

# **SPECIFICATIONS & SPECIAL PROVISIONS**

**FOR**

**COUNTY 15<sup>TH</sup> STREET – AVENUE A  
INTERSECTION IMPROVEMENT PROJECT**

**CIP NO. 1.9915E**



**07/30/2020**

**YUMA COUNTY DEPARTMENT OF ENGINEERING**

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# TABLE OF CONTENTS

## COUNTY 15<sup>TH</sup> STREET – AVENUE A INTERSECTION IMPROVEMENT PROJECT CIP NO. 1.9915E

THE SPECIFICATIONS CONTAIN:

### **PROPOSAL PAMPHLET** (Bound Separately)

- Project Name, Location, and General Description
- Advertisement for Bids
- Information for Bidders
- Receipt Acknowledgement Form
- Proposal Kit
  - Proposal
  - Bid Schedule
  - Bid Surety Bond
  - Non-Collusion Affidavit
  - Bidder's Participation, Subcontractor and Supplier List
- Contract Kit
  - Contract
  - Contract Performance Surety Bond
  - Labor and Materials Surety Bond
  - Certificate of Insurance
- Contractor's Affidavit Regarding Settlement of Claims

### **PUBLIC WORKS STANDARDS FOR YUMA COUNTY, VOLUME I** August 1998 (Separate Publication)

IN ITS ENTIRETY INCLUDING CONSTRUCTION STANDARDS

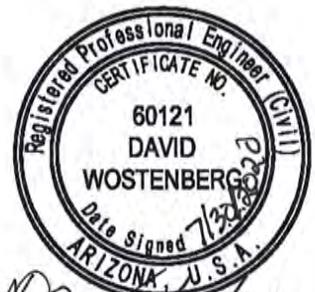
### **PUBLIC WORKS STANDARDS, FOR YUMA COUNTY VOLUME II** July 1993 (Separate Publication)

IN ITS ENTIRETY INCLUDING ALL GENERAL CONDITIONS AND TECHNICAL SPECIFICATIONS

### **ADOT STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION,** 2008 Current Edition (Stored Specifications).

## SPECIAL PROVISIONS

SECTION 102	BIDDING REQUIREMENTS AND CONDITIONS
SECTION 103	AWARD AND EXECUTION OF CONTRACT
SECTION 104	SCOPE OF WORK
SECTION 105	CONTROL OF WORK
SECTION 106	CONTROL OF MATERIALS
SECTION 107	LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC
SECTION 108	COMMENCEMENT, PROSECUTION AND PROGRESS
SECTION 109	MEASUREMENTS AND PAYMENTS
SECTION 201	CLEARING & GRUBBING
SECTION 202	REMOVAL OF STRUCTURES & OBSTRUCTIONS
SECTION 205	ROADWAY EXCAVATION
SECTION 218	SUBGRADE PREPARATION
SECTION 225	WATER
SECTION 310	UNTREATED BASE
SECTION 321	PLACEMENT AND CONSTRUCTION OF ASPHALT CONCRETE PAVEMENT
SECTION 340	CONCRETE CURB, GUTTER, SIDEWALK, DRIVEWAYS, ALLEY ENTRANCE, AND PAVEMENT BORDER
SECTION 401	TRAFFIC CONTROL
SECTION 402	CONSTRUCTION SURVEYING AND LAYOUT
SECTION 403	MOBILIZATION
SECTION 504	STANDPIPES (FURNISH AND CONSTRUCT IRRIGATION SIPHON REPLACEMENT)
SECTION 607	ROADSIDE SIGN SUPPORTS
SECTION 608	SIGN PANELS
SECTION 701.2	TEMPORARY PAVEMENT MARKERS
SECTION 701.3	OBLITERATE EXISTING STRIPING BY SANDBLASTING
SECTION 704	THERMOPLASTIC PAVEMENT MARKINGS (704THRMO, 01/16/2018)
SECTION 706	RAISED PAVEMENT MARKERS
SECTION 708	PERMANENT PAVEMENT MARKINGS (708WPM, 09/06/19)
SECTION 710	ASPHALT CONCRETE
SECTION 711	PAVING ASPHALT
SECTION 731	STRUCTURAL SUPPORTS AND FOUNDATIONS FOR TRAFFIC SIGNAL AND HIGHWAY LIGHTING (731STRSUP, 04/11/19)
SECTION 732	ELECTRICAL UNDERGROUND MATERIALS
SECTION 733	SIGNAL INDICATIONS AND MOUNTING ASSEMBLIES
SECTION 734	TRAFFIC CONTROLLER ASSEMBLY (734PATSC, 07/01/14)
SECTION 735	Video Image Vehicle Tracking and Detection System (Turnkey)
SECTION 736	HIGHWAY AND SIGN LIGHTING (LED, 12/10/19)
SECTION 924	MISCELLANEOUS WORK
SECTION 1007	RETROREFLECTIVE SHEETING (1007REFS, 11/05/13)



Expires 06/30/2021

# Special Provisions

## Yuma County Department of Engineering

### COUNTY 15<sup>TH</sup> STREET – AVENUE A

### INTERSECTION IMPROVEMENT PROJECT

### CIP NO. 1.9915E

The purpose of these Special Provisions is to supplement, modify, replace, and/or delete that portion of the Public Works Standards for Yuma County Volumes I and II, given herein, which do not meet specific requirements of this project.

#### 100 GENERAL CONDITIONS

##### SECTION 102 BIDDING REQUIREMENTS AND CONDITIONS

**Section 102.2 Contents of Proposal Pamphlet** of the Standard Specifications, first paragraph is revised to read:

The prospective bidder may examine and/or purchase plans, special provisions, and proposal pamphlets at the Yuma County Department of Engineering. Alternatively, an electronic version of the BID DOCUMENTS is available on line at <http://www.yumacountyaz.gov/rfp>. CAD drawings are not provided to the successful bidder.

The Proposal Pamphlet will state the location of the contemplated construction, give the description of the various quantities of work to be performed or materials to be furnished, and have a bid schedule of pay items for which unit bid prices are invited. In addition, it will state the form and amount of the proposal guarantee, the time in which the work shall be completed and include additional instructions not included in these specifications.

The standard plans, project plans, the standard specifications, the standard details, the special provisions, the contracting agency's supplements and all supplementary documents are essential parts of the contract and a requirement occurring in one is as binding as though occurring in all. They are intended to be complementary and to describe and provide for a complete work.

**Section 102.5 Examination of Plans, Special Provisions and Site of Work** of the Standard Specifications is modified to add:

The Bidder shall be responsible to investigate the project site, inspect the ground water levels, satisfy himself as to the actual conditions, anticipate fluctuations in the ground water table and anticipate potential surface water flows as a condition to be encountered in the performance of his work.

It shall be the Contractor's responsibility to control all water to the extent required to complete the contract items, and to repair and restore all damages due to the ground water fluctuations and surface water flows at no cost to the County. Depth to groundwater in the Project area is unknown.

**Geotechnical Evaluation & Report:** A geotechnical investigation and evaluation was conducted for this project by the firm Ninyo & Moore. A report dated July 20, 2018, was issued to RICK Engineering Company for Yuma County. This report sets forth existing asphalt thickness and subgrade conditions. The report is available upon request for review by the bidders/contractors.

No additional measurement or additional compensation will be made for any additional work required or associated with pipeline excavations, earthwork, structures, protecting work areas, move-out and move-in due to flooding (including flood irrigation), damaged equipment, or dewatering of construction areas, the cost being considered as included in the cost of contract items.

##### SECTION 103 AWARD AND EXECUTION OF CONTRACT

**Section 103 Award and Execution of Contract** of the Standard Specifications is modified to add the following:

### 103.10 Standard Specifications and Details:

All work done under this Contract shall be accomplished in accordance with the Public Works Standards For Yuma County Volume I (dated August, 1998) and Volume II (dated July, 1993) supplemented by these Special Provisions for this project. When other specifications, standards, details, or documents are referenced, the latest revisions shall be used, unless otherwise specified. Other standard specifications and details applicable to this project include the following:

- 2020 Edition of the Uniform Standard Specifications and Details for Public Works Construction, sponsored and distributed by the Maricopa Association of Governments (MAG), January 2020
- Arizona Department of Transportation, Standard Specifications for Road and Bridge Construction, 2008 Edition, latest revision (Stored Specifications)
- Manual on Uniform Traffic Control Devices (latest revision) and the Arizona Supplement to the MUTCD (latest revision)

**103.11 Plans:** The following sealed drawings, in print form, are the plans for this project, as revised:

<u>Sheet No.</u>	<u>Title</u>
CV01	Cover
GN01	General Notes
GN02	General Notes & Survey Control
GN03	Typical Sections
GN04	Quantities
PP01	Plan and Profile Sheet, Sta. 12+80 to Sta. 14+00
PP02	Plan and Profile Sheet, Sta. 14+00 to Sta. 18+50
PP03	Plan and Profile Sheet, Sta. 18+50 to Sta. 23+00
PP04	Plan and Profile Sheet, Sta. 23+00 to Sta. 27+50
PP05	Plan and Profile Sheet, Sta. 41+00 to Sta. 45+50
PP06	Plan and Profile Sheet, Sta. 45+50 to Sta. 50+00
PP07	Plan and Profile Sheet, Sta. 50+00 to Sta. 54+50
PP08	Plan and Profile Sheet, Sta. 54+50 to Sta. 59+00
SS01	Signing and Striping Plan, Sta. 9+50 to Sta. 18+50
SS02	Signing and Striping Plan, Sta. 18+50 to Sta. 27+50
SS03	Signing and Striping Plan, Sta. 27+50 to Sta. 32+00
SS04	Signing and Striping Plan, Sta. 41+00 to Sta. 50+00
SS05	Signing and Striping Plan, Sta. 50+00 to Sta. 58+50
SI01	Sign Inventory
TS01	Traffic Signal Layout
TS02	Pole Schedule
TS03	Phasing Diagram
TS04	Signal Schedules
DT01	Details
DT01	Intersection Grading Detail
CS01	CO 15 <sup>th</sup> Cross Sections
CS02	CO 15 <sup>th</sup> Cross Sections
CS03	Avenue A Cross Sections
CS04	Avenue A Cross Sections
CS05	Avenue A Cross Sections

Printed and PDF copies of Plans will be provided to Bidders and Contractor.

