixture is used, meet the requirements of a Type A. When a water-reducing and retarding admixture is used, meet the requirements of a Type D.

346-2.5.2 Air Entrainment Admixtures: Use an air entraining admixture in all concrete mixes except counterweight concrete. For precast concrete products, the use of air entraining admixture is optional for Class I and Class II concrete.

346-2.5.3 High Range Water-Reducing Admixtures:

346-2.5.3.1 General: When a high range water-reducing admixture is used, meet the requirements of a Type F or Type I. When a high range water-reducing and retarding admixture is used, meet the requirements of a Type G or Type II. When silica fume or metakaolin is incorporated into a concrete mix design, use a high range water-reducing admixture Type I, II, F or G.

346-2.5.3.2 Flowing Concrete Admixtures for Precast/Prestressed

Concrete: Use a Type I, II, F or G admixture for producing flowing concrete. If Type F or G admixture is used, verify the distribution of aggregates in accordance with ASTM C 1610 except allow for minimal vibration for consolidating the concrete. The maximum allowable difference between the static segregation is less than or equal to 15 percent. Add the flowing concrete admixtures at the concrete production facility.

346-2.5.4 Corrosion Inhibitor Admixture: Use only with concrete containing Type II cement, or Type II (MH) cement, and a water-reducing retardant admixture, Type D, or High Range Water-Reducer retarder admixture, Type G, to normalize the setting time of concrete. Ensure that all admixtures are compatible with the corrosion inhibitor admixture.

346-2.5.5 Accelerating Admixture for Precast Drainage and Incidental Concrete Products: The use of non-chloride admixtures Type C or Type E is allowed in the manufacturing of precast concrete products.

346-3 Classification, Strength, Slump and Air Content.

346-3.1 General: The separate classifications of concrete covered by this Section are designated as Class I, Class II, Class III, Class IV, Class V and Class VI. Strength and slump are specified in Table 2. The air content range for all classes of concrete is 1.0 to 6.0%, except for Class IV (Drilled Shaft) which is 0.0 to 6.0%.

Substitution of a higher class concrete in lieu of a lower class concrete may be allowed when the substituted concrete mixes are included as part of the Contractor’s Quality Control Plan, or for precast concrete, the Precast Concrete Producer’s Quality Control Plan. The substituted higher class concrete must meet or exceed the requirements of the lower class concrete and both classes must contain the same types of mix ingredients. When the compressive strength acceptance data is less than the minimum compressive strength of the higher design mix, notify the Engineer. Acceptance is based on the requirements in Table 2 for the lower class concrete.

TABLE 2		
Class of Concrete	Specified Minimum Strength (28-day) (psi)	Target Slump Value (inches) (c)
STRUCTURAL		
I (a)	3,000	3 (b)
I (Pavement)	3,000	2
II (a)	3,400	3 (b)
II (Bridge Deck)	4,500	3 (b)
III (e)	5,000	3 (b)
III (Seal)	3,000	8
IV (d)(f)	5,500	3 (b)
IV (Drilled Shaft)	4,000	8.5
V (Special) (d)(f)	6,000	3 (b)
V (d)(f)	6,500	3 (b)
VI (d)(f)	8,500	3 (b)

(a) For precast three-sided culverts, box culverts, endwalls, inlets, manholes and junction boxes, the target slump value and air content will not apply. The

maximum allowable slump is 6 inches, except as noted in (b). The Contractor is permitted to use concrete meeting the requirements of ASTM C 478 4,000 psi in lieu of Class I or Class II concrete for precast endwalls, inlets, manholes and junction boxes.

(b) The Engineer may allow a higher target slump when a Type F, G, I or II admixture is used, except when flowing concrete is used. The maximum target slump shall be 7 inches.

(c) For a reduction in the target slump for slip-form operations, submit a revision to the mix design to the Engineer.

(d) When the use of silica fume, ultrafine fly ash, or metakaolin is required as a pozzolan in Class IV, Class V, Class V (Special) or Class VI concrete, ensure that the concrete meets or exceeds a resistivity of 29 KOhm-cm at 28 days, when tested in accordance with FM 5-578. Submit three 4 x 8 inch cylindrical test specimens to the Engineer for resistivity testing before mix design approval. Take the resistivity test specimens from the concrete of the laboratory trial batch or from the field trial batch of at least 3 cubic yards. Verify the mix proportioning of the design mix and take representative samples of trial batch concrete for the required plastic and hardened property tests. Cure the field trial batch specimens similar to the standard laboratory curing methods. Submit the resistivity test specimens at least 7 calendar days prior to the scheduled 28 day test. The average resistivity of the three cylinders, eight readings per cylinder, is an indicator of the permeability of the concrete mix.

(e) When precast three-sided culverts, box culverts, endwalls, inlets, manholes or junction boxes require a Class III concrete, the minimum cementitious materials is 470 pounds per cubic yard. Do not apply the air content range and the maximum target slump shall be 6 inches, except as allowed in (b).

(f) Highly reactive pozzolans may be used outside the lower specified ranges to enhance strength and workability. Testing in accordance with FM 5-578 is not required.

346-3.2 Drilled Shaft Concrete: Notify the Engineer at least 48 hours before placing drilled shaft concrete. Obtain slump loss test results demonstrating that the drilled shaft concrete maintains a slump of at least 5 inches throughout the concrete elapsed time before drilled shaft concrete operations begin.

Obtain slump loss test results from an approved laboratory or from a field demonstration. Slump loss test results for drilled shafts requiring 30 cubic yards of concrete or less and a maximum elapsed time of five hours or less may be done in a laboratory. Obtain all other slump loss test results in the field. Technicians performing the slump test must be ACI Field Grade I qualified.

Ambient temperature conditions for placement of drilled shaft concrete for summer condition is 85° or higher, and below 85° for normal condition. Perform the slump loss test in one of the above ambient temperature conditions.

The concrete elapsed time is defined in Section 455. Obtain the Engineer's approval for use of slump loss test results including elapsed time before concrete placement begins.

Test each load of concrete for slump to ensure the slump is within the limits of 346. Initially cure acceptance cylinders for 48 hours before transporting to the laboratory.

If the elapsed time during placement exceeds the slump loss test data, provide an engineering analysis performed by a Professional Engineer, registered in the State of Florida, and knowledgeable in the area of foundations, to determine if the shaft is structurally sound and there are no voids in the drilled shaft concrete. At the direction of the Engineer, excavate the

drilled shaft for inspection. Obtain approval from the Engineer before placing any additional shafts.

346-3.3 Mass Concrete: When mass concrete is designated in the Contract Documents, provide an analysis of the anticipated thermal developments in the mass concrete elements for all expected project temperature ranges using the selected mix design, casting procedures, and materials.

Use a Specialty Engineer competent in the design and temperature control of concrete in mass elements. The Specialty Engineer shall follow the procedure outlined in Section 207 of the ACI Manual of Concrete Practice to formulate, implement, administer and monitor a temperature control plan, making adjustments as necessary to ensure compliance with the Contract Documents. The Specialty Engineer shall select the concrete design mix proportions that will generate the lowest maximum temperatures possible to ensure that a 35°F differential temperature between the concrete core and the exterior surface is not exceeded. The mass concrete maximum allowable temperature is 180°F. If either the differential temperature or the maximum allowable temperature is exceeded, the Specialty Engineer shall be available for immediate consultation.

Describe the measures and procedures intended for use to maintain a temperature differential of 35°F or less between the interior core center and exterior surface(s) of the designated mass concrete elements during curing. Submit both the mass concrete mix design and the proposed mass concrete plan to monitor and control the temperature differential to the Engineer for acceptance. Provide temperature monitoring devices to record temperature development between the interior core center and exterior surface(s) of the elements in accordance with the accepted mass concrete plan.

The Specialty Engineer, or a person designated by the Specialty Engineer, must personally inspect and approve the installation of monitoring devices and verify that the process for recording temperature readings is effective for the first placement of each size and type mass component. Submit to the Engineer for approval the qualification of all technicians employed to inspect or monitor mass concrete placements. Designate an employee(s) approved by the Specialty Engineer, as qualified to inspect monitoring device installation, to record temperature readings, to be in contact at all times with the Specialty Engineer if adjustments must be made as a result of the temperature differential or the maximum allowable temperature being exceeded, and to immediately implement adjustments to temperature control measures as directed by the Specialty Engineer. Read the monitoring devices and record the readings at intervals no greater than 6 hours. The readings will begin when the mass concrete placement is complete and continue until the maximum temperature differential and the temperature is reached and a decreasing temperature differential is confirmed as defined in the temperature control plan. Do not remove the temperature control mechanisms until the core temperature is within 50°F of the ambient temperature. Furnish a copy of all temperature readings to the Engineer. Provide determined temperature differentials, the summary sheet from the data logger, which includes the maximum temperature, the maximum temperature differential and a final report within three calendar days of completion of monitoring of each element.

Request approval of reduced monitoring of same least dimensioned mass concrete elements containing the same mix design, concrete placement temperatures (within plus 3°F), and insulation thermal resistance value. The Specialty Engineer may monitor and record the temperature for the first element only. Each subsequent element must be started within one hour of the first placement and be completed within one hour of the completion of the first element.

Each mass concrete element must be instrumented with monitoring devices in case of failure in meeting the one hour time limit.

Changes or adjustments made to the monitored element must be made to all elements. Failure to follow this will require an Engineering Analysis Report (EAR) for the elements not monitored even if the element that was monitored had a temperature differential well below the maximum allowed. The reduced monitoring option will not be allowed by the Engineer if the Contractor fails to comply with these requirements.

If the 35°F differential or the 180°F maximum allowable temperature has been exceeded, take immediate action as directed by the Specialty Engineer to retard further growth of the temperature differential. Describe methods of preventing thermal shock in the temperature control plan. Use a Specialty Engineer to revise the previously accepted plan to ensure compliance on future placements. Do not place any mass concrete until the Engineer has accepted the mass concrete plan(s). When mass concrete temperature differentials or maximum allowable temperature has been exceeded, provide all analyses and test results deemed necessary by the Engineer for determining the structural integrity and durability of the mass concrete element, to the satisfaction of the Engineer. The Owner will make no compensation, either monetary or time, for the analyses or tests or any impacts upon the project.

346-3.4 Flowing Concrete for Precast/Prestressed Concrete: Produce flowing concrete mix with target slump of 9 inches.

Subsequent to the laboratory trial batch, perform a field demonstration of the proposed mix design by production and placement of at least three batches, 3 cubic yard minimum size each, of concrete containing flowing concrete HRWR admixture. Take representative samples from each batch and perform slump, air content, density (unit weight), and temperature tests on these samples. Cast specimens from each sample for compressive strength tests. Record the ambient air temperature during the test. Ensure that the concrete properties are within the required specification limits. The plants that are producing concrete with batch sizes of less than 3 cubic yards are required to produce and place at least a total amount of 9 cubic yards and perform the aforementioned tests on at least three randomly selected batches.

Determine the workability of the demonstration concrete batches by performing the slump tests on the samples taken at 15 minute intervals from each batch. Continue sampling and testing until the slump measures 6 inches or less. From the plot of slump versus time, determine the time for each batch when the slump is at 7.5 inches. The shortest time period determined from three consecutive batches, at 7.5 inches slump, is considered the cutoff time of the proposed concrete mix. For production concrete, ensure that the time between the batching and depositing of each load of concrete is less than the cutoff time of the mix and also does not exceed the allowable time limit specified in this Section.

Ensure that the demonstration concrete is mixed, delivered, placed, consolidated and cured in accordance with the proposed method and sequence. Produce the flowing concrete batches at slumps between 7.5 inches to 10.5 inches.

Perform inspection of the demonstration concrete during batching, delivery, placement and post placement. During placement, ensure that the concrete batches meet all plastic property requirements of the specifications and maintain their cohesive nature without excessive bleeding, segregation, or abnormal retardation.

Dispose of concrete produced for demonstration purposes at no expense to the Owner. Subject to the Engineer's approval, the Contractor may incorporate this concrete

into non-reinforced concrete items and may be included for payment, provided it meets Contract requirements for slump, entrained air, and strength.

After removal of the forms, perform the post-placement inspection of the in-place concrete. Observe for any signs of honeycombs, cracks, aggregate segregation or any other surface defects and ensure that the hardened concrete is free from these deficiencies. The Engineer may require saw cutting of the mock-up products to verify the uniform distribution of the aggregates within the saw cut surfaces and around the reinforcing steel and prestressing strands. The Engineer will require saw cutting of the demonstration mock-up products for plants that are demonstrating the use of the flowing concrete for the first time. Obtain core samples from different locations of mock-up products to inspect the aggregate distribution in each sample and compare it with the aggregate distribution of other core samples. Perform surface resistivity tests on the core samples or test cylinders at 28 days.

Submit the results of the laboratory trial batch tests and field demonstration of verified test data and inspection reports to the Engineer, along with certification stating that the results of the laboratory trial batch tests and field demonstration tests indicate that the proposed concrete mix design meets the requirements of the specifications. For the proposed mix design, state the anticipated maximum time limit between the batching and when the concrete of each batch is deposited during the production.

Upon the review and verification of the laboratory trial batch, field demonstration test data, inspection reports and contractor's certification statement, the Owner will approve the proposed mix design.

The Owner may approve proposed flowing concrete mixes, centrally mixed at the placement site, without the production of demonstration batches, provided that the proposed mix meets the following two criteria:

(1) A previously approved flowing concrete mix of the same class has demonstrated satisfactory performance under the proposed job placing conditions with a minimum of fifteen consecutive Owner acceptance tests, which met all plastic and hardened concrete test requirements.

(2) The cementitious materials and chemical admixtures, including the flowing concrete HRWR admixture, used in the proposed mix are the same materials from the same source used in the previously approved mix, (1) above.

Do not produce or place concrete until the design mixes have been approved.

346-4 Composition of Concrete.

346-4.1 Master Proportion Table: Proportion the materials used to produce the various classes of concrete in accordance with Table 3:

TABLE 3		
Class of Concrete	Minimum Total Cementitious Materials Content pounds per cubic yard	Maximum Water to Cementitious Materials Ratio pounds per pounds*
I	470	0.53
I (Pavement)	470	0.50
II	470	0.53
II (Bridge Deck)	611	0.44

TABLE 3		
Class of Concrete	Minimum Total Cementitious Materials Content pounds per cubic yard	Maximum Water to Cementitious Materials Ratio pounds per pounds*
III	611	0.44
III (Seal)	611	0.53
IV	658	0.41**
IV (Drilled Shaft)	658	0.41
V (Special)	752	0.37**
V	752	0.37**
VI	752	0.37**

*The calculation of the water to cementitious materials ratio (w/cm) is based on the total cementitious material including cement and any supplemental cementitious materials that are used in the mix.
 **When the use of silica fume or metakaolin is required, the maximum water to cementitious material ratio will be 0.35. When the use of ultrafine fly ash is required, the maximum water to cementitious material ratio will be 0.30.

346-4.2 Chloride Content Limits for Concrete Construction:

346-4.2.1 General: Use the following maximum chloride content limits for the concrete application and/or exposure environment shown:

TABLE 4		
Application/Exposure Environment		Maximum Allowable Chloride Content, pounds per cubic
Non Reinforced Concrete		No Test needed
Reinforced Concrete	Slightly Aggressive Environment	0.70
	Moderately or Extremely Aggressive Environment	0.40
Prestressed Concrete		0.40

346-4.2.2 Control Level for Corrective Action: If chloride test results exceed the limits of Table 4, suspend concrete placement immediately for every mix design represented by the failing test results, until corrective measures are made. Perform an engineering analysis to demonstrate that the material meets the intended service life of the structure on all concrete produced from the mix design failing chloride test results to the previous passing test results. Supply this information within 30 business days of the failing test results from a Professional Engineer registered in the State of Florida, and knowledgeable in the areas of corrosion and corrosion control.

346-5 Sampling and Testing Methods.

Perform concrete sampling and testing in accordance with the following methods:

TABLE 5	
Description	Method
Slump of Hydraulic Cement Concrete	ASTM C 143

TABLE 5	
Description	Method
Air Content of Freshly Mixed Concrete by the Pressure Method*	ASTM C 231
Air Content of Freshly Mixed Concrete by the Volumetric Method*	ASTM C 173
Making and Curing Test Specimens in the Field**	ASTM C 31
Compressive Strength of Cylindrical Concrete Specimens***	ASTM C 39
Obtaining and Testing Drilled Core and Sawed Beams of Concrete	ASTM C 42
Initial Sampling of Concrete from Revolving Drum Truck Mixers or Agitators	FM 5-501
Low Levels of Chloride in Concrete and Raw Materials	FM 5-516
Density (Unit Weight), Yield and Air Content (Gravimetric) of Concrete	ASTM C 138
Temperature of Freshly Mixed Portland Cement Concrete	ASTM C 1064
Sampling Freshly Mixed Concrete****	ASTM C 172
Static Segregation of Self Consolidating Concrete using Column Techniques	ASTM C 1610
Slump Flow of Self Consolidating Concrete	ASTM C 1611
Passing Ability of Self Consolidating Concrete by J-Ring	ASTM C 1621
Concrete Resistivity as an Electrical Indicator of its Permeability	FM 5-578
<p>*The Owner will use the same type of meter for Verification testing as used for QC testing. When using pressure type meters, use an aggregate correction factor determined by the concrete producer for each mix design to be tested. Record and certify test results for correction factors for each type of aggregate at the concrete production facility.</p> <p>** Provide curing facilities that have the capacity to store all QC, Verification, “hold” and Independent Verification cylinders simultaneously for the initial curing.</p> <p>***The Verification technician will use the same size cylinders as the Quality Control technician.</p> <p>**** Take the test sample from the middle portion of the batch in lieu of collecting and compositing samples from two or more portions, as described in ASTM C172.</p>	

346-6 Control of Quality.

346-6.1 General: Develop a Quality Control Plan (QCP) as specified in Section 105. Meet the requirements of the approved QCP and Contract Documents. Ensure the QCP includes the necessary requirements to control the quality of the concrete.

Perform QC activities to ensure materials, methods, techniques, personnel, procedures and processes utilized during production meet the specified requirements. For precast/prestressed operations, ensure that the QC testing is performed by the party responsible for QC inspections on all phases of work. Ensure all materials and workmanship incorporated into the project meet the requirements of the Contract Documents.

Ensure the QCP includes any anticipated requirements for adjusting and controlling the concrete at the placement site. Include the testing procedures that will be implemented to control the quality of the concrete and ensure that concrete placed is within the tolerance range. Also, include provisions for the addition of water to concrete delivered to the placement site at designated level areas, to ensure the allowable amount of water stated

on the concrete delivery ticket is correct and the maximum water to cementitious materials ratio on the approved design mix is not exceeded. Ensure the anticipated ranges of jobsite water additions are described and the proposed methods of measuring water for concrete adjustments are included. Failure to meet the requirements of this Specification or the QCP will automatically void the concrete portion of the QCP. To obtain QCP re-approval, implement corrective actions as approved by the Engineer. The Engineer may allow the Contractor to continue any ongoing concrete placement but the Engineer will not accept concrete for any new placement until the QCP re-approval is given by the Engineer.

346-6.2 Concrete Design Mix: Provide concrete that has been produced in accordance with a Owner's Engineer approved design mix, in a uniform mass free from balls and lumps.

For slump target values in excess of 6 inches or self consolidating concrete, utilize a grate over the conveyance equipment to capture any lumps or balls that may be present in the mix. The grate must cover the entire opening of the conveyance equipment and have an opening that is a maximum of 2 1/2 inches in any one direction. Remove the lumps or balls from the grate and discard them. Discharge the concrete in a manner satisfactory to the Engineer. Perform demonstration batches to ensure complete and thorough placements in complex elements, when requested by the Engineer.

Do not place concretes of different compositions such that the plastic concretes may combine, except where the plans require concrete both with and without silica fume, ultrafine fly ash, metakaolin or calcium nitrite in a continuous placement. Produce these concretes using separate design mixes. For example, designate the mix with calcium nitrite as the original mix and the mix without calcium nitrite as the redesigned mix. Ensure that both mixes contain the same cement, fly ash or slag, coarse and fine aggregates and compatible admixtures. Submit both mixes for approval as separate mix designs, both meeting all requirements of this Section. Ensure that the redesigned mix exhibits plastic and hardened qualities which are additionally approved by the Engineer as suitable for placement with the original mix. The Engineer will approve the redesigned mix for commingling with the original mix and for a specific project application only. Alternately, place a construction joint at the location of the change in concretes.

346-6.3 Delivery Certification: Ensure that an electronic delivery ticket is furnished with each batch of concrete before unloading at the placement site. The delivery ticket may be proprietary software or in the form of an electronic spreadsheet, but shall be printed. Ensure that the materials and quantities incorporated into the batch of concrete are printed on the delivery ticket. Include the following information on the Delivery Ticket:

- (1) Arrival time at jobsite,
- (2) Time that concrete mix has been completely discharged,
- (3) Number of revolutions upon arrival at the jobsite,
- (4) Total gallons of water added at the jobsite,
- (5) Additional mixing revolutions when water is added,
- (6) Total number of revolutions.

Items 3 through 6 do not apply to non-agitating concrete transporting vehicles.

Ensure the batcher responsible for production of the batch of concrete signs the delivery ticket, certifying the batch of concrete was produced in accordance with the Contract Documents.

Sign the delivery ticket certifying that the design mix maximum specified water to cementitious materials ratio was not exceeded due to any jobsite adjustments to the batch of

concrete, and that the batch of concrete was delivered and placed in accordance with the Contract Documents.

346-6.4 Plastic Property Tolerances: Do not place concrete with a slump more than plus or minus 1.5 inches from the target slump value specified in Table 2.

Reject concrete with slump or air content that does not fall within the specified tolerances and immediately notify the concrete production facility that an adjustment of the concrete mixture is required. If a load does not fall within the tolerances, test each subsequent load and the first adjusted load. If failing concrete is not rejected or adjustments are not implemented, the Engineer may reject the concrete and terminate further production until the corrections are implemented.

Do not allow concrete to remain in a transporting vehicle to reduce slump. Water may be added only upon arrival of the concrete to the jobsite and not thereafter.

346-7 Mixing and Delivering Concrete.

346-7.1 General Requirements: Operate all concrete mixers at speeds and volumes per the manufacturer’s design or recommendation as stipulated on the mixer rating plate.

346-7.2 Transit Truck Mixing: When water is added at the jobsite, mix the concrete 30 additional drum mixing revolutions. Do not add water after the total number of drum mixing revolutions exceeds 130, do not make additional mix adjustments. Discharge all concrete from truck mixers before total drum revolutions exceed 300. Seek approval from the Engineer prior to using a central mixer and depositing the batch into a truck mixer.

346-7.2.1 Transit Time: Ensure compliance with Table 6 between the initial introduction of water into the mix and completely discharging all of the concrete from the truck. Reject concrete exceeding the maximum transit time. For critical placements, the Engineer may authorize the placement of the concrete.

TABLE 6	
Maximum Allowable Time	
Non-Agitator Trucks	Agitator Trucks
45 minutes	60 minutes
75 minutes*	90 minutes*

*When a water-reducing and retarding admixture (Type D, Type G or Type II) is used.

346-7.2.2 Placement Time: All the concrete in a load must be in its final placement position a maximum of 15 minutes after the transit time has expired unless a time extension is approved in advance by the Engineer.

346-7.3 On-site Batching and Mixing: Include provisions in the QCP for the mixing at the site. Use a mixer of sufficient capacity to prevent delays that may be detrimental to the quality of the work. Ensure that the accuracy of batching equipment is in accordance with requirements of this Section.

346-7.4 Concreting in Cold Weather: Do not mix or place concrete when the air temperature is below 45°F. Protect the fresh concrete from freezing in accordance with Section 400. The requirements of concreting in cold weather are not applicable to precast concrete mixing and placement operations occurring in a temperature controlled environment.

346-7.5 Concreting in Hot Weather: Hot weather concreting is defined as the production, placing and curing of concrete when the concrete temperature at placing exceeds 85°F but is less than 100°F.

Unless the specified hot weather concreting measures are in effect, reject concrete exceeding 85°F at the time of placement. Regardless of special measures taken, reject concrete exceeding 100°F. Predict the concrete temperatures at placement time and implement hot weather measures to avoid production shutdown.

346-7.6 Adding Water to Concrete at the Placement Site: If the slump, as delivered, is outside the tolerance range, reject the load. If the slump is within the tolerance range, that load may be adjusted by adding water provided the addition of water does not exceed the water to cementitious materials ratio as defined by the mix design. After adding water, perform a slump test to confirm the concrete is within the slump tolerance range. If an adjustment is made at the concrete production facility, perform a slump test on the next load to ensure the concrete is within the slump tolerance range. Do not place concrete represented by slump test results outside of the tolerance range. Include water missing from the water storage tanks upon arrival at the project site in the jobsite water added.

346-7.7 Sample Location: Obtain acceptance samples from the point of final placement. Describe in the QCP the method to sample the plastic concrete at the point of final placement. Where concrete buckets are used to discharge concrete directly to the point of final placement or into the hopper of a tremie pipe, samples will be obtained from the discharge of the bucket. When the concrete is discharged directly from the mixer into the bucket and the bucket is discharged within 20 minutes, samples may be obtained from the discharge of the mixer.

Where conveyor belts, troughs, pumps, or chutes are used to transport concrete directly to the point of final placement or into the hopper of a tremie pipe, samples will be obtained from the discharge end of the entire conveyor belt, trough, pump, or chute system.

Where concrete is placed in a drilled shaft or other element using a tremie pipe and a concrete pump, samples will be obtained from the discharge of the pump line at the location of the tremie hopper.

For all other placement methods, prior to each placement, obtain Owner approval for sampling at the discharge of the mixer in lieu of sampling at the point of final placement. Describe the sampling correlation procedure in the QCP. Once the comparative sampling correlation is approved by the Engineer, apply this correlation to the plastic properties tolerances for samples obtained from the discharge of mixer.

Where a concrete pump is used to deposit concrete directly into a drilled shaft which is a wet excavation without the use of a tremie, or other applications as approved by the Engineer, ensure the discharge end of the pump line remains immersed in the concrete at all times after starting concrete placement.

346-8 Plastic Concrete Sampling and Testing.

QC tests include air content, temperature, slump, and preparing compressive strength cylinders for testing at later dates. In addition, calculate the water to cementitious materials ratio in accordance with FM 5-501 for compliance to the approved mix design.

Ensure that each truck has a rating plate and a valid mixer identification card issued by the Owner. Ensure that the revolution counter on the mixer is working properly, and calibration of the water dispenser has been performed within the last twelve months. Reject any concrete batches that are delivered in trucks that do not have mixer identification cards. Remove

the mixer identification card when a truck mixer is discovered to be in noncompliance and the mixer deficiencies cannot be repaired immediately. When the mixer identification card is removed for noncompliance, make note of the deficiency or deficiencies found, and forward the card to the District Materials and Research Engineer who has Producer QC Plan acceptance authority.

Perform plastic concrete tests on the initial delivery of each concrete design mix each day. Ensure QC technicians meeting the requirements of Section 105 are present and performing tests throughout the placement operation. Ensure one technician is present and performing tests throughout the placement operation at each placement site. If a project has multiple concrete placements at the same time, identify the number of technicians in the Quality Control Plan to ensure minimum sampling and testing frequencies are met. Ensure that the equipment used for delivery, placement and finishing meets the requirements of this Specification. When a truck designated for QC testing arrives at the discharge site, a subsequent truck may also discharge once a representative sample has been collected from the QC truck and while awaiting the results of QC testing. Reject non-complying loads at the jobsite. Ensure that corrections are made on subsequent loads. Immediately cease concrete discharge of all trucks if the QC truck has failing test. Perform plastic properties tests on all trucks prior to the first corrected truck and the corrected truck. When more than one truck is discharging into a pump simultaneously, only the truck designated for QC testing may discharge into the pump to obtain a representative sample of concrete from the QC truck only.

Furnish sufficient concrete of each design mix as required by the Engineer for verification testing. When the Engineer's verification test results do not compare with the QC plastic properties test results, within the limits defined by the Independent Assurance (IA) checklist comparison criteria, located in Materials Manual Chapter 5, disposition of the concrete will be at the option of the Contractor.

On concrete placements consisting of only one load of concrete, perform initial sampling and testing in accordance with this Section. The acceptance sample and plastic properties tests may be taken from the initial portion of the load.

If any of the QC plastic properties tests fail, reject the remainder of that load, and any other loads that have begun discharging, terminate the LOT and notify the Engineer. Make cylinders representing that LOT from the same sample of concrete.

Following termination of a LOT, obtain samples from a new load, and perform plastic properties tests until such time as the water to cementitious materials ratio, air content, temperature and slump comply with the Specification requirements. Initiate a new LOT once the testing indicates compliance with Specification requirements.

Suspend production when any five loads in two days of production of the same design mix are outside the specified tolerances. Make the necessary revisions to concrete operations and increase the frequency of QC testing in the QCP to bring the concrete within allowable tolerances. Obtain the Engineer's approval of the revisions before resuming production. After production resumes, obtain the Engineer's approval before returning to the normal frequency of QC testing.

If concrete placement stops for more than 90 minutes, perform initial plastic properties testing on the next batch and continue the LOT. Cylinders cast for that LOT will represent the entire LOT.

When the Owner performs Independent Verification, the Contractor may perform the same tests on the concrete at the same time. The Owner will compare results based on the Independent Assurance Checklist tolerances.

When the Owner's Independent Verification test results do not meet the requirements of this Section, the Engineer may require the Contractor to revise the QCP.

346-9 Acceptance Sampling and Testing.

346-9.1 General: Perform plastic properties tests in accordance with 346-8 and cast a set of three QC cylinders, for all structural concrete incorporated into the project. Take these acceptance samples randomly as determined by a random number generator. The Owner will independently perform verification plastic properties tests and cast a set of verification cylinders. The verification cylinders will be the same size cylinder selected by the Contractor, from a separate sample from the same load of concrete as the Contractor’s QC sample.

For each set of QC cylinders verified by the Owner, cast one additional cylinder from the same sample, and identify it as the QC “hold” cylinder. The Owner will also cast one additional “hold” cylinder from each Verification sample. All cylinders will be clearly identified as outlined in the Sample/Lot Numbering System instructions located on the State Materials Office website. Deliver the QC samples, including the QC “hold” cylinder to the final curing facility in accordance with ASTM C 31. At this same time, the Owner will deliver the Verification samples, including the Verification “hold” cylinder, to their final curing facility.

Test the QC laboratory cured samples for compressive strength at the age of 28 days, or any other specified age, in a laboratory meeting and maintaining at all times the qualification requirements listed in Section 105.