Electronic copies of the plans, regardless of format or source, are not official copies of the plans.

Copy fees apply unless otherwise specified.

### SECTION 104 SCOPE OF WORK

**Section 104 Scope of Work** of the Standard Specifications is modified to add the following:

**Contractor's Participation:** Contractor shall self-perform at least 51% of the project based on the value established by the Bid Schedule.

**104.1.3 Cleanup and Dust Control:** At reasonable intervals during the progress of the work, cleanup and disposal of waste materials and debris will be performed on the project site. Waste materials and debris shall be disposed of by the Contractor at legally established landfill areas, private disposal sites located by the Contractor, or as directed by the Engineer.

The Contractor shall be responsible for and incur all costs for periodic and final cleanup of the site during construction. Payment for cleanup and disposal shall be an integral part of associated Bid Items shown on the Contract Proposal. No separate payment shall be made for cleanup and disposal. Should the Contractor dispose of excavated soils on a private property, the Contractor shall first review the site with a representative of the Engineer to determine the impact upon any existing floodplains, grading requirements and permitting requirements.

**104.3 Notification of Claims:**

Section 104.03, of the 2008 Arizona Department of Transportation Standard Specifications for Road and Bridge Construction is incorporated into this contract by reference.

The notice requirements of this incorporated section are stringent. The Contractor is hereby advised that failure to make proper notice as required, waives the right to additional compensation.

**104.4 Incidental Items:**

Any and all items of work to be provided by the Contractor to complete the project that are not specifically listed in the Bid Schedule will NOT BE MEASURED OR PAID FOR SEPARATELY as they are considered "incidental" and "subsidiary" to the overall project. The cost associated with each incidental item of work shall be applied to its associated bid schedule line item or across all applicable bid schedule line items as most appropriate in the judgment of the Contractor.

The following is a list of some, but not all, construction items that are considered "incidental" to the construction project that shall be provided, but will not be paid for separately as a bid item:

**104.4.1 Water Used by the Contractor for Construction Purposes:** The Contractor shall establish an account with the water system owner to purchase water for construction purposes. The water system owner will provide a meter for this purpose. The Contractor shall pay the water system owner directly for the cost of water used for this project. The cost of the associated work and the cost of water used are incidental to the overall project.

**104.4.2 Construction Staking for all Improvements:** Cost for all labor, materials, and equipment associated with construction surveying and staking including, but not limited to, information gathering of existing control points and elevation benchmarks and the staking of all the proposed improvements for construction purposes. Any survey monuments that are disturbed during construction activities shall be replaced at the Contractor's expense.

**SECTION 105 CONTROL OF WORK**

**Section 105 Control of Work** of the Standard Specifications is modified to add:

**105.5 Coordination of Plans and Specifications** is modified to replace the fourth sentence with:

In a case of a discrepancy or conflict, the order in which the various documents shall govern is as follows, from highest to lowest: Addenda, Special Provisions, Plans, Agency's' Supplements to the Standard Specifications, Agency's Supplements to the Standard Details, Standard Specifications and Standard Details.

**105.16 (C) Substantial Completion is added:** The project is substantially complete and liquidated damages will no longer be assessed when all of the following have occurred:

- (A) All lanes of traffic of the completed project are finished and accepted and traffic can move unimpeded through the project at the posted speed;
- (B) All signage is in place and accepted;
- (C) Traffic signal is in place and in operation;
- (D) All guardrails, drainage devices, ditches, excavation and embankment have been accepted; and
- (E) The only work left for completion is incidental, away from the paved portion of the highway, and does not affect the safety or convenience of the traveling public;

The decision whether the project is substantially complete is within the sole discretion of the Engineer.

## **SECTION 106 CONTROL OF MATERIALS**

**Section 106 Control of Materials** of the Standard Specifications is modified to add the following:

### **106.1 Source of Materials and Quality:**

The Contractor shall be responsible for providing all materials to the project except the materials acquired in advance by Yuma County for this project. Materials to be provided by Yuma County are identified in the bid item description that starts: INSTALL DEPARTMENT FURNISHED..."

No time extensions or adjustments to the contract will be made due to lack of a materials source being available in close proximity to the project.

Any materials source used for the project shall be properly permitted as applicable. Upon request, the Contractor shall furnish documentation showing the materials source used for the project has current permits as required by local, County, State, or Federal regulations.

### **106.2 Tests and Acceptance of Materials:**

The county will contract with an independent testing laboratory to sample and test materials incorporated into the project. Testing will include but is not limited to soil sampling, establishment of proctors, compaction testing, concrete sampling and testing, and the review of all mix designs. The testing laboratory is required to send one copy of all test results to Yuma County and one copy to the contractor. After the establishment of compactive effort on earth and aggregate (five tests maximum), any retesting due to failed tests will be at the Contractor's expense. A supplemental agreement will be executed at the conclusion of the contract to adjust the contract for the County's cost of retesting compaction.

## **SECTION 107 LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC**

**Section 107 Legal Relations and Responsibility to Public** of the Standard Specifications is modified to add the following:

### **107.2 Permits**

A Storm Water Pollution Prevention Plan (SWPPP) is not required for this project. The contractor is required to install and maintain Best Management Practices to control erosion from storm water runoff.

### **107.6 Public Convenience and Safety:**

The Contractor shall provide safety construction fencing around all open trenches, excavations, material and equipment storage yards and other work zones during all non-working hours and while unattended.

There will be no separate measurement or payment for furnishing, installing or maintaining protective fencing. The cost shall be considered incidental to the cost of the appurtenant work.

The contractor shall maintain local access to all side streets, access roads, driveways, alleys and parking lots at all times.

### **107.11 Contractor's Responsibility for Utility Property and Services** Paragraph three is modified to:

It shall be the contractor's responsibility to provide seven (7) calendar days' notice to all appropriate governmental agencies and utility companies prior to starting work affecting their area of concern.

The Contractor's attention is called to the existence of overhead lines within, crossing and adjacent to the project. The Contractor at all times shall maintain the proper, safe, legal clearances to all overhead lines as required by federal, state and local regulations. During excavation, the Contractor will maintain a minimum of 5 feet of lateral clearance around the base of overhead line poles unless arrangements are made with APS to insure the integrity of the pole's foundation.

The following utility companies and irrigation entities have known facilities in conflict with the proposed construction, and anticipate certain adjustments and relocations:

<u>ORGANIZATION</u>	<u>CONTACT NAME</u>	<u>PHONE</u>	<u>EMAIL</u>
APS (electric)	Antonia Morales	(520) 227-3786	antonia.morales@aps.com
CenturyLink (telecom)	Ed S. Alupay	(928) 343-8943	ed.alupay@centurylink.com
Terra Technologies (telecom)	Kevin Wagner	(815) 245-9640	kwagner@terratechllc.net
Southwest Gas	Jim Larson	(928) 341-2604	james.larson@swgas.com
Unit B Irrigation District	Bryan Knight	(928) 627-8891	bryank@unitbirr.com

**107.12.1 Air Quality Non-Attainment Area:**

This project is located within the Yuma PM10 Non-attainment Area for airborne dust particles. Prior to construction the Contractor will be required to submit for approval a Dust Control Plan. The plan must be able to reduce and maintain visible emissions from fugitive dust sources to a minimum daily. The plan should address the following mitigation action items:

- (A) Control for traffic emission from within the construction site.
- (B) Control of track out from unpaved areas of the construction site.
- (C) Control of emissions from haul trucks.
- (D) Dust control measures at all construction staging areas, detour routes and worksites.
- (E) Control of dust by the use of covers on all trucks hauling material to and from the project.

Measures to clean paved roads may include, but are not limited to water flushing, vacuum sweeping and manual cleaning of access points.

No measurement or direct payment will be made for this item, the cost being considered incidental to the project.

**107.13.1 Right of Way/Property Acquired:** Yuma County has obtained the right-of-way/property for the permanent project features. No construction activities are allowed to occur beyond the established right-of-way. Any damage to adjacent property due to construction or its related activities is the responsibility of the contractor.

**107.16 Public Information and Notification:**

The contractor shall provide written notification to the Yuma County Department of Engineering and each business and residence abutting the project site a minimum of two weeks prior to beginning construction. The contractor shall provide the proposed construction schedule, including anticipated work hours, contact personnel with telephone numbers, road restrictions, temporary fencing plans, equipment and material storage plans, anticipated utility disruptions or relocations, and any other pertinent information.

The contractor shall also provide written notification to each business and residence abutting the project site a minimum of two weeks prior to beginning construction. The notice shall address the proposed construction schedule, contact personnel with telephone numbers, temporary fencing plans, equipment and material storage plans, anticipated utility disruptions or relocations, and any other pertinent information. A second notice containing the same information shall be provided to each business and residence abutting the project site two (2) days prior to the start of construction on the project.

## **SECTION 108 COMMENCEMENT, PROSECUTION AND PROGRESS**

**108.1 Pre-Construction Conference** of the Standard Specifications is modified to add:

Prior to and as a prerequisite of the Notice to Proceed the contractor shall provide the County with the following submittals for review and at least five (5) working days prior to preconstruction meeting:

- (A) Proposed project materials
- (B) Construction schedule
- (C) Safety plan
- (D) Traffic Control Plan [11x17" sheet] for every stage of work
- (E) Draft Public Information and Notification to Yuma County, abutting business and residences
- (F) Listing of afterhours / emergency contact personnel for the contractor and subcontractors [include office and cell phone numbers]
- (G) Equipment List [to include brand, model, year, capacity]
- (H) Survey Plan and Schedule
- (I) Subcontractors List- [contact name, address, telephone & fax no's]
- (J) Asphalt and Concrete Mix Design
- (K) Dust Control Plan
- (L) Material suppliers list [contact names, address, telephone & fax no's]
- (M) Shop drawings

**108.2 Notice to Proceed** of the Standard Specifications is modified to add:

After the pre-construction conference, and once all required submittals are reviewed, a notice to proceed will be issued by the Contracting Agency.

Neither the Contractor nor any Subcontractor shall commence work on a project prior to receipt of the written Notice to Proceed from the Contracting Agency. The Contractor shall begin work within 30 days after the date of the Notice of Award of contract from the Board of Supervisors. All work under the contract shall be completed within the number of calendar days stated in the proposal, plus any extensions, beginning with the day following the starting date specified in the Notice to Proceed.

**108.5 Contractor's Construction Schedule** of the Standard Specifications is replaced with:

At the preconstruction conference, the contractor shall submit a written and digital progress schedule. The written schedule shall be submitted on an 11"x17" format showing the order in which the contractor proposes to carry out the work, the dates on which the contractor and its subcontractors will start the salient features of the work, including procurement of materials, equipment, etc.; the ordering of articles of special manufacture; the furnishing of drawings, plans and other data required under Subsection 105.2 for the review and approval by the Engineer; the inspection of structural steel fabrication; and the contemplated dates for the completion of the said salient features. The schedule may be in a bar chart format or a critical path method format. No schedule activity shall be shorter than one day, or longer than 15 working days. The schedule must identify and show interrelationships among the activities and the controlling items of work throughout the project. If requested by the Engineer, the contractor shall furnish information needed to justify activity time durations. Such information shall include estimated manpower, equipment, unit quantities, and production rates. The schedule shall illustrate the completion of the work not later than the contract completion date.

**108.5.1 Weekly Meetings and Progress Report:** At a mutually convenient location and time, the contractor shall meet weekly with the Engineer to discuss construction activities. However, a meeting may be waived if mutually agreed to, due to inclement weather conditions, work progress or other reasons. At the meetings, the contractor shall provide the Engineer with a detailed, written schedule of all construction activities and phases of work for the forthcoming two-week period. This written schedule shall detail the start and anticipated completion date of major phases of work as well as indicate the status of major ongoing activities. Minutes of the weekly meetings will be kept by the Engineer and a copy given to the contractor. Failure to provide an accurate, appropriate schedule may be grounds for the suspension of the work. Schedule changes requiring an increase in the County's engineering personnel will not be put into effect for 10 days after the submission of weekly schedules detailing such activities, or until the Engineer has made arrangements for additional personnel, whichever is the shorter time.

Every 30 days throughout the term of the contract, or at any time as requested by the Engineer, the contractor shall submit a revised progress schedule reflecting the actual progress of activities, all activity logic revisions, the anticipated completion dates of the major phases of work remaining, and the anticipated completion date of the work.

**108.5.2 Technical Requirements for Software Compatibility Requirements in Preparation of Project Schedule:** The owner uses Microsoft Project to schedule and monitor its construction program. Contractor must prepare and maintain the schedule using Microsoft Project or other software that is compatible with Microsoft Project's latest version.

## **SECTION 109 MEASUREMENTS AND PAYMENTS**

**109.2 Scope of Payment** of the Standard Specifications is modified to add:

**109.2.1 Measure and Payment for Pay Items in the Proposal:** The items listed in the Bid Schedule of the Proposal are intended to include the major items for the project; however, there is other incidental, supplemental, and contingent work necessary to complete the project. If work to complete the project has not been designated by a specific item on the Bid Schedule, the Contractor shall include the cost for the work in some related bid item so that his Proposal for the Project does reflect the total cost of all necessary and required work to complete the project in its entirety.

Payment for sheeting, shoring and bracing for the protection of property, life and limb, in conformance with the applicable permits and safety orders and standards will not be paid as separate item and shall be distributed in with applicable bid items.

These Special Provisions provide supplemental information regarding the bid line items for the project, and shall be used in conjunction with the Bid Schedule for determination of the quantities and line item costs for measurement and payment purposes for this project. These Special Provisions and the Additional Technical Provisions shall govern and control anywhere they may deviate or conflict with the Yuma County Standard Specifications and other related standard specifications referenced herein.

The various bid items set forth in the Bid Schedule are described herein, and the measurement and payment for each bid item are defined for this project as provided for in these Special Provisions.

**109.4 Compensation for Alteration of Work** of the Standard Specifications is modified to add:

Adjustment in bid item unit prices shall only apply to major items of work when considering an adjustment for an over run in excess of 20% or an under run in excess of 20%. A major item of work as defined by Section 101 of the General Conditions is an item on the bidding schedule whose total cost is greater than five percent (5%) of the total contract price.

**109.7.1 Failure to Locate or Incorrect Location of Utilities** of the Standard Specifications is revised to read: Arizona Revised Statutes 40-360.28 indicates that if a person (owner, operator, or agent) fails to locate or incorrectly marks the location of the underground facility in a timely manner, the person (owner, operator, or agent) becomes liable for resulting damages, costs and expense to the injured party." The Contracting Agency will deny any claims for damages or delays if another owner or operator is at fault.

## **SECTION 201 CLEARING & GRUBBING**

**201.1 Description** of the Standard Specifications is modified to add:

Clearing and Grubbing shall include removal of trees in the area to be excavated or areas to be filled. Tree removal shall be in accordance with the Yuma County Standard Specifications. Trees or other undesirable or objectionable materials not identified on plans shall also be removed from the site. No measurement or direct payment will be made for this item, the cost being considered incidental to the project.

Clearing and grubbing shall also include tree pruning and trimming to eliminate half of the tree branches from overhanging onto the road right of way and to further eliminate all tree branches from overhanging onto the road right of way within 15-feet of the new pavement edge.

**201.4.1 Tree Pruning and Trimming** within the project limits, the Contractor shall prune and trim trees to cut and completely remove any tree branch located within 15-feet of the new pavement edge. In addition, at least 50% of the branches that overhang onto the road right of way are to be cut at the road right of way line and removed. Removed green waste shall be properly disposed of at a legal landfill or other disposal site for such materials.

The following items of work shall be included in the Bid Price for this Bid Item:

- (A) Pruning tree limbs, branches, and other overhanging vegetation per these specification requirements
- (B) Disposing all removed branches, vegetation, and related materials properly at a legal disposal site that accepts such waste
- (C) Providing all tools, equipment, supplies, materials, and labor to complete the work
- (D) Completing all other contingent and miscellaneous work needed to complete the intended work item
- (E) Completing the tree pruning and trimming in accordance with the following standards:
  - Tree Care Industry Association – ANSI A300 Standards
  - National Arborist Association – Pruning Standards for Shade Trees

**201.6 Method of Measurement:**

Measurement shall be on a lump sum (LS) basis for ‘Tree Pruning and Trimming’ completed to the satisfaction of the County Inspector.

**201.7 Basis of Payment:**

Payment shall be made and prorated based on the percentage completed of the lump sum (LS) amount completed at the time of the progress payment application.