The QC testing laboratory will input the compressive strength test results into the Owner’s sample tracking database within 24 hours. When the QC testing laboratory cannot input the compressive strength test results into the owner’s sample tracking database within 24 hours, the QC testing laboratory will notify the Verification testing laboratory within 24 hours of testing the cylinder and provide the Verification testing laboratory the compressive strength test results. Ensure the compressive strength results are input into the Owner’s sample tracking database within 72 hours of determining the compressive strength of the cylinders. The Owner will compare the Verification sample results with the corresponding QC sample results. In the event that one set of compressive strength data for a set of cylinders falls outside the range of the other set of cylinders, use the lower Range of Average Compressive Strength to determine the comparison criteria. Based on this comparison, the Owner will determine if the Comparison Criteria as shown in Table 7 has been met. When the difference between QC and Verification is less than or equal to the Comparison Criteria, the QC data is verified. When the difference between QC and Verification data exceeds the Comparison Criteria, the data is not verified and the Engineer will initiate the resolution procedure.

Table 7	
Range of Average Compressive Strength	Comparison Criteria
Less than 3500 psi	420 psi
3,501 – 4,500 psi	590 psi

4,501 – 6,500 psi	910 psi
6,501 – 8,500 psi	1,275 psi
Greater than 8,500 psi	1,360 psi

346-9.2 Sampling Frequency:

As a minimum, sample and test concrete of each design mix for water to cementitious materials ratio, air content, temperature, slump and compressive strength once per LOT as defined by Table 8. When a mix design is used for a different application, the LOT is defined by the application. When more than one concrete production facility is used for the same mix design, describe the method of sampling, testing and LOT numbering in the QC Plan. The Engineer will randomly verify one of every four consecutive LOTs of each design mix based on a random number generator. The Owner's Engineer may perform Independent Verification testing to verify compliance with specification requirements. All QC activities, calculations, and inspections will be randomly confirmed by the Owner.

TABLE 8	
Class Concrete*	LOT Size
I	one day's production
I (Pavement)	2,000 square yards, or one day's production, whichever is less
II, II (Bridge Deck), III, IV, V (Special), V, VI	50 cubic yards, or one day's production, whichever is less
IV (Drilled Shaft)	50 cubic yards, or two hours between the end of one placement and the start of the next placement, whichever is less
III (Seal)	Each Seal placement
*For any class of concrete used for roadway barrier wall, the lot size is defined as 100 cubic yards, or one day's production, whichever is less.	

346-9.2.1 Reduced Frequency for Acceptance Tests: The LOT size may represent 100 cubic yards when produced at the same mix design at the same concrete production facility for the same prime contractor and subcontractor on a given Contract. Submit test results indicating the average compressive strength is greater than two standard deviations above the specified minimum strength for that class of concrete. Base calculations on a minimum of ten consecutive strength test results for a Class IV or higher; or a minimum of five consecutive strength results for a Class III or lower.

The average of the consecutive compressive strength test results, based on the class of concrete, can be established using historical data from a previous Owner project. The tests from the previous Owner project must be within the last 60 calendar days or may also be established by a succession of samples on the current project. Only one sample can be taken from each LOT. Test data must be from a laboratory meeting the requirements of Section 105. Obtain Owner approval before beginning reduced frequency LOT's. If at any time a strength test is not verified or the average strength of the previous ten or five consecutive samples based on the class of concrete from the same mix

design and the same production facility is less than the specified minimum plus two standard deviations, return to the maximum production quantity represented by the LOT as defined in Table 8. Notify the Engineer that the maximum production rate is reinstated. In order to reinitiate reduced frequency, submit a new set of strength test results.

346-9.3 Strength Test Definition: The strength test of a LOT is defined as the average of the compressive strengths tests of three cylinders cast from the same sample of concrete from the LOT.

346-9.4 Acceptance of Concrete:

Ensure that the hardened concrete strength test results are obtained in accordance with 346-9.3. Do not discard a cylinder strength test result based on low strength (strength below the specified minimum strength as per the provisions of this Section).

When one of the three QC cylinders from a LOT is lost, missing, damaged or destroyed, determination of compressive strength will be made by averaging the remaining two cylinders. If more than one QC cylinder from a LOT is lost, missing, damaged or destroyed, the Contractor will core the structure at no additional expense to the Owner to determine the compressive strength. Acceptance of LOT may be based on verification data at the discretion of the Engineer. Obtain the approval of the Engineer to core, and of the core location prior to coring.

For each QC cylinder that is lost, missing, damaged or destroyed, payment for that LOT will be reduced by \$750.00 per 1,000 psi of the specified design strength [Example: loss of two Class IV (Drill Shaft) QC cylinders that has no verification data will require the element to be cored and a pay reduction will be assessed (4,000 psi / 1,000 psi) x \$750 x 2 = \$6,000]. This reduction will be in addition to any pay adjustment for low strength.

When QC compressive strength test results are not verified, the resolution procedure will be used to accept or reject the concrete. Maintain the “hold” cylinders until the verification of the compressive strength test results.

When QC test results are verified, the Engineer will accept the concrete based on QC test results. The Engineer will accept at full pay only LOTs of concrete represented by plastic property results which meet the requirements of the approved mix design and strength test results which equal or exceed the respective specified minimum strength.

346-9.5 Resolution Procedure: The Owner may initiate an IA review of sampling and testing methods. The resolution procedure may consist of, but need not be limited to, a review of sampling and testing of fresh concrete, calculation of water to cementitious materials ratio, handling of cylinders, curing procedures and compressive strength testing. Compare the Verification sample results with the verification hold cylinders results. Comparison results must not be greater than 14%. Compare the QC sample results with the QC hold cylinders results. Comparison results must not be greater than the comparison requirements in Table 7. Core samples of the hardened concrete may be required.

The Engineer will determine through the resolution procedure whether the QC strength test results or the verification strength test are deemed to be the most accurate, LOTs will then be considered to be verified. When the Engineer cannot determine which strength test results are the most accurate, the concrete represented by the four consecutive LOTs will be evaluated based on the QC data. The Engineer will inform the QC and the Verification lab within three calendar days of the acceptance compressive strength test to transport their “hold” cylinders to the resolution lab. The QC and Verification laboratories will transport their own hold cylinder to the resolution testing laboratory within 72 hours after the Engineer notifies the

Contractor that a resolution is required. In addition, the Engineer will ensure that the QC and verification “hold” cylinders are tested within seven calendar days of the acceptance strength tests.

The resolution investigation will determine the strength test results for each of the four or less LOTs. When the QC strength test results are deemed to be the most accurate, the QC strength test results will represent the four or less consecutive LOTs and the Owner will pay for the resolution testing and investigation. When the verification strength test results are deemed to be the most accurate, the Owner will assess a \$1,000 pay reduction for the cost of the Resolution Investigation.

The results of the resolution procedure will be forwarded to the Contractor within five working days after completion of the investigation. If the Owner finds deficiencies based on the Contractor’s QCP, the Engineer may suspend that part of the QCP. When the QC plan is suspended, submit corrective actions for approval to the Engineer. The Engineer may take up to five working days to review corrective actions to the QCP. The Engineer will not allow changes to contract time or completion dates. Incur all delay costs and other costs associated with QC plan suspension and re-approval.

346-9.6 Small Quantities of Concrete: When a project has a total plan quantity of less than 50 cubic yards, that concrete will be accepted based on the satisfactory compressive strength of the QC cylinders. Provide certification to the Engineer that the concrete was batched and placed in accordance with the Contract Documents. Submit a quality control plan for the concrete placement operation in accordance with Section 105. In addition, the Engineer may conduct Independent Verification (IV) testing as identified in 346-9. Evaluate the concrete in accordance with 346-10 at the discretion of the Engineer.

346-10 Investigation of Low Strength Concrete for Structural Adequacy.

346-10.1 General: When a concrete acceptance strength test result falls more than 500 psi below the specified minimum strength and the Owner determines that an investigation is necessary, make an investigation into the structural adequacy of the LOT of concrete represented by that acceptance strength test result at no additional expense to the Owner. The Engineer may also require the Contractor to perform additional strength testing as necessary to determine structural adequacy of the concrete.

Furnish either a structural analysis performed by the Specialty Engineer to establish strength adequacy or drilled core samples as specified in 346-10.3 to determine the in-place strength of the LOT of concrete in question at no additional expense to the Owner. Obtain the Engineer’s approval before taking any core samples. When the concrete is deemed to have low strength, obtain and test the cores and report the data to the Engineer within 14 calendar days of the 28 day compressive strength tests. Core strength test results obtained from the structure will be accepted by both the Contractor and the Owner as the in-place strength of the LOT of concrete in question. The core strength test results will be final and used in lieu of the cylinder strength test results for determination of structural adequacy and any pay adjustment. The Owner’s Engineer will calculate the strength value to be the average of the compressive strengths of the three individual cores. This will be accepted as the actual measured value.

346-10.2 Determination of Structural Adequacy: If core strength test results are less than 500 psi below the specified minimum strength, consider the concrete represented by the cores structurally adequate. If the core strength test results are more than 500 psi below the specified minimum strength, the Owner’s Engineer will consider the concrete represented by the

cores structurally questionable. Submit a structural analysis performed by the Specialty Engineer.

If the results of the structural analysis indicate adequate strength to serve its intended purpose with adequate durability, and is approved by the Owner, the Contractor may leave the concrete in place subject to the requirements of 346-11, otherwise, remove and replace the LOT of concrete in question at no additional expense to the Owner.

346-10.3 Coring for Determination of Structural Adequacy: Notify the Engineer 48 hours prior to taking core samples. The Engineer will select the size and location of the drilled cores so that the structure is not impaired and does not sustain permanent damage after repairing the core holes. Sample three undamaged cores taken from the same approximate location where the questionable concrete is represented by the low strength concrete test cylinders. Repair core holes after samples are taken.

346-10.4 Core Conditioning and Testing: Test the cores in accordance with ASTM C 42. Test the cores after obtaining the samples within seven calendar days.

346-11 Pay Adjustments for Low Strength Concrete.

346-11.1 General: Any LOT of concrete failing to meet the specified minimum strength as defined in 346-3, 346-9, 346-10 and satisfactorily meeting all other requirements of the Contract Documents, including structural adequacy, the Engineer will individually reduce the price of each low strength LOT in accordance with this Section.

346-11.2 Basis for Pay Adjustments: When an acceptance strength test result falls more than 500 psi below the specified minimum strength, core samples may be obtained in accordance with ASTM C 42 from the respective LOT of concrete represented by the low acceptance strength test result for determining pay adjustments. A price adjustment will be applied to the certified invoice price the Contractor paid for the concrete or the precast product.

Do not core hardened concrete for determining pay adjustments when the 28 day acceptance cylinder strength test results are less than 500 psi below the specified minimum strength.

The results of strength tests of the drilled cores, subject to 346-11.5 and 346-11.6, will be used as the acceptance results and will be used in lieu of the cylinder strength test results for determining pay adjustments.

In precast operations, excluding prestressed, ensure that the producer submits acceptable core sample test results to the Engineer. The producer may elect to use the products in accordance with 346-11. Otherwise, replace the concrete in question at no additional cost to the Owner. For prestressed concrete, core sample testing is not allowed for pay adjustment. The results of the cylinder strength tests will be used to determine material acceptance and pay adjustment.

346-11.3 Coring for Determination of Pay Adjustments: Obtain the cores in accordance with 346-10.3.

346-11.4 Core Conditioning and Testing: Test the cores in accordance with 346-10.4.

346-11.5 Core Strength Representing Equivalent 28 Day Strength: For cores tested no later than 42 calendar days after the concrete was cast, the Engineer will accept the core strengths obtained as representing the equivalent 28 day strength of the LOT of concrete in question. The Engineer will calculate the strength value to be the average of the compressive strengths of the three individual cores. The Engineer will accept this strength at its actual measured value.

346-11.6 Core Strength Adjustments: For cores tested later than 42 calendar days after the concrete was cast, the Engineer will establish the equivalency between 28 day strength and strength at ages after 42 calendar days. The Engineer will relate the strength at the actual test age to 28 day strength for the design mix represented by the cores using the following relationship:

346-11.6.1 Portland Cement Concrete without Pozzolan or Slag:

Equivalent 28 Day Strength, $f_c(28) = 1/F$ (Average Core Strength) x 100 where:

$$F = 4.4 + 39.1 (\ln x) - 3.1 (\ln x)^2 \text{ (Type I Cement)}$$

$$F = -17.8 + 46.3 (\ln x) - 3.3 (\ln x)^2 \text{ (Type II Cement)}$$

$$F = 48.5 + 19.4 (\ln x) - 1.4 (\ln x)^2 \text{ (Type III Cement)}$$

x = number of days since the concrete was placed

\ln = natural log

346-11.6.2 Pozzolanic-Cement Concrete:

Equivalent 28 day compressive strength = $f_c(28)$, where:

$$f_{c_c}(28) = 0.490 f_{c_c}(t) e^{\left\{ \ln \left(\frac{8.31}{t} \right) \right\}^{0.276}} \text{ (Type I Cement)}$$

$$f_{c_c}(28) = 0.730 f_{c_c}(t) e^{\left\{ \ln \left(\frac{2.89}{t} \right) \right\}^{0.514}} \text{ (Type II Cement)}$$

$$f_{c_c}(28) = 0.483 f_{c_c}(t) e^{\left\{ \ln \left(\frac{5.38}{t} \right) \right\}^{0.191}} \text{ (Type III Cement)}$$

$f_c(t)$ = Average Core Strength at time t (psi)

t = time compressive strength was measured (days)

346-11.6.3 Slag-Cement Concrete:

Equivalent 28 day compressive strength = $f_c(28)$, where:

$$f_{c_c}(28) = 0.794 f_{c_c}(t) e^{\left\{ \ln \left(\frac{7.06}{t} \right) \right\}^{1.06}} \text{ (Type I Cement)}$$

$$f_{c_c}(28) = 0.730 f_{c_c}(t) e^{\left\{ \ln \left(\frac{6.02}{t} \right) \right\}^{0.747}} \text{ (Type II Cement)}$$

$$f_{c_c}(28) = 0.826 f_{c_c}(t) e^{\left\{ \ln \left(\frac{2.36}{t} \right) \right\}^{0.672}} \text{ (Type III Cement)}$$

$f_c(t)$ = Average Core Strength at time t (psi)

t = time compressive strength was measured (days)

346-11.7 Calculating Pay Adjustments: The Engineer will determine payment reductions for low strength concrete accepted by the Owner and represented by either cylinder or core strength test results below the specified minimum strength, in accordance with the following:

Reduction in Pay is equal to the reduction in percentage of concrete cylinder strength (specified minimum strength minus actual strength divided by specified minimum strength).

For the elements that payments are based on the per foot basis, the Engineer will adjust the price reduction from cubic yards basis to per foot basis, determine the total linear feet of the elements that are affected by low strength concrete samples and apply the adjusted price reduction accordingly.

346-12 Pay Reduction for Plastic Properties

A rejected load in accordance with 346-6.4 is defined as the entire quantity of concrete contained within a single ready mix truck or other single delivery vehicle regardless of what percentage of the load was placed. If concrete fails a plastic properties test and is thereby a rejected load but its placement continues after completion of a plastic properties test having a failing result, payment for the concrete will be reduced.

The pay reduction for cast-in-place concrete will be twice the certified invoice price per cubic yard of the quantity of concrete in the rejected load.

The pay reduction for placing a rejected load of concrete into a precast product will be applied to that percentage of the precast product that is composed of the concrete in the rejected load. The percentage will be converted to a reduction factor which is a numerical value greater than zero but not greater than one. The precast product payment reduction will be twice the Contractor's billed price from the Producer for the precast product multiplied by the reduction factor.

If the Engineer authorizes placement of the concrete, even though plastic properties require rejection, there will be no pay reduction based on plastic properties failures; however, any other pay reductions will apply.

SECTION 425 INLETS, MANHOLES, AND JUNCTION BOXES

425-1 Description.

Adjust structures shown in the Plans to be adjusted or requiring adjustment for the satisfactory completion of the work.

425-2 Composition and Proportioning.

425-2.1 Concrete: For inlets, manholes, and junction boxes, use Class II or IV concrete, as designated in the Plans and FDOT Design Standards and as specified in Section

346. For yard drains use concrete as specified in Section 347.

425-2.2 Mortar: For brick masonry, make the mortar by mixing one part Portland cement to three parts sand. Miami Oolitic rock screenings may be substituted for the sand, provided the screenings meet the requirements of 902-5.2.3 except for gradation requirements. Use materials passing the No. 8 sieve that are uniformly graded from coarse to fine.

Masonry cement may be used in lieu of the above-specified mortar provided it is delivered in packages properly identified by brand name of manufacturer, net weight of package, and whether it is Type 1 or Type 2, and further provided that it has not been in storage for a period greater than six months.

425-3 Materials.

425-3.1 General: Meet the following requirements:

Sand (for mortar).....	902
Portland Cement.....	Section 921
Water.....	Section 923
Reinforcing Steel	931 and 415
Liner Repair Systems.....	Section 948
Brick and Concrete Masonry Units.....	Section 949
Castings for Frames and Gratings.....	962

425-3.2 Gratings, Covers, and Frames: Use gratings and frames fabricated from structural steel or cast iron as designated in the appropriate FDOT Design Standard. When “Alt. G” grates are specified in the Plans, provide structural steel grates that are galvanized in accordance with the requirements of ASTM A123.

Use rigid frames and covers either 24 inches or 36 inches or optional three-piece adjustable frames and covers as indicated in FDOT Design Standards, Index No. 201.

For three-piece adjustable frames, the inner frame may include replaceable resilient seats to support the cover. In addition, the inner frame shall indicate it is adjustable, by clearly having the word “adjustable” imprinted into the exposed portion of the inner frame so ”adjustable” is visible from the roadway after installation.

425-4 Forms.

Design and construct wood or metal forms so that they may be removed without damaging the concrete. Build forms true to line and grade and brace them in a substantial and unyielding manner. Obtain the Engineer’s approval before filling them with concrete.

425-5 Precast Inlets, Manholes, and Junction Boxes.

N/A.

425-6 Construction Methods.

425-6.1 Excavation:

Where unsuitable material for foundations is encountered, excavate the unsuitable material and backfill with suitable material prior to constructing or setting inlets, manholes and junction boxes.

As an option to the above and with the Engineer’s approval, the Contractor may carry the walls down to a depth required for a satisfactory foundation, backfill to 8 inches below the

flowline with clean sand and cast a non-reinforced 8 inch floor.

425-6.2 Placing and Curing Concrete: Place the concrete in the forms, to the depth shown in the Plans, and thoroughly vibrate it. After the concrete has hardened sufficiently, cover it with suitable material and keep it moist for a period of three days. Finish the traffic surface in accordance with 522-7.2, or with a simulated broom finish approved by the Engineer.

425-6.3 Setting Manhole Castings: After curing the concrete as specified above, set the frame of the casting in a full mortar bed composed of one part Portland cement to two parts of fine aggregate.

425-6.3.1 Standard Castings: Set manhole frames in a mortar bed and adjust to grade using brick or concrete grade rings, with a maximum 12 inch adjustment.

425-6.3.2 Optional Adjustable Castings: When using a three-piece adjustable frame and cover, install the frame and cover with brick or concrete grade rings to the base course height. Make adjustments using the inner frame in accordance with the manufacturer's installation recommendations so the inner frame and cover meet the grade and slope of the pavement surface opened to traffic.

425-6.4 Reinforcing Steel: N/A

425-6.5 Laying Brick: Brick masonry may be used if the structure is circular and constructed in place, or for adjustments of rectangular risers up to a maximum 12 inches in height. Saturate all brick with water before laying. Bond the brick thoroughly into the mortar using the shove-joint method to lay the brick. Arrange headers and stretchers so as to bond the mass thoroughly. Finish the joints properly as the work progresses and ensure that they are not less than 1/4 inch or more than 3/4 inch in thickness. Do not use spalls or bats except for shaping around irregular openings or when unavoidable at corners.

425-6.6 Backfilling: Backfill as specified in Section 125, meeting the specific requirements for backfilling and compaction around inlets, manholes, and junction boxes detailed in 125-8.1 and 125-8.2. However; for outfall lines beyond the sidewalk or future sidewalk area, where no vehicular traffic will pass over the pipe, inlets, manholes, and junction boxes, compact backfill as required in 125-9.2.2.

425-6.7 Adjusting Structures: Cut down or extend existing manholes, catch basins, inlets, valve boxes, etc., within the limits of the proposed work, to meet the finished grade of the proposed pavement, or if outside of the proposed pavement area, to the finished grade designated in the Plans for such structures. Use materials and construction methods which meet the requirements specified above to cut down or extend the existing structures.

The Contractor may extend manholes needing to be raised using adjustable extension rings of the type which do not require the removal of the existing manhole frame. Use an extension device that provides positive locking action and permits adjustment in height as well as diameter and meets the approval of the Engineer. When adjusting structures in flexible pavement, restore final road surface in accordance with the FDOT Design Standards, Index No. 307.

425-7 Method of Measurement.

The quantities to be paid for will be (1) the number of inlets, manholes, junction boxes, and yard drains, completed and accepted; and (2) the number of structures of these types (including also valve boxes) satisfactorily adjusted.

425-8 Basis of Payment.

425-8.1 New Structures:N/A

425-8.2 Adjusted Structures: When an item of payment for adjusting manholes, valve boxes, or inlets is provided in the proposal, price and payment will be full compensation for the number of such structures designated to be paid for under such separate pay items, and which are satisfactorily adjusted, at the Contract unit prices each for adjusting inlets, adjusting manholes, and adjusting valve boxes; as included within the contract plans and pay item descriptions.

**SECTION 430
PIPE CULVERTS**

430-1 Description.

Furnish and install drainage pipe and end sections at the locations called for in the Plans. Furnish and construct joints and connections to existing pipes, catch basins, inlets, manholes, walls, etc., as may be required to complete the work.

Meet the requirements of 449-1.

For pipe culverts installed by jack & bore, install in accordance with Section 556.

430-2 Materials.

430-2.1 Pipe: Meet the following requirements where applicable:

Concrete Pipe	Section 449
Round Rubber Gaskets	Section 942
Corrugated Steel Pipe and Pipe Arch	Section 943
Corrugated Aluminum Pipe and Pipe Arch	Section 945
Corrugated Polyethylene Pipe	Section 948
Steel Reinforced Polyethylene Ribbed Pipe	Section 948
Corrugated Polypropylene Pipe	Section 948
Corrugated Polyvinyl Chloride (PVC) Pipe	Section 948
Fiberglass Reinforced Polymer Pipe.....	Section 948
Liner Repair Systems	Section 948

430-2.2 Joint Materials: Use joint materials specified in 430-7 through 430-9 according to type of pipe and conditions of usage.

430-2.3 Mortar: Use mortar composed of one part Portland cement and two parts of clean, sharp sand, to which mixture the Contractor may add hydrated lime in an amount not to exceed 15% of the cement content. Use mortar within 30 minutes after its preparation.

430-3 Type of Pipe to Be Used.

430-3.1 General: During the preconstruction conference, notify the Owner in writing as to which optional pipe material from the optional materials tabulation sheet will be used. Once a pipe material is selected, do not change pipe materials without approval of the Engineer.

When the Plans designate a type (or types) of pipe, use only the type (or choose from the types) designated. As an exception, when the Plans designate reinforced concrete pipe as Class S, Class I, Class II, Class III and Class IV, the Contractor may use non-reinforced concrete pipe up to and including 36 inch in diameter.

430-3.2 Side Drain: If the Plans do not designate a type (or types) of pipe, the Contractor may use either a minimum Class I concrete pipe, corrugated steel pipe, corrugated aluminum pipe, corrugated polyethylene pipe, polypropylene pipe, or PVC pipe. If one of the

metal types is chosen, use the minimum gage specified in Section 943 for steel pipe or Section 945 for aluminum pipe. When extending existing pipes, construct the pipe extensions of the same size and kind as the existing pipe. Extensions of existing pipes, whose materials are no longer produced, shall be extended with the most similar pipe material available.

Non-reinforced concrete pipe may also be substituted for concrete pipe in side drains, subject to the provisions of 430-3.1.

430-4 Laying Pipe.

430-4.1 General: Lay all pipe, true to the lines and grades given, with hubs up and tongue end fully entered into the hub. When pipe with quadrant reinforcement or circular pipe with elliptical reinforcement is used, install the pipe in a position such that the manufacturer’s marks designating “top” and “bottom” of the pipe are not more than five degrees from the vertical plane through the longitudinal axis of the pipe. Do not allow departure from and return to plan alignment and grade to exceed 1/16 inch per foot of nominal pipe length, with a total of not more than 1 inch departure from theoretical line and grade. Take up and relay any pipe that is not in true alignment or which shows any settlement after laying at no additional expense to the Owner.

Do not use concrete pipe with lift holes except (1) round pipe which has an inside diameter in excess of 54 inches or (2) any elliptical pipe.

Repair lift holes, if present, with hand-placed, stiff, non-shrink, 1-to-1 mortar of cement and fine sand, after first washing out the hole with water. Completely fill the void created by the lift hole with mortar. Cover the repaired area with a 24 by 24 inch piece of filter fabric secured to the pipe. Use a Type D-3 filter fabric meeting the requirements specified in Section 985.

Secure the filter fabric to the pipe using a method that holds the fabric in place until the backfill is placed and compacted. Use grout mixtures, mastics, or strapping devices to secure the fabric to the pipe.

When installing pipes in structures, construct inlet and outlet pipes of the same size and kind as the connecting pipe shown in the Plans. Use the same pipe material within each continuous run of pipe. Extend the pipes through the walls for a distance beyond the outside surface sufficient for the intended connections, and construct the concrete around them neatly to prevent leakage along their outer surface as shown on FDOT Design Standards, Index No. 201. Keep the inlet and outlet pipes flush with the inside of the wall. Resilient connectors as specified in

942-3 may be used in lieu of a masonry seal.

Furnish and install a filter fabric jacket around all pipe joints and the joint between the pipe and the structure in accordance with FDOT Design Standards, Index Nos. 201 and 280. Use fabric meeting the physical requirements of Type D-3 specified in Section 985. Extend the fabric a minimum of 12 inches beyond each side of the joint or both edges of the coupling band, if a coupling band is used. The fabric must have a minimum width of 24 inches, and a length sufficient to provide a minimum overlap of 24 inches. Secure the filter fabric jacket against the outside of the pipe by metal or plastic strapping or by other methods approved by the Engineer.

Meet the following minimum joint standards:

Pipe Application	Minimum Standard
Storm and Cross Drains	Water-tight

Gutter Drain	Water-tight
Side Drains	Soil-tight

When rubber gaskets are to be installed in the pipe joint, the gasket must be the sole element relied on to maintain a tight joint. Soil tight joints must be watertight to 2 psi. Water-tight joints must be water-tight to 5 psi unless a higher pressure rating is required in the Plans.

430-4.2 Trench Excavation: Excavate the trench for storm and cross drains, and side drains as specified in Section 125.

430-4.3 Foundation: Provide a suitable foundation, where the foundation material is of inadequate supporting value, as determined by the Engineer. Remove the unsuitable material and replace it with suitable material, as specified in 125-8. Where in the Engineer’s opinion, the removal and replacement of unsuitable material is not practicable, he may direct alternates in the design of the pipe line, as required to provide adequate support. Minor changes in the grade or alignment will not be considered as an adequate basis for extra compensation.

Do not lay pipe on blocks or timbers, or on other unyielding material, except where the use of such devices is called for in the Plans.

430-4.4 Backfilling: Backfill around the pipe as specified in 125-8 unless specific backfilling procedures are described in the Contract Documents.

430-4.5 Plugging Pipe: When existing pipe culverts are to be permanently placed out of service, fill them with flowable fill that is non-excavatable, contains a minimum 350 pounds per cubic yard of cementitious material and meets the requirements of Section 121 and/or plug them with masonry plugs as shown in the Plans. Install masonry plugs that are a minimum of 8 inches in thickness, in accordance with FDOT Design Standards, Index 280.

When proposed or existing pipe culverts are to be temporarily placed out of service, plug them with prefabricated plugs as shown in the Plans. Install prefabricated plugs in accordance with the manufacturer’s recommendations. Do not fill or construct masonry plugs in any pipe culvert intended for current or future service.

430-4.6 End Treatment: Place an end treatment at each storm and cross drain, and side drain as shown in the Plans. Refer to the FDOT Design Standards for types of end treatment details. As an exception to the above, when concrete mitered end sections are permitted, the Contractor may use reinforced concrete U-endwalls, if shop drawings are submitted to the Engineer for approval prior to use.

Provide end treatments for corrugated polyethylene pipe, polypropylene pipe, and PVC pipe as specified in Section 948, or as detailed in the Plans.

430-4.7 Metal Pipe Protection: Apply a bituminous coating to the surface area of the pipe within and 12 inches beyond the concrete or mortar seal prior to sealing, to protect corrugated steel or aluminum pipe embedded in a concrete structure, such as an inlet, manhole, junction box, endwall, or concrete jacket.

Ensure that the surface preparation, application methods (dry film thickness and conditions during application), and equipment used are in accordance with the coating manufacturers’ published specifications.

Obtain the Engineer’s approval of the coating products used.

430-4.8 Pipe Inspection: For pipes installed under the roadway, inspection is to be conducted when backfill reaches 3 feet above the pipe crown or upon completion of placement of the stabilized subgrade. For pipe installed within fills, including embankments confined by walls, inspection is to be conducted when compacted embankment reaches 3 feet above the

pipe crown or the finished earthwork grade as specified in the Plans. Prior to conducting the inspection, provide the Engineer with a video recording schedule for videoing, dewater installed pipe, and remove all silt, debris and obstructions. Submit pipe videoing and reports to the Owner for review prior to the continuation of paving.

For pipe 48 inches or less in diameter, provide the Engineer a video DVD and report using low barrel distortion video equipment with laser profile technology, non-contact video micrometer and associated software that provides: Actual recorded length and width measurements of all cracks within the pipe.

1. Actual recorded separation measurement of all pipe joints.
2. Pipe ovality report.
3. Deflection measurements and graphical diameter analysis report in terms of x and y axis.
4. Flat analysis report.
5. Representative diameter of pipe.
6. Pipe deformation measurements, leaks, debris, or other damage or defects.
7. Deviation in pipe line and grade, joint gaps, and joint misalignment.
8. A video record of the actual speed at which the camera is traveling through the pipe, ensuring that the rate of travel does not exceed the limit defined in 430-4.8.1 below.

The Engineer may waive this requirement for side drains and cross drains which are short enough to inspect from each end of the pipe.

430-4.8.1 Video Report: Provide a high quality DVD in a MPEG2 format video with a standard resolution of 720 x 480. Use a camera with lighting suitable to allow a clear picture of the entire periphery of the pipe. Center the camera in the pipe both vertically and horizontally and be able to pan and tilt to a 90 degree angle with the axis of the pipe and rotating 360 degrees. Use equipment to move the camera through the pipe that will not obstruct the camera's view or interfere with proper documentation of the pipe's condition.