Bid Item:           **2010100 TREE PRUNING AND TRIMMING**

**SECTION 202 REMOVAL OF STRUCTURES AND OBSTRUCTIONS**

**202.1 Description** of the Standard Specifications is modified to add:

The existing asphalt pavement sections shall be removed for the full width, depth, and length as shown on the plans. The depth of removal for asphalt pavements shall include any additional excavation of existing base and/or subgrade materials encountered to the subgrade depth required for new pavement construction as shown on the plans. Removals shall be made to a sawcut line to provide a clean vertical edge to pave against. The work shall include all materials, equipment, and labor costs to remove the existing asphalt pavement and any underlying base and/or subgrade materials as needed, and to properly dispose of these materials at a legal and approved site.

Adjacent sections of asphalt and concrete pavement not slated for removal shall be protected in place and not disturbed. Any areas outside the designated removal areas that may be damaged by the contractor’s actions shall be removed and replaced at the Contractor’s sole expense.

The work under this item shall consist of removing existing sign posts and associated sign panels, markers, and the foundations, filling all voids, restoring any disturbed ground. Remove existing sign assemblies where shown on the plans. This work includes all materials, supplies, hardware, equipment, and labor needed to remove the existing sign panel, post, base, and foundation. Salvage the sign panel and post without causing damage to its existing condition and provide to the County for storage and reuse if the County wants the salvage. If not, then the Contractor shall properly dispose of the sign panel and post, along with the removed sign base/foundation, at a legal disposal site.

The Contractor shall remove all existing landscape materials, plants, and other items from the area that will need to be cleared to accommodate and allow for construction of the proposed improvements.

- (A) Decomposed granite (or other decorative rock surfacing) shall be removed, salvaged, and re-spread if practical. If not, or at the Contractor’s option, new decomposed granite shall be furnished and spread over the disturbed landscaped areas. Removed and non-salvaged decomposed granite and other similar landscape surfacing materials shall be legally disposed of at an approved landfill or disposal site.

- (B) Rock boulders, if any, shall be removed, salvaged, and temporarily stored on site. Landscape boulders shall be relocated at or near their original locations upon completion of the adjacent pavement improvements.
- (C) Existing landscape plants (shrubs, bushes, decorative plants, etc.) shall be removed, salvaged, temporarily stored on site as needed, and maintained throughout the entire construction period. The Contractor shall re-plant the landscape plants at or near their original locations upon completion of the adjacent pavement improvements.
- (D) Existing shrubs or other plants that are removed shall be removed completely, including roots. All vegetation removed and not to be salvaged and relocated shall be legally disposed of at an approved landfill or disposal site.
- (E) No irrigation facilities are known to be present at this project site. However, if any existing irrigation piping, fixtures, wiring, and related equipment and components are encountered and disturbed or in need of removal to accommodate the proposed improvements, the Contractor shall repair and/or replace irrigation facilities to restore the system to good working order and suitable for its intended purpose.

All existing landscaping not directly impacted by the street construction shall be protected in place from any damage by construction activities. Any existing landscaping materials, plants, and other items that may be damaged during construction shall be replaced in kind at the Contractor's expense.

Remove and relocate existing fence bid item includes all materials, supplies, equipment, labor, and work needed to remove and relocate the existing fence material, fabric, wire, posts, and fence post base/foundation, and the proper disposal of the removed fencing and related materials at a legal and approved site. Relocation is intended to use existing salvage materials and to relocate in-kind at locations shown on the project plans

The existing street surfaces and pavements shall be sawcut the complete length of the removal line denoted on the plans where adjacent to new construction match lines. The sawcut shall be for the full depth of pavement with an appropriate paving saw. The sawcut edges shall present a neat, trim, and vertical line. The sawcut work shall include all materials, supplies, equipment, and labor costs to sawcut the existing pavement materials. The mill and overlay match shall be sawcut to the depth of mill to provide a clean joint to match overlay pavement to existing pavement.

'New Traffic Pattern Ahead' signs, mounted on Type 2S galvanized square tube posts with foundations, are to be placed on each approach approximately 750 LF in advance of the painted stop bar location. The signs are temporary in nature and shall be in place prior to completion of construction and shall remain in place for 45 calendar days after completion of construction. The work to remove these signs shall be measured and paid for under this section. Salvage of the sign panel and square tube sign post shall be to Yuma County and the salvaged sign and post shall be delivered to and unloaded at a location specified by the County Inspector. The Contractor shall remove and dispose of the sign post foundation at a landfill or other approved and legal disposal site.

**202.11 Method of Measurement and Basis of Payment** of the Standard Specifications is modified to add:

Measurement will be based on the square yards (SY) of asphalt and/or concrete pavement surface area removed as measured on the ground by the County Inspector.

Payment will be made at the bid unit price per square yard (SY) of asphaltic concrete pavement surface area removed based on the measured quantity. Excavation as needed and proper and legal disposal of the removed materials shall be included in the bid price for this construction item.

Bid Item:           **2020040 REMOVE ASPHALTIC CONCRETE PAVEMENT**

Measurement shall be based on each (EA) sign removed and salvaged as shown on the plans and as determined by the County Inspector. This work item includes the 'temporary duration' Traffic Control Change signs.

Payment will be made at the bid unit price per each (EA) removed and salvaged sign based on the measured quantity. This work item includes the 'temporary duration' Traffic Control Change signs.

Bid Item:           **2020055 REMOVE AND SALVAGE SIGN**

Measurement shall be based on total length in linear feet (LF) of removed fence, and relocating the salvaged material complete, as measured by the County Inspector.

Payment will be made at the bid unit price per linear feet (LF) of removed fence based on the measured quantity. All work, supplies, materials, and labor related to complete the removal of existing fence shall be included in the bid unit price for this construction item, whether specifically stated or not. This item also includes material and labor required to relocate the salvaged fence, including providing any new materials as required for the installation, to the new location shown on the project plans.

Bid Item: **2020100 REMOVE AND RELOCATE FENCE**

Measurement will be based on the linear feet (LF) of asphalt pavement sawcut for removals and new construction as measured on the ground by the County Inspector.

Payment will be made at the bid unit price per linear feet (LF) of sawcutting for pavement removal based on the measured quantity.

Bid Item: **2020201 SAWCUTTING**

### **SECTION 205 ROADWAY EXCAVATION**

**205.1 Description** of the Standard Specifications is modified to add:

The Contractor shall construct roadway excavation where shown on the plans and per Yuma County Specification Section 205. The project is unbalanced and requires both excavation and embankment as shown on the project plans and cross sections. The Contractor shall provide the required grading, compaction, and shaping of the excavation areas and fill embankments to ensure positive drainage throughout the project site. This bid item includes roadway excavations, construction of embankments to a minimum of 95% standard proctor density (ASTM D698) per Yuma County Specification Section 211, and removal and proper disposal of excess excavated material. The work shall include all materials, equipment, and labor costs to construct the fill embankment including excavation, transport of excavated materials, and the construction and compaction of the embankment to the extents, slopes, and cross-sections shown on the plans.

**205.7 Measurement** of the Standard Specifications is modified to add:

Measurement will be based on the cubic yards (CY) of excavated material. Placement of embankment will not be measured and is incidental to the Roadway Excavation pay items. Estimated quantities for roadway excavation, fill embankment, and disposal of excess material are shown on the project plans.

**205.8 Payment** of the Standard Specifications is modified to add:

Payment will be made on the total line item bid price based on the unit price bid per cubic yard (CY) of embankment constructed. No separate payment will be made for fill construction or disposal of excess material.

Bid Item: **2030302 ROADWAY EXCAVATION**

### **SECTION 218 SUBGRADE PREPARATION**

**218.1 Description** of the Standard Specifications is modified to add:

The Contractor shall prepare the subgrade under all new pavements in accordance with the specifications. No measurement or direct payment will be made for this item, the cost being considered incidental to the project. Removal of vegetation is included in, and incidental to, this item of work.

### **SECTION 225 WATER**

**225.1 Description** of the Standard Specifications is modified to add:

Watering shall include making arrangements for developing water sources and supplying all labor, equipment and materials to collect, load, transport and apply water as necessary for compaction of materials, concrete construction operations, testing, dust control, pre-wetting and other material and construction uses.

**225.2 Water Supply** of the Standard Specifications is modified to add:

Water shall be clean and free from objectionable deleterious amounts of acids, alkalis, salts or organic materials.

**SECTION 310 UNTREATED BASE**

**310.1 Description** of the Standard Specifications is modified to add:

The Contractor shall place and compact the required thickness of aggregate base course on the prepared subgrade in accordance with the pavement structural section shown on the plans and per these specifications. The depth of aggregate base course shall be 6" depth, or 10" depth where designated on the plans.