The video image shall be clear, focused, and relatively free from roll, static, or other image distortion qualities that would prevent the reviewer from evaluating the condition of the pipe. The video will include identification before each section of pipe filmed. The identification will include the project number, the structure number corresponding to the structure number in the Plans for the project, size of pipe, the date and time, and indicate which pipe is being filmed if multiple pipes are connected to the structure. Notes should be taken during the video recording process. Provide the Engineer with copies of these notes along with the video.

Move the camera through the pipe at a speed not greater than 30 feet per minute. Mark the video with the distance down the pipe. The distance shall have an accuracy of one foot per 100 feet. Film the entire circumference at each joint. Stop the camera and pan when necessary to document and measure defects. Position the camera head perpendicular to all defects requiring measurement by the video micrometer.

430-4.8.2 Reinspection: At any time after reviewing the submitted pipe inspection reports, the Engineer may direct additional inspections. If no defects are observed during the reinspection, the Owner will pay for the cost of the reinspections in accordance with 4-3. If defects are observed, the reinspection and all work performed to correct the defects will be done at no cost to the Owner. Acceptance of all replacements or repairs will be based on video documentation of the completed work prior to Final Acceptance.

430-5 Removing Existing Pipe.

If the Plans indicate that existing pipe is to remain the property of the Owner, collect and stack along the right-of-way all existing pipe or pipe arch so indicated in the Plans to be removed, or that does not conform to the lines and grades of the proposed work and that is not to be re-laid, as directed by the Engineer. Take care to prevent damage to salvageable pipe during removal and stacking operations.

430-6 Specific Requirements for Concrete Pipe.

430-6.1 Sealing Joints: Seal the pipe joints with round rubber or profile gaskets meeting the requirements of Section 449. Ensure that the gasket and the surface of the pipe joint, including the gasket recess, are clean and free from grit, dirt and other foreign matter, at the time the joints are made. In order to facilitate closure of the joint, application of a vegetable soap lubricant immediately before closing of the joint will be permitted. Prelubricated gaskets may be used in lieu of a vegetable soap lubricant when the lubricating material is certified to be inert with respect to the rubber material.

430-6.2 Laying Requirements for Concrete Pipe with Rubber Gasket Joints: Do not allow the gap between sections of pipe to exceed 5/8 inch for pipe diameters of 12 inches through 18 inches, 7/8 inch for pipe diameters of 24 through 66 inches, and 1 inch for pipe diameters 72 inches and larger. Where minor imperfections in the manufacture of the pipe create an apparent gap in excess of the tabulated gap, the Engineer will accept the joint provided that the imperfection does not exceed 1/3 the circumference of the pipe, and the rubber gasket is

1/4 inch or more past the pipe joint entrance taper. Where concrete pipes are outside of these tolerances, replace them at no expense to the Owner. Do not apply mortar, joint compound, or other filler to the gap which would restrict the flexibility of the joint.

430-6.3 Field Joints for Elliptical Concrete Pipe: Use either a preformed plastic gasket material or an approved rubber gasket to make a field joint.

430-6.3.1 Plastic Gasket: Meet the following requirements when field joints are made from preformed plastic gasket material:

430-6.3.1.1 General: Install field joints in accordance with the manufacturer's instructions and the following:

430-6.3.1.2 Material: Meet the requirements of 942-2.

430-6.3.1.3 Joint Design: Ensure that the pipe manufacturer furnishes the Engineer with details regarding configuration of the joint and the amount of gasket material required to affect a satisfactory seal. Do not brush or wipe joint surfaces which are to be in contact with the gasket material with a cement slurry. Fill minor voids with cement slurry.

430-6.3.1.4 Primer: Apply a primer of the type recommended by the manufacturer of the gasket material to all joint surfaces which are to be in contact with the gasket material, prior to application of the gasket material. Thoroughly clean and dry the surface to be primed.

430-6.3.1.5 Application of Gasket: Apply gasket material to form a continuous gasket around the entire circumference of the leading edge of the tongue and the groove joint, in accordance with the detail shown on the FDOT Design Standards, Index No. 280. Do not remove the paper wrapper on the exterior surface of the gasket material until immediately prior to joining of sections. Apply plastic gasket material only to surfaces which are dry. When the atmospheric temperature is below 60°F, either store plastic joint seal

gaskets in an area above

70°F, or artificially warm the gaskets to 70°F in a manner satisfactory to the Engineer.

430-6.3.1.6 Installation of Pipe: Remove and reposition or replace any displaced or contaminated gasket as directed by the Engineer. Install the pipe in a dry trench. Carefully shape the bottom of the trench to minimize the need for realignment of sections of pipe after they are placed in the trench. Hold to a minimum any realignment of a joint after the gaskets come into contact. Prior to joining the pipes, fill the entire joint with gasket material and ensure that when the pipes are joined there is evidence of squeeze-out of gasket material for the entire internal and external circumference of the joint. Trim excess material on the interior of the pipe to provide a smooth interior surface. If a joint is defective, remove the leading section of pipe and reseal the joint.

430-6.3.2 Rubber Gasket: Meet the following requirements when field joints are made with profile rubber gaskets:

430-6.3.2.1 General: Install field joints in accordance with the manufacturer's instructions and the following:

430-6.3.2.2 Material: Meet the requirements of 942-4.

430-6.3.2.3 Joint Design: Ensure that the pipe manufacturer furnishes the Engineer with details regarding configuration of the joint and gasket required to effect a satisfactory seal. Do not apply mortar, joint compound, or other filler which would restrict the flexibility of the gasket joint.

430-6.4 Requirements for Concrete Radius Pipe:

430-6.4.1 Design: Construct concrete radius pipe in segments not longer than 4 feet (along the pipe centerline), except where another length is called for in the Contract Documents. Join each segment using round rubber gaskets. Ensure that the pipe manufacturer submits details of the proposed joint, segment length and shape for approval by the Engineer, prior to manufacture.

430-6.4.2 Pre-Assembly: Ensure that the manufacturer pre-assembles the entire radius section in his yard, in the presence of the Engineer, to ensure a proper fit for all parts. At the option of the manufacturer, the Contractor may assemble the pipe without gaskets. Consecutively number the joints on both the interior and exterior surfaces of each joint, and make match marks showing proper position of joints. Install the pipe at the project site in the same order as pre-assembly.

430-7 Specific Requirements for Corrugated Metal Pipe.

430-7.1 Field Joints:

430-7.1.1 General: Make a field joint with locking bands, as specified in Article 9 of AASHTO M36 and AASHTO M196M for aluminum pipe. For aluminum pipe, fabricate bands from the same alloy as the culvert sheeting.

When existing pipe to be extended is helically fabricated, make a field joint between the existing pipe and the new pipe using one of the following methods:

(1) Cut the new pipe to remove one of the re-rolled annular end sections required in Sections 943 or 945, or fabricate the pipe so that the re-rolled annular section is fabricated only on one end. Use either a spiral (helical) band with a gasket or a flat band with gaskets as required by 430-8.1.2 (2) to join the pipe sections.

(2) The Contractor may construct a concrete jacket as shown on the FDOT Design Standards, Index No. 280.

430-7.1.2 Side Drain, Storm and Cross Drain, and Gutter Drains: Where corrugated metal pipe is used as side drain, storm and cross drain, or gutter drain, use a rubber or neoprene gasket of a design shown to provide a joint as specified in 430-4.

Use a gasket of one of the following dimensions:

(1) For annular joints with 1/2 inch depth corrugation: either a single gasket a minimum of 7 inches by 3/8 inch or two gaskets a minimum of 3-1/2 inches by 3/8 inch; and for annular joints with 1 inch depth corrugations: either a single gasket a minimum of 7 inches by 7/8 inch or two gaskets a minimum of 3-1/2 inches by 7/8 inch.

(2) For helical joints with 1/2 inch depth corrugation: either a single gasket a minimum of 5 inches by 1 inch or two gaskets a minimum of 3-1/2 inches by 1 inch; and for helical joints with 1 inch depth corrugations: either a single gasket a minimum of 5 inches by 1-1/2 inches or two gaskets a minimum of 3-1/2 inches by 1-1/2 inches.

(3) Such other gasket designs as may be approved by the Engineer. If, in lieu of a single gasket spanning the joint, two gaskets are used, place these individual gaskets approximately 2 inches from each pipe end at the joint. When two gaskets are used, seal the overlapping area on the coupling band between the gaskets consistent with the joint performance specified. The Contractor may tuck a strip of preformed gasket material over the bottom lip of the band for this purpose. Use coupling bands that provide a minimum circumferential overlap of 3 inches. As the end connections on the coupling band are tightened, ensure that there is no local bending of the band or the connection. Use precurved coupling bands on pipe diameters of 24 inches or less.

Use flat gaskets meeting the requirements of ASTM D1056, designation 2C2 or 2B3. In placing flat gaskets on pipe prior to placing the coupling band, do not stretch the gasket more than 15% of its original circumference. Use circular gaskets meeting the requirements of ASTM C361. Do not stretch the circular gasket more than 20% of its original circumference in placing the gasket on pipe. Use preformed plastic gasket material meeting the composition requirements of 942-2.2.

Apply an approved vegetable soap lubricant, as specified for concrete pipe in 430-7.1.1

430-7.1.3 Alternate Joint: In lieu of the above-specified combination of locking bands and flat gaskets, the Contractor may make field joints for these pipe installations by the following combinations:

(a) Use the metal bands as specified in Article 9 of AASHTO M36M that are at least 10-1/2 inches wide and consist of a flat central section with a corrugated section near each end, designed to match the annular corrugation in the pipe with which they are to be used. Connect the bands in a manner approved by the Engineer, with a suitable fastening device such as the use of two galvanized 1/2 inch diameter bolts through a galvanized bar and galvanized strap, suitably welded to the band. Use a strap that is the same gage as the band. Where helically corrugated pipe is to be joined by this alternate combination, ensure that at least the last two corrugations of each pipe section are annular, and designed such that the band will engage each pipe end with the next-to-outside annular corrugation.

(b) For these bands, use a rubber gasket with a circular cross-section of the "O-ring" type conforming to ASTM C361. Use gaskets having the following cross-sectional diameter for the given size of pipe:

Non-SI Units	
Pipe Size	Gasket Diameter

12 inches through 36 inches (with 1/2 inch depth corrugations)	13/16 inch
42 inches through 96 inches (with 1/2 inch depth corrugations)	7/8 inch
36 inches through 120 inches (with 1 inch depth corrugations)	1-3/8 inches

Use preformed gasket material to seal the overlapping area on the coupling band between gaskets.

(c) Use channel band couplers in helical pipe with ends which have been reformed and flanged specifically to receive these bands. Use channel band couplers that are of a two piece design, are fabricated from galvanized steel stock conforming to AASHTO M36, have 2 inch by 2 inch by 3/16 inch angles fastened to the band ends to allow for proper tightening, and meet the following:

Non SI Units	
Band Thickness	Pipe Wall Thickness
0.079 inch	0.109 inch or lighter
0.109 inch	0.138 inch or heavier
3/4 inch wide	0.109 inch or lighter
1 inch wide	0.138 inch or heavier

Furnish two 1/2 inch diameter connection bolts with each band, that conform to ASTM A307, Grade A and are electroplated in accordance with ASTM B633.

Use a gasket with the joint that is a hydrocarbon blend of butyl rubber meeting the chemical composition and physical properties of 942-2.2. Use a 3/8 by 3/4 inch gasket for pipe fabricated from 0.109 inch or lighter material and a 3/8 by 1 inch gasket for pipe fabricated from 0.138 inch and heavier material.

The Contractor may use a flange band coupler without the gasket for all applications other than side drain, storm and cross drain, and gutter drain.

Do not use the flange band coupler to join dissimilar types of pipe.

The Contractor may join reformed flanged helical pipe to existing annular or reformed pipe having annular ends. On non-gasketed installations, use either an annular band or an alternate joint described in 430-8.1.3. On gasketed installations, use an annular band, minimum of five corrugations in width, in conjunction with two O-ring gaskets as specified in 430-8.1.3. Use mastic material to seal the area of band overlap.

The minimum joint performance standards specified in 430-4.1 apply.

430-7.2 Laying and Shape Requirements for Corrugated Metal Pipe: Install pipe using either a trench or open ditch procedure.

Check pipe shape regularly during backfilling to verify acceptability of the construction method used. Pipe deflected 5% or more of the certified actual mean diameter of the pipe at final inspection shall be replaced at no cost to the Owner. Deflection measurements are taken at the point of smallest diameter on the corrugations.

430-8 Specific Requirements for Steel Reinforced Polyethylene Ribbed Pipe, Corrugated Polyethylene Pipe, Polypropylene Pipe, and Polyvinyl Chloride (PVC) Pipe.

430-8.1 Field Joints: Use gasketed joints to seal side drain, and storm and cross

drain. Use gaskets meeting the requirements of Section 449. Ensure that the pipe manufacturer provides a joint design approved by the Engineer before use.

430-8.2 Installation Requirements Including Trenching, Foundation and Backfilling Operations: Check structure shape regularly during backfilling to verify acceptability of the construction method used.

Replace pipe deflected 5% or more of the certified actual mean diameter of the pipe at final inspection at no cost to the Owner.

430-9 Desilting Pipe or Concrete Box Culvert.

Desilt pipe culvert and concrete box culvert as designated in the Plans.

430-10 Method of Measurement.

430-10.1 New Pipe Installed by Excavation or Trenching: The quantity of storm and cross drain pipe, storm drain trench, side drain and gutter drain pipe, installed by pipe culvert optional material - excavation or trenching, to be paid for will be plan quantity, in place and accepted. The plan quantity will be determined from the inside wall of the structure as shown in the Plans, along the centerline of the pipe.

Adjustment to bid quantities, prices and payment will not be allowed for increases, decreases or changes in material or installation requirements due to the use of any optional pipe materials.

If adjustments are required due to Plan errors or omissions or authorized field changes, the plotted material and not the material elected would be used to establish new pay quantities.

Pipe sizes other than round (elliptical/arch) are summarized and paid for using equivalent round pipe diameter.

430-10.2 New Pipe Installed by Jack & Bore: The quantity of storm and cross drain pipe, storm drain trench, side drain and gutter drain pipe, installed by pipe culvert optional material - jack & bore, to be paid for will be the plan quantity, in place and accepted. The measurement and payment will be the plan quantity length of the casing or carrier pipe installed by jack & bore.

Carrier pipe installed through/inside the casing is paid for as pipe culvert optional material – excavation or trenching.

430-10.3 Mitered End Section: The quantity of mitered end sections to be paid for will be the number completed and accepted.

430-11 Basis of Payment.

430-11.1 General: Prices and payments will be full compensation for all work specified in this Section, including all excavation except the volume included in the items for the grading work on the project, and except for other items specified for separate payment in Section 125; all backfilling material and compaction; disposal of surplus material; and all clearing and grubbing outside of the required limits of clearing and grubbing as shown in the Plans.

No payment will be made for failed bore paths, injection of excavatable flowable fill, products taken out of service, or incomplete installations. Payment will include all work and materials necessary for jack & bore, including boring, backfilling, flowable fill, and restoration materials necessary for a complete and accepted installation.

No payment will be made for jack & bore until a Bore Path Report has

been delivered to the Engineer.

430-11.2 Removing Existing Pipe: When existing pipe is removed and replaced with new pipe approximately at the same location, the cost of excavating and removing the old pipe and of its disposal will be included in the Contract unit price for clearing and grubbing.

430-11.3 Site Restoration: The cost of restoring the site, as specified in 125-11, that is disturbed, solely for the purpose of constructing pipe culvert, will be included in the Contract unit price for the pipe culvert, unless designated specifically to be paid for under other items.

430-11.4 Plugging Pipes: The cost of temporarily plugging a pipe culvert, either proposed or existing, will be incidental to the contract unit price for new pipe culvert.

The cost of filling and/or plugging an existing pipe culvert that is to be permanently placed out of service will be included in the Contract unit price for clearing and grubbing. Price and payment will be full compensation for flowable fill, masonry, concrete, mortar, and all labor and materials necessary to complete the work.

430-11.5 Desilting Pipe: The cost of desilting new drainage pipe prior to final acceptance will be included in the contract unit price for that specific pipe culvert.

SECTION 443 FRENCH DRAINS

443-1 Description.

Construct French Drains, utilizing one of the authorized types of pipe, with coarse aggregate, or ballast rock when specified, and filter fabric.

443-2 Materials.

443-2.1 Pipe: Unless a particular type is specified in the Plans, pipe furnished may be any of the following types:

(1) Concrete Pipe (Bell & Spigot): Slotted or perforated concrete pipe may be used. Meet the requirements of Section 449 for concrete pipe. Do not use gaskets. Fully insert the spigot in the bell, and bring home. Conform to FDOT Design Standards, Index No. 285 for slotted pipe. Use perforated pipe having perforations equally located 360 degrees around the pipe. Use pipe having not less than 30 round perforations, 3/8 inch each, per square foot of inside pipe surface. Extend perforations to within 6 inches of the bell or spigot area. The Engineer will permit other perforations not less than 5/16 inch nor more than 3/8 inch in the least dimension if they provide an opening area not less than 3.31 in²/ft² of pipe surface.

(2) Corrugated Aluminum Alloy Culvert Perforated Pipe: Meet the requirements of Section 945. Use perforated pipe having perforations equally located 360 degrees around the pipe. Locate perforations either on the inside crests or on the neutral axis of all corrugations except that perforations are not required within 4 inches of each end of each length of pipe or in a corrugation where seams are located.

Provide pipe having not less than 30 round perforations, 3/8 inch each, per square foot of pipe surface. The Engineer will permit other perforations not less than 5/16 inch nor more than 3/8 inch in the least dimension if they provide an opening area not less than 3.31 in²/ft² of pipe surface.

(3) Corrugated Steel Perforated Pipe: Meet the requirements of Section 943. Space the perforations and meet the requirements as specified in (2) above.

(4) Bituminous Coated Corrugated Steel Perforated Pipe: Meet the requirements of Section 943. Space the perforations and meet the requirements as specified in (2) above. Place the perforations prior to the bituminous coating. The Engineer will accept the minimum opening of not less than 3.31 in²/ft² of pipe if 50% of the opening area is maintained after coating.

(5) Corrugated Polyethylene Pipe: Meet the requirements of 948-2.3. Space the perforations and meet the requirements as specified in (2) above.

(6) Polyvinyl Chloride (PVC) Pipe: Meet the requirements of 948-1.7. Space the perforations and meet the requirements as specified in (2) above.

443-2.2 Coarse Aggregate: Meet the requirements of 901-1.4 for No. 4 stone.

443-2.3 Select Fill: Use select fill meeting the requirements of either Section 911, 913, 913A or 915.

443-3 Excavating Trench.

Excavate the trench in accordance with Section 125 unless specific trench excavation procedures are described in the Plans.

Carefully excavate the trench to such depths as required to permit the filter fabric, coarse aggregate and the pipe to be placed in accordance with the details shown in the Plans.

443-4 Laying Pipe.

Lay all pipe conforming to the lines and grades specified in the Plans and in accordance with these Specifications. Unless otherwise specified in the Plans, set the pipe with a 36 inch minimum cover and a maximum cover of 66 inches.

443-5 Placing Coarse Aggregate and Backfilling.

After placing the pipe and without disturbing the pipe, carefully place the coarse aggregate around the pipe to a depth shown in the Plans. Fold the filter fabric over the coarse aggregate. Backfill and compact as described below.

443-5.1 French Drains Under Pavement: Fill the area above the coarse aggregate with select fill material meeting the requirements of this Section. Place and compact the select fill according to the requirements for pipe as specified in Section 125. The Engineer will allow use of additional coarse aggregate over the top of the pipe instead of select fill material. In this case, the filter fabric shall be extended to wrap the additional coarse aggregate. The top of the coarse aggregate shall not be higher than the bottom of the base, unless shown in the Plans. The Engineer will not pay additional costs associated with substituting coarse aggregate for select fill.

443-5.2 French Drains not Under Pavement: Fill and compact the area above the coarse aggregate according to the requirements for pipe in Section 125, unless specific procedures are described in the Plans as specified in Section 125.

443-6 Method of Measurement.

The quantity of French drains to be paid for under this Section will be the length in feet, measured in place, completed and accepted as specified on FDOT Design Standards,

Index No. 285 for French drains.

443-7 Basis of Payment.

The quantities determined as provided above will be paid for at the Contract unit price per foot for French drains. Such prices and payments will be full compensation for all the work specified in this Section and will include all materials and all excavation, and will also include sheeting or shoring, if required, the disposal of surplus material, pavement restoration, backfilling and tamping, but will not include payment for items paid for elsewhere in the specifications.

**SECTION 449
PRECAST CONCRETE DRAINAGE PRODUCTS**

449-105 Description.

Precast concrete drainage products hereinafter called products, may include but are not limited to, round concrete pipe, elliptical concrete pipe, underdrains, manholes, endwalls, inlets, junction boxes, three-sided precast concrete culverts, and precast concrete box culverts.

Ensure that all precast drainage products are designed and manufactured in accordance with the requirements of the Contract Documents.

At the beginning of each project, provide a notarized certification statement to the Engineer from a company designated representative certifying that the plant will manufacture the products in accordance with the requirements set forth in the Contract Documents and plant's Quality Control (QC) Plan. The Quality Control Manager's stamp on each product indicates certification that the product was fabricated in conformance with the Contractor's QC Plan, the Contract, and this Section. Ensure that each shipment of precast concrete products to the project site is accompanied with a QC signed or stamped delivery ticket providing the description and the list of the products.

The Engineer will not allow changes in Contract time or completion dates as a result of the plant's loss of qualification. Accept responsibility for all delay costs or other costs associated with the loss of the plant's qualification.

449-106 Materials.

Ensure that the materials used for the construction of the precast drainage products have a certification statement from the source, showing that they meet the applicable requirements of the Specifications with the following modifications:

Reinforcing Bar.....	Section 415
Coarse Aggregate*.....	Section 901
Fine Aggregate*.....	Section 902
Portland Cement and blended cement.....	Section 921
Water.....	Section 923
Admixtures.....	Section 924
Pozzolans and slag.....	Section 929
Gasket Material.....	Section 942
Blended Hydraulic Cements.....	AASHTO M 240
Welded Wire Reinforcement.....	Section 931
Wire for Site Cage Machines.....	Section 931
Liner Repair Systems.....	Section 948

*For concrete pipes the gradation requirements of concrete aggregates as set forth in Sections 901 and 902 are not applicable.

449-107 Construction Requirements.

Unless otherwise stipulated within the Contract Documents, meet the following requirements for concrete mix, product design, fabrication, transportation, and installation:

Precast Concrete Box Culvert.....	Section 410
Pipe Culverts and Storm Sewers	Section 430
French	Drains
.....	Section 443
Inlets, Manholes, and Junction Boxes	Section 425
.....	and ASTM C 478
Steel Reinforced Round Concrete Pipe	ASTM C 76
Reinforced Elliptical Concrete Pipe	ASTM C 507
Non-reinforced Concrete Pipe	ASTM C 985

Meet the special requirements for the applicable pipes as described in 449-4 and 449-5.

449-108 Requirements For Pipe Joints When Rubber Gaskets Are To Be Used.

449-4.1 Design of Joint: Use pipe joint of the bell-and-spigot type or the double spigot and sleeve type, meeting the requirements called for in the FDOT Design Standards. Ensure the joint is so proportioned that the spigot, or spigots, will readily enter the bell or sleeve of the pipe.

Ensure the joint ring forms for forming the joint surface are made of either heavy steel, cast iron, or aluminum, and accurately machined to the dimensions of the joint. They must be a true circular form within a tolerance of 1/32 inch. Dimensional checks of joint ring form will indicate for each size pipe a length of spigot, or tongue, not more than 1/8 inch shorter than the bell, or groove, depth. The pipe will be so manufactured that joint surfaces are concentric with the inside of the pipe within a tolerance of 3/32 inch. The shape and dimensions of the joint must be such as to provide compliance with the following requirements:

1. The joint must be so dimensioned that when the gasket is placed on the spigot it will not be stretched more than 20% of its original length, or the maximum stretch length that is recommended by the manufacturer, whichever is lower.
2. The space provided for the gasket must be a groove in the spigot end of the pipe and such space, when the joint is made, it cannot be more than 110% of the volume of the gasket.

3. The joint must be designed so that when the outer surface of the spigot and the inner surface of the bell come into contact at some point on the periphery, the diametric deformation in the gasket at the point of contact cannot be greater than 50% of the normal gasket diameter, and the diametric deformation in the gasket at a point opposite the contact point cannot be less than 20% of the normal gasket diameter.

4. When the pipes are joined, there must be parallel surfaces on both the bell and the spigot, extending from the outside edge of the gasket toward the bell face for a distance of not less than 3/4 inch. These parallel surfaces cannot be farther apart than 1/8 inch, when the spigot is centered in the bell. The tapers on these surfaces cannot exceed three degrees.

5. The inside surface of the bell at the end of the bell must be flared to facilitate joining the pipe sections without damaging or displacing the gasket.

449-4.2 When Rubber Gaskets are Used: Ensure that the pipe joints have been tested at the plant hydrostatically and shown to meet the requirements of Section 6.2 of the Materials Manual, which is available at the following URL:

<http://www.dot.state.fl.us/specificationsoffice/Implemented/URLinSpecs/files/section62.pdf>.

449-4.3 When Profile Rubber Gaskets are Used: Ensure the joint design meets the requirements set forth in Article 7 of ASTM C443.

449-4.4 Tolerances in Imperfections, and Permissible Repairs for Joint of Concrete Gasketed Pipe: Ensure that all surfaces of near-contact of the jointed pipes are free from air holes, chipped or spalled concrete, laitance, and other such defects.

Pipes showing minor manufacturing imperfections or handling injuries to the bell or spigot may be acceptable if such defects are acceptably repaired as prescribed below. Individual air holes (trapped air), or spalled areas with a length of up to one-half the pipe radius, or 12 inches whichever is less, may be repaired by careful use of a hand-placed, stiff, pre-shrunk, 1-to-1 mortar of cement and fine sand, and with no additional preparation other than a thorough washing with water of the defect. Curing will be done either by moisture curing under wet burlap or by application of an approved membrane curing compound. Such repaired pipe which is sound, properly finished and cured, and which otherwise conforms to specification requirements will be acceptable.

Exposed reinforcing and minor spalling in the spigot groove may be accepted if repaired in the following manner: The spalled areas will be chipped back to solid concrete. Exposed reinforcing will be cleaned of all laitance and scale. The entire area is to be coated with an approved epoxy at a thickness of 5 to 10 mils. The coating must be smooth and conform to the shape of the groove. The epoxy must be a Type F-1 as specified in Section 926.

SECTION 520 CONCRETE GUTTER, CURB ELEMENTS, AND TRAFFIC SEPARATOR

520-1 Description.

Construct Portland cement concrete curb. Curb will include concrete curb and gutter, concrete traffic separator, valley gutter, special concrete gutter, curb for sidewalk curb ramps and driveways, and any other types of concrete curb not specified in other Sections.

520-2 Materials.

520-2.1 Concrete: Use concrete meeting the requirements of Section 347.

520-2.2 Reinforcement: For all steel reinforcement required by the Plans, meet the requirements of Section 415.

520-2.3 Joint Materials: Meet the requirements of Section 932.

520-3 Forms.

520-3.1 Form Materials: Construct forms for this work of either wood or metal. Provide forms that are straight, free from warp or bends, and of sufficient strength, when staked, to resist the pressure of the concrete without deviation from line and grade. For all items constructed on a radius, use flexible forms.

520-3.2 Depth of Forms: Ensure that forms have a depth equal to the plan dimensions for the depth of concrete being deposited against them.

520-3.3 Machine Placement: The Contractor may place these items by machine methods with the approval of the Engineer provided that the Contractor consistently produces an acceptable finished product, true to line, grade, and cross section.

520-4 Excavation.

Excavate to the required depth, and compact the foundation material upon which these items are to be placed as specified in 120-9.

520-5 Placing Concrete.

Place the concrete in the forms, and tamp and spade it to prevent honeycombing, and until the top of the structure can be floated smooth and the edges rounded to the radius shown in the Plans.

520-6 Joints.

520-6.1 Contraction Joints: Except for machine placed items, the Contractor may form joints by using dummy joints (either formed or sawed) or by using sheet metal templates. If using sheet metal templates, ensure that they are of the dimensions, and are set to the lines, shown in the Plans. Hold templates firmly while placing the concrete. Leave templates in place until the concrete has set sufficiently to hold its shape, but remove them while the forms are still in place.

Saw contraction joints, for machine placed items, unless the Engineer approves an alternate method. Saw the joints as soon as the concrete has hardened to the degree that excessive raveling will not occur and before uncontrolled shrinkage cracking begins. Space contraction joints at intervals of 10 feet except where closure requires a lesser interval, but do not allow any section to be less than 4 feet in length.

520-6.2 Expansion Joints: Construct expansion joints at all inlets, at all radius points, and at other locations indicated in the Plans. Locate them at intervals of 500 feet between other expansion joints or ends of a run. Ensure that the joint is 1/2 inch in width.

520-7 Finishing.

520-7.1 Repair of Minor Defects: Remove the forms within 24 hours after placing the concrete, and then fill minor defects with mortar composed of one part Portland cement and two parts fine aggregate. The Engineer will not allow plastering on the face of the curb. Remove and replace any rejected curb, curb and gutter, or valley gutter without additional compensation.

520-7.2 Final Finish: Finish all exposed surfaces while the concrete is still green. In general, the Engineer will only require a brush finish. For any surface areas, however, which are too rough or where other surface defects make additional finishing necessary, the Engineer may require the Contractor to rub the curb to a smooth surface with a soft brick or wood block, using water liberally. Also, if necessary to provide a suitable surface, the Engineer may require the Contractor to rub further, using thin grout or mortar.

520-7.3 Imprinted Concrete: Install imprinted concrete as shown in the Plans.

520-8 Curing.

520-8.1 General: Continuously cure the concrete for a period of at least 72 hours. Commence curing after completely finishing and as soon as the concrete has hardened sufficiently to permit application of the curing material without marring the surface. Immediately replace any curing material removed or damaged during the 72 hour period.

After removing the forms, cure the surfaces exposed by placing a berm of moist earth against them or by any of the methods described below, for the remainder of the 72 hour curing period.

520-8.2 Wet Burlap Method: Place burlap, as specified in 925-1, over the entire exposed surface of the concrete, with sufficient extension beyond each side to ensure complete coverage. Overlap adjacent strips a minimum of 6 inches. Hold the burlap securely in place such that it will be in continuous contact with the concrete at all times, and do not allow any earth between the burlap surfaces at laps or between the burlap and the concrete. Saturate the burlap with water before placing it, and keep it thoroughly wet throughout the curing period.

520-8.3 Membrane Curing Compound Method: Apply clear membrane curing compound or white pigmented curing compound, as specified in 925-2, by a hand sprayer meeting the requirements of 350-3.10, in a single coat continuous film at a uniform coverage of at least one gallon per 200 square feet. Immediately recoat any cracks, checks, or other defects appearing in the coating. Thoroughly agitate the curing compound in the drum prior to application, and during application as necessary to prevent settlement of the pigment.

520-8.4 Polyethylene Sheeting Method: Place polyethylene sheeting, as specified in 925-3, over the entire exposed surface of the concrete, with sufficient extension beyond each side to ensure complete coverage. Overlap adjacent strips a minimum of 6 inches. Hold the sheeting securely in place and in continuous contact with the concrete at all times.

520-9 Backfilling and Compaction.

After the concrete has set sufficiently, but not later than three days after pouring, refill the spaces in front and back of the curb to the required elevation with suitable material. Place and thoroughly compact the material in layers not thicker than 6 inches.

520-10 Surface Requirements.

Test the gutter section of curb and gutter with a 10 foot straightedge laid parallel to the centerline of the roadway and while the concrete is still plastic. Perform straightedging along the edge of the gutter adjacent to the pavement or along other lines on the gutter cross-section, as directed by the Engineer. Immediately correct irregularities in excess of 1/4 inch.

520-11 Method of Measurement.

For curb or curb and gutter, the quantity to be paid will be plan quantity, in feet, measured along the face of the completed and accepted curb or curb and gutter. Curb for sidewalk curb ramps or driveways will be paid at the contract unit price for the adjacent curb type.

For valley gutter or shoulder gutter, the quantity to be paid will be plan quantity, in feet, measured along the gutter line of the completed and accepted valley gutter or shoulder gutter.

For concrete traffic separator of constant width, the quantity to be paid will be plan quantity, in feet, measured along the center of its width, completed and accepted, including the length of the nose.

For concrete traffic separator of varying width, the quantity to be paid will be plan quantity, in square yards, completed and accepted.

520-12 Basis of Payment.

520-12.1 Concrete Gutter, Curb Elements, and Traffic Separator: Price and payment will be full compensation for all work specified in this Section, including removal of existing curb (repair and replacement/relocation operations), reinforcement steel, joint materials and asphalt or 4" limerock curb pad.

SECTION 522 CONCRETE SIDEWALK AND DRIVEWAYS

522-1 Description.

Construct concrete sidewalks and driveways. Sidewalk will include sidewalk curb ramps with detectable warning surface per FDOT Index 304.

522-2 Materials.

Meet the requirements specified in 520-2.

522-3 Forms.

Provide forms as specified in 520-3.

522-4 Foundation.

Compact fill areas, including cut areas under the sidewalk that have been excavated more than 6 inches below the bottom of sidewalk, to a minimum of 95% of AASHTO T99 density.

The area to be compacted is defined as that area directly under the sidewalk and 1 foot beyond each side of the sidewalk when right-of-way allows.

522-5 Joints.

522-5.1 Expansion Joints: Form 1/2 inch expansion joints between the sidewalk and the curb or driveway or at fixed objects and sidewalk intersections with a preformed joint filler meeting the requirements specified in 932-1.1.

522-5.2 Contraction Joints:

522-5.2.1 Types: The Contractor may use open type or sawed contraction joints.

522-5.2.2 Open-Type Joints: Form open type contraction joints by staking a metal bulkhead in place and depositing the concrete on both sides. After the concrete has set sufficiently to preserve the width and shape of the joint, remove the bulkhead. After finishing the sidewalk over the joint, edge the slot with a tool having a 1/2 inch radius.

522-5.2.3 Sawed Joints: If electing to saw the contraction joints, cut a slot approximately 3/16 inch wide and not less than 1-1/2 inches deep with a concrete saw after the concrete has set, and within the following periods of time:

Joints at not more than 30 feet intervals

.....within 12 hours after

finishing. Remaining jointswithin 96 hours
after finishing.

522-6 Placing Concrete.

Place the concrete as specified in 520-5.

522-7 Finishing.

522-7.1 Screeding: Strike-off the concrete by means of a wood or metal screed, used perpendicular to the forms, to obtain the required grade and remove surplus water and laitance.

522-7.2 Surface Requirements: Imprint concrete as detailed in the Plans, otherwise provide a broom finish. Ensure that the surface variations are not more than 1/4 inch under a 10 foot straightedge or more than 1/8 inch on a 5 foot transverse section. Finish the edge of the sidewalk with an edging tool having a radius of 1/2 inch.

522-8 Curing.

Cure the concrete as specified in 520-8.

522-9 Method of Measurement.

The quantity to be paid will be plan quantity, in square yards, completed and accepted. Ramps, reconstructed sidewalks, walk around sidewalks, sidewalk landings, sidewalk curb, and driveways will be included in the area to be paid.

522-10 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section. Excavation for new installations will be paid for under the items for the grading work on the project. For repairs and replacements, removal of the existing sidewalk or driveway will be included in the cost of new sidewalks and driveways.

For new sidewalk and curb ramp installation, the cost of labor and material for the installation of detectable warnings as indicated on the contract plans will be included in the cost of new 4" sidewalk, as described in the pay item description.

SECTION 523 PATTERNED PAVEMENT

523-1 Description.

Construct patterned pavement on asphalt or concrete pavement areas at locations and with the color and pattern as specified in the Plans. Use products listed on the Qualified Products List (QPL), as approved for use in areas subject to vehicular traffic or non-vehicular traffic, respectively, as specified herein. Install products in accordance with manufacturer's recommendations. For the purpose of this Specification, patterned pavements are defined as surface markings applied either as an overlay to the pavement surface or imprinted in the pavement surface. Vehicular traffic areas are defined as those subject to vehicles within the traveled way, shoulders and auxiliary lanes. Non-vehicular travel areas include medians, islands, curb extensions, sidewalks, borders, plazas and other areas typically subject to foot traffic only. For installation of overlay products in areas subject to vehicular traffic, the finished thickness shall not exceed 180 mils. Products requiring removal of pavement or requiring blockouts or trenches below the top of pavement, shall not be used. Provide the pattern type and color as specified in the Plans or as otherwise directed. Variations within a pattern shall comply with ADA requirements.

523-2 Materials.

523-2.1 General: Use only patterned pavement products approved for use in vehicular and non-vehicular areas, as appropriate, and listed on the QPL. Meet manufacturer's specifications for all patterns, textures, templates, sealers, coatings and coloring materials. Material coatings used to achieve the pattern and color shall produce an adherent, weather resistant, skid resistant, wear resistant surface under service conditions. Color shall be integral and consistent throughout the installation. The composition of materials is intended to be left to the discretion of the manufacturer.

Materials shall be characterized as non-hazardous as defined by Resource Conservation and Recovery Act (RCRA), Subpart C, Table 1 of 40 CFR 261.24 "Toxicity Characteristic". Materials shall not exude fumes which are hazardous, toxic or detrimental to persons or property.

523-2.2 Qualified Products List (QPL): Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6 along with the following documentation:

1. Manufacturer's recommendations for applicability of use on concrete or asphalt surfaces.
2. Manufacturer's recommendation for applicability of use in vehicular or non-vehicular travel areas.
3. Manufacturer's specifications and procedures for materials and installation for each use above.
4. For products proposed for use in vehicular traffic areas, test data verifying the material meets the requirements of this Section including verification that the product, installed in accordance with the manufacturer's specifications and procedures, has been tested in accordance with either:
 - a. ASTM E-274, Skid Resistance of Paved Surfaces using a standard ribbed full scale tire at a speed of 40 mph (FN40R), and has a minimum FN40R value

of 35, or

b. ASTM E-1911, Measuring Paved Surface Frictional Properties

Using the Dynamic Friction Tester (DFT), at a speed of 40 mph (DFT40), and has a minimum DFT40 value of 40.

5. For products proposed for use in non-vehicular traffic areas, test data verifying the material meets the requirements of this Section including verification that the product, installed in accordance with the manufacturer's specifications and procedures, has been tested in accordance with ASTM E-303 using the British Pendulum Tester and has a British Pendulum Number (BPN) of at least 40.

523-2.3 Performance Requirements for Products in Vehicular Travel Areas: In

addition to the submittal requirements of 523-2.2, QPL approval will be contingent on a field service test demonstrating that the patterned pavement product meets the following performance measures at the end of three years from opening to traffic:

1. The average thickness shall be a minimum of 50% of the original thickness.
2. Wearing of the material coating shall not expose more than 15% of the underlying surface area as measured within the traveled way.
3. Friction performance of patterned/textured pavement materials shall meet or exceed one of the following test method values:

(a) FN40R value of 35 in accordance with ASTM E-274; or,

(b) DFT40 value of 40 in accordance with ASTM E-1911

Manufacturers shall provide a field service test installation of each product within a marked crosswalk on a roadway with an ADT of 6,000 to 12,000 vehicles per day per lane, on a site approved by the Department. The test installation shall be a minimum six feet wide and extend from pavement edge to pavement edge across all traffic lanes and shoulder pavement at the crosswalk location. The test installation shall be tested by the manufacturer in accordance with FM 5-592.

523-3 Construction.

523-3.1 Product Submittals: Prior to installation, submit pattern and color samples to the Engineer for confirmation that the product meets the pattern and color specified in the Plans. Do not begin installation until acceptance by the Engineer.

523-3.2 Pavement Cuts: Complete all utility, traffic loop detector, and other items requiring a cut and installation under the finished surface, prior to product installation.

523-3.2 Surface Protection: Protect treated surfaces from traffic and environmental effects until the product is completely installed, including drying and curing according to the manufacturer's instructions.

523-3.3 Installation Acceptance: For installation on new asphalt roadways, apply patterned pavement a minimum of 14 days after placement of the adjacent pavement. Upon completion of the installation, the Engineer will check the area at random locations for geometric accuracy. If any of the chosen areas are found to be deficient, correct the entire patterned area at no additional cost to the Department. Provide certification that the patterned pavement was installed in accordance with the manufacturer's requirements.

523-4 Method of Measurement.

The quantity to be paid will be the plan quantity in square yards of patterned pavement, completed, protected and accepted. No deduction will be made for areas occupied by landscaping, manholes, inlets, drainage structures, or by any public utility appurtenances within the area.

523-5 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section.

**SECTION 526
ARCHITECTURAL PAVERS**

526-1 Description.

Furnish and install architectural pavers and bedding material manufactured to ASTM standards. Other necessary elements and pay items of this type of paving, such as edge restraints, base and subbase materials are not covered in this Section.

526-2 Materials.

526-2.1 General: Architectural pavers shall meet the following requirements:

Proposed Use	ASTM C902 (Brick Paver)	ASTM C1272 (Brick Paver)	ASTM C936 (Concrete Paver)
Roadways	Do Not Use	X	Do Not Use
Commercial Driveways	Do Not Use	X	X
Sidewalks and Medians	X	Do Not Use	X
Residential Driveways	X	Do Not Use	X

Ensure that the pavers are consistent in color, size and appearance.

Architectural paver type, pattern, and shape will be in accordance with Plan details, when specified. Color shall be Red (per GEM Pavers, or Old Castle)

526-2.2 Architectural Pavers - Roadway: For installations on roadways and commercial driveways, provide architectural pavers having a minimum thickness of 3-1/8 inch.

526-2.3 Architectural Pavers - Sidewalk: For installations on sidewalks, medians and residential driveways, provide architectural pavers having a minimum thickness of 2-3/8 inch.

526-2.4 Bedding and Joint Sands: Provide clean, non-plastic bedding and joint sand, free from deleterious or foreign matter, natural or manufactured from crushed rock.

Ensure the bedding sand meets the grading requirements of ASTM C33 Standard Specification for Concrete Aggregate.

Ensure the joint sand meets the grading requirements of ASTM C144 Standard Specification for Aggregate for Masonry Mortar.

Bedding sand may be used for joint sand. Do not use joint sand for bedding sand.

526-2.5 Bedding and Joint Grouts: A suitable grout, in thickness specified by the manufacturer and approved for use by the Architectural Paver manufacturer, may be substituted for either bedding sand, joint sand or both when specified in the Plans and approved by the Engineer.

526-3 Construction Methods.

526-3.1 General:

526-3.1.1 Submittals: For Architectural Pavers – Roadway, furnish full size samples to the Engineer for approval prior to beginning placement. For Architectural Pavers - Sidewalk, provide the Engineer a certification that the architectural pavers meet the requirements of this Section. In addition, for all architectural pavers, submit a certified sieve analysis for gradation comparing results of the bedding sand and joint sand with the requirements of ASTM C33 or ASTM C144 as applicable.

526-3.1.2 Mock-ups: Prior to beginning placement, install a 6 foot by 6 foot paver area following these specifications. This area will be used to determine surcharge of the paver area following these specifications. This area will be used to determine surcharge of the bedding material layer, joint sizes, lines, laying patterns and colors of the job. This area will be adjacent to an edge treatment, incorporated into the work, and will be the standard from which the work will be judged.

526-3.1.3 Environmental Conditions: Cover stockpiled materials with waterproof covering to prevent exposure to rainfall. Do not install bedding materials or architectural pavers during heavy rains or over wet substrata.

526-3.2 Installation: Install the architectural pavers in the following manner:

1. Spread the bedding material evenly over the base course and screed to plan thickness, not to exceed a thickness of 1-1/2 inch. Do not disturb the screeded bedding material. Ensure placement of sufficient bedding material to stay ahead of the laid architectural pavers. Do not use the bedding material to fill depressions in the base course.
2. Lay architectural pavers in the pattern(s) shown in the Plans and maintain straight pattern lines.
3. Joints between the architectural pavers, on average, will be between 1/16 to 3/16 inch wide.
4. Fill gaps at the edges of the paved area with cut or edge architectural pavers.
5. When utilizing bedding and joint sand:
 - Use a low amplitude vibrator capable of 5,000 foot-pounds with 7- 100 Hz frequencies to vibrate and compact architectural pavers into bedding sand.
 - Vibrate the architectural pavers, sweeping dry joint sand into the joints and vibrating, until the joints are full. Do not vibrate within 3 feet of the unrestrained edges of the architectural pavers.
 - At the end of each day, all work within 3 feet of laying face must be left fully compacted, with sand-filled joints.
 - Sweep off the excess sand.
6. Leave a final surface elevation of architectural pavers of 1/8 to 1/4 inch above adjacent drainage inlets, concrete collars or channels.
7. Don't permit the final surface elevations of the pavers to deviate more than 3/8 inch under a 10 foot long straightedge, or more than 1/8 inch between pavers.

526-4 Method of Measurement.

The quantity to be paid for will be the area in square yards for Architectural Pavers, measured in place, completed and accepted. Measurement will be as specified in 9-1.3.1. No deduction will be made for the areas occupied by ornamental trees left within and any other

areas occupied by manholes, inlets, drainage structures or by public utility appurtenances within the normal areas of the architectural pavers.

526-5 Basis of Payment.

Price and payment will be full compensation for all work, labor and materials required to furnish and install proposed Architectural Pavers with concrete base and reinforcement in accordance to the contract plans. Installation of concrete base will be in accordance with the Contract Plans and Section 346. Includes all cost necessary to comply with Section 415 & 526 of the Specifications included herein.

**SECTION 527
DETECTABLE WARNINGS**

527-1 Description.

Furnish and install detectable warnings on newly constructed and/or existing concrete or asphalt walking surfaces (sidewalk curb ramps, sidewalks, shared use paths, etc.) constructed in accordance with the FDOT Design Standards, Index No. 304.

527-2 Materials.

527-2.1 Detectable Warnings: Provide detectable warnings in accordance with the Americans with Disabilities Act Standards for Transportation Facilities, Section 705. Use detectable warnings consisting of materials intended for exterior use subject to routine pedestrian traffic and occasional vehicular traffic. Use detectable warnings with size and pattern shown in the Plans comprised of truncated domes aligned in parallel rows in accordance with the FDOT Design Standards, Index No. 304. Do not use detectable warnings with a diagonal pattern. Do not cut through the middle of truncated domes.

527-2.1.1 Preformed Materials: Use detectable warnings consisting of weather-resistant tiles or pavers that are cast into concrete, or tiles or mats that are surface-applied to concrete or asphalt surfaces with adhesives and mechanical fasteners or torch-applied preformed thermoplastic.

527-2.1.2 Field-Formed Materials: Use detectable warnings applied as a secondary application to the substrate.

527-2.2 Material Properties: Provide detectable warnings that meet the following minimum material property requirements when tested in accordance with the following:

PROPERTY	STANDARD	TEST VALUE
Slip Resistance	FM 3-C1028	Dry Coefficient of Friction – 0.8 min. Wet Coefficient of Friction – 0.65 min. (include recessed areas between truncated domes)
Wear Resistance	FM 5-594	Average Volume Loss: no more than 0.06 cm ³
Water Absorption*	ASTM D570	Not to exceed 5%.
Adhesion/Bond Strength**	FM 5-589	150 psi min. tensile adhesion strength

Non-Hazardous Classification	Submit Material Safety Data Sheet (MSDS)	Non-Hazardous, per RCRA Subtitle C
* Applies only to plastic materials. ** Applies only to surface-applied materials.		

527-2.3 Color/Contrast: Use safety yellow colored detectable warnings on concrete walking surfaces. Use safety yellow colored detectable warnings on asphalt walking surfaces. Acceptable detectable warnings shall meet the following criteria for a duration of three years.

COLOR	LIGHT REFLECTANCE VALUES (LRV) CAP Y*
Safety Yellow	25 – 45
Brick Red	5 – 15
Black	0 – 5

*When measured with a spectrophotometer

527-2.4 Approved Product List: Methods or products used to form detectable warnings in wet concrete will not be permitted. Use detectable warnings listed on the Florida Department of Transportation’s Approved Product List (APL). Manufacturers seeking evaluation of products for inclusion on the APL shall submit an application in accordance with Section 6 and include certified test reports from an independent lab showing the product meets the requirements of this Section and the FDOT Design Standards, Index No. 304 Acceptance Criteria and manufacturer’s drawings, specifications and procedures for materials and installation, including touch-up and repair.

527-3 Installation Procedures.

527-3.1 Surface Preparation and Installation: Prepare the surface in accordance with the manufacturer’s recommendations. Use only products and materials appropriate for the surface on which they will be applied. Install in accordance with the manufacturer’s instructions, using materials and equipment recommended and approved by the manufacturer. For surface- applied tiles or mats, use adhesives applied over the entire surface and mechanical fasteners. Clean up excess concrete from tile.

527-4 Method of Measurement.

Detectable warnings will be paid by plan quantity, per square foot, furnished, installed and accepted. Payment for installation on newly constructed or re-constructed concrete may be included in applicable pay item for concrete sidewalk construction or reconstruction if specified in applicable pay item description.

527-5 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section, including all labor, surface preparation, materials and incidentals necessary to complete the work.

**SECTION 570
PERFORMANCE TURF**

570-1 Description.

Establish a growing, healthy turf over all areas designated in the Plans. Use sod in areas designated in the Plans to be sodded. Maintain turf areas until final acceptance of all contract work.

570-2 Materials.

Meet the following requirements:

Turf Materials	Section 981
Fertilizer	Section 982
Water	Section

983

570-3 Construction Methods.

570-3.1 General: Incorporate turf installation into the project at the earliest practical time. Shape the areas to be planted to the plan typical sections and lines and grade shown in the Contract Documents.

Except in areas where the Contract Documents requires specific types of grass to match adjoining private property, any species of grass designated in Section 981 may be used. Use the methods and materials necessary to establish and maintain the initial grassing until acceptance of the Contract work. All of the permanent grassing material shall be in place prior to final acceptance.

Complete all grassing on shoulder areas prior to the placement of the friction course on adjacent pavement unless otherwise directed by the Owner.

570-3.2 Seeding: At the Contractor's option, wildflower seed may be included in the turf seeding operation or performed separately from the turf seeding.

Use of compost meeting the requirements of Section 987 as mulch is acceptable unless otherwise specified.

570-3.3 Sod: Place the sod on the prepared surface, with edges in close contact. Do not use sod which has been cut for more than 48 hours.

Place the sod to the edge of all landscape areas as shown in the Plans and as shown in the FDOT Design Standards.

Place rolled sod parallel with the roadway and cut any exposed netting even with the sod edge. Monitor placed sod for growth of pest plants and noxious weeds. If pest plants and/or noxious weeds manifest themselves within 30 days of placement of the sod during the months April through October, within 60 days of placement of the sod during the months of November through March treat affected areas by means acceptable to the Owner at no expense to the Owner. If pest plants and/or noxious weeds manifest themselves after the time frames described above from date of placement of sod, the Engineer, at his sole option, will determine if treatment is required and whether or not the Contractor will be compensated for such treatment. If compensation is provided, payment will be made as unforeseeable work. Remove and replace any sod as directed by the Engineer.

570-3.4 Watering: Water all turf areas as necessary to produce a healthy and vigorous stand of turf. Ensure that water used for turf irrigation meets the requirements of Section 983.

570-3.5 Fertilizing: Fertilize as necessary based on soil testing performed in

accordance with Section 162. Refer to Section 982 for fertilizer rates.

For bid purposes, base estimated quantities on an initial application of 265 lbs/acre and one subsequent application of 135 lbs/acre of 16-0-8.

570-4 Turf Establishment.

Perform all work necessary, including watering and fertilizing, to sustain an established turf until final acceptance, at no additional expense to the Owner. Provide the filling, leveling, and repairing of any washed or eroded areas, as may be necessary.

Established turf is defined as follows:

1. An established root system (leaf blades break before seedlings or sod can be pulled from the soil by hand).

2. No bare spots larger than one square foot.

3. No continuous streaks running perpendicular to the face of the slope.

4. No bare areas comprising more than 1% of any given 1,000 square foot area.

5. No deformation of the turf areas caused by mowing or other Contractor equipment.

6. No exposed sod netting.

7. No pests or noxious weeds. Monitor turf areas and remove all competing vegetation, pest plants, and noxious weeds (as listed by the Florida Exotic Pest Plant Council, Category I "List of Invasive Species", Current Edition, <http://www.fleppc.org>). Remove such vegetation regularly by manual, mechanical, or chemical control means, as necessary. When selecting herbicides, pay particular attention to ensure use of chemicals that will not harm desired turf or wildflower species.

If at the time that all other work on the project is completed, but all turf areas have not met the requirements for established turf set forth in 570-4, continuously maintain all turf areas until the requirements for established turf set forth in 570-4 have been met.

During the entire establishment period and until turf is established in accordance with this specification, continue inspection and maintenance of erosion and sedimentation control items in accordance with Section 104. Take responsibility for the proper removal and disposal of all erosion and sedimentation control items after turf has been established.

Notify the Engineer, with a minimum of seven calendar days advance notice, to conduct inspections of the turf at approximate 90-day intervals during the establishment period to determine establishment. Results of such inspections will be made available to the Contractor within seven calendar days of the date of inspection. Determination of an established turf will be based on the entire project and not in sections.

Upon the determination by the Engineer that the requirements of 570-4 have been met and an established turf has been achieved and all erosion and sedimentation control items have been removed, the Engineer will release the Contractor from any further responsibility provided for in this Specification.

The Contractor's establishment obligations of this specification will not apply to deficiencies due to the following factors, if found by the Engineer to be beyond the control of the Contractor, his subcontractors, vendors or suppliers:

a. Determination that the deficiency was due to the failure of other features of the Contract.

b. Determination that the deficiency was the responsibility of a third party

performing work not included in the Contract or its actions.

570-5 Responsible Party.

For the purposes of this Specification, the Contractor shall be the responsible party throughout construction and establishment periods.

Upon final acceptance of the Contract, the Contractor's responsibility for maintenance of all the work or facilities within the project limits of the Contract will terminate; with the sole exception that the facilities damaged due to lack of established turf and the obligations set forth in this Specification for performance turf shall continue thereafter to be responsibility of the Contractor as otherwise provided in this Section.

570-6 Method of Measurement.

The quantities to be paid for will be plan quantity in square yards based on the area shown in the Plans, completed and accepted.

570-7 Basis of Payment.

Prices and payments will be full compensation for all work and materials specified in this Section.

**SECTION 700
ROADWAY SIGNING**

700-1 General Requirements.

700-1.1 Description: Furnish and erect roadway signs at the locations shown in the Plans and in accordance with the Broward County details shown in the Plans.

The Owner designates ground traffic signs as signs erected on the shoulders, slopes, or medians, but not extending over the traveled roadway, and may further classify these signs as single post or multi-column.

Meet the requirements of Section 603.

700-1.2 Materials:

700-1.2.1 General: Meet the materials requirements shown in the Specifications and FDOT Design Standards and any other requirements identified in the Plans.

700-1.2.2 Concrete: Use concrete meeting the requirements of Section 346.

700-1.2.3 Static Sign Assembly Requirements: All sign panels shall be aluminum unless otherwise shown in the Plans. Sheets and plates for sign panels shall meet the requirements of ASTM B209, Aluminum Association Alloy 6061-T6, 5154-H38 or 5052-H38. Sign panels for single column ground mounted signs shall utilize aluminum plate with a minimum thickness of 0.08 inches. All other sign panels shall utilize aluminum plate with a minimum thickness of 0.125 inches. All panels shall have rounded corners.

700-1.2.4 Retroreflective Sign Sheeting: Use signs that meet the material and process requirements of Section 994.

Use Type XI sheeting for all regulatory, warning and overhead signs. The R1-1, R1-2, R5-1 and R5-1a signs must use a sheeting system that includes a colorless film overlay. Type XI sheeting shall also be used for all limited access advance exit and exit guide signs.

Use Type IV yellow-green fluorescent sheeting for school S1-1, S3-1, S4-3, S4-5 and supplemental panels used with S1-1 signs. Do not mix signs having fluorescent yellow-green sheeting with signs having yellow retroreflective sheeting.

Roll-up signs shall meet the requirements of Type VI sheeting. Use Type IV sheeting for all other signs.

700-1.3 Storage, Handling and Labeling: If signs are stored prior to installation, store them in accordance with the manufacturer's recommendations. Properly package signs to protect them during storage, shipment and handling to prevent damage to the sign face and panel.

In addition to the information required in Section 994, all permanent roadway signs must be labeled on the back bottom edge with the date of installation. Make the labels unobtrusive, but legible enough to be easily read by an observer on the ground when the sign is in its final position. Apply the label in a manner that is at least as durable as the sign face.

700-1.4 Acceptance of Signs:

700-1.4.1 Sign Inspection: Provide certification that the sign assembly meets the material and installation requirements of the Contract. The Engineer will inspect the signs upon delivery to the storage or project site and again at the final construction inspection. Repair and replace signs deemed unacceptable by the Engineer at no expense to the Owner.

700-1.4.2 Imperfections and Repairs: Repair or replace signs containing imperfections or damage regardless of the kind, type, or cause of the imperfections or damage.

For sign panels exceeding 30 square feet, the Contractor may make one patch, if necessary, to each sign panel to exceed two square inches. Make repairs according to the manufacturer's recommendations and to the satisfaction of the Engineer. Ensure that completed repairs provide a level of quality necessary to maintain the service life of the sign and are satisfactory in appearance to the Engineer.

700-2 Static Signs.

700-2.1 Ground Mounted Signs: Ground mounted signs consist of both single column and multi-column static signs.

700-2.1.1 Materials: Use "Square Tube Sign Post" materials meeting the general provisions of the Broward County Public Works Department – Traffic Engineering Division.

700-2.1.2 Fabrication of Panel Messages: Fabricate standard sign panel messages in accordance with details included in the Standard Highway Signs (SHS) manual published by the U.S. Department of Transportation. Submit shop drawings to the Engineer for approval.

700-2.1.3 Foundation: Construct foundations in accordance with the applicable standards from the Broward County Public Works Department – Traffic Engineering Division.

700-2.1.4 Breakaway Support Mechanisms for Ground Traffic Signs:

700-2.1.4.1 Frangible Supports: Provide support posts for all frangible sign assemblies consisting of "Square Tube" in accordance with the requirements of the Broward County Public Works Department – Traffic Engineering Division.

700-2.1.4.2 Slip Bases: All slip bases must be fabricated in accordance with the requirements of the Broward County Public Works Department – Traffic Engineering Division.

700-2.1.5 Installation: Verify the length of the column supports in the field prior to fabrication to permit the appropriate sign mounting height. Fabricate the supports and wind beams in accordance with the applicable standards from the Broward County Public Works Department – Traffic Engineering Division. Columns must be plumb and panels must be level with the proper orientation.

700-2.2.5 Shop Drawings: Submit shop drawings to the Owner for approval.

Prior to the submittal of the shop drawings, determine the actual in- place dimensions for all sign structures on the basis of existing field conditions and include these on the shop drawings.

700-2.3 Method of Measurement: For single post and multi post sign assemblies, an assembly consists of all the signs mounted on a single structure. The Contract unit price per assembly for ground mounted signs (single post and multi-post), furnished and installed, will include furnishing the sign panels, support structure, foundation, hardware, and labor necessary for a complete and accepted installation.

Relocation of signs will consist of removing the existing sign assembly and installing the sign on a new foundation at the location shown in the Plans. When the Plans call for existing ground-mounted signs to be relocated or removed, after removing the sign panel from the assembly, remove supports and footings. Restore the area of the sign removal or relocation to the condition of the adjacent area.

700-2.4 Basis of Payment: Price and payment will be full compensation for all work specified in this Section.

SECTION 706 RAISED RETROREFLECTIVE PAVEMENT MARKERS AND BITUMINOUS ADHESIVE

706-1 Description.

Place raised retroreflective pavement markers (RPMs) and adhesive, which upon installation produces a positive guidance system to supplement other reflective pavement markings.

706-2 Materials.

Use only Class B markers unless otherwise shown in the Plans. Meet the requirements of Section 970.

706-2.1 Product Acceptance on the Project. Use only reflective pavement markers and bituminous adhesive that are listed on the FDOT's Approved Product List (APL).

Provide to the Engineer a manufacturer's certification conforming to the requirements of Section 6, which confirms that each product meets the requirements of this Section.

706-3 Equipment.

Use equipment having either thermostatically controlled double boiler type units utilizing heat transfer oil or thermostatically controlled electric heating pots to install hot applied bituminous adhesive. Do not use direct flame melting units with flexible adhesives; however, this type of unit may be used with standard adhesive in accordance with manufacturer's recommendations. Use a melter/applicator unit suited for both melting and pumping the adhesive through heated applicator hoses.

Heat the adhesive to between 375°F and 425°F and apply directly to the bonding surface from the melter/applicator by either pumping or pouring. Maintain the application temperature between 375°F and 425°F. The adhesive may be reheated. However, do not exceed the manufacturer's recommendations for pot life at application temperatures.

706-4 Application.

Apply RPMs to the bonding surface using bituminous adhesives only. The Engineer will conduct field testing in accordance with FM 5-566. Correct RPMs not applied in

accordance with these requirements at no cost to the Owner.

Prior to application of adhesive, clean the portion of the bonding surface of any material which would adversely affect the adhesive.

Apply the adhesive to the bonding surface (not the marker) so that 100% of the bonding area of the marker will be covered, in accordance with adhesive manufacturer's recommendations. Apply sufficient adhesive to ensure, that when the marker is pressed downward into the adhesive, adhesive will be forced out around the entire perimeter of the marker.