Placement and construction of the aggregate base course shall generally consist of furnishing aggregate base course material that meets the specification requirements, placement of the material on the prepared subgrade, and compaction of the aggregate base course material to its specified density with the finished surface of the base material being to the required lines and grades for the bottom of the proposed pavement surface. Subgrade preparation shall be per Yuma County Specification Section 218. Compaction of the aggregate base shall be to 100% of maximum density per Yuma County Specification Section 205. The finished surface of the aggregate base course shall represent the bottom surface of the specified depth of asphalt pavement to be subsequently constructed on the aggregate base course. The work shall include all materials, equipment, and labor costs to furnish, place, compact, and construct the aggregate base course where shown on the plans and per the specifications.

The Contractor shall exercise care not to damage any existing abutting curb and gutter sections during the excavation operations. Any concrete damaged by the Contractor's actions shall be repaired to the satisfaction of the County at no additional cost to the County.

**310.9 Measurement** of the Standard Specifications is modified to add:

Measurement will be based on the square yards (SY) of 6" depth, or 10" depth, of aggregate base course constructed to the required extent and depth as measured on the ground by the County Inspector.

**310.10 Payment** of the Standard Specifications is modified to add:

Payment will be made at the bid unit price per square yard (SY) of 6" depth, or 10" depth, of aggregate base course based on the measured quantity. Payment shall be considered full compensation for all work involved per the specification requirements.

Bid Items:	<b>3030110</b>	<b>AGGREGATE BASE – 6" DEPTH</b>
	<b>3030111</b>	<b>AGGREGATE BASE – 10" DEPTH</b>

**SECTION 321 PLACEMENT AND CONSTRUCTION OF ASPHALT CONCRETE PAVEMENT**

The work under this section shall conform to the requirements of Section 321 of Maricopa Association of Governments (MAG) Uniform Standard Specifications and Details for Public Works Construction 2020 Edition and is included in these standards by this reference.

**321.5 Mix Design** is revised to replace:

"five working days" with "ten working days" at both occurrences.

**321.6 Mix Production** Paragraph 1 is revised to delete:

Each hot mix asphalt plant shall be inspected in accordance with the provisions contained in the 'Hot Mix Asphalt Production Facilities; by the Arizona Rock Products Association and shall have a current inspection certificate.

**321.8.1 Placing** is revised to add: When more than one width of asphalt concrete material will be placed, a 6 inch strip adjacent to the area on which future material is to be laid shall not be rolled until such material has been placed but shall not be left unrolled more than 2 hours after being placed, unless the 6 inch unrolled strip is first heated with a joint heater. After the first strip or width has been compacted, the second width shall be placed, finished, and compacted as provided for the first width, except that rolling shall be extended to include the 6 inches of the first width not previously completed.

**321.8.2 Joints** is revised to replace "vertical face" with "a face with a 10 to 15 degree skew" and to add:

An approved joint heater shall be used on cold transverse or longitudinal joints where conditions are such that it is deemed necessary by the Engineer. The joint heater shall be capable of heating the joint to a minimum temperature of 200°F for a minimum depth of ¼ inch at a speed commensurate with that of the laydown machine. If it is deemed necessary by the Engineer to seal the joints, a light coat of asphalt emulsion shall be applied to the exposed edge before the joint is made.

**321.8.3 Asphalt Leveling Course** is revised to add:

After the prime coat or tack coat has been applied, the leveling course mixture shall be spread to the proper width and to such depth as will compact to the required thickness. Actual quantities of the mixture required will be determined by the Engineer.

The distance to which a leveling course may be spread in advance of covering it with the following course shall be as ordered by the Engineer.

The leveling course material shall be placed in layers, 2 inches maximum compacted thickness, by means of self-propelled spreading equipment, or spreader box. Other means may be permitted for placing the leveling course provided the method, at the discretion of the Engineer, can provide a finish surface that does not vary from the design surface by more than the amount specified below. In order to obtain a smooth surface, manipulation of the controls of the paver shall be at a minimum.

Unless otherwise permitted by the Engineer, adjustments shall not be made on less than 50 feet intervals and any adjustment shall not result in a change in thickness of the pavement in excess of 1/8 inch, except where the machine is equipped with electronic grade controls.

The placing of the leveling course shall be for no less than one lane width and for the longest practical length for any one lay, preferably not less than 1200 feet. The exact width and length will be approved by the Engineer.

Compaction shall be accomplished by use of pneumatic-tire or steel-wheel rollers. Rolling shall proceed concurrently with the laydown of the leveling course. During the rolling operation, the speed of the roller shall not exceed 3 miles per hour. Additional rollers may be required depending on the placement rate of the asphalt concrete. If ample number of rollers are not present, the Contractor shall adjust the placement rate to accommodate the roller speed.

The leveling course shall be thoroughly compacted, smooth and true to grade and cross-section and free from ruts, humps and depressions or irregularities. An acceptable surface shall not vary more than ½ inch from the lower edge of a 12foot straightedge when the straightedge is placed parallel to the centerline of the roadway. The straightedge shall be furnished by the Contractor and shall be constructed of such lightweight materials that it can be handled by the inspector without assistance.

When deviations in excess of the above tolerance are found, such places as humps or depressions shall be corrected to meet the specified tolerance. All labor and equipment necessary to correct such deviations shall be at no additional cost to the Contracting Agency. Adjustment in the cost for the material may be requested by either the Contracting Agency or Contractor depending on the type of deviation.

**321.8.4 Compaction: Asphalt Base Course and Surface Course** is revised to add: Sufficient rolling equipment shall be furnished to compact and finish satisfactorily the amount of mixture being placed. However, there shall be a minimum of two rollers with two (2) operators at all times. Upon direction of the Engineer, one of the rollers may be a pneumatic roller. During rolling operations, the speed of the roller(s) shall not exceed 3 miles per hour. If ample number of rollers are not present, the Contractor shall adjust the asphalt placement rate to accommodate the roller(s) speed. The type and required number of rollers shall be on the project and in acceptable operation, prior to the placement of any asphalt material. All rollers shall be operated continuously from the breakdown through finish rolling. The Contractor may use vibratory rollers in lieu of the steel-wheeled roller, however when the thickness of the asphalt is one (1) inch or less, all rolling will be done in the static mode.

Breakdown rolling shall begin as soon as the mixture will bear the roller without undue displacement. Rolling shall be longitudinal, overlapping on successive trips by at least 1/2 but not more than ¾ the width of the rear wheels. Alternate trips of the roller shall be of slightly different lengths. The motion of the roller shall at all times be slow enough to avoid displacement of the mixture.

Breakdown and compaction rolling shall be done by either steel-wheel or pneumatic-tire rollers. The Engineer may require a pneumatic-tire roller for one of the rolling operations. Rolling shall continue until the specific gravity of the compacted mixture is not less than 95 percent of the specific gravity of specimens composed of the same materials in similar proportions or composed of the same mixture compacted in the laboratory by the 75 blow method of AASHTO T-245.

Finish rolling shall be done by means of a steel-wheel roller or a vibratory steel-wheel roller operated in the static mode.

All rollers used in compaction of asphalt concrete shall be self-propelled and reversible, with a minimum weight of 8 tons. All rollers shall be maintained to insure smooth operation in respect to steering, the ability to stop, start and reverse. All rollers shall be equipped with an automatic device or devices capable of properly dispensing an approved releasing agent on the wheels to prevent the wheels from picking up the asphalt concrete. Diesel fuel shall not be used as a releasing agent. All rollers shall be equipped with scrapers to keep the wheels clean from asphalt and other debris.

Pneumatic-tire rollers shall be of the 2 axle tandem type, having a rolling width no less than 5 feet. All tires shall be no less than 20 inches in diameter, shall be of the same size and shall have treads satisfactory to the Engineer. The roller shall be so constructed that the operating weight per tire shall be no less than 2000 pounds and the tires shall be spaced so that the entire gap between adjacent tires will be covered by the tread of the following tire. Except as otherwise specified, each tire shall be inflated to and maintained at  $90 \pm 5$  psi. Pneumatic-tired rollers shall be equipped with skirt-type devices mounted around the tires so that the temperature of the tires will be maintained during the rolling process.

Steel-wheel tandem rollers or vibratory rollers may be used where applicable. In all cases, the larger of the two roller wheels will be operated in the forward position. The steel wheels shall be straight, free from grooves and/or pits. Vibratory rollers shall be operated in accordance with standard practices and manufacturer recommendations.

The completed surfacing shall be thoroughly compacted, smooth and true to grade and cross-section and free from ruts, humps, depressions or irregularities. An acceptable surface shall not vary more than  $\frac{1}{4}$  inch from the lower edge of a 12-foot straightedge when the straightedge is placed parallel to the centerline of the roadway. The straightedge shall be furnished by the Contractor and shall be acceptable to the Engineer.

**321.8.5 Smoothness** is revised to add: In addition to the smoothness requirements specified above, asphalt concrete pavement shall be true to the grades shown or indicated on the plans and shall not vary more than  $\frac{1}{4}$ -inch from the plan elevations. Finish pavement grades adjacent to curbs shall be within  $\frac{1}{4}$ -inch of the design elevation but in no case below the lip of the gutter.

All streets shall be water tested for drainage in the presence of the Engineer or designated representative before final acceptance. Any areas not draining properly shall be corrected to the Engineer's satisfaction at the Contractor's expense. Water for this testing shall be provided and paid for by the Contractor. When deviations in excess of the above tolerance are found, humps or depressions shall be corrected to meet the specified tolerance or shall be cut out along neat straight lines and replaced with fresh hot mixture and thoroughly compacted to conform with and bond to the surrounding area. Materials and work necessary to correct such deviations shall be at no additional cost to the Contracting Agency.

**321.8.9 Safety Edge** is revised to add: The top lift of an overlay or reconstruction street section, with a lift thickness 1.5" and greater, without curb and gutter, and posted speed 40 mph and greater are required to have an Asphalt Pavement Safety Edge per Section 411.

**321.8.11 Preservative Seal** is added: An asphalt concrete preservative seal shall be used on all new asphalt concrete pavement and shall comply with Section 334. The Engineer will make a field determination and provide the actual application rate or delete the requirement. This seal is not required for pavement matching and surface replacement over pipe trenches, etc., unless specified in the special provisions.

Preservative seal on streets classified as residential and local collector shall be in accordance with Section 718, Type 4 (polymer modified rejuvenating emulsion). Preservative seal shall be applied no earlier than 48 hours after completion of surface course paving and no later than the end of the warranty period.

**321.8.12 Sand Application** is revised to add: In order to alleviate the problem of raveling resulting from oil drippings between wheel paths of automobiles adjacent to stop lights, the surface of the Open Grade G-3/8 course shall be made denser by an application of sand at each traffic signal or stop sign on a major street.

The sand application shall be in the amount of 10 to 15 pounds per square yard, and shall be applied immediately after initial rolling of the Open Grade G-3/8 course and then rolled, concurrent with final rolling. The application shall extend through the intersection for the full width, and for 200 feet on each side of the centerline of the intersecting street. Throughout other areas a light application of 2 to 3 pounds of sand shall be applied, after final rolling, to minimize pickup by traffic.

The grading for sand shall be as given in Table 321-1.

TABLE 321-1	
SAND GRADATION	
Sieve Size	Percent Passing
No. 4	100
No. 8	90-100
No. 30	40-75
No. 200	0-10

**321.10.1 Acceptance** is revised to add: Asphalt concrete gradation and binder content shall be tested according to ASTM Designation D6307 (Ignition Furnace). Sampling shall be done during the laydown operation.

Tack coat and asphalt concrete preservative seal (fog seal) are considered subsidiary and incidental to these bid items and neither will be measured or paid for separately.

**321.13 Measurement and Payment** is modified to add:

Measurement will be based on the square yards (SY) of existing asphalt pavement surface milled and prepared to the required extent and depth as established by the plans, specifications, and details. This pay item includes all related items of work required for the milling and preparation of the existing street pavement surface.

Payment will be made on the bid unit price per square yard (SY) existing asphalt pavement surface milled and prepared based on the measured quantity (average milling depth of 1" over the 60' transition length)

Bid Item: **4060010 MILL ASPHALT PAVEMENT – 0" TO 2" DEPTH**

Measurement will be based on the square yards (SY) of asphaltic concrete pavement initial/base course lift of 2" depth of Type C – 3/4" mix for pavement widening, constructed as measured on the ground by the County Inspector.

Payment will be made at the bid unit price per square yard (SY) of asphaltic concrete pavement for the initial/base course lift of 2" depth of Type C – 3/4" mix for pavement widening, based on the measured quantity.

Bid Item: **4060023 ASPHALTIC CONCRETE PAVEMENT, INITIAL/BASE COURSE, TYPE C, 3/4" MIX – 2" DEPTH**

Measurement will be based on the square yards (SY) of asphaltic concrete pavement surface course lift of 2" depth of Type C – 3/4" mix, constructed as measured on the ground by the County Inspector. The surface course lift shall include both the surfacing of the existing asphalt prepared for overlay and the initial/base course asphalt constructed for the pavement widening.

Payment will be made at the bid unit price per square yard (SY) of asphaltic concrete pavement for the surface course lift of 2" depth of Type C – 3/4" mix, based on the measured quantity. The surface course lift shall include both the surfacing of the existing asphalt prepared for overlay and the initial/base course asphalt constructed for the pavement widening.

Bid Item: **4060024 ASPHALTIC CONCRETE PAVEMENT, SURFACE COURSE, TYPE C, 3/4" MIX 2" DEPTH**

Measurement will be based on the square yards (SY) of asphaltic concrete driveway pavement surface course lift of 3" depth of Type C – 3/4" mix, constructed as measured on the ground by the County Inspector.

Payment will be made at the bid unit price per square yard (SY) of asphaltic concrete driveway pavement for the surface course lift of 3" depth of Type C – 3/4" mix, based on the measured quantity.

Bid Item: **4060025 ASPHALTIC CONCRETE DRIVEWAY PAVEMENT, SURFACE COURSE, TYPE C, 1/4" MIX – 3" DEPTH**

**SECTION 340 CONCRETE CURB, GUTTER, SIDEWALK, DRIVEWAYS, ALLEY ENTRANCE, AND PAVEMENT BORDER**

**340.1 Description** of the Standard Specifications is modified to add:

New concrete curb and gutter shall be constructed at all four corners of the intersection as shown on the plans. Construction shall be in accordance with Yuma County Specification Section 340 and per Yuma County Standard Detail 3.120. The standard details are modified to a 38.5 feet radius at the northwest and northeast intersection returns and to a 40 feet radius at the southwest and southeast intersection returns. On the southwest and southeast corner the curb and gutter section shall be a ribbon curb to enable Unit "B" irrigation channel maintenance vehicles to drive over the curb without a bump.

The work shall include all materials, equipment, and labor costs to furnish, place, install, and construct the concrete 2' wide curb and gutter section.

Remove and replace concrete driveways shall include removal of the existing concrete pavement where shown on the plans to an existing construction joint (or sawcut line if no construction joint exists within 3-feet). The Contractor shall remove the existing surface materials, regardless of their nature, and the underlying soil material, to the subgrade elevation for the new concrete driveway pavement section (6" PC concrete). The removed concrete drive pavement and any earth subgrade materials shall be hauled and disposed of at a legal disposal site or landfill. The Contractor shall prepare the subgrade for the new PC concrete driveway pavement in accordance with Yuma County Specification Section 218. The Contractor shall construct the new 6" thick PCC driveway pavement per the plans and the specifications and construct the replacement concrete driveway on the prepared subgrade. Concrete shall be Class B, 2,500 psi at 28-days, per Yuma County Specification Section 725.

The concrete driveway pavement construction work shall include all materials, equipment, and labor costs to excavate and remove the existing pavement and underlying earth materials to the PCC subgrade; to legally dispose of the excavated materials, and to furnish, place, finish, joint, cure, seal, and complete the construction of the 6" deep PC concrete driveway pavement in accordance with the plans and specifications.

Hot weather protection measures shall be employed when needed per ACI standards and Yuma County Specification Section 505. The new PCC Pavement shall be finished and textured with a burlap drag, transverse broomed, or a grooved finish and cured per as required. The new PC concrete pavement shall be jointed with a centerline longitudinal construction or sawed joint and with sawed transverse contraction/construction joints to create approximately square panels with no angles less than 90 degrees. All joints shall be filled with an approved non-tracking pour type joint sealant material per MAG Standard Specification Section 324 and 729.

**340.7 Measurement** of the Standard Specifications is modified to add:

Measurement of new Type "A" Curb will be based on the lineal feet (LF) of concrete curb and gutter constructed on a compacted subgrade to the required extent, cross-section, and elevations as established by the plan, specifications, and details.

Measurement of Remove and Replace Concrete Driveway will be based on the square feet (SF) of 6" thick concrete driveway constructed on a compacted subgrade to the required extent, cross-section, and elevations as established by the plan, specifications, and details. This pay item includes all related items of work required for the construction of the PC concrete pavement, including the removal of existing pavement, excavation of existing street surfacing and earth materials to subgrade, subgrade preparation, and the proper and legal disposal of the excavated materials.

**340.8 Payment** of the Standard Specifications is modified to add:

Payment will be made at the bid unit price per lineal feet (LF) of Type "A" curb constructed based on the measured length of concrete curb and gutter satisfactorily completed.

Bid Item: **3400001 NEW TYPE "A" CURB**

Payment will be made on the bid unit price per square foot (SF) of 6" thick concrete driveway constructed on a prepared subgrade based on the measured quantity. The removal and disposal of the existing driveway concrete pavement is incidental to this pay item.

Bid Item: **3400005 REMOVE AND REPLACE CONCRETE DRIVEWAY**

**SECTION 401 TRAFFIC CONTROL** is replaced:

#### **401.1 Description**

The purpose of a Traffic Control Plan (TCP) is to encourage proper planning as to the time of day, sequence of construction, degree of restriction required, and temporary traffic control needed.

Traffic control shall consist of traffic control devices and flagmen or pilot cars. All traffic control devices, the application of traffic control measures, and traffic regulation in these specifications are to supplement and are not intended to delete any of the provisions of the MUTCD.