Immediately remove excess adhesive from the bonding surface and exposed surfaces of the RPMs. Soft rags moistened with mineral spirits meeting Federal Specifications TT-T-291 or kerosene may be used to remove adhesive from exposed faces of the RPMs. Do not use any other solvent. If any adhesive, pavement marking materials or other foreign matter adheres to the reflective face of the marker, replace the marker at no cost to the Owner.

Install RPMs with the reflective face of the RPM perpendicular to a line parallel to the roadway centerline.

Ensure that all final RPMs are in place prior to opening the road to traffic. If more than 2% of the RPMs fail in adhesion or alignment within the first 45 days under traffic, replace all failed markers at no expense to the Owner. If more than 5% of the markers fail in adhesion and or alignment during the initial 45 day period, the Engineer will extend the replacement period an additional 45 days from the date that all replacement markers have been installed. If, at the end of the additional 45 day period, more than 2% of all markers (initial installation and 45 day replacements combined) fail in adhesion or alignment, replace all failed markers at no expense to the Owner.

706-5 Contractor's Responsibility for Notification.

Notify the Engineer prior to the placement of RPMs. At the time of notification, indicate the manufacturer and the LOT numbers of RPMs and bituminous adhesive that are intended for use. Verify that the approved LOT numbers appear on the material packages. Furnish a test report to the Engineer certifying that the materials meet all requirements specified.

706-6 Method of Measurement.

The quantities to be paid for will be the number of RPMs, furnished and installed, completed and accepted.

706-7 Basis of Payment.

706-7.1 General: Price and payment will be full compensation for all work specified in this Section.

706-7.2 Unit Payment: Price and payment for retroreflective pavement markers will be for number of RPMs furnished and installed, completed and accepted.

SECTION 710

PAINTED PAVEMENT MARKINGS

710-1 Description.

Apply Painted Traffic Stripes and Markings, in accordance with the Contract Documents.

710-2 Materials.

Use only materials listed on the FDOT's Approved Product List (APL) meeting the following requirements:

Raised Retroreflective Pavement Markers and Bituminous Adhesive	Section 970
Standard Waterborne Fast Dry Traffic Paint	971-1 and 971-3
Fast Dry Solvent Paint	971-1 and 971-4
Glass Spheres	971-1 and 971-2

The Engineer will take random samples of all material in accordance with the Owner's Sampling, Testing and Reporting Guide schedule.

710-3 Equipment.

Use equipment that will produce continuous uniform dimensions of pavement markings of varying widths and meet the following requirements:

1. Capable of traveling at a uniform, predetermined rate of speed, both uphill and downhill, in order to produce a uniform application of paint and capable of following straight lines and making normal curves in a true arc.
2. Capable of applying glass spheres to the surface of the completed stripe by an automatic sphere dispenser attached to the striping machine such that the glass spheres are dispensed closely behind the installed line. Use a glass spheres dispenser equipped with an automatic cut-off control that is synchronized with the cut-off of the traffic paint and applies the glass spheres in a manner such that the spheres appear uniform on the entire pavement markings surface with, 50 to 60% embedment.
3. Capable of spraying the paint to the required thickness and width without thinning of the paint. Equip the paint tank with nozzles equipped with cut-off valves, which will apply broken or skip lines automatically.

710-4 Application:

710-4.1 General: Remove existing pavement markings, such that scars or traces of removed markings will not conflict with new pavement markings, by a method approved by the Engineer. Payment for marking removal will be in accordance with 102-5.8.

Before applying traffic stripes and markings, remove any material by a method approved by the Engineer that would adversely affect the bond of the traffic stripes.

Apply traffic stripes and markings only to dry surfaces, and when the ambient air and surface temperature is at least 40°F and rising. Do not apply traffic stripes and markings when winds are sufficient to cause spray dust.

Apply traffic stripes and markings, having well defined edges, over existing pavement markings such that not more than 2 inches on either end and not more than 1 inch on either side is visible. When stencils are used to apply symbols and messages, the areas covered by the stencil reinforcing will not be required to be painted.

Mix the paint thoroughly prior to pouring into the painting machine. Apply paint to the pavement by spray or other means approved by the Engineer.

Conduct field testing in accordance with FM 5-541. Remove and replace traffic stripes and markings not meeting the requirements of this Section at no additional cost to the Owner.

Apply all pavement markings prior to opening the road to traffic.

710-4.1.1 Final Surface: Painted pavement markings (final surface) will include two applications of standard painted pavement markings and one application of retroreflective pavement markers applied to the final surface. Wait at least 14 days after the first application to apply the second application of painted pavement markings (final surface). Second application must be applied prior to final acceptance of the project.

Apply all retroreflective pavement markers per the requirements of Section 706.

710-4.2 Thickness: Apply paint to attain a minimum wet film thickness in accordance with the manufacturer's recommendations.

710-4.3 Retroreflectivity: Apply white and yellow standard pavement markings that will attain an initial retroreflectance of not less than $300 \text{ mcd/lx}\cdot\text{m}^2$ and not less than $250 \text{ mcd/lx}\cdot\text{m}^2$, respectively. Measure, record and certify and submit to the Engineer, the retroreflectivity of white and yellow pavement markings in accordance with FM 5- 541.

The Owner reserves the right to test the markings within 3 days of receipt of the Contractor's certification. Failure to afford the Owner opportunity to test the markings will result in non-payment. The test readings should be representative of the Contractor's striping performance. If the retroreflectivity values measure below values shown above, reapply the striping at no additional cost to the Owner.

For standard pavement markings, ensure that the minimum retroreflectance of white and yellow pavement markings are not less than 150 mcd/lx m^2 . If the retroreflectivity values fall below the 150 mcd/lx m^2 value within six months of initial application, the striping will be reapplied at the Contractor's expense.

710-4.4 Color: Use paint material that meets the requirements of 971-1.

710-4.5 Glass Spheres: Apply glass spheres on all pavement markings immediately and uniformly following the paint application. The rate of application shall be based on the manufacturer's recommendation.

710-5 Tolerances in Dimensions and in Alignment.

Establish tack points at appropriate intervals for use in aligning stripes, and set a stringline from such points to achieve accuracy.

710-5.1 Dimensions:

710-5.1.1 Longitudinal Lines: Apply painted skip line segments with no more than plus or minus 12 inches variance, so that over-tolerance and under-tolerance lengths between skip line and the gap will approximately balance. Apply longitudinal lines at least 2 inches from construction joints of Portland cement concrete pavement.

710-5.1.2 Transverse Markings, Gore Markings, Arrows, and Messages: Apply paint in multiple passes when the marking cannot be completed in one pass, with an overall line width allowable tolerance of plus or minus 1 inch.

710-5.1.3 Contrast Lines: Use black paint to provide contrast on concrete or light asphalt pavement, when specified by the Engineer. Apply black paint in 10 foot segments following each longitudinal skip line.

710-5.2 Alignment: Apply painted stripes that will not deviate more than 1 inch from the stringline on tangents and curves one degree or less. Apply painted stripes that will not deviate more than 2 inches from the stringline on curves greater than one degree. Apply painted edge stripes uniformly, not less than 2 inches or more than 4 inches from the edge of pavement, without noticeable breaks or deviations in alignment or width.

Remove and replace at no additional cost to the Owner, traffic stripes that deviate more than the above stated requirements.

710-5.3 Correction Rates: Make corrections of variations in width at a maximum rate of 10 feet for each 0.5 inches of correction. Make corrections of variations in alignment at a maximum rate of 25 feet for each 1 inch of correction, to return to the stringline.

710-6 Contractor's Responsibility for Notification.

Notify the Engineer prior to the placement of the materials. Furnish the Engineer with the manufacturer's name and batch numbers of the materials and glass spheres to be used. Ensure that the approved batch numbers appear on the materials and glass spheres packages.

710-7 Protection of Newly Painted Pavement Markings.

Do not allow traffic onto or permit vehicles to cross newly applied pavement markings until they are sufficiently dry. Remove and replace any portion of the pavement markings damaged by passing traffic or from any other cause, at no additional cost to the Owner.

710-8 Corrections for Deficiencies to Applied Painted Pavement Markings.

Reapply a 1.0 mile section centered on any deficiency, at no additional cost to the Owner.

710-9 Submittals.

710-9.1 Submittal Instructions: Prepare a certification of quantities, using the Owner's current approved form, for each project in the Contract. Submit the certification of quantities and daily worksheets to the Engineer. The Owner will not pay for any disputed items until the Engineer approves the certification of quantities.

710-10 Method of Measurement.

The quantities to be paid for under this Section will be, as follows:

1. The length, in net miles, of 6 inch solid traffic stripe, authorized and acceptably applied.
2. The total traversed distance in gross miles of 10-30 or 3-9 skip line. The actual applied line is 25% of the traverse distance for a 1:3 ratio. This equates to 1,320 feet of marking per mile of single line.
3. The net length, in feet, of each of all other types of lines and stripes, authorized and acceptably applied.
4. The number of pavement messages, symbols and directional arrows, authorized and acceptably applied.
5. Lump Sum, as specified in 710-4.1.1 when the item for painted pavement markings (final surface) is included in the proposal.

The net length, in feet of dotted and skip stripes other than 10-30 and 3-9 will be measured as the distance from the beginning of the first painted stripe to the end of the last

painted stripe with proper deductions made for unpainted intervals as determined by plan dimensions or stations, subject to 9-1.3. Unpainted intervals will not be included in pay quantity.

The gross-mile measurement of 10-30 and 3-9 skip traffic stripes will be taken as the distance from the beginning of the first painted stripe to the end of the last painted stripe, and will include the unpainted intervals. It will not include any lengths of unpainted intervals which, by design or by other intent of the Owner, are greater than 30 feet. Final measurement will be determined by plan dimensions or stations, subject to 9-1.3.1.

710-11 Basis of Payment.

710-11.1 General: Prices and payments will be full compensation for all work specified in this Section, including, all cleaning and preparing of surfaces, furnishing of all materials, application, curing and protection of all items, protection of traffic, furnishing of all tools, machines and equipment, and all incidentals necessary to complete the work. Final payment will be withheld until all deficiencies are corrected.

710-11.2 Painted Pavement Markings: When the item for painted pavement markings (final surface) is included in the proposal, prices and payments will be full compensation for two applications of all painted pavement markings applied to the final surface, and one application of retroreflective pavement markers applied to the final surface in accordance with Section 706.

SECTION 711 THERMOPLASTIC TRAFFIC STRIPES AND MARKINGS

711-1 Description.

Apply new thermoplastic traffic stripes and markings, or refurbish existing thermoplastic traffic stripes and markings, in accordance with the Contract Documents.

711-2 Materials.

711-2.1 Thermoplastic: Use only thermoplastic materials listed on the FDOT's Approved Product List (APL). The Engineer will take random samples of all material in accordance with the Owner's Sampling, Testing and Reporting Guide schedule.

711-2.1.1 Initial or Recapped Stripes and Markings: Use materials meeting the requirements of 971-1 and 971-5.

711-2.1.2 Refurbishing Existing Stripes and Markings: Use materials meeting the requirements of 971-1 and 971-5.

711-2.1.3 Preformed Stripes and Markings: Use Materials meeting the requirements of 971-1 and 971-6.

711-2.2 Glass Spheres: Use only glass spheres listed on the APL, meeting the requirements of 971-1 and 971-2. The Engineer will take random samples of all glass spheres in accordance with ASTM D1214 and the Owner's Sampling, Testing and Reporting Guide schedule.

711-2.3 Sand: Use materials meeting the requirements of 971-5.4.

711-3 Equipment.

Use equipment capable of providing continuous uniform heating of striping materials to temperatures exceeding 390°F, mixing and agitation of the material reservoir to provide a homogeneous mixture without segregation. Use equipment that will maintain the striping material in a plastic state, in all mixing and conveying parts, including the line dispensing device until

applied. Use equipment which can produce varying width traffic stripes and which meets the following requirements:

(a) capable of traveling at a uniform, predetermined rate of speed, both uphill and downhill, in order to produce a uniform application of striping material and capable of following straight lines and making normal curves in a true arc.

(b) is capable of applying glass spheres to the surface of the completed stripe by a double drop application for initial traffic striping and marking and a single drop application for recapping and refurbishing. The bead dispenser for the first bead drop shall be attached to the striping machine in such a manner that the beads are dispensed closely behind with the thermoplastic material. The second bead dispenser bead shall be attached to the striping machine in such a manner that the beads are dispensed immediately after the first bead drop application. Glass spheres dispensers shall be equipped with an automatic cut-off control that is synchronized with the cut-off of the thermoplastic material and applies the glass spheres in a manner such that the spheres appear uniform on the entire traffic stripes and markings surface with, 50 to 60% embedment.

(c) Equipped with a special kettle for uniformly heating and melting the striping material. The kettle must be equipped with an automatic temperature control device and material thermometer for positive temperature control and to prevent overheating or scorching of the thermoplastic material.

(d) Meet the requirements of the National Fire Protection Association, state, and local authorities.

711-4 Application.

711-4.1 General: Remove existing pavement markings such that scars or traces of removed markings will not conflict with new stripes and markings by a method approved by the Engineer. Cost for removing conflicting pavement markings during maintenance of traffic operations to be included in Maintenance of Traffic, Lump Sum.

Before applying traffic stripes and markings, remove any material by a method approved by the Engineer that would adversely affect the bond of the traffic stripes. Before applying traffic stripes to any Portland cement concrete surface, apply a primer, sealer or surface preparation adhesive of the type recommended by the manufacturer. Offset longitudinal lines at least 2 inches from any longitudinal joints of Portland cement concrete pavement.

Apply traffic stripes or markings only to dry surfaces, and when the ambient air and surface temperature is at least 50°F and rising for asphalt surfaces and 60°F and rising for concrete surfaces.

Apply striping to the same tolerances in dimensions and in alignment specified in 710-5. When applying traffic stripes and markings over existing markings, ensure that no more than 2 inches on either end and not more than 1 inch on either side of the existing line is visible.

Apply thermoplastic material to the pavement either by spray, extrusion or other means approved by the Engineer.

Conduct field tests in accordance with FM 5-541. Take test readings representative of the striping performance. Remove and replace traffic stripes and markings not meeting the requirements of this Section at no additional cost to the Owner.

Apply all final pavement markings prior to opening the road to traffic.

711-4.1.1 Preformed Thermoplastic: Apply markings only to dry surfaces and when ambient air temperature is at least 32°F. Prior to installation, follow the manufacturer's recommendations for pre-heating.

711-4.2 Thickness:

711-4.2.1 Initial or Recapped Stripes and Markings: Apply or recap traffic stripes or markings such that all lane lines, center lines, transverse markings and traffic stripes and markings within traffic wearing areas, will have a thickness of 0.10 to 0.15 inch when measured above the pavement surface.

Also, all gore, island, and diagonal stripe markings, bike lane symbols and messages, wherever located, will have a thickness of 0.09 to 0.12 inch when measured above the pavement surface.

Measure, record and certify and submit to the Engineer, the thickness of white and yellow pavement markings in accordance with FM 5-541.

The Engineer will verify the thickness of the pavement markings in accordance with FM 5-541 within 30 days of receipt of the Contractor's certification.

711-4.2.2 Refurbishing Existing Traffic Stripes and Markings: Apply a minimum of 0.06 inch of thermoplastic material. Ensure that the combination of the existing stripe and the overlay after application of glass spheres does not exceed the maximum thickness of 0.150 inch for all lines. Measure, record and certify and submit to the Engineer, the thickness of white and yellow pavement markings in accordance with FM 5-541.

The Engineer will verify the thickness of the pavement markings in accordance with FM 5-541 within 30 days of receipt of the Contractor's certification.

711-4.3 Retroreflectivity: Apply white and yellow traffic stripes and markings that will attain an initial retroreflectivity of not less than $450 \text{ mcd/lx}\cdot\text{m}^2$ and not less than $350 \text{ mcd/lx}\cdot\text{m}^2$, respectively for all longitudinal lines. All transverse lines, messages and arrows will attain an initial retroreflectivity of not less than $300 \text{ mcd/lx}\cdot\text{m}^2$ and $250 \text{ mcd/lx}\cdot\text{m}^2$ for white and yellow respectively. All pedestrian crosswalks, bike lane symbols or messages in a proposed bike lane shall attain an initial retroreflectivity of not less than $275 \text{ mcd/lx}\cdot\text{m}^2$.

Measure, record and certify and submit to the Engineer, the retroreflectivity of white and yellow pavement markings in accordance with FM 5-541.

711-4.4 Glass Spheres:

711-4.4.1 Longitudinal Lines: For initial traffic striping and marking, apply the first drop of Type 4 or larger glass spheres immediately followed by the second drop of Type 1 glass spheres. For refurbishing, apply a single drop of Type 3 glass spheres. Apply reflective glass spheres to all markings at the rates determined by the manufacturer's recommendations.

711-4.4.2 Transverse Stripes and Markings: Apply a single drop of Type 1 glass spheres. Apply reflective glass spheres to all markings at the rates determined by the manufacturer's recommendations.

Apply a mixture consisting of 50% glass spheres and 50% sharp silica sand to all thermoplastic pedestrian crosswalk lines and bike lane symbols at the rates determined by the manufacturer's recommendations.

711-4.4.3 Preformed Markings: These markings are factory supplied with glass spheres and skid resistant material. No additional glass spheres or skid resistant material should be applied during installation.

711-5 Contractor's Responsibility for Notification.

Notify the Engineer prior to the placement of the thermoplastic materials. Furnish the Engineer with the manufacturer's name and batch numbers of the thermoplastic materials and glass spheres to be used. Ensure that the approved batch numbers appear on the thermoplastic

materials and glass spheres packages.

711-6 Protection of Newly Applied Traffic Stripes and Markings.

Do not allow traffic onto or permit vehicles to cross newly applied pavement markings until they are sufficiently dry. Remove and replace any portion of the pavement markings damaged by passing traffic or from any other cause, at no additional cost to the Owner.

711-7 Observation Period.

Longitudinal pavement markings are subject to a 180 day observation period under normal traffic. The observation period shall begin with the satisfactory completion and acceptance of the work.

The longitudinal pavement markings shall show no signs of failure due to blistering, excessive cracking, chipping, discoloration, poor adhesion to the pavement, loss of reflectivity or vehicular damage. The retroreflectivity shall meet the initial requirements of 711-4.3. The Owner reserves the right to check the retro reflectivity any time prior to the end of the observation period.

Replace, at no additional expense to the Owner, any longitudinal pavement markings that do not perform satisfactorily under traffic during the 180 day observation period.

711-8 Corrections for Deficiencies.

Recapping applies to conditions where additional striping material is applied to new or refurbished traffic stripes or markings to correct a deficiency. Recap a 1.0 mile section centered on the deficiency with additional striping material or by complete removal and reapplication at no additional cost to the Owner.

If recapping will result in a thickness exceeding the maximum allowed, the traffic stripes or markings will be removed and reapplied.

711-9 Submittals.

711-9.1 Submittal Instructions: Prepare a certification of quantities, using the Owner's current approved form, for each project in the Contract. Submit the certification of quantities and daily worksheets to the Engineer. The Owner will not pay for any disputed items until the Engineer approves the certification of quantities.

711-10 Method of Measurement.

The quantities to be paid for under this Section will be as follows:

- (a) The length, in net miles, of 6 inch solid traffic stripe, authorized and acceptably applied.
- (b) The total traversed distance in gross miles of 10-30 or 3-9 skip line. The actual applied line is 25% of the traverse distance, for a 1:3 ratio. This equates to 1,320 feet of marking per mile of single line.
- (c) The net length, in feet, of all other types of lines and stripes, authorized and acceptably applied.
- (d) The area, in square feet, of removal of existing pavement markings, acceptably removed.
- (e) The number of pavement messages, symbols and directional arrows, authorized and acceptably applied.

711-11 Basis of Payment.

Prices and payments will be full compensation for all work specified in this Section,

including, all cleaning and preparing of surfaces, furnishing of all materials, application, curing and protection of all items, protection of traffic, furnishing of all tools, machines and equipment, and all incidentals necessary to complete the work. Final payment will be withheld until all deficiencies are corrected.

SECTION 911 LIMEROCK MATERIAL FOR BASE AND STABILIZED BASE

911-1 General.

This Section governs materials to be used on construction of limerock base and limerock stabilized base.

911-2 Furnishing of Material.

Except as might be specifically shown otherwise, all limerock material and the sources thereof shall be furnished by the Contractor. Approval of mineral aggregate sources shall be in accordance with 6-2.3. Any limerock material occurring in State-furnished borrow areas shall not be used by the Contractor in constructing the base, unless permitted by the Plans or other Contract Documents.

911-3 Composition.

The minimum of carbonates of calcium and magnesium in the limerock material shall be 70%. The maximum percentage of water-sensitive clay mineral shall be 3%. Determination shall be at the option of the Engineer.

911-4 Liquid Limit and Plasticity Requirements.

911-4.1 Material for Limerock Base: The liquid limit shall not exceed 35 and the material shall be non-plastic.

911-4.2 Material Used in Limerock Stabilized Base: The liquid limit shall not exceed 35 and the plastic index shall not exceed 10.

911-5 Mechanical Requirements.

911-5.1 Deleterious Material: Limerock material shall not contain cherty or other extremely hard pieces, or lumps, balls or pockets of sand or clay size material in sufficient quantity as to be detrimental to the proper bonding, finishing, or strength of the limerock base.

911-5.2 Gradation and Size Requirements:

911-5.2.1 For Limerock Base: At least 97% (by weight) of the material shall pass a 3-1/2 inch sieve and the material shall be graded uniformly down to dust. The fine material shall consist entirely of dust of fracture. All crushing or breaking-up which might be necessary in order to meet such size requirements shall be done before the material is placed on the road.

911-5.2.2 For Limerock Stabilized Base: For this use, the limerock material shall meet the requirements of 911-5.2.1 except that 97% shall pass the 1-1/2 inch sieve.

911-6 Limerock Bearing Ratio Requirements.

Limerock material used in construction of limerock base shall have an average LBR value of not less than 100. The average LBR value of material produced at a particular source shall be determined in accordance with an approved quality control procedure.

**SECTION 916
BITUMINOUS MATERIALS**

916-1 Asphalt Cement.

The grades of asphalt cement shall conform to the requirements given in the following Table 1:

Table 1 ASPHALT		
Test	Conditions	Viscosity Grade
AC-5		
Viscosity - η	140°F [60°C]	500 ± 100 [50 ± 10 Pa·s]
Viscosity - cSt	275°F [135°C] _____	minimum 175 [0.000175m ² /s]
Penetration (0.1 mm)	77°F [25°C], 100 g, 5 seconds	minimum 140
Flash Point	COC	minimum 350°F [177°C]
Solubility	in Trichlorethylene	minimum 99.0%
Tests on Residue from Thin Film Oven Test:		
Viscosity Ratio	Visc. 140°F [60°C] after TFOT Visc. 140°F [60°C] before	maximum 4
Loss on Heating		maximum 1.0%
Ductility	77°F [25°C], 50 mm/minute	minimum 1,000 mm
AC-10		
Viscosity - η	140°F [60°C]	1,000 ± 200 [100 ± 20]
Viscosity -cSt	275°F [135°C] _____	minimum 250 [0.00025]
Penetration (0.1 mm)	77°F [25°C], 100 g, 5 seconds	minimum 80
Flash Point	COC	minimum 425°F [218°C]
Solubility	in Trichloroethylene	minimum 99.0%
Tests on Residue from Thin Film Oven Test:		
Viscosity Ratio	Visc. 140°F [60°C] after TFOT Visc. 140°F [60°C] before	maximum 4
Loss on Heating		maximum 0.5%
Ductility	77°F [25°C], 50 mm/minute	minimum 900 mm
AC-20		
Viscosity - η	140°F [60°C]	2,000 ± 400 [200 ± 40]
Viscosity -cSt	275°F [135°C]	minimum 300
Penetration (0.1 mm)	77°F [25°C], 100 g, 5 seconds	minimum 60
Flash Point	COC	minimum 450°F [230°C]
Solubility	in Trichlorethylene	minimum 99.0%
Test on Residue from Thin Film Oven Test:		
Viscosity Ratio	Visc. 140°F [60°C] after TFOT Visc. 140°F [60°C] before	maximum 4
Loss on Heating		maximum 0.5%
Ductility	77°F [25°C], 50 mm/minute	minimum 800 mm

		AC-30
Viscosity -	140°F [60°C]	3000 ± 600 [300 ± 60 Pa·s]
Viscosity -cSt	275°F [135°C]	minimum 350 [0.000350]
Table 1 ASPHALT		
Test	Conditions	Viscosity Grade
Penetration (0.1 mm)	77°F [25°C], 100 g, 5 seconds	minimum 50
Flash Point	COC	minimum 450°F [230°C]
Solubility	in Trichlorethylene	minimum 99.0%
Tests on Residue from Thin Film Oven Test:		
Viscosity Ratio	Visc. 140°F [60°C] after Visc. 140°F [60°C] before JT	maximum 4
Loss on Heating		maximum 0.5%
Ductility	77°F [25°C], 50 mm/minute	minimum 500 mm
Spot Test, when and as specified. (See note below.) Standard with Naphtha Solvent- Negative for all grades. Naphtha-Xylene Solvent- percent Xylene-Negative for all grades Heptane-Xylene Solvent- percent Xylene-Negative for all grades.		
Note: The use of the spot test is optional. When it is specified, the Engineer shall indicate whether the standard naphtha solvent, the naphtha-xylene solvent, or the heptane-xylene solvent will be used in determining compliance with this requirement, and also, in the case of xylene solvents, the percentage of xylene to be used.		

All hot bituminous mixtures (except recycled mixtures) must contain Viscosity Grade AC-30 as specified above.

For Viscosity Grade AC-30, silicone shall be added to the asphalt cement at the rate of 25 cm³ of silicone mixed to each 5,000 gallons [19 m³] of asphalt cement. If a dispersing fluid is used in conjunction with the silicone, the resultant mixture containing the full 25 cm³ shall be added, in accordance with the manufacturer's recommendation. The blending of silicone mixture with the asphalt cement shall be done by the producer prior to shipment.

Viscosity Grade AC-30 used in friction course mixes shall contain 0.5% heat-stable antistrip additive by weight of asphalt from an approved source. The antistrip additive shall be introduced and mixed into the asphalt cement at the asphalt terminal during loading or by the Contractor at the asphalt plant in a manner satisfactory to the Engineer.

Material failing to meet the viscosity requirements (140°F [60°C]) shown above will be paid for at reduced rates as shown in Table 2 below:

Table 2	
AC-5:	Percentage of Original Payment
Viscosity in poises at 140°F, [in Pa·s at 60°C]	
400 - 600 [40 - 60]	100%
375 - 399 or 601 - 625 [37 - 39 or 60 - 63]	90%
340 - 374 or 626 - 660 [34 - 36 or 64 - 66]	80%
Less than 340 [34] or greater than 660 [66]	*50%
AC-10:	Percentage of Original Payment
Viscosity in poises at 140°F, [in Pa·s at 60°C]	

800 - 1,200 [80 - 120]	100%
750 - 799 or 1,201 - 1,250 [75 - 79 or 120 - 125]	90%
680 - 749 or 1,251 - 1,320 [68 - 74 or 126 - 132]	80%
Less than 680 [68] or greater than 1,320 [132]	*50%

AC-20: Viscosity in poises at 140°F, [in Pa·s at 60°C]	Percentage of Original Payment
1,600 - 2,400 [160 - 240]	100%
1,500 - 1,599 and 2,401 - 2,500 [150 - 159 and 240 - 250]	90%
1,375 - 1,499 and 2,501 - 2,625 [138 - 149 and 251 - 263]	80%
Less than 1,375 [138] or greater than 2,625 [263]	*50%

AC-30: Viscosity in poises at 140°F, [in Pa·s at 60°C]	Percentage of Bid Price square yard or ton [square meter or metric]
2,400 - 3,600 [240 - 360]	100%
2,250 - 2,399 or 3,601 - 3,750 [225 - 239 or 360 - 375]	97%
2,075 - 2,249 or 3,751 - 3,925 [208 - 224 or 376 - 393]	94%
Less than 2,075 [208] or greater than 3,925 [393]	*86%

* May be removed and replaced at the discretion of the Engineer.

916-1.2 Sampling and Certification: The supplier shall furnish a certification indicating compliance with the above specifications, including silicone and antistrip when required, for all asphalt cements delivered to the project.

For each shipment delivered to the asphalt terminal, the asphalt supplier shall submit a certified test report to the Owner to include all properties specified for a particular grade of asphalt cement. The test results may be from a sample taken from the storage tank(s) after delivery or from a random sample taken from the barge or rail car(s).

All materials delivered to the project shall be identified by viscosity grade.

916-2 Recycling Agents.

916-2.1 Requirements: The asphalt recycling agent shall be an asphalt cement or an asphalt cement blended (as necessary) with a softening agent or flux oil, and shall meet the following requirements:

TABLE I

Absolute Viscosity, (V60) after TFOT (Thin Film Oven Test)	3:1 Ratio maximum
Smoke Point	260°F [125°C] minimum
Flash Point	400°F [205°C] minimum
Solubility.....	97.5% minimum

Emulsified recycling agent shall meet the following requirements:

TABLE II

Storage Stability- 24 hour	1.0% maximum
Sieve Test.....	0.1% maximum
Residue by Evaporation	65.0% minimum

Residue from the emulsified recycling agent shall meet the requirements in Table I. Recycling Agents may also be standard grade asphalt cements meeting the requirements of Table 1 in 916-1.1.

Silicone shall be added to the recycling agent at a rate of 25 cm³ for each 5,000 gallons [19 m³] of recycling agent. For emulsified recycling agent the silicone shall be added to the residue at the stated rate prior to emulsification. If a dispersing fluid is used in conjunction with the silicone, the resultant mixture containing the full 25 cm³ shall be added, in accordance with the manufacturer's recommendation. The blending of silicone mixture with the residue shall be done by the supplier prior to shipment.

The recycling agent, or emulsified asphalt recycling agent, shall contain 0.5% heat-stable antistripping additive by weight of asphalt from an approved source. The antistripping additive shall be introduced and mixed into the recycling agent, or emulsified recycling agent, at the terminal.

916-2.2 Sampling and Certification: The supplier shall furnish a certification indicating compliance with the above specification for all recycling agents or emulsified recycling agents delivered to the project.

For each shipment delivered to the asphalt terminal, the asphalt supplier shall submit a test report to the Owner to include all properties specified for a particular recycling agent or emulsified recycling agent. The test results may be from a sample taken from the storage tank(s) after delivery or from a random sample taken from the barge or rail car(s).

916-3 Cut-Back Asphalts.

916-3.1 Requirements: Rapid-curing, cut-back asphalt shall conform to the requirements of AASHTO M 81, except that the penetration range shall be from 60-120 instead of 80-120.