**401.1.1 Traffic Control Plan Requirements:** Traffic control plans are to be submitted by the Contractor for work undertaken in County right of way and shall be in compliance with the MUTCD. This submittal shall be part of the required project submittals and must be approved by Yuma County Department of Engineering prior to commencing construction.

The traffic control plan includes the following components:

- (A) **Traffic control plan** must include detailed site plan showing signing, striping, barricading, detours, pedestrian walkways, bike lanes, construction fences, and project phasing.
- (B) **Traffic control cover sheet** includes additional requirements that are part of the traffic control plan. The traffic control cover sheet can be downloaded at:  
<https://www.yumacountyaz.gov/home/showdocument?id=41277>

The Contractor's Traffic Control Submittal shall be prepared by an individual meeting one of the following criteria:

- (A) Has successfully completed a recognized Traffic Control Supervisor Training and Certification program. The Traffic Control Supervisor Training and Certification provided by the American Traffic Safety Services Association (A.T.S.S.A.) or the International Municipal Signal Association (IMSA) shall be acceptable. Training and certification through other programs must be approved in advance by the Engineer. The individual's training and certification shall be current and must be valid throughout the duration of the project. In order to remain current, training and certification shall be completed or renewed at least once every four years.
- (B) Be a licensed Professional Engineer registered in the State of Arizona and have completed an approved Traffic Control Supervisor Training program. The training shall be current and must be valid throughout the duration of the project. In order for the training to remain current, it shall be completed or renewed every four years.

The Contractor shall submit proof of the proposed individual's credentials at the preconstruction conference. The Contractor bears all responsibility for any such contractor submitted control plan, whether prepared by its direct employee or other individual.

On most minor projects, the typical illustrations contained in the MUTCD can be applied and constitute a pre-approved TCP upon authorization from Yuma County Department of Engineering.

#### **401.2 Traffic Control Devices**

Traffic control devices shall consist of providing, erecting, and maintaining necessary and adequate devices for the protection of the work, the workmen and the traveling public as approved by the Engineer.

- (A) Temporary traffic control devices shall be used to guide or detour traffic through or around construction areas. They include traffic cones to channelize traffic, portable barricades for warning, vertical panel channelizing devices to divert traffic, and lighting devices between the hours of sunset and sunrise.
- (B) Advance warning devices shall be used to alert the motorist of an obstruction in the roadway. They include diamond-shaped signs, flags, and flasher type high level warning devices mounted 8 feet above the roadway.

Signs, barricades, lights, arrow boards, message boards or other devices which, in the sole opinion of the Engineer, are in poor condition shall be removed and replaced with equipment that is in good condition.

Equipment that is scratched, marred, discolored, bent, stained, set at incorrect height, or otherwise in poor condition as determined by the Engineer shall be removed and replaced with equipment in new or good condition as directed by the Engineer.

The Contractor shall inspect all traffic control installations for the project at such regular times but not less than once every six (6) hours day and night or as directed by the Engineer, and shall reset, replace, clean, adjust or otherwise maintain all traffic control in good condition for the use intended.

All barricades, vertical panel, tubular markers, sign stands, or other equipment as appropriate, shall be sand bagged upon initial installation or relocation and re-sand bagged as necessary or as directed by the Engineer. Sand bags shall be of good, tightly woven cloth and shall be filled to a minimum of 75% of their capacity with clean sand free from objectionable material such as rock or concrete pieces. Bags that are torn or sun rotted shall not be used and shall be removed from the project. The use of asphalt or concrete pieces in lieu of sand bags is prohibited at all times. Sand bags shall not be placed on the top of signs or barricades at any time.

Minimum sand bagging requirements are one (1) sand bag for vertical panels, type II barricades (suspended bag), small sign stands, tubular markers, etc.

Minimum sand bagging requirements for spring stands, type III barricades, large sign stands, etc. is two (2) sand bags per unit. In any event or when so directed by the Engineer, the Contractor shall provide additional sand bags for traffic control equipment.

The Contractor shall be prepared in advance of high wind events to respond immediately with additional sand bags for traffic control equipment.

Elements of work which are lost, stolen, destroyed, or are deemed unacceptable by the Engineer, while in use on a project shall be replaced by the Contractor and, except as hereinafter specified for temporary impact attenuation devices, at no additional cost to the County.

Sign sheeting shall be in accordance with ADOT standards, section 1007, and shall be orange prismatic sheeting.

#### **401.3 Flagmen or Pilot Cars**

Flagmen or pilot cars shall consist of providing sufficient flagmen, uniformed off-duty law enforcement officers or pilot cars to expedite the safe passage of traffic.

Uniformed off-duty law enforcement officers shall be required for lane closures on two way roadways, where posted speed is 45mph or higher unless otherwise approved by Yuma County Engineering Department.

#### **401.4 Traffic Control Measures**

The application of all traffic control measures shall be based primarily upon the conditions existing at the time that such measures are deemed necessary. Prior to the start of any work that would interrupt the normal flow of traffic; sufficient and adequate devices and measures shall be provided and erected in accordance with the approved Traffic Control Plan or as directed by the Engineer. These devices shall be immediately removed when no longer needed.

#### **401.5 General Traffic Regulations**

A traffic lane shall be a minimum of 10 feet of clear street width with a safe motor vehicle operating speed of at least 25 miles per hour.

Message boards shall be required on major collector and arterial streets when a street closure will be conducted, the notice shall be provided 7 calendar days in advance of work. In addition, message boards will be required on arterial streets for the duration of the closure unless waived by the Engineer,

Arrow Boards for lane closures will be required on multi-lane streets when lanes are fully closed at night. If two lanes are closed sequentially, an arrow board is required for the first one to get the drivers attention.

An intersection shall be all of the area within the right of way intersection streets plus 300 feet beyond the edge of the intersected right of way on all legs of the intersection.

A minimum of two traffic lanes, one for each direction, shall be maintained open to traffic at all times on all major streets. On multi-lane streets two or more lanes of traffic may be required depending on traffic conditions.

All existing traffic lanes on major streets shall be maintained open to traffic at signalized intersections between the hours of 6:00 a.m. to 9:00 a.m. and 3:00 p.m. to 6:00 p.m. weekdays unless otherwise specified in the special provisions.

Streets shall be maintained open to through traffic at all times unless approved by the Engineer. The Contractor shall notify residents at least 48 hours in advance of work and coordinate with all businesses and residents to insure construction activities are scheduled and ingress/egress for deliveries and access to the properties shall be maintained. Access to cross streets or use of streets scheduled for improvement must be reasonably maintained during the work day and fully re-established at the end of each work day.

A traffic lane shall not be considered as satisfactorily open to traffic unless it is paved with hot mix or cold mix asphalt paving if surrounded by or adjacent to existing pavement. Where pavement did not previously exist or where all of the existing pavement has been removed, a traffic lane shall not be considered as satisfactorily open to traffic unless it is graded reasonably smooth and maintained dust free as directed by the Engineer.

The Contractor shall provide and maintain all necessary traffic controls to protect and guide traffic for all work in the construction area.

The Contractor shall maintain all existing STOP, YIELD, and street name signs erect, clean, and in full view of the intended traffic at all times. If these signs interfere with construction, the Contractor shall temporarily relocate the signs away from construction but still in full view of the intended traffic.

Existing traffic signs other than STOP, YIELD, and street name signs shall be maintained by the Contractor until such time as construction renders them obsolete or they are replaced. At that time the Contractor shall remove signs and posts without damage and deliver them as directed by the Engineer.

Subject to the approval of the County Engineer, the Contractor shall furnish and install the 25 MPH Construction Zone Speed Limit Signs. The Contractor shall maintain the signs erect, clean and in full view of the intended traffic at all times. Should the signs interfere with construction, the Contractor shall relocate the signs as necessary.

At any time project construction shall require the closure or disruption of traffic in any roadway, alley, or refuse collection easement such that normal refuse collection will be interfered with, the Contractor shall prior to causing such closure or disruption, make arrangements with the Sanitation Department in order that refuse collection service can be maintained.

Shoulders used to route traffic are to be watered to control dust and are to be graded a minimum of once a day. The Contractor, at no additional cost to the County, is responsible for repairing any pavement edges or pavement surfaces which are damaged by related operations or the routing of traffic off of the pavement.

Special traffic regulation are listed below:

*\*\*\*List any restrictions or requirements\*\*\**

#### **401.5.1 Reimbursement Exceptions**

**401.5.1.1 Deficient Elements of Work:** Any deficiencies in the traffic control plan, devices, equipment, services, or other elements of work listed will be brought to the attention of the Contractor by the Engineer, and all deficiencies shall be corrected by the Contractor before the close of that work shift, unless otherwise specified.

The Contractor will not be paid for those deficient elements of work listed unless restored to full usefulness prior to the close of the work shift in which notice of the defect is given. Measurement for reimbursement will not resume until the beginning of the work shift following that work shift in which those elements are restored to usefulness.