For Grade RC-3000, in addition to the requirements shown in Table 1 of AASHTO M 81 the following values shall be added to the requirements for Distillation Test:

Distillate, Percentage by Volume of	Grade RC-3000
to 320°F	0
to 374°F	10
to 437°F	40

All other requirements for the distillation test (and for other properties included in the table) shall be as shown in Table 1 of AASHTO M 81.

82. Medium-curing, cut-back asphalt shall conform to the requirements of AASTHO M

916-3.2 Sampling and Certification: For each tank of cut-back asphalt delivered to or prepared

at the asphalt terminal, the asphalt supplier shall submit a sample to the Owner for testing before use. A pretest number will then be assigned by the Owner which shall be furnished with all cut-back asphalt delivered to the project.

916-4 Emulsions.

916-4.1 Requirements: Anionic Emulsified Asphalt shall meet the requirements of AASHTO M

140 with the exception that the cement mix test will be waived when the asphalt is used in non-mix application, such as tack coats and primes. Cationic Emulsified Asphalt shall meet the requirements of AASHTO M 208. Additional emulsions permitted by specifications shall meet the following requirements:

**HIGH FLOAT
EMULSIONS**

Test	Conditions	Asphalt Emulsion Grade AE-60
		Minimum/Maximum
Tests on Emulsion:		
Saybolt Furol Visc	122°F [50°C]	75/400 seconds
Settlement	5 days (a)	maximum 5%
Storage Stability	24 hour (b)	maximum 1%
Sieve Test		maximum 0.10%
Demulsibility	50 mL CaCl ₂ 0.10 N	minimum 75%
Residue by Distillation		minimum 65%
Oil Portion	500°F. Dist. [260°C. Dist.]	maximum 1% by volume
Tests on Residue:		
Penetration (0.1 mm)	77°F [25°C], 100 g, 5 seconds	minimum 40
Absolute Viscosity	140°F [60°C]	minimum 3,200 poise [320 Pa·s]
Ductility	77°F [25°C], 50 mm/minute	minimum 400 mm
Float Test	140°F [60°C]	minimum 1,200 seconds
Solubility	in Trichlorethylene	minimum 97.5%

Test	Conditions	Asphalt Emulsion Grade AE-90
		Minimum/Maximum
Tests on Emulsion:		
Saybolt Furol Visc	122°F [50°C]	75/400 seconds
Settlement	5 days (a)	maximum 5%
Storage Stability	24 hour (b)	maximum 1%
Sieve Test		maximum 0.10%
Demulsibility	50 mL CaCl ₂ 0.10 N	minimum 75%
Residue by Distillation		minimum 65%
Oil Portion	500°F. Dist. [260°C. Dist.]	maximum 2% by volume
Tests on Residue:		
Penetration (0.1 mm)	77°F [25°C], 100 g, 5 seconds	minimum 70
Absolute Viscosity	140°F [60°C]	minimum 1,600 poise [160

Ductility	77°F [25°C], 50 mm/minute	minimum 400 mm
Float Test	140°F [60°C]	minimum 1,200 seconds
Solubility	in Trichlorethylene	minimum 97.5%

Test	Conditions	Asphalt Emulsion Grade AE-150 Minimum/Maximum
Tests on Emulsion:		
Saybolt Furol Visc	122°F [50°C]	75/400 seconds
Settlement	5 days (a)	maximum 5%
Storage Stability	24 hour (b)	maximum 1%
Sieve Test		maximum 0.10%
Demulsibility	50 mL CaCl ₂ 0.10 N	minimum 75%
Residue by Distillation		minimum 65%
Oil Portion	500°F. Dist. [260°C. Dist)]	maximum 3% by volume
Tests on Residue:		
Penetration (0.1 mm)	77°F [25°C], 100 g, 5 seconds	minimum 125
Absolute Viscosity	140°F [60°C]	minimum 800 poise [80 Pa·s]
Ductility	77°F [25°C], 50 mm/minute	minimum 400 mm
Float Test	140°F [60°C]	minimum 1,200 seconds
Solubility	in Trichlorethylene	minimum 97.5%

Test	Conditions	Asphalt Emulsion Grade AE-200 Minimum/Maximum
Tests on Emulsion:		
Saybolt Furol Visc	122°F [50°C]	minimum 45 seconds
Settlement	5 days (a)	maximum 5%
Storage Stability	24 hour (b)	maximum 1%
Sieve Test		maximum 0.10%
Demulsibility	50 mL CaCl ₂ 0.10 N	minimum 75%
Residue by Distillation		minimum 62%
Oil Portion	500°F. Dist. [260°C. Dist)]	maximum 8% by volume
Tests on Residue:		
Penetration (0.1 mm)	77°F [25°C], 100 g, 5 seconds	minimum 150
Absolute Viscosity	140°F [60°C]	minimum 400 poise [40 Pa·s]
Ductility	77°F [25°C], 50 mm/minute	
Float Test	140°F [60°C]	minimum 1,200 seconds
Solubility	in Trichlorethylene	minimum 97.5%

(a) The test requirement for settlement may be waived when the emulsified asphalt is used in less than five days.

(b) The 24-hour (one day) storage stability test may be used instead of the five day settlement test.

SPECIAL MS-		
Test	Conditions	Minimum/Maximum
Tests on Emulsion:		
Saybolt Furol Visc	77°F [25°C]	minimum 45 seconds
Storage Stability	24 hour	maximum 1%
Sieve Test	50 mL CaCl ₂ 0.10 N	maximum 0.10%
Demulsibility		minimum 65%
Residue by Distillation		minimum 62%
Naphtha Content	500°F. Dist. [260°C. Dist.]	maximum 8% by volume
Tests on Residue:		
Penetration (0.1 mm)	77°F [25°C], 100 g, 5 seconds	minimum 50
Ductility	77°F [25°C], 50 mm/minute	minimum 400 mm
Absolute Viscosity	140°F [60°C]	minimum 800 poise [80 Pa·s]
Solubility	in Trichloroethylene	minimum 97.5%
Maximum application temperature shall be 170°F [75°C].		

EMULSIFIED ASPHALT GRADE CRS-2H		
Test	Conditions	Minimum/Maximum
Tests on Emulsion:		
Saybolt Furol Visc.	122°F [50°C]	100/400 seconds
Settlement	5 days (a)	maximum 5%
Storage Stability	24 hour (b)	maximum 1%
Demulsibility	35 mL 0.8% Sodium Dioctyl Sulfosuccinate (c)	minimum 40%
Particle Charge		positive
Sieve Test		maximum 0.1%
Residue		minimum 65%
Tests on Residue:		
Penetration (0.1 mm)	77°F [25°C], 100 g, 5 seconds	80/140
Ductility	77°F [25°C], 50 mm/minute	minimum 400 mm
Solubility	in Trichloroethylene	minimum 97.5%
(a) The test requirement for settlement may be waived when the emulsified asphalt is used in less than five days.		
(b) The 24-hour (one day) storage stability test may be used instead of the five day settlement test.		
(c) The demulsibility test shall be made within 30 days from date of shipment.		

ASPHALT EMULSION PRIME (AEP)		
Test	Conditions	Minimum/Maximum
Tests on Emulsion:		
Saybolt Furol Visc.	77°F [25°C]	20/150 seconds
Settlement	5 days (a)	maximum 5%
Storage Stability	24 hour (b)	maximum 1%
Sieve Test		maximum 0.1%
Residue		minimum 55%
Naphtha Content	500°F. Dist [260°C. Dist.]	maximum 12% by volume
Tests on Residue:		
Penetration (0.1 mm)	77°F [25°C], 100 g, 5 seconds	40/200
Ductility	77°F [25°C], 50 mm/minute	minimum 400 mm
Solubility	in Trichloroethylene	minimum 97.5%
(a) The test requirement for settlement may be waived when the emulsified asphalt is used in less than five days.		
(b) The 24-hour (one day) storage stability test may be used instead of the five day settlement test.		

ASPHALT EMULSION GRADE RS-1		
Test	Conditions	Minimum/Maximum
Tests on Emulsion:		
Saybolt Furol Visc	77°F [25°C]	20/100 seconds
Storage Stability	24 hour	maximum 1%
Demulsibility	35 mL 0.02N CaCl ₂ (a)	minimum 60%
Sieve Test		maximum 0.10%
Residue by Distillation		minimum 55%
Naphtha Portion	500°F. Dist [260°C. Dist.](b)	maximum 3% by volume
Tests on Residue From Distillation Test:		
Penetration (0.1 mm)	77°F [25°C], 100 g, 5 seconds	minimum 60
Viscosity	140°F [60°C]	minimum 1,600 poise [160 Pa·s]
Ductility	77°F [25°C], 50 mm/minute	minimum 400 mm
Solubility	in Trichloroethylene	minimum 97.5%
(a) The demulsibility test shall be made within 30 days from the date of shipment.		
(b) When RS-1 has been modified to include naphtha, the 24-hour storage stability test will be waived.		

EMULSION PRIME (RS)		
Test	Conditions	Minimum/Maximum
Tests on Emulsion:		
Saybolt Furol Visc.	77°F [25°C]	minimum 75 seconds
Storage Stability	24 hour	maximum 1.0%
Sieve Test		maximum 0.1%
Naphtha Content		5/15% by volume
Residue		minimum 55%
Tests on Residue:*		
Penetration (0.1 mm)	77°F [25°C], 100 g, 5 seconds	minimum 50
Viscosity	140°F [60°C]	minimum 800 poise [80 Pa·s]
Solubility	in Trichloroethylene	minimum 97.5%
* Residue by distillation shall be in accordance with AASHTO T 59 except that the maximum temperature shall be 329 ± 10°F [165 ± 5°C] and the sample shall be maintained at this temperature for 20 minutes.		

EPR-1		
Tests	Conditions	Minimum/Maximum
Tests on Emulsion:		
Saybolt Furol Visc.	77°F [25°C]	6/24 seconds
Sieve Test (a)		maximum 0.1%
Residue by Distillation (b)		minimum 15%
Particle Charge Test (c)		positive
Tests on Residue: (d)		
Flash Point	COC	minimum 410°F [210°C]
Viscosity	cSt-140°F [60°C]	350/600 [0.00035/0.00060 m ² /s]
Aniline Point		85°/110°F [29°/43°C]
(a) Distilled water shall be used in place of 2% sodium oleate solution.		
(b) Residue by distillation shall be in accordance with AASHTO T 59 with the exception that a 50 g sample is heated to 300°F [149°C] until foaming ceases, then cooling immediately and calculating results.		
(c) Caution: this material has a positive particle charge, and therefore should not be mixed with materials having a negative particle charge.		
(d) Residue by distillation shall be in accordance with AASHTO T 59 except that the maximum temperature shall be 329 ± 10°F [165 ± 5°C] and the sample shall be maintained at this temperature for 20 minutes.		

916-4.2 Sampling and Certification: For each tank of emulsified asphalt delivered to or prepared at the asphalt terminal, the asphalt supplier shall submit a sample to the Owner for testing before use. A pretest number will then be assigned by the Owner which shall be furnished with all emulsified asphalt delivered to the project.

For all emulsion prime (EPR-1) delivered directly to the project for use, the supplier shall furnish a certification indicating compliance with all the specification requirements for EPR-1 Prime. When the EPR-1 is shipped to the Contractor in concentrated form, the supplier shall furnish a certification indicating compliance with all the specification requirements for EPR-1 Prime for each batch of material when blended with the appropriate amount of water. The Contractor shall blend the concentrate EPR-1 with the appropriate amount of water indicated by the supplier prior to use as a prime coat, and for each distributor load of material delivered to the project, shall furnish a certification indicating compliance with the supplier's requirements for blending along with a copy of the supplier's certification for the

concentrate. In the event that the diluted EPR-1 Prime is not used in a 12-hour period, the material shall be thoroughly mixed by circulation or other suitable means prior to its use.

SECTION 921 PORTLAND CEMENT AND BLENDED CEMENT

921-1 General.

Cement shall conform to the requirements of AASHTO M85 or AASHTO M240, as applicable, except as defined below or as specifically restricted in Section 346.

921-1.1 Type of Cement: Cement may be Types I, II, II (MH), III, IV, V (AASHTO M85), or IP, IP (MS), IS (AASHTO M240). Different brands of cement, cement of the same brand from different facilities, or different types of cement shall be stored separately and shall not be mixed.

921-1.2 Alkali Content: Only Portland cement containing a maximum of 0.60% alkali, or less, calculated as Na_2O (% Na_2O plus 0.658% K_2O), may be used with no further testing. When tests performed in accordance with ASTM C33 X1.3 on coarse and fine aggregate indicate the aggregate to be non-reactive to alkalis, cements exceeding 0.60% alkali is allowed.

921-1.3 Heat of Hydration: The cement heat of hydration for Type II (MH) shall be 88 cal/g or less at 7 days when tested in accordance with ASTM C186. For Type II (MH) used in mass concrete, the cement heat of hydration shall be 80 cal/g or less at 7 days when tested in accordance with ASTM C186.

921-2 Terminology.

The following definitions are applicable to the production and quality control of cement:

Source of Supply - indicates a cement supplier responsible for supplying the final product. Where the supplier has more than one manufacturing facility, the source of supply may be designated as the manufacturer/facility.

Approved Source - indicates a cement supplier, including but not limited to a plant, a terminal, or a transfer facility, that has been qualified by the State Materials Office. A list of Approved Cement Sources will be maintained by the State Materials Office.

Quality Control (QC) Plan Status - indicates quality control approval status, for each cement supplier and will be maintained by the State Materials Office in conjunction with the Approved Source List.

Purchaser - The term "purchaser" in the AASHTO Specifications shall be taken as the Owner or jurisdictional authority if applicable.

Approved Laboratory - indicates a laboratory acceptable to the State Materials Office which has been currently inspected by the Cement and Concrete Reference Laboratory (CCRL), is actively participating in their proficiency program and which has all deficiencies noted at the time of inspection corrected. The laboratory must also authorize CCRL to send copies of final inspection reports to the State Materials Office.

Mill Test Report - indicates a certification from the cement supplier identifying that the cement meets Section 921, the Type, the production period the sample represents and the chemical and physical analyses of the cement, and the silo numbers where the cement is stored. The mill test report must identify that there is limestone in the cement, if limestone is included.

An acceptable mill test report is found in the appendix of AASHTO M85.

921-3 Packing, Handling and Storing.

Cement may be delivered in bags or in bulk. The storage building, bin or silo shall be weatherproof and shall be located convenient to the work. On small jobs, storage in the open may be permitted by the Engineer in which case raised platforms and adequate waterproof coverings shall be provided.

921-4 Rejection.

The entire contents of the sack or bulk container which contains cement that does not meet the requirements of this Specification or has been damaged, is partially set, lumpy or caked shall be rejected.

Bagged cement which varies more than 5% from the designated weight, or if the average weight of 50 sacks, taken at random, is less than the designated weight, the cement shall be rejected.

921-5 Quality Control Plan.

921-5.1 General: The Quality Control Program of a cement supplier shall conform to Section 105.

921-5.2 Acceptance of Portland Cement: Portland cement from an approved source with a current QC Plan approval may be accepted on the basis of mill test reports meeting the requirements of the applicable AASHTO and FDOT Specifications and a delivery ticket printed on the producer's letterhead and traceable to the mill test report. Quality control testing shall be performed by an approved laboratory.

921-5.3 Cement Ownership and Responsibility: For purposes of QC Plan approval status, the cement supplier shall be responsible for cement quality until the cement is accepted by the concrete producer. Where the cement has been accepted by a concrete producer and is subsequently found deficient, the concrete plant QC Plan approval may be withdrawn with respect to further use of that cement and reinstated only when the deficiency is adequately resolved. Reinstatement is made by the State Materials Office.

921-5.4 Quality Control Plan Approval Control: The State Materials Office may withdraw QC Plan approval and may require cement shipments to be individually tested prior to incorporation. QC Plan approvals may be rescinded when the performance of cement is in question, including problems with concrete quality, inconsistent quality control data, or failure of quality control or verification test results. Discontinuance of approval may be based on testing at the point of use, testing by the manufacturer or proven poor performance of the cement in concrete.

921-5.5 Sampling of Cement: The verification samples may be taken at the manufacturer's plant, distribution facility or at the concrete production facility. Samples shall be obtained by one of the methods in FM 5-503. Samples shall be a minimum of 10 pounds in size. At the concrete production facility, cement samples shall be jointly obtained by the authorized Inspector and the concrete producer's representative.

SECTION 923 WATER FOR CONCRETE

923-1 General Requirements.

Water for use with cement shall be clear and free from oil, and injurious amounts of acid, alkali, chlorides, organic matter, and other deleterious substances. It shall not be salty or brackish. If it contains quantities of substances which discolor it or make it smell or taste unusual or objectionable or cause suspicion, it shall not be used unless approved by the Owner or other jurisdictional authority. Water sources permitted include potable water supplies that are approved by a public health department, open bodies of water, well water, reclaimed water, and recycled water. Reclaimed water shall be as defined in Chapter 62-610, F.A.C. Open bodies of water are defined as naturally occurring rivers, lakes, and ponds. Recycled water includes wash water from mixer washout operations (stored in a lined settling pond). All other sources of water not listed above shall be considered recycled and reclaimed water. Recycled and reclaimed may be used only to sprinkle the coarse aggregate stockpiles and for batching concrete meeting the requirements of Section 347.

923-2 Evaluation of Water for Concrete.

923-2.1 General: Water from potable water supplies approved by a public health department may be used without additional testing. The concrete producer shall provide test data of water samples from other sources. To determine chemical properties, use a laboratory accredited by the National Environmental Laboratory or Construction Materials Engineering Council Accreditation Program. To determine physical properties, use a laboratory accredited by the Construction Materials Engineering Council Accreditation Program or Cement and Concrete Reference Laboratory.

923-2.2 Initial Sampling and Testing Frequency: Open bodies of water and well water shall be initially sampled once prior to use. Recycled and reclaimed water shall be tested once per week for four weeks initially, and thereafter once per month for four months prior to its use, provided that the results of the test samples comply with all the applicable limits. Failing test results will result in restarting initial sampling and testing.

923-2.3 Production Sampling and Testing Frequency: Open bodies of water and recycled water shall be tested monthly. Well water and reclaimed water shall be tested once every three months. If the last eight consecutive well water and reclaimed water samples meet the requirements, then the sample frequency may be reduced to one sample every six months. If a well water or reclaimed water sample fails once the frequency has been reduced, then the sampling frequency shall revert back to once every three months.

923-3 Chemical Requirements.

923-3.1 Testing: All chemical analysis or tests shall be performed in accordance with the test methods listed in Tables 1 and 2 or Standard Methods for the Examination of Water and Wastewater.

923-3.2 Recycled and Reclaimed Water: Recycled and reclaimed water shall be tested before use and shall not exceed the limits in Table 1:

Table 1		
Chemical Test	Test Method	Maximum (%)
Total Solids	AASHTO T 26	5.00
Total Chlorides as Cl ⁻	ASTM D 512	0.031
Total Sulfates as SO ₄	ASTM D 516	0.30

923-3.3 Open Bodies of Water and Well Water: Open bodies of water and well water shall be tested before use and shall not exceed the limits of Table 2:

Table 2		
Chemical Test	Test Method	Maximum (%)
Acidity or Alkalinity Calculated in terms of Calcium Carbonate	AASHTO T 26	0.05
Total Organic Solids	AASHTO T 26	0.05
Total Inorganic Solids	AASHTO T 26	0.08
Total Chlorides as Cl ⁻	ASTM D 512	0.031
Total Sulfates as SO ₄	ASTM D 516	0.30

923-4 Physical Requirements for Mortar.

Mortar shall be tested in accordance with ASTM C 109 with the following exception: the mortar shall not be tested for flow. The mortar, composed of the sampled water, shall have a compressive strength of not less than 90% when compared to a mortar prepared using distilled water and tested at seven days.

Water of a questionable quality, shall be subject to the acceptance criteria for time of set as required by ASTM C 1602, Table 1.

**SECTION 925
CURING MATERIALS FOR CONCRETE**

925-1 Burlap.

Burlap for curing concrete shall consist either of two layers, each weighing 10 to 18 ounces/10 square feet, or of four layers, each weighing 6 to 7 ounces/10 square feet. Burlap which has been used as a container for sugar shall not be used. Burlap that is being used for the first time shall be thoroughly washed in order to remove starches used in sizing the material. Burlap shall be furnished in strips of at least 3 feet wide and shall be at least 3 feet longer than the width of surface to be covered.

925-2 Membrane-Forming Curing Compound.

925-2.1 General: Membrane-forming curing compound shall conform to requirements of ASTM C309 and the following requirements:

Requirement	Test Method	Test Value
Water Loss@72 hours	ASTM C156	0.55 kg/m ²
Deleterious Reaction with Concrete	ASTM C309	None
Reflectance	ASTM E1347	60% minimum*
Drying Time	ASTM C309	4 hours maximum

Non-Volatile Content	ASTM D1644 (Method A)	(informational)
Density, lbs/gal	ASTM D1475	(informational)
*Type 2 (White) compounds only.		

The membrane-forming curing compound shall be of a consistency suitable for spraying at temperatures prevalent at the time of application, and which forms a continuous, uniform film. It shall be free from precipitated matter caused by conditions of storage or temperature. Thoroughly agitate the curing compound in accordance with the manufacturer's recommendations prior to shipment from manufacturer's plant and prior to use at job site.

Curing compound delivered to the jobsite shall be in the manufacturer's original container and clearly labeled with the following information:

1. manufacturer's name
2. product name (trade name)
3. type
4. batch or LOT number
5. date of manufacture

925-2.2 Product Acceptance: Acceptance of membrane-forming curing compound shall be based on the product being listed on the jurisdictional authority's Approved Product List (APL).

925-2.2.1 Approved Product List: Manufacturers seeking evaluation of their product must submit an application in accordance with Section 6 and include product data sheets, material safety data sheets (MSDS) and certified test reports from an independent laboratory showing the product meets the requirements of this Section. Testing in accordance with the National Transportation Product Evaluation Program (NTPEP) Project Work Plan for the Laboratory QPL to APL change.

Testing of Liquid Membrane-Forming Compounds for Curing Concrete shall be acceptable as independent laboratory data. Include an Infrared Spectrophotometry (IR) Scan and a certification stating the nominal minimum percentage of non-volatile material for the product formulation. Deviation of the non-volatile material below this certified value shall be considered a change in formulation and shall be grounds for removal from the APL.

925-2.2.2 Certification: Prior to use, the Contractor shall provide the Engineer a certification from the manufacturer conforming to the requirements of Section 6 that the requirements of this Section are met.

925-2.3 Product Life: Store the curing compound in accordance with the manufacturer's recommendations. Curing compounds not used within one year of the date of manufacture shall not be incorporated into the work.

925-3 Sheet Materials.

925-3.1 General: Waterproof paper, polyethylene film and white burlap-polyethylene sheet, for curing concrete shall meet the requirements of ASTM C171, with the additional requirements for waterproof paper and for polyethylene film as shown below.

925-3.2 Additional Requirements for Waterproof Paper: The paper as prepared for use shall be in such dimensions that each unit as laid will extend at least 18 inches beyond the edges of the slab. If laid longitudinally, paper not manufactured in sizes which will provide this width shall be securely sewed or cemented together; the joints being sealed in such manner that they do not open up or separate during the curing period.

At the option of the Contractor, instead of the single longitudinal strip specified above, the blanket may be furnished in three strips; one strip being the neat width of the pavement, with two side strips.

925-3.3 Additional Requirements for Polyethylene Sheeting: The sheets, as prepared for use, shall be of such dimensions that each unit as laid will extend beyond the edges of the slab by at least twice the thickness dimension of the pavement edge, and the sheets shall overlap by at least 18 inches.

No sheet may be reused except after individual inspection and approval by the Engineer. Any sheets determined by the Engineer to be so damaged as to not afford the protection to the concrete in preventing moisture loss during the curing period will be rejected.

925-4 Certification.

For burlap or white burlap-polyethylene, the Contractor shall provide the Engineer a certification conforming to the requirements of Section 6 from the manufacturer confirming that the requirements of this Section are met. Each certification shall cover only one type of burlap or white burlap-polyethylene sheeting.

**SECTION 970
MATERIALS FOR RAISED RETROREFLECTIVE PAVEMENT
MARKERS AND BITUMINOUS ADHESIVE**

970-1 Raised Retro-Reflective Pavement Markers (RPM).

970-1.1 Composition: The marker shall consist of materials conforming to ASTM D4280.

970-1.2 Physical Requirements: The physical size of the RPM shall conform to the requirements of ASTM D4280. Laboratory and field samples for RPMs and bituminous adhesives shall meet the requirements of ASTM D4280 and include the following requirements:

The minimum area of each reflective face shall be 2.5 square inches.
The minimum base size shall be 12 square inches.

970-1.2.1 Designation of Marker Type, Color and Classification: The marker description shall be in order of type, color and reflective surface condition in accordance with ASTM D4280 and the following chart.

RPM Class			
Class	Description	Expected Normal Service	ASTM Surface Designation
A	Temporary marker	Up to six months	none
B	Permanent marker	Long life	H, hard abrasion resistant lens

970-1.3 Performance Requirements: The RPM shall meet the performance requirements specified in ASTM D4280, Section 6.2, for luminous intensity, flexural strength, compressive strength, resistance to cracking, and thermal cycling, as modified herein. Test method FM 5-566 will be used to evaluate marker performance.

970-1.3.1 Class A Markers: Meet the coefficient of luminous intensity requirements of ASTM D4280. Abrasion treatment is not required for Class A Markers.

970-1.3.2 Class B (Abrasion Resistant) Markers: Meet the coefficient of luminous intensity requirements of ASTM D4280 after abrasion. Each marker shall be marked as abrasion resistant by the manufacturer.

970-1.3.3 In-service Minimum Reflective Intensity: The Class B reflective pavement marker shall retain a minimum coefficient of luminous intensity for 18 months of not less than 30% of the values shown in Table 1 of ASTM D4280, and a minimum luminous intensity of 0.2 cd/fc at the end of two years.

970-1.4 Application Properties: Application properties shall meet the requirements of Section 706.

970-1.5 Packaging and Labeling: Shipment shall be made in containers which are acceptable to common carriers and packaged in such a manner as to ensure delivery is in perfect condition. Each package shall be clearly marked as to the name of the manufacturer, type, color, quantity enclosed and date of manufacture. Show the designation of the marker in accordance with ASTM D4280.

970-2 Bituminous Adhesive for Pavement Markers.
970-2.1 General: Bituminous adhesive as recommended by the marker manufacturer shall be used for bonding the markers to the pavement.

970-2.2 Specific Requirements for Bituminous Adhesives: The bituminous adhesive shall meet the properties of adhesives per ASTM D4280 Section A1, including filler-free and filler alone properties.

970-2.3 Performance Requirements: The performance of the adhesive shall be determined in accordance with the test methods listed in ASTM D4280.

925-5 Product Acceptance on the Project.

Acceptance will be made in accordance with the requirements of Section 706.

SECTION 971 TRAFFIC MARKING MATERIALS

971-1 General Requirements.

971-1.1 Packaging and Labeling: All traffic marking materials shall be shipped in strong containers plainly marked with the weight in pounds per gallon, the volume of traffic marking materials content in gallons, the color, user information, date of manufacture, batch and DOT code number. Each batch manufactured shall have a unique number. A true statement of the percentage composition of the pigment, the proportion of pigment to vehicle, and the name

and address of the manufacturer, also shall be shown. The label shall warn the user of any special handling or precautions of the material, as recommended by the manufacturer. Any package not so marked will not be accepted for use under these specifications.

Preformed thermoplastic materials and permanent tape products shall be marked with content, color, date of manufacture and batch number.

971-1.2 Storage: Any traffic marking materials, which although inspected and approved at the point of manufacture, hardens or livers in the containers so that it cannot be readily broken up with a paddle to a smooth, uniform painting consistency, will be rejected. All materials shall have a container storage life of one year from date of manufacture. Any traffic marking materials not acceptable for proper application will be rejected, even though it conforms to these Specifications in all other respects.

971-1.3 Mixing: All paints shall be delivered to the project completely mixed, and ready to be used without additional oil or thinner. Gasoline shall not be used for thinner under any circumstances.

971-1.4 Approved Product List (APL): All traffic marking materials shall be one of the products listed on the jurisdictional authority's Approved Product List (APL). Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6 accompanied by a copy of the infrared identification curve (2.5 to 15 μm) for the vehicle component. Products may only be used for applications recommended by the manufacturer. A notation of the number of coats and the thickness of each coat at which the product passes testing may be placed on the APL. When listed, this will be the minimum criteria for application of the traffic marking material.

971-1.5 Samples: Field samples will be obtained in accordance with the applicable Sampling, Testing and Reporting Guide Schedule.

971-1.6 Color: Materials other than yellow shall meet the color requirements as identified in 23 CFR 665 Table 5 Appendix to Part 655, Subpart F. Yellow materials for pavement markings shall meet the following performance requirements.

The initial daytime chromaticity for yellow materials shall fall within the box created by the following coordinates:

Initial Daytime Chromaticity Coordinates (Corner Points)

	1	2	3	4
X	0.530	0.510	0.455	0.472
Y	0.456	0.485	0.444	0.400

The nighttime chromaticity for yellow materials shall fall within the box created by the following coordinates:

Nighttime Chromaticity Coordinates (Corner Points)

	1	2	3	4
X	0.575	0.508	0.473	0.510
Y	0.425	0.415	0.453	0.490

971-1.7 Additional Requirements: Traffic marking materials shall be characterized as non-hazardous as defined by Resource Conservation and Recovery Act (RCRA) 40 CFR 261. Provide supporting independent analytical data or product material safety data sheets (MSDS) identifying any components listed in Table 1 of 40 CFR 261.24.

Additionally, retroreflective elements shall contain no more than 200 ppm by weight of lead or arsenic when tested in accordance with the Environmental Protection Agency (EPA) Testing Methods 3052, 6010B, and 6010C.

971-2 Glass Spheres.

971-2.1 General Requirements: Glass spheres shall be of a composition designed to be highly resistant to traffic wear and to the effects of weathering for the production of a reflective surface, creating night visibility of the pavement markings without altering day visibility of the marking. The general requirements of 971-1 apply to glass spheres.

971-2.2 Specific Properties: The large (Type 3 or larger) glass spheres used for drop on beads shall have an adhesion coating. Type 1 glass spheres used for drop on beads shall have a dual coating. Beads used in the intermix of materials are not required to be coated.

The following physical requirements apply:

Property	Test Method	Specification
Roundness*	ASTM D1155	Min: 70 % by weight
Roundness**	ASTM D1155	Min: 80% by weight
Refractive Index*	Becke Line Method (25+/-5C)	1.5 minimum
Refractive Index**	Becke Line Method (25+/-5C)	1.9 minimum
*Type 1, 3, 4 and 5 beads		
**High Index beads		

Sieve Size	Percent by Mass Passing Designated Sieve (ASTM D1214)				
	Grading Designation				
	Type 1 (AASHTO)	Type 3 (FP 96)	Type 4 (FP 96)	Type 5 (FP 96)	High Index
No. 8				100	
No. 10			100	95 - 100	
No. 12		100	95 - 100	80 - 95	
No. 14		95 - 100	80 - 95	10 - 40	
No. 16	100	80 - 95	10 - 40	0 - 5	100
No. 18		10 - 40	0 - 5	0 - 2	
No. 20	95 - 100	0 - 5	0 - 2		95 - 100
No. 25		0 - 2			
No. 30	75 - 95				55 - 85

Sieve Size	Percent by Mass Passing Designated Sieve (ASTM D1214)				
	Grading Designation				
	Type 1 (AASHTO)	Type 3 (FP 96)	Type 4 (FP 96)	Type 5 (FP 96)	High Index
No. 40					15 - 45
No. 50	15 - 35				0 - 5
No. 80					
No. 100	0 - 5				

Provide the Engineer Certified test reports from the manufacturer confirming that all glass spheres conform to the requirements of this Section.

971-2.3 Sampling:

971-2.3.1 Sampling: A random 50 pound sample of glass spheres shall be obtained for each 50,000 pound shipped. Upon arrival, the quantity of material will be reduced in a sample splitter to a size of approximately one quart by the Engineer, or one 50 pound unopened bag.

971-2.3.2 Containers: The spheres shall be furnished in new 50 pound moisture- proof bags. All containers shall meet ICC requirements for strength and type and be marked in accordance with AASHTO 247 Part 5.

971-3 Standard Waterborne Fast Dry Traffic Paint.

971-3.1 General: Standard waterborne fast dry traffic paints intended for use under this Specification shall include water reducible products that are single packaged and ready mixed. Upon curing, these materials shall produce an adherent, reflective pavement marking capable of resisting deformation by traffic. The material shall have the capability of being cleaned and flushed from the striping machines using regular tap water and any required rust inhibitors. The manufacturer shall have the option of formulating the material according to his own specifications. However, the requirements delineated in this Specification and Section 710 shall apply regardless of the type of formulation used. The material shall be free from all skins, dirt and foreign objects.

971-3.2 Composition:

Component	Test Method	Criteria
Total Solids, by weight	ASTM D2369	minimum 75%
Pigments, by weight	ASTM D3723	minimum 57%
Vehicle Solids % of Vehicle*		minimum 40%
TiO ₂ , Type II Rutile (white paint only)	ASTM D476	minimum 1.0 lb/gal
Volatile Organic Content, (VOC)	ASTM D3960	maximum 150 g/L

*Vehicle Solids % of Vehicle = $\frac{\% \text{ total solids} - \% \text{ pigment}}{100 - \% \text{ pigment}}$

971-3.3 Physical Requirements: The material shall meet the following criteria:

Property	Test Method	Minimum	Maximum
Density	ASTM D1475	13.5 ± 1.4 lb/gal	-
Viscosity at 77°F	ASTM D562	80 KU	100 KU
Fineness of Grind	ASTM D1210	3(HS)	
Dry Opacity at 5 mils WFT	ASTM D2805	0.92	-
Bleed Ratio	ASTM D969	0.95	-
Flexibility	ASTM D522 Method B	Pass	-
Abrasion Resistance	971-3.3.2	Pass	-

971-3.3.1 Set To Bear Traffic Time: The material shall set to bear traffic in not more than two minutes.

971-3.3.2 Abrasion Resistance: Test four samples per LOT using a Taber Abrader. The paint shall be applied to specimen plates using a drawdown blade having a clearance of 26 mils. Air dry each sample for 30 minutes and bake at 220°F for 18 hours. Clean with a soft brush and weigh each sample. Abrade samples for 1,000 cycles with 500 g weights and CS-10 wheels. Clean the samples with a soft brush and weigh again. The average weight loss for the four plates shall not exceed 50 mg per plate.

971-3.3.3 Retroreflectivity: The white and yellow pavement markings shall attain an initial retroreflectance of not less than 300 mcd/lx·m² and 250 mcd/lx·m². The retroreflectance of the white and yellow pavement markings at the end of the six month service life shall not be less than 150 mcd/lx·m².

971-3.4 Packaging and Labeling: The traffic paint shall be placed in 55 gallon open-end steel drums with a re-usable multi-seal sponge gasket. No more than 50 gallons of material shall be placed in any drum to allow for expansion during transport and storage.

971-4 Fast Dry Solvent Traffic Paint.

971-4.1 General: Fast dry traffic paints intended for use under this Specification shall include products that are single packaged and ready mixed. Upon curing, these materials shall produce an adherent, reflective pavement marking capable of resisting deformation by traffic. The manufacturer shall have the option of formulating the material according to his own specifications. However, the requirements delineated in this Specification and Section 710 shall apply regardless of the type of formulation used. The material shall be free from all skins, dirt and foreign objects.

971-4.2

Composition:

Component	Test Method	Criteria
Total Solids, by weight	ASTM D2369	75% minimum
Pigments, by weight	ASTM D3723	57% minimum
Vehicle Solids, % on Vehicle*		40% minimum
TiO ₂ , Type II Rutile (white paint only)	ASTM D476	1.5 lb/gal minimum
Volatile Organic Content, (VOC)	ASTM D3960	150 g/L maximum

971-4.3 Physical Requirements: The material shall meet the following criteria:

Property	Test Method	Minimum	Maximum
Density	ASTM D1475	13.5 ± 0.37 lb/gal	N/A
Viscosity at 77°F	ASTM D562	80 KU	100 KU
Fineness of Grind	ASTM D1210	3(HS)	
Dry Opacity at 5 mils WFT	ASTM D2805	0.92	-
Bleed Ratio	ASTM D969	0.95	-

Flexibility	ASTM D522 Method B	Pass	-
Abrasion Resistance	971-4.3.2	Pass	-

971-4.3.1 Set To Bear Traffic Time: The material shall set to bear traffic in not more than two minutes.

971-4.3.2 Abrasion Resistance: Test four samples per LOT using a Taber Abrader. The paint shall be applied to specimen plates using a drawdown blade having a clearance of 26 mils. Air dry each sample for 30 minutes and bake at 220°F for 18 hours. Clean with a soft brush and weigh each sample. Abrade samples for 1,000 cycles with 500 g and CS-10 wheels. Clean the samples with a soft brush and weigh again. The average weight loss for the four plates shall not exceed 50 mg per plate.

971-4.3.3 Retroreflectivity: The white and yellow pavement markings shall attain an initial retroreflectance of not less than 300 mcd/lx·m² and 250 mcd/lx·m², respectively. The retroreflectance of the white and yellow pavement markings at the end of the six month service life shall not be less than 150 mcd/lx·m².

971-4.4 Application Properties: Application properties shall meet the requirements of Section 710.

971-4.5 Packaging and Labeling: The traffic paint shall be placed in 55 gallon open-end steel drums with a re-usable multi-seal sponge gasket. No more than 50 gallons of material shall be placed in any drum to allow for expansion during transport and storage.

971-5 Thermoplastic Materials for Traffic Stripes.

971-5.1 General: Upon cooling to normal pavement temperature, these materials shall produce an adherent, reflective pavement marking capable of resisting deformation by traffic. The manufacturer shall utilize alkyd based materials only and shall have the option of formulating the material according to his own specifications. However, the requirements delineated in this Specification and Section 711 shall apply regardless of the type of formulation used. The pigment, glass spheres, and filler shall be well dispersed in the resin. The material shall be free from all skins, dirt and foreign objects.

971-5.2 Composition:

Component	Test Method	White	Yellow
Binder		20.0% minimum	20.0% minimum
TiO ₂ , Type II Rutile	ASTM D476	10.0% minimum	-
Glass Spheres	AASHTO T250	40.0% minimum	40.0% minimum
Yellow Pigment		-	% minimum per manufacturer
Calcium Carbonate and Inert Filler (-200 mesh sieve)		30.0% maximum	37.5% maximum

Percentages are by weight.

The alkyd/maleic binder must consist of a mixture of synthetic resins (at least one synthetic resin must be solid at room temperature) and high boiling point plasticizers. At

least one-half of the binder composition must be 100% maleic-modified glycerol of rosin and be no less than 15% by weight of the entire material formulation.

971-5.3 Glass Spheres: The glass spheres in the intermix shall consist of 50% Type 1 and 50% Type 3. Glass spheres shall meet the requirements of 971-2.

971-5.4 Sharp Silica Sand: Sharp silica sand used for bike lane symbols and pedestrian crosswalk lines shall meet the following gradation requirements:

Sieve Size	% Passing
20	100
50	0 to 10

971-5.5 Physical Requirements: Laboratory samples shall be prepared in accordance with ASTM D4960 and shall meet the following criteria:

Property	Test Method	Minimum	Maximum
Water Absorption	ASTM D570	-	0.5%
Softening Point	ASTM D36	195°F	-
Low Temperature Stress Resistance	AASHTO T250	Pass	-
Specific Gravity	Water displacement	1.9	2.3
Indentation Resistance	ASTM D7735* Type A Durometer	40	75
Impact Resistance	ASTM D256, Method A	1.0 N·m	-
Flash Point	ASTM D92	475°F	-

* The durometer and panel shall be at 115°F with a 1000 g load applied. Instrument measurement shall be taken after 15 seconds.

971-5.5.1 Set To Bear Traffic Time: The thermoplastic shall set to bear traffic in not more than two minutes.

971-5.5.2 Retroreflectivity: The white and yellow pavement markings shall attain an initial retroreflectance of not less than 450 mcd/lx·m² and not less than 350 mcd/lx·m², respectively. The retroreflectance of the white and yellow pavement markings at the end of the three year service life shall not be less than 150 mcd/lx·m².

971-5.6 Application Properties: Application properties shall meet the requirements of Section 711.

971-5.7 Packing and Labeling: The thermoplastic material shall be packaged in suitable biodegradable or thermo-degradable containers which will not adhere to the product during shipment and storage. The container of thermoplastic material shall weigh approximately 50 lb. The label shall warn the user that the material shall be heated in the range as recommended by the manufacturer.

971-6 Preformed Thermoplastic Materials for Traffic Stripes.

971-6.1 General: Upon cooling to normal pavement temperature, these materials shall produce an adherent, reflective pavement marking capable of resisting deformation by traffic. The manufacturer shall have the option of formulating the material according to his own specifications. However, the requirements delineated in this Specification and Section

711 shall apply regardless of the type of formulation used. The pigment, glass spheres, and filler shall be well dispersed in the resin. The material shall be free from all skins, dirt and foreign objects.

971-6.2 Composition: The preformed thermoplastic shall consist of high quality materials, pigments and glass spheres or other reflective material uniformly distributed throughout their cross-sectional area, with a reflective layer of spheres or other reflective material embedded in the top surface.

971-6.3 Glass Spheres: Material shall contain no less than 30% glass spheres by weight.

971-6.4 Color: Materials shall meet the performance requirements specified in 971-1 and the following additional requirements. The initial luminance factor, Cap Y, shall not be less than 55.

971-6.5 Physical Requirements: Laboratory samples shall be prepared in accordance with ASTM D4960 and shall meet the following criteria:

Property	Test Method	Minimum	Maximum
Softening Point	ASTM D36	195°F	-
Low Temperature Stress Resistance	AASHTO T250	Pass	-
Indentation Resistance	ASTM D7735* Type A Durometer	40	75
Impact Resistance	ASTM D256, Method A**	1.0 N·m	-

*The durometer and panel shall be at 115°F with a 1000 g load applied. Instrument measurement shall be taken after 15 seconds.
**The test specimen for ASTM D256 shall be 1 in. x 1 in. x 6 in. and shall not be notched.

971-6.5.1 Retroreflectivity: The white and yellow pavement markings shall attain an initial retroreflectance of not less than 300 mcd/lx·m². The retroreflectance of the white pavement markings at the end of the three year service life shall not be less than 150 mcd/lx·m². All pedestrian crosswalks, bike lane symbols and messages in a proposed bike lane shall attain initial retroreflectivity of not less than 275 mcd/lx·m².

971-6.5.2 Skid Resistance: The surface of the stripes and markings shall provide a minimum skid resistance value of 35 BPN (British Pendulum Number) when tested according to ASTM E303. Bike lane symbols and pedestrian crosswalks shall provide a minimum skid resistance value of 55 BPN.

971-6.6 Application Properties: Application properties shall meet the requirements of Section 711.

971-6.7 Packing and Labeling: The thermoplastic material shall be packaged in suitable biodegradable or thermo-degradable containers which will not adhere to the product during shipment and storage.

971-7 Permanent Tape Materials for Traffic Stripes and Markings.

971-7.1 General: The materials for pavement stripes and markings shall consist of white or yellow weather-resistant reflective film as specified herein. The pigment, glass spheres, and filler shall be well dispersed in the resin. However, the requirements delineated in

this Specification and Section 713 shall apply. The material shall be free from all skins, dirt and foreign objects.

971-7.2 Composition: The pavement stripes and markings shall consist of high-quality plastic materials, pigments, and glass spheres uniformly distributed throughout their cross-sectional area, with a reflective layer of spheres embedded in the top surface.

971-7.3 Skid Resistance: The surface of the stripes and markings shall provide a minimum skid resistance value of 35 BPN when tested according to ASTM E303. Bike lane symbols and pedestrian crosswalks shall provide a minimum skid resistance value of 55 BPN.

971-7.4 Thickness: The APL will list the specified thickness of each approved product.

971-7.5 Durability and Wear Resistance: When properly applied, the material shall provide neat, durable stripes and markings. The materials shall provide a cushioned resilient substrate that reduces sphere crushing and loss. The film shall be weather resistant and, through normal wear, shall show no significant tearing, rollback or other signs of poor adhesion.

971-7.6 Conformability and Resealing: The stripes and markings shall be capable of conforming to pavement contours, breaks and faults under traffic at pavement temperatures recommended by the manufacturer. The film shall be capable of use for patching worn areas of the same types of film in accordance with the manufacturer's recommendations.

971-7.7 Tensile Strength: The stripes and markings shall have a minimum tensile strength of 40 psi when tested according to ASTM D638. A rectangular test specimen 6 inches by 1 inch by 0.05 inches minimum thickness shall be tested at a temperature range of 40 to 80°F using a jaw speed of 0.25 inch/min.

971-7.8 Plastic Pull test: The stripes and markings shall support a dead weight of 4 lb for not less than five minutes at a temperature range of 70 to 80°F. Rectangular test specimen size shall be 6 inches by 1 inch by 0.05 inches minimum thickness.

971-7.9 Pigmentation: The pigment shall be selected and blended to provide a material which is white or yellow conforming to standard highway colors through the expected life of the stripes and markings.

971-7.10 Glass Spheres: The stripes and markings shall have glass retention qualities such that, when at room temperature a 2 inches by 6 inches specimen is bent over a 0.5 inch diameter mandrel axis, a microscopic examination of the area on the mandrel shall show no more than 10% of the spheres with entrapment by the material of less than 40%. The bead adhesion shall be such that spheres are not easily removed when the film surface is scratched firmly with a thumbnail.

971-7.11 Retroreflectivity: The permanent tape materials for traffic stripes and markings shall have a service life of five years. The materials shall attain an initial retroreflectance of not less than 450 mcd/lx·m² for white and contrast markings and not less than 350 mcd/lx·m² for yellow markings. The pavement stripes and markings shall retain a minimum retroreflectance for two years of not less than 300 mcd/lx·m² for white and contrast markings and not less than 250 mcd/lx·m² for yellow markings. The retroreflectance of the white, yellow and contrast pavement markings at the end of the five year service life shall not be less than 150 mcd/lx·m².

971-8 Two Reactive Component Materials For Traffic Stripes And Markings.

971-8.1 General: Two reactive component materials intended for use under this Specification shall include, but not be limited to, epoxies, polyesters and urethanes. Upon curing, these materials shall produce an adherent, reflective pavement marking capable of resisting deformation by traffic. The manufacturer shall have the option of formulating the material according to his own specifications. However, the criteria outlined in this Specification and Section 709 shall apply regardless of the type of formulation used. The material shall be free from all skins, dirt and foreign objects.

971-8. Composition:

Component	Test Method	Criteria
TiO ₂ , Type II Rutile (white material only)	ASTM D476	minimum 10% by weight
Volatile Organic Content, (VOC)	ASTM D3960	maximum 150 g/L

971-8.3 Physical Requirements: The material shall meet the following criteria:

Property	Test Method	Minimum	Maximum
Adhesion to Concrete	ASTM D4541, ASTM D7234 or ACI 503	Concrete Failure	-
Hardness	ASTM D7735 Type D	75	-
Abrasion Resistance	971-8.3.2	Pass	-

971-8.3.1 Set To Bear Traffic Time: The material shall set to bear traffic in not more than two minutes.

971-8.3.2 Abrasion Resistance: Test four samples per LOT using a Taber Abrader. The material shall be applied to specimen plates using a drawdown blade having a clearance of 26 mils. Air dry each sample for 30 minutes and bake at 220°F for 18 hours. Clean with a soft brush and weigh each sample. Abrade samples for 1,000 cycles with 500 g weights and CS-10 wheels. Clean the samples with a soft brush and weigh again. The average weight loss for the four plates shall not exceed 50 mg per plate.

971-8.3.3 Retroreflectivity: The white and yellow pavement markings shall attain an initial retroreflectance of not less than 450 mcd/lx·m² and not less than 350 mcd/lx·m², respectively. The retroreflectance of the white and yellow pavement markings at the end of the three year service life shall not be less than 150 mcd/lx·m².

971-8.4 Application Properties: Application properties shall meet the requirements of Section 709.

971-8.5 Packaging and Labeling: The two reactive component material shall be placed in 55 gallon open-end steel drums with a re-usable multi-seal sponge gasket. No more than 50 gallons of material shall be placed in any drum to allow for expansion during transport and storage. Other containers will be used for applicable products. Each container shall designate the color, generic type (e.g. epoxy), user information, manufacturer’s name and address, batch

number and date of manufacture. Each batch manufactured shall have a unique number. The label shall warn the user of hazards associated with handling or using the material.

971-9 Thermoplastic Material for Audible and Vibratory Traffic Stripes.

971-9.1 General: Upon cooling to normal pavement temperature, the thermoplastic material shall produce an adherent, reflective pavement marking capable of resisting deformation by traffic. The manufacturer shall utilize alkyd based materials only and shall have the option of formulating the material according to his own specifications. However, the requirements delineated in this Specification shall apply regardless of the type of formulation used. The pigment, reflective elements, and filler shall be well dispersed in the resin. The material shall be free from all skins, dirt and foreign objects.

971-9.2 Composition:

Component	Test Method	White	Yellow
Binder		20.0% minimum	20.0% minimum
TiO ₂ , Type II Rutile	ASTM D476	10.0% minimum	-
Reflective Elements	AASHTO T250	% minimum per manufacturer	% minimum per manufacturer
Yellow Pigment		-	% minimum per manufacturer
Calcium Carbonate and Inert Filler (-200 mesh sieve)		% minimum per manufacturer	% minimum per manufacturer

Percentages are by weight.

The alkyd/maleic binder must consist of a mixture of synthetic resins (at least one synthetic resin must be solid at room temperature) and high boiling point plasticizers. At least one-half of the binder composition must be 100% maleic-modified glycerol of rosin and be no less than 15% by weight of the entire material formulation.

971-9.3 Retroreflective Elements: The reflective elements in the intermix shall be determined by the manufacturer and identified for the APL.

971-9.4 Physical Requirements: Laboratory samples shall be prepared in accordance with ASTM D4960 and shall meet the following criteria:

Property	Test Method	Minimum	Maximum
Water Absorption	ASTM D570	-	0.5%
Softening Point	ASTM D36	210°F	-
Low Temperature Stress Resistance	AASHTO T250	Pass	-
Specific Gravity	Water displacement	1.9	2.3
Indentation Resistance	ASTM D7735* Type A Durometer	65	-
Impact Resistance	ASTM D256, Method A	1.0 N·m	-
Flash Point	ASTM D92	475°F	-

*The durometer and panel shall be at 80°F, with a 1000g load applied. Instrument measurement shall be taken after 15 seconds.

971-9.4.1 Set To Bear Traffic Time: When applied at the temperatures and thickness specified by Section 701, the baseline material shall set to bear traffic in not more

than two minutes. The audible bump shall set to bear traffic in not more than 10 minutes at ambient air temperatures of 80°F or less and in not more than 15 minutes for ambient air temperatures exceeding 80°F.

971-9.4.2 Retroreflectivity: The white and yellow pavement markings shall attain an initial retroreflectance of not less than 300 mcd/lx·m² and not less than 250 mcd/lx·m², respectively. The retroreflectance of the white and yellow pavement markings at the end of the three year service life shall not be less than 150 mcd/lx·m².

971-9.4.3 Durability: Durability shall include flattening of the profile or raised portions of the line. The flattening of the profile or raised portion of the line shall not exceed 25% at the end of the three year service life.

971-9.5 Application Properties: Application properties shall meet the requirements of Section 701.

971-9.6 Packing and Labeling: The thermoplastic material shall be packaged in suitable biodegradable or thermo-degradable containers which will not adhere to the product during shipment and storage. The container of thermoplastic material shall weigh approximately 50 lb. The label shall warn the user that the material shall be heated in the range as recommended by the manufacturer.

SECTION 983 WATER FOR GRASSING

The water used in the grassing operations may be obtained from any approved source. The water shall be free of any substance which might be harmful to plant growth. Effluent water shall meet all Federal, State and local requirements.

Sod shall be watered daily for 30 days upon installation, every other day for 60 days, and twice weekly thereafter. Sod and sodding soil mixture shall be watered to provide moisture to a depth of 3 inches upon installation, and for 1 to 2 weeks thereafter.

Sod shall be watered to avoid wilting. The contractor shall water the sod every 6 to 8 hours until the roots penetrate the sodding soil mixture, applying a quarter inch of water each time. Thereafter, the contractor shall water to maintain soil moisture and avoid wilting as required.

SECTION 990 TEMPORARY TRAFFIC CONTROL DEVICE MATERIALS

990-1 General.

This Section specifies the material requirements for temporary traffic control devices.

990-2 Retroreflective Sheeting for Temporary Traffic Control Devices.

990-2.1 Approved Product List (APL): Sheeting for use on Temporary Traffic Control Devices shall be one of the products listed on the Approved Product List (APL) or jurisdictional authority. Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6.

990-2.1.1 Sign Panels, Bands for Tubular Markers, Vertical Panels, Barricades and other Devices: Sign panels, bands for tubular markers, vertical panels,

barricades and other devices shall meet the requirements of ASTM D4956 for Type III or higher retroreflective sheeting materials identified in Section 994 except for mesh signs shall meet the color, daytime luminance and non-reflective property requirements of Section 994, Type VI.

990-2.1.2 Collars for Traffic Cones: Collars for traffic cones shall meet the requirements of ASTM D4956 Type VI.

990-2.1.3 Drums: Drums shall meet the requirements of ASTM D4956 for Type III or higher retroreflective sheeting materials identified in Section 994 including supplementary requirements for reboundable sheeting.

990-3 Portable Devices (Arrow Boards, Changeable Message Signs, Regulatory Signs, Radar Speed Display Units and Truck Mounted Changeable Message Signs).

990-3.1 General: All portable devices shall meet the physical display and operational requirements of the Manual on Uniform Traffic Control Devices (MUTCD) and be listed on the Approved Product List (APL). Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6 and include certification showing that the product meets the requirements of this Section.

1. Ensure that all assembly hardware less than 5/8 inch in diameter, including nuts, bolts, external screws and locking washers are Type 304 or 316 passivated stainless steel. Stainless steel bolts, screws and studs shall meet ASTM F593. Nuts shall meet ASTM F594. All assembly hardware greater than or equal to 5/8 inch in diameter shall be galvanized. Bolts, studs, and threaded rod shall meet ASTM A 307. Structural bolts shall meet ASTM A325.

2. The controllers and associated on-board circuitry shall meet the requirements of the Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise by Class A digital devices.

3. The controller and associated on-board circuitry shall not be affected by mobile radio, or any other radio transmissions.

4. An operator's manual shall be furnished with each unit.

5. All portable devices shall be permanently marked with the APL number, manufacturer's name or trademark, model/part number, and date of manufacture or serial number.

990-3.1.1 Electrical Systems:

990-3.1.1.1 Solar Powered Unit: The solar powered unit shall meet the following:

(a) The unit shall provide automatic recharging of power supply batteries to normal operating levels with meters showing charge.

(b) Solar array recovery time for arrow boards and regulatory signs shall be accomplished in a maximum of three hours.

(c) Arrow boards and changeable message signs shall be designed to provide 180 days of continuous operation with minimum onsite maintenance.

990-3.1.1.2 Battery Life Test: Meet the following:

(a) The photovoltaic unit shall be designed to provide 21 days of continuous operation without sunlight with a minimum of onsite maintenance for arrow boards and changeable message signs, or 10 days of continuous operation without sunlight with a minimum of onsite maintenance for regulatory signs and radar speed display units.

(b) The battery shall be equipped with a battery controller to prevent overcharging and over-discharging. An external battery level indicator shall be provided.

(c) The battery, controller, and power panel shall be designed to be protected from the elements and vandalism.

(d) Automatic recharging of power supply batteries shall be provided with charge indicator meter.

(e) An AC/DC battery charger unit shall be provided.

990-3.1.2 Display Panel and Housing:

(a) The display housing assembly shall be weather-tight.

(b) The display assembly shall be equipped with an automatic dimming operational mode capable of a minimum of 50% dimming and a separate manual dimmer switch

(c) The display panel background and frame for the display assembly shall be painted flat black and shall meet Federal Specification TT-E-489.

(d) The display panel for arrow boards and changeable message signs, when raised in the upright position, shall have a minimum height of 7 feet from the bottom of the panel to the ground, in accordance with the MUTCD. The display panel for radar speed display units, when raised in the upright position, will have a minimum height of 5 feet from the bottom of the panel to the ground.

(e) The regulatory speed sign panel for regulatory signs and radar speed display units, when raised in the upright position, shall have a minimum height of 7 feet from the bottom of the regulatory sign panel to the ground.

(f) The unit shall have an accessible mechanism to easily raise and lower the display assembly. A locking device shall also be provided to ensure the display panel will remain in the raised or lowered position.

990-3.1.3 Controller: The Controller shall meet the following:

(a) Controller and control panel shall be housed in a weather, dust, and vandal resistant lockable cabinet.

(b) Controller and associated on-board circuitry shall meet the requirements of the FCC Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise by Class A digital devices.

(c) For changeable message signs and arrow boards ensure that the sign control software provides an on-site graphical representation that visibly depicts the message displayed on the sign face

(d) For changeable message signs, if remote communication is included, ensure that the sign controller is addressable through the Ethernet communications network using software that complies with the National Transportation Communications for ITS Protocol (NTCIP) 1101 base standard, including all amendments as published at the time of contract letting, the NTCIP Simple Transportation Management Framework, and conforms to Compliance Level 1. Ensure that the software implements all mandatory objects in the supplemental

requirement SR-781-3-1, FDOT Dynamic Message Sign NTCIP Requirements, as published on the FDOT State Traffic Engineering and Operations Office web site at the time of contract letting. Ensure that the sign complies with the NTCIP 1102v01.15, 2101 v01.19, 2103v02.07, 2201v01.15, 2202 v01.05, and 2301v02.19 standards. Ensure that the sign complies with NTCIP 1103v02.17, section 3. Ensure that additional objects implemented by the software do not interfere with the standard operation of mandatory objects.

990-3.1.4 Support Chassis: The support chassis shall meet the following:

(a) The support chassis shall be self-contained and self-supporting without the use of additional equipment or tools.

(b) Both trailer and truck-mounted units are allowed for arrow boards and changeable message signs. Trailer mounted units are required for regulatory signs and radar speed display units.

(1) Trailer mounted unit:

- (a) The sign, power supply unit and all support systems shall be mounted on a wheeled trailer.
- (b) The trailer shall be equipped with Class A lights, using
- (c) The trailer shall be equipped with adjustable outrigger leveling pads, one on each of the four frame corners.
- (d) The trailer shall be designed to be set up at the site with its own chassis and outriggers, without being hitched to a vehicle.
- (e) The trailer shall be equipped with fenders over the tires and shall be made from heavy-duty material sufficient to allow a person to stand and operate or perform maintenance on the unit.
- (f) The trailer shall meet all equipment specifications set forth in Chapter 316 of the Florida Statutes, and by such rule, regulation or code that may be adopted by the Department of Highway Safety and Motor Vehicles.
- (g) The trailers should be delineated on a permanent basis by affixing retroreflective material, known as conspicuity material, in a continuous line on the face of the trailer as seen by oncoming road users.

990-3.2 Portable Arrow Board:

990-3.2.1 Arrow Board Matrix:

(a) The minimum legibility distance for various traffic conditions are based on the decision-sight distance concept. The minimum legibility distance is the distance at which a driver can comprehend the arrow board message on a sunny day or a clear night. The arrow board size that is needed to meet the legibility distance is listed as follows:

Type	Minimum Size	Minimum Number of Elements	Minimum Legibility Distance
B	30 by 60 inches	13	3/4 mile

Type	Minimum Size	Minimum Number of Elements	Minimum Legibility Distance
C	48 by 96 inches	15	1 mile

Type B arrow boards may be used on low to intermediate speed (0 mph to 50 mph) facilities or for maintenance or moving operations on any speed facility. Type C arrow boards shall be used for all other operations on high-speed (50 mph and greater) facilities and

may be substituted for Type B arrow boards on any speed facility.

(b) Devices shall meet all arrow board displays identified in the MUTCD.

(c) The element lens should be 5-3/4 inches in diameter. Smaller element lens diameters are permissible only if they provide an equivalent or greater brightness indication and meet the legibility criteria in 990-3.2.1(a).

(d) The color of the light emitted shall be in accordance with the MUTCD.

(e) There shall be a 360 degree hood for close-up glare reduction.

(f) For solar powered arrow boards the bulbs shall provide a 350 candle power intensity for day use and an automatic reduction or dimming capacity for night use. The dimmed night operation shall provide adequate indication without excessive glare.

(g) The flashing rate of the element shall not be less than 25 flashes or more than 40 flashes per minute as required in the MUTCD.

(h) The minimum element “on time” shall be 50% for the flashing arrow and 25% for the sequential chevron.

990-3.3 Portable Changeable Message Sign: 990-

3.3.1 Message Matrix:

(a) Message matrix panel shall be a maximum height of 7 feet by a maximum width of 10 feet.

(b) The matrix must be capable of displaying three lines of 8 characters using an 18 inch font that meets the height to width ratio and character spacing requirements in the MUTCD, Section 2L.04, paragraphs 05, 06, and 08.

(c) The matrix must display characters that meet or exceed the numeral and letter sizes prescribed in the MUTCD and SHS (Standard Highway Signs) companion document. Fonts and graphics must mimic the characteristics of fonts and graphics defined in NEMA TS4, the MUTCD, and SHS.

(d) For flip disk matrix signs, the disk elements shall be coated on the display side with a highly reflective florescent yellow Mylar material, and on the back with a flat black to blend in with the flat black background.

(e) Similar components shall be interchangeable.

990-3.3.2 Operation and Performance:

(a) The message shall be displayed in upper case except when lower case is project specific and is allowed by the MUTCD.

(b) The message matrix panel shall be visible from one-half mile and legible from a distance of 650 feet under both day and night conditions. Under variable light level conditions the sign shall automatically adjust its light source to meet the 650 feet visibility requirement. The message panel shall have adjustable display rates, so that the entire message can be read at least twice at the posted speed.

(c) The control panel shall have the capability to store a minimum 50 pre-programmed messages.

(d) The controller in the control panel shall be able to remember messages during non-powered conditions.

(e) The controller shall allow the operator to generate additional messages on site via the keyboard.

(f) For a portable changeable message sign using Flip-Disk technology, the controller shall have the capability to provide a stipulated default message upon loss of controller function.

(g) All messages shall be flashed or sequenced. In the sequence mode, the controller shall have the capability to sequence three line messages during one cycle.

990-3.4 Portable Regulatory Signs:

990-3.4.1 Sign Panel Assembly: The sign panel assembly shall consist of a 24 inches by 30 inches “SPEED LIMIT XX” sign panel and a “WHEN FLASHING” sign panel, intended to notify oncoming traffic the speed limit where workers are present. The sign panel assembly shall meet the following minimum physical requirements:

(a) The sign panel shall fold down and be pinned in place for towing. Maximum travel height shall be 80 inches.

(b) Construct the sign panel and light housing to allow the unit to be operated in the displayed position at speeds of 30 mph. Design the sign panel assembly to withstand transport speeds of 65 mph.

(c) Construct the sign panel such that, when in the raised position, the sign panel will have a height of 7 feet from the bottom of the lowest panel to the ground, in accordance with the MUTCD.

(d) Provide the unit with a mechanism to raise and lower the sign panel. Provide the unit with a device to lock the sign panel in the raised and lowered position.

990-3.4.2 Flashing Lights: Provide a pair of hooded PAR 46 LED advance warning flashing lamps on each side of the top of the sign panel. These lamps shall be visible day or night at a distance of one mile with a flash rate of approximately 55 flashes per minute.

The lamp lens should be at least 5-3/4 inches in diameter. Smaller diameter lens are permissible if they provide an equivalent or greater brightness indication and meet the legibility criteria above.

The color of the light emitted shall be in accordance with the MUTCD. For solar powered units, the bulbs shall provide a 350 candlepower intensity for day use and an automatic reduction or dimming capacity for night use. The dimmed night operation shall provide adequate indication without excessive glare.

990-3.5 Portable Radar Speed Display Unit:

990-3.5.1 Display Unit Panel and Housing: Meet the requirements of 990-3.1.2 and the following physical requirements as a minimum:

(a) Provide capability to mount a 24 inches by 30 inches regulatory sign with interchangeable numbers showing the posted speed limit above the message display.

(b) Provide legend “YOUR SPEED” either above or below the message display.

990-3.5.2 Message Display: The message display shall meet the following physical requirements as a minimum:

(a) Provide a bright LED, two-digit speed display on a flat black background with bright yellow LEDs.

(b) Each digit shall contain either a seven-segment layout or matrix-style design. Each digit shall measure a minimum 18 inches in height.

(c) Speed display shall be visible from a distance of at least one-half mile and legible from a distance of at least 650 feet under both day and night conditions.

(d) Display shall adjust for day and night operation automatically with a photocell.

990-3.5.3 Radar: The radar unit shall not be affected by normal radio transmissions and meet the following physical requirements as a minimum:

(1) Approach-Only sensor.

(2) Equipped with a low power K-Band transmitter.

(3) Part 90 FCC acceptance, 3 amps, 10.8 vdc to 16.6 vdc. Fuse and reverse polarity protected.

(4) Range of 1,000 feet for mid-size vehicle, capable of accurately sensing speeds of 10 mph to 99 mph with over speed function that operates when a vehicle approaches over the posted speed limit.

990-3.6 Truck Mounted Changeable Message Sign:

990-3.6.1 General: Truck mounted changeable message signs shall meet the physical display and operational requirements of the MUTCD and be listed on the APL.

a) Sign shall be secured on the vehicle for normal operation.
b) A fault light shall be located on rear of the sign and operate whenever the sign is displaying a message. The light shall flash at the same rate as the message being displayed.

c) An operator's manual shall be furnished with each sign.
d) The manufacturer name, model or part number, and date of manufacture or serial number shall be permanently affixed to the sign housing.

990-3.6.2 Display Panel and Housing:

a) The housing maximum size shall not exceed a width of 75 inches, a height of 48 inches, or a depth of 12 inches.

b) The housing shall be designed to withstand exposure to the elements and include a locking device to secure the housing from unauthorized entry.

c) Provisions (by convection or fan) shall be made for heat dissipation within the unit.

d) The message matrix panel background and frame for the dynamic message assembly shall be painted flat black, Federal Specification TT-E-489.

e) The face of the display shall be easily opened from the front. Faces that open up shall be locked to stay open far enough to allow for servicing of all message panel components.

f) The face of the sign shall be covered by an impact resistant polycarbonate face that aids against glare and includes an ultraviolet inhibitor to protect from fading and yellowing.

g) The display panel support structure, when raised in the upright position, shall be designed to allow for a minimum height of 7 feet from the bottom of the panel to the ground.

h) The unit shall have a manual and automatic control mechanism to raise and lower the display assembly. A locking device shall also be provided to ensure the display panel will remain in the raised or lowered position.

990-3.6.3 Message Matrix:

a) The matrix shall utilize light emitting diodes (LED).
b) LEDs used shall be amber (590 nm dominate wavelength) and shall meet the visibility requirements of this specification. LEDs shall have a viewing angle no less than 30 degrees. LED intensity shall not fall below 80 percent within three years.

c) All display modules shall be identical and interchangeable.
d) The matrix shall be capable of displaying a minimum of two lines of eight characters each, using a 10 inch font that meets the height to width ratio and character spacing requirements in the MUTCD, Section 2L.04 (paragraphs 05, 06, and 08) and

Section 6F.60, paragraph 15.

e) The matrix shall provide variable letter, graphic and symbol sizes from 10 to 36 inches. The matrix must display characters that meet or exceed the numeral and letter sizes prescribed in the MUTCD and SHS companion document. Fonts and graphics must mimic the characteristics of fonts and graphics defined in NEMA TS4, the MUTCD, and SHS.

990-3.6.4 Electrical System:

a) The power supply shall be a 12 V_{DC} system designed to operate the sign with a dedicated battery that is charged by the vehicle electrical system, but isolated so it does not drain the vehicle battery.

b) All internal sign components shall be treated with a protective, weather-resistant polyurethane or silicone conformal coating to protect against the adverse effects of humidity and moisture.

990-3.6.5 Sign Controller:

a) The sign controller shall be housed inside the sign and shall be equipped with a security lockout feature to prevent unauthorized use.

b) An external weather-resistant, hand-held control keypad shall be used to display the message on the sign.

c) The sign controller shall have the capability to provide a predetermined or blank default message upon loss of controller function.

990-3.6.6 Operation and Performance:

a) The message shall be displayed in upper case.

b) The message matrix panel shall be visible from one-half mile. With a 10 inch character displayed, the sign shall be legible from a distance of 400 feet in both day and night conditions. Under variable light level conditions, the sign shall automatically adjust its light source to meet the 400 foot visibility requirement.

c) The sign shall have the capability to store a minimum of 40 common messages and graphics of which a minimum of 30 shall be user-programmable messages.

d) All messages shall be capable of being flashed or sequenced. In the sequence mode, the message shall consist of no more than two phases, with each phase consisting of no more than three lines of text. Both message dwell time and message flash rate shall be individually programmable.

990-4 Removable Tape.

990-4.1 Composition: Removable tape shall be one of the products listed on the APL. The pavement stripes and markings shall consist of high quality plastic materials, pigments, and glass spheres or other retroreflective materials uniformly distributed throughout their cross-sectional area, with a reflective layer of spheres or other retroreflective material embedded in the top surface. No foil type materials shall be allowed.

990-4.2 Skid Resistance: The surface of the stripes and markings shall provide a minimum skid resistance value of 35 BPN (British Pendulum Number) when tested according to ASTM E303. Bike lane symbols and pedestrian crosswalks shall provide a minimum skid resistance value of 55 BPN.

990-4.3 Thickness: The APL will list the specified thickness of each approved product.

990-4.4 Durability and Wear Resistance: When properly applied, the material shall provide neat, durable stripes and markings. The materials shall provide a cushioned resilient

substrate that reduces sphere crushing and loss. The film shall be weather resistant and, through normal wear, shall show no significant tearing, rollback or other signs of poor adhesion. Durability is the measured percent of pavement marking material completely removed from the pavement. The pavement marking material line loss must not exceed 5.0% of surface area.

990-4.5 Conformability and Resealing: The stripes and markings shall be capable of conforming to pavement contours, breaks and faults under traffic at pavement temperatures

recommended by the manufacturer. The film shall be capable of use for patching worn areas of the same types of film in accordance with the manufacturer’s recommendations.

990-4.6 Tensile Strength: The stripes and markings shall have a minimum tensile strength of 40 psi when tested according to ASTM D638. A rectangular test specimen 6 inches by 1 inch by 0.05 inches minimum thickness shall be tested at a temperature range of 40°F to 80°F using a jaw speed of 0.25 inches per minute.

990-4.7 Elongation: The stripes and markings shall have a minimum elongation of 25% when tested in accordance with ASTM D638.

990-4.8 Plastic Pull test: The stripes and markings shall support a dead weight of 4 pounds for not less than five minutes at a temperature range of 70°F to 80°F. Rectangular test specimen size shall be 6 inches by 1 inch by 0.05 inches minimum thickness.

990-4.9 Adhesive: Precoat removable tape with a pressure sensitive adhesive capable of being affixed to asphalt concrete and Portland cement concrete pavement surfaces without the use of heat, solvents, and other additional adhesives or activators. Ensure that the adhesive does not require a protective liner when the removable tape is in rolled form for shipment. Ensure that the adhesive is capable of temporarily bonding to the roadway pavement at temperatures of 50°F and the above without pick-up distortion by vehicular traffic.

990-4.10 Color: Meet the requirements of 971-1.6.

990-4.11 Removability: Ensure that the manufacturer shows documented reports that the removable tape is capable of being removed intact or in substantially large strips after being in place for a minimum of 90 days and under an average daily traffic count per lane of at least 5,000 vehicles per day.

990-5 Temporary Retroreflective Pavement Markers.

Temporary retroreflective pavement markers (RPM’s) shall meet the requirement of 970-1.2.1, be one of the products listed on the APL and be certified as meeting the following:

(a) **Composition:** Use markers made of plastic, ceramic or other durable materials. Markers with studs or mechanical attachments will not be allowed.

(b) **Dimensions:** Marker minimum and maximum surface dimensions is based on an x and y axis where the y dimension is the axis parallel to the centerline and the x axis is 90 degrees to y.

The marker’s reflective face shall be completely visible and above the pavement surface after installation, measured from a line even with the pavement perpendicular to the face of the marker.

(c) **Optical Performance:** Ensure that the specific intensity of each white reflecting surface at 0.2 degrees observation angle shall be at least the following when the incident light is parallel to the base of the marker:

Horizontal Entrance Angle	Specific Intensity (SI)
0 deg.	3

20 deg.	1.2
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For yellow reflectors, the specific intensity shall be 60% of the value for white.
 For red reflectors, the specific intensity shall be 25% of the value for white. Reflectivity of all RPM's shall not be less than 0.2 specific intensity any time after installation.

(d) Strength requirements: Markers shall support a load of 5,000 pounds. Three markers per lot or shipment will be randomly tested as follows:

Position the marker base down, between the flat, parallel 0.5 inch steel plates of a compression testing machine. Place on top of the marker, a flat piece of 60 (Shore A) durometer rubber, 6 inches by 6 inches by 0.37 inches, centered on the marker. Apply the compressive load through the rubber to the top of the marker at a rate of 0.1 inches per minute.

Either cracking or significant deformation of the marker at any load less than 5,000 pounds will constitute failure.

(e) Adhesion: Use bituminous adhesive materials for bonding the markers to the pavement that meet the requirements of Section 970 and are listed on the APL.

(f) Removability: Ensure that the pavement marker is removable from asphalt pavement and Portland cement concrete pavement intact or in substantially large pieces, either manually or by mechanical devices at temperatures above 40°F, and without the use of heat, grinding or blasting.

990-6 Temporary Glare Screen.

990-6.1 Design and Installation: Manufactured glare screen systems may be modular or individual units listed on the APL and shall meet the following requirements:

(a) Glare screen units shall be manufactured in lengths such that when installed the joint between any one modular unit will not span barrier sections. Color shall be green, similar to Federal Color Standard 595-34227.

(b) Blades, rails and/or posts shall be manufactured from polyethylene, fiberglass, plastic, polyester or polystyrene, and be ultraviolet stabilized and inert to all normal atmospheric conditions and temperature ranges found in Florida.

(c) For paddle type designs, the blade width shall not be more than 9 inches. Blades or screen for individual or modular systems shall be 24 inches to 30 inches high and capable of being locked down at an angle and spacing to provide a cut-off angle not less than 20 degrees.

(d) For glare screen mounted on temporary barrier wall, a strip (6 inches by 12 inches) of reflective sheeting as specified in 994-2 shall be placed on a panel, centered in each barrier section (at a spacing not to exceed 15 feet) and positioned in such a manner as to permit total right angle observation by parallel traffic. When glare screen is utilized on temporary concrete barriers, warning lights will not be required.

(e) Prior to approval an impact test shall be performed by the manufacturer to verify the safety performance of the proposed system. The minimum impact strength of the posts, blades, rail and the barrier attachment design shall be sufficient to prevent the unit from separating from the barrier when impacted by a 3 inches outside diameter steel pipe traveling at 30 mph and impacting mid-height on the glare screen assembly.

(f) All hardware shall be galvanized in accordance with ASTM A123 or stainless steel in accordance with AISI 302/305.

Alternative designs for temporary glare screen may be submitted as a Cost Savings Initiative Proposal in accordance with 4-3.9.

990-7 Temporary Traffic Control Signals.

990-7.1 General: Temporary traffic control signals shall meet the physical display and operational requirements of conventional traffic signal described in the MUTCD for portable traffic signals and be listed on the APL. The standard includes but is not limited to the following:

(a) Use signal heads having three 12 inch vehicular signal indications (Red, Yellow and Green). Ensure there are two signal heads for each direction of traffic.

(b) The traffic signal heads on this device will be approved by the jurisdictional authority.

(c) Approved lighting sources will be installed in each section in accordance with the manufacturer's permanent directional markings, that is, an "Up Arrow", the word "UP" or "TOP," for correct indexing and orientation within a signal housing.

(d) The masts supporting the traffic signal heads will be manufactured with the lowest point of the vehicular signal head as follows:

(1) Eight feet above finished grade at the point of their installation for "pedestal" type application or

(2) Seventeen to 19 feet above pavement grade at the center of roadway for "overhead" type application.

(e) The yellow clearance interval will be programmed 3 seconds or more. Under no condition can the yellow clearance interval be manually controlled. It must be timed internally by the controller as per contract specifications.

(f) The green interval must display a minimum of 5 seconds before being advanced to the yellow clearance interval.

(g) The controller will allow for a variable all red clearance interval from 0 seconds to 999 seconds.

(h) Portable traffic control signals will be either manually controlled or traffic actuated. Indicator lights for monitoring the signal operation of each approach will be supplied and visible from within the work zone area.

(i) When the portable traffic control signals are radio actuated the following will apply:

(1) The transmitter will be FCC Type accepted and not exceed 1 watt output per FCC, Part 90.17. The manufacturer must comply with all "Specific limitations" noted in FCC Part 90.17.

(2) The Controller will force the traffic signal to display red toward the traffic approach in case of radio failure or interference.

(j) The trailer and supports will be painted construction/maintenance orange enamel in accordance with the MUTCD color.

(k) Ensure the certification number is engraved or labeled permanently on equipment.

(l) Ensure the device has an external, visible, water resistant label with the applicable Certification information.

990-7.2 Work Zone Signs: Provide steel flanged U-channel or square tube steel meeting the mechanical requirements of ASTM A499, Grade 60. For each U-channel or square tube, punch or drill 3/8 inch diameter holes on 1 inch centers through the center of the post, starting approximately 1 inch from the top and extending the full length of the post. Ensure that the weight per foot of a particular manufacturer's post size does not vary more than plus or minus 3.5% of its specified weight per foot. Taper the bottom end of the post for easier installation. Machine straighten the U-channel to a tolerance of 0.4% of the length. Use only non-corrosive metal, aluminum, or galvanized steel attachment hardware. Work zone sign systems shall be one of the products listed on the APL.

990-9 Temporary Raised Rumble Strips.

990-9.1 General: Temporary raised rumble strips shall meet the physical display and operational requirements in the MUTCD for temporary raised rumble strips and be listed on the APL. The temporary raised rumble strip may be either a removable polymer striping tape type or a molded engineered polymer material type as described below:

990-9.1.1 Removable Polymer Striping Tape:

Characteristic	Requirement
Composition:	Removable Polymer Striping Tape with pre-applied adhesive
Color:	White, Black or Orange
Cross-section:	0.25 in. to 0.50 in. (height) x 4 in. (wide)

990-9.1.2 Molded Engineered Polymer Material:

Characteristic	Requirement
Composition:	Molded Engineered Polymer Material
Weight	Internally ballasted to provide proper weight to maintain position in use without the use of adhesives or mechanical fasteners
Color:	White, Black or Orange
Shape	Beveled on the leading edge
Cross-section:	0.625 in. to 0.875 in. (height) x 12 in. (wide)

925-2 Automated Flagger Assistance Devices (AFAD).

990-10.1 General: AFAD's shall meet the physical display and operational requirements in the MUTCD and be listed on the APL.

990-10.1.1 Stop/Slow Automated Flagger Assistance Devices: Provide a Stop/Slow AFAD including a Stop/Slow sign that alternately displays the stop face and the slow face of a Stop/Slow paddle without the need for a flagger in the immediate vicinity of the AFAD or on the roadway.

Ensure that the Stop/Slow AFAD includes a gate arm that descends to a down position across the approach lane of traffic when the stop face is displayed and then ascends to an upright position when the slow face is displayed.

Ensure the gate arm is fully retro-reflectorized on both sides, with vertical alternating red and white stripes at 16 inch intervals measured horizontally in accordance with the MUTCD. When the arm is in the down position blocking the approach lane:

- A. The minimum vertical aspect of the arm and sheeting shall be 2 inches; and, being controlled.
- B. The end of the arm shall reach at least to the center of the lane.

990-10.1.2 Red/Yellow Lens Automated Flagger Assistance Devices: Provide a Red/Yellow Lens AFAD that alternately displays a steadily illuminated circular red lens and a flashing circular yellow lens to control traffic without the need for a flagger in the immediate vicinity of the AFAD or on the roadway.

Ensure that the Red/Yellow Lens AFAD includes a gate arm that descends to a down position across the approach lane of traffic when the steady circular red lens is illuminated and then ascends to an upright position when the flashing circular yellow lens is illuminated.

Ensure that the gate arm is fully retro-reflectorized on both sides, with vertical alternating red and white stripes at 16 inch intervals measured horizontally in accordance with the MUTCD. When the arm is in the down position blocking the approach lane:

- A. The minimum vertical aspect of the arm and sheeting shall be 2 inches and being controlled.
- B. The end of the arm shall reach at least to the center of the lane Do not provide a change interval

between the display of the steady circular red indication and the display of the flashing circular yellow indication. Provide a steady illuminated circular yellow indication, with at least a 5 second duration, between the transition from flashing circular yellow indication and the display of the steady circular red indication. The Engineer may approve a different duration, provided it falls within the range recommended by the MUTCD.

SECTION 994 RETROREFLECTIVE AND NON-REFLECTIVE SHEETING AND SIGN PANEL FABRICATION

994-1 Description.

994-1.1 General: This Section specifies the requirements for retroreflective and non-reflective sheeting and sign panel materials and fabrication. This includes the sign sheeting materials such as transparent and opaque process inks for retroreflective sheeting materials, vinyl and transparent overlays.

994-2 Retroreflective and Non-Reflective Sheeting Systems.

994-2.1 Materials: Retroreflective sheeting material will be classified in accordance with and meet the requirements of ASTM D4956. Overlay materials include colored and colorless transparent overlays and vinyl.

994-2.2 Approved Product List (APL): All sheeting, process inks and overlay materials will be listed as a system on the jurisdictional authority's Approved Product List (APL). Sign sheeting systems will consist of base sheeting with ink and/or overlay materials. Products with an ASTM classification of Type XI or greater will not be accepted for qualification on the APL for fluorescent orange, fluorescent yellow and fluorescent yellow-green. Manufacturers seeking evaluation of their products need to submit product data sheets, performance test reports from an independent laboratory showing the sign sheeting system meets the requirements of this Section, and an APL application in accordance with Section 6. Information on the APL application must include the individual materials comprising the sign sheeting system and identify colors, ASTM base sheeting classification, adhesive backing class, availability of transparent and/or opaque backing and availability of liner types. Submit an infrared identification curve (2.5 to 15 μm) for each color of ink.

994-2.3 Performance Requirements.

994-2.3.1 General: Sheeting, process inks and overlay materials must be tested in accordance with, and meet all the performance requirements of ASTM D4956, including Supplemental Requirement S2, Rebound able Sheeting Requirements, except as amended in this Section.

For performance requirements that are color dependent, each color included in the APL application must be tested and meet the requirements identified in ASTM D4956 or this Section as applicable. Purple sign sheeting materials must meet the color requirements as identified in the 23 CFR 665 Table 1 to Appendix to Part 655, Subpart F. All sign sheeting systems consisting of inks and/or overlays will be tested as a system consisting of white base sheeting and each color of ink and/or overlay.

Panels for testing sheeting must be prepared in accordance with 994-3 for testing. The in-service life for the sign sheeting system will equal the life of the reflective base sheeting of the system.

994-2.3.2 Retroreflective Intensity: The retroreflectivity of sheeting and sheeting systems must meet the minimum initial requirements as stated for all observation and entrance angles as identified in ASTM D 4956. The 0.2 and 0.5 degree observation angles with an entrance angle of minus 4 degrees per ASTM D4956 will be used for in-service requirements.

Rotational sensitivity shall be tested in accordance with AASHTO M268. Rotationally sensitive sheeting will be noted on the APL.

Type VI Sheeting	
Minimum Coefficient of Retroreflection (cd/foot-candle·ft ²)(cd/ft·ft ²)	
Observation/Entrance Angle (degree)	Fluorescent Pink
0.2/-4	160
0.5/-4	100
0.2/30	100
0.5/30	40

994-2.3.3 Colorless Overlay Films: Colorless overlay film is allowed for the purpose of improving color retention. These films must be compatible with the sign sheeting system and not delaminate or discolor for the in-service life of the system.

994-2.3.4 Color: The fluorescent pink initial color shall meet the following x, y chromaticity coordinates:

Fluorescent Pink	1	2	3	4
x	.450	.590	.644	.536
y	.270	.350	.290	.230

Fluorescent pink sheeting shall have a minimum luminance factor of 25.

994-2.3.5 Outdoor Weathering: Outdoor weathering exposure of sign sheeting systems will be in accordance with, and meet the requirements of ASTM D4956 for each system, color and classification. All testing will be conducted at an exposure location meeting the Tropical Summer Rain Climate Type (Miami, Florida or equivalent). Outdoor weathering is not required for Type VI fluorescent pink.

994-2.3.6 Packaging and Labeling.

Packaging and labeling must meet the requirements of ASTM D4956.

994-2.3.7 Samples.

Field samples will be obtained in accordance with the approved Sampling, Testing and Reporting Guide Schedule and on a random basis at the discretion of the Engineer.

994-3 Sign Panels.

994.3.1 Materials: For aluminum sheets and plates for sign panels, meet the requirements of ASTM B 209, Aluminum Association Alloy 6061-T6, 5154-H38 or 5052-H38 and those shown in the Plans.

994-3.2 Preparation of Sign Blanks.

994-3.2.1 De-greasing and Etching for Aluminum Sign Blanks:

994-3.2.1.1 General: Prior to the application of retroreflective sheeting, use any of the methods shown below to de-grease and etch the aluminum sign blanks.

994-3.2.1.2 Hand Method: Under this method, de-grease and etch the blanks in one operation, using steel wool (medium grade) with any of the following combinations of materials:

6. An abrasive cleanser of a commercial grade kitchen scouring Powder.
7. Acid and a suitable detergent solution.
8. An alkaline solution.

Thoroughly rinse the blanks with clean water following all hand de-greasing operations.

994-3.2.1.3 Power-Washer Method: Under this method, de-grease the blanks with an inhibited alkaline cleanser, by spraying for 90 seconds with the solution between 135 and 249°F, the exact temperature to be as recommended by the manufacturer of the cleanser. After the spraying, rinse the blanks with clean water. Then etch the blanks by immersing them in a 6 to 8% solution of phosphoric acid at a temperature of 100 to 180°F for 60 seconds. After immersion, rinse the blanks in clean water.

994-3.2.1.4 Immersion Method: Under this method, de-grease the blanks by immersing them in a solution of inhibited alkaline cleanser at a temperature between 160 and 180°F for three to five minutes, and then rinsing with clean water. Then etch blanks by immersing them in a 6 to 8% solution of phosphoric acid at a temperature of 100°F for three minutes. After immersion, rinse the blanks in clean water.

994-3.2.1.5 Vapor De-greasing Method: Under this method, de-grease the blanks by totally immersing them in a saturated vapor of trichloroethylene. Remove trademark printing with lacquer thinner or a controlled alkaline cleaning system.

994-3.2.1.6 Alkaline De-greasing Method: De-grease the blanks by totally immersing them in a tank containing an alkaline solution, controlled and titrated in accordance with the solution manufacturer's directions. Adapt immersion time to the amount of soil present and the thickness of the metal. After immersion, thoroughly rinse the blanks with running water.

994-3.2.1.7 Etching Method when De-greasing is Separate

Operation: If using either of the de-greasing methods described in this section, accomplish etching by one of the following alternate methods:

- Acid Etch: Etch well in a 6 to 8% phosphoric acid solution at 100°F, or in a proprietary acid etching solution. Rinse thoroughly with running cold water, which may be followed by a hot water rinse.
- Alkaline Etch: Etch aluminum surfaces in an alkaline etching material that is controlled by titration. Meet the time, temperature, and concentration requirements specified by the solution manufacturer. After completing etching is complete, rinse the panel thoroughly.

994-3.2.1.8 Chromate Coating: Before applying retroreflective sheeting to the aluminum, treat the aluminum sign surfaces with chromate conversion coating. Coating may consist of an organic or inorganic chromate material. Coatings shall be applied according to the manufacturer's instructions and shall conform to ASTM B449, Class 2.

994-3.3 Drying: Dry the panels using a forced-air drier. Use a device or clean canvas gloves, to handle the material between all cleaning and etching operations and the application of retroreflective sheeting. Do not allow the metal to come in contact with greases, oils or other contaminants prior to the application of retroreflective sheeting.

994-3.4 Fabrication of Sign Blanks: Fabricate all metal parts to ensure a proper fit of all sign components. Complete all fabrication, with the exception of cutting and punching of holes, prior to metal de-greasing and applying the retroreflective sheeting. Cut metal panels to size and shape and keep free of buckles, warp, dents, burrs, and defects resulting from fabrication. Use aluminum sheets with increments of 4 feet in width; except, for sign widths that are not multiples of 4 feet. A maximum of two panels may be cut to less than 4 feet, and no panel may be cut to less than one foot. Mount aluminum sheets vertically and provide backing strips a vertical joints to keep the abutting sheets in proper alignment.

Ship all multi-panel signs to the project intact, completely assembled and ready to be installed. Fabricate signs taller than 10 feet as two separate signs with a horizontal splice, ready to be spliced and installed.

994-3.5 Fabrication of Retroreflective Sign Faces.

994-3.5.1 General: Fabricate signs with sign sheeting systems listed on the APL meeting the requirements in Section 700, FDOT Design Standards and Plans.

994-3.5.2 Application of Sheeting: Apply retroreflective sheeting to the base panels with mechanical equipment in a manner specified for the manufacture of traffic control signs by the sheeting manufacturer. For sheeting that has been identified as rotationally sensitive, apply white sheeting for cut-out legends, symbols, borders and route marker attachments within the parent sign face at the optimum rotation angle according to the identification markings. Apply all background sheeting at a uniform rotational angle. The retroreflective sheeting for each sign will be from the same roll or lot number. Apply consecutively alternate successive width sections of either sheeting or panels to ensure that corresponding edges of sheeting lie adjacent on the finished sign. If the sign cannot be constructed from retroreflective sheeting from the same roll or lot number, the fabricator may color match from a different lot; the color between the rolls cannot exceed three ΔE 's using test method ASTM D 2244. The Engineer will not accept nonconformance that may result in non-uniform shading and an undesirable contrast between adjacent widths of applied sheeting or non-optimum retroreflectivity in the finished sign and installation.

Sheeting is to be trimmed at 45 degree angle from the edge of each panel. Finish signs by sealing sheeting splices and sign edges according to sign manufacturer recommendations.

994-3.5.3 Direct and Reverse Screen Processing: Screen message and borders on retroreflective sheeting in accordance with the recommendations of the ink or overlay manufacturer. Process messages either before or after applying the sheeting to the base panels.

The transparent and opaque process inks furnished for direct and reverse screen processing shall be of a type and quality formulated for retroreflective sheeting materials as listed on the APL and applied in accordance with the manufacturer's instruction. Screen processing in accordance with the techniques and procedures recommended by the manufacturer must produce a uniform legend of continuous stroke width of either transparent or opaque ink, with sharply defined edges and without blemishes on the sign background that will affect the intended sign use.

994-3.5.4 Finished Sign Face: Provide finished signs with properly aligned clean cut and sharp messages and borders. Fabricated signs must be free of wrinkles, bubbles,

foreign matter, scratches, free of patches, or other visually identifiable defects. Ensure that finished background panels are essentially a plane surface.

994-3.5.5 Packaging and Labeling: For permanent roadway signs, label the back of all finished panels at the bottom edge with the date of fabrication, sign sheeting system manufacturer, Type, and the fabricator's initials. Make the labels unobtrusive, but legible enough to be easily read by an observer on the ground when the sign is in its final position. Apply the label in a manner that is at least as durable as the sign face.

Properly package signs to protect them during storage, shipment and handling to prevent damage to the sign face and panel.