**401.5.1.2 Substantial Deficiencies:** For each work day or work shift during which there are, as determined by the Engineer, substantial deficiencies in the Contractor's traffic control plan, devices, and/or services, no reimbursement will be made to the Contractor for any element of work listed.

Measurement for reimbursement will not resume for any element of work until the beginning of the work day or work shift following that work day or work shift in which all corrective measures have been performed by the Contractor and approved by the Engineer.

In cases of serious or willful disregard for the safety of the public or the Contractor's employees by the Contractor, the Engineer may place the traffic control elements in proper condition and deduct the cost thereof from monies due or becoming due the Contractor.

**401.5.1.3 Non-diligent Prosecution of Work:** In the event that the Engineer determines that the Contractor's construction operations are not resulting in the diligent prosecution of the work under contract, no reimbursement will be made to the Contractor for the elements of work listed until such time as the Engineer determines that the Contractor is devoting appropriate efforts toward completion of the work.

Payment will be suspended effective with the end of the work day or work shift in which written notice is issued to the Contractor by the Engineer notifying the Contractor of its failure to prosecute the work.

Payment will resume with the beginning of the work day or work shift following that work day or work shift in which the Engineer determines that satisfactory efforts are being made by the Contractor toward completion of the work.

In any case, the Contractor shall continue to be responsible for maintaining all barriers, attenuators, signs, lights and other traffic control devices in proper functioning condition at all times.

#### **401.6 Measurement**

No measurement will be made for traffic control devices.

If listed in the bid schedule, flagmen, uniformed off-duty law enforcement officers or pilot cars, with driver, will be measured by the hour for each individual, including vehicle and equipment, required to perform traffic control. When an officer is used less than 3 hours, a minimum of 3 hours will be charged. Anything over 3 hours will be measured by the hour.

No reimbursement will be made to the contractor for the elements of work listed herein when they are required in association with construction work being performed after the expiration of the contract time and all approved extensions.

#### **401.7 Payment**

Payment for temporary traffic control shall be made by the lump sum items in the bid schedule, which will include all traffic control not paid separately, and will be paid as follows:

- (A) When the first Construction pay estimate is submitted, a payment of 25 (twenty-five) percent of the Lump Sum price will be made. For each progress payment thereafter, the remainder 75% of the line item shall be paid on a prorated basis based on the total dollar percentage completion of the project, not to exceed 100 (one-hundred) percent.

Bid Item:           **4010003   TRAFFIC CONTROL**

## **SECTION 402 CONSTRUCTION SURVEYING AND LAYOUT**

**402.1 Description** of the Standard Specifications is modified in the first paragraph last two sentences as follows:

The work shall be done under the direction of an Arizona registered professional engineer employed by the contractor. All right of way monuments and lines shall be established by an Arizona registered land surveyor employed by the contractor.

**402.4 Construction Requirements** of the Standard Specifications is modified to add:

Failure of the contractor to verify control points in writing to the Engineer shall serve to waive any contractor request for additional compensation based on error in the control points.

The contractor is required to control the construction of cuts and fills by the use of slope stakes or off-set slope stakes. Slope building is to be controlled at all times by a grade checker working from the slope stakes. Failure to use slope stakes and a grade checker will result in no payment for the work done.

**402.4.1 "As-Built" Record Drawing** The Contractor shall prepare and furnish "As-Built" record drawings to Yuma County. The Contractor shall obtain one (1) set of plans from the Engineer and shall record in red colored pencil all cases where actual field construction differs from work shown on the plans. All concealed work and utility locations shall be dimensioned horizontally and vertically to project or set Benchmarks not to Temporary Bench Marks [TBM]. Drawings shall be maintained in a current condition at all times until completion of the work and shall be made available for review by the engineer at all times.

In addition to "As-Built" record drawings, as-built cross sections shall be required if deemed necessary by the Engineer.

Failure of the Contractor to submit as-builts within 30 days of completion of the project and receive approval by the Engineer for the same shall result in 10% of the Construction Staking Bid Schedule line item being withheld from payment.

**402.4.2 Monument Recordation [ARS § 33-106]** The Contractor and his Surveyor are advised that restoration or establishment of public land corners as required by Arizona Revised Statutes 33-106 requires the monument be filed with the County Recorder. The Contractor is required to provide copies of the filing record to the Engineer. Failure of the Contractor or his surveyor to properly file on monuments and to provide copies of the filing documentation to the Engineer will result in the Engineer having the work done and the cost thereof deducted from the contract.

**402.5 Construction Measurement** of the Standard Specifications is modified as follows:

No measurement will be made for this item, the cost being considered incidental to the project.

**402.6 Basis of Payment** of the Standard Specifications is modified as follows:

No direct payment will be made for this item, the cost being considered incidental to the project.

## **SECTION 403 MOBILIZATION**

**403.1 Description** of the Standard Specifications is modified to add the following:

The work under this item shall consist of preparatory work and operations, including but not limited to, the movement of personnel, equipment, materials, supplies, and incidentals to the project site; the establishment of restroom facilities; establishment of storage/staging facilities necessary for work on the project; and for all other work and operations that must be performed and costs incurred prior to beginning work on the various construction items at the project site. The mobilization/demobilization work shall also include the movement of personnel, equipment, materials, supplies, tools, and other items from the site following completion of construction activities and restoration of any site(s) used for Contractor storage and staging.

The Contractor shall obtain approval of the property owner and the County Project Manager when using vacant private property to park and service equipment, and/or to store materials for use on this project.

The Contractor shall notify adjacent property owners/residents of this proposed use.

1. Any use of vacant property adjacent to or near the project for parking or servicing equipment and/or storing of material will require the Contractor to obtain written approval from the property owner. This approval shall contain any requirements which are a condition of this approval.
2. A copy of the property owner's approval shall be submitted along with the Contractor's request to the County Project Manager for approval for the use of the marshaling yard in connection with the project. An appropriate distance from adjacent properties will be set by the County Project Manager on a case by case basis based on the size and type of equipment to be used on the project.
3. The yard shall be securely fenced and adequately dust-proofed in a manner such as to preclude dirt and dust blowing off the site and tracking of mud onto paved or unpaved City streets.
4. Work in the yard shall be scheduled so as to comply with the County's Noise Ordinance and other applicable ordinances, rules, and regulations pertaining to construction activities.
5. Equipment, materials, supplies, etc., shall be located so as to minimize impact on adjacent properties. A sound barrier may be required if deemed necessary by the County Project Manager.
6. The Contractor shall clean up the property promptly upon completion of use and shall provide a signed property release as a condition of final acceptance.
7. Contractor's request for approval shall specify in detail how he or she proposes to comply with 1 through 7 above.

Site Use and Clean-up: Fine grading of disturbed surfaces; spreading new decomposed granite on disturbed surfaces where it existed prior to construction; returning staging areas and surrounding disturbed areas to their original condition (or better), and including reseeding, if necessary. Bid price shall include all costs associated with implementation of street sweeping as necessary to eliminate tracked dirt, mud, and debris from the project site onto paved surfaces via construction vehicle traffic and domestic traffic as a storm water management, pollution, and sediment control mitigation measure.

Sweeping and dust control shall be monitored and performed daily as needed and as may be directed by the County Inspector. Staging areas shall be provided with security fencing, scrubber pad to keep from tracking dirt/mud onto street surfaces, frequent housekeeping clean-up, and restoration of site to a condition as good if not better than found prior to construction. Dust control measures (including spraying water and/or dust palliatives on disturbed ground surfaces) are to be employed as needed to minimize fugitive dust from project activities.

This item includes all costs to mobilize for the project such as moving equipment, trucks, and personnel, both to the site and off the site upon completion of the work. This item also includes expenses for bonds, licenses, permits, project insurance, project coordination, materials, quality control testing, testing coordination, cut-sheet submittals, storage of materials, removal and disposal of construction debris, and the temporary supplies, power, and telephone, all necessary for the execution of the work.

**403.2 Method of Measurement** of the Standard Specifications is applicable to this bid item. Mobilization will be measured as a lump sum (LS) item of work.

**403.3 Basis of Payment** of the Standard Specifications is applicable to this bid item. Payment will be made at the lump sum (LS) price indicated on the Bid Schedule which amount shall be considered full compensation for the work as described herein. The lump sum amount shall be considered full compensation for the all work associated with this bid item, whether specifically stated or not.

Bid Item:           **9010001    MOBILIZATION**

#### **SECTION 504 STANDPIPES (FURNISH AND CONSTRUCT IRRIGATION SIPHON REPLACEMENT)**

The work under this section shall conform to the requirements of Section 504 of the ADOT Standard Specifications for Road and Bridge Construction, 2008 Edition.

**504.1 Description** is modified to add the following:

The work under this item shall consist of furnishing and installing a complete unit siphon replacement as shown on the plans. The work includes all excavation, removal of improvements, installation of 36" polyvinyl chloride (PVC) C905 pipe, and construction of headwalls and transition sections. Unit B Irrigation District requires that debris grates be furnished and installed on both ends. Grates and installation shall be "trash racks" per MAG Detail 502-2.

The construction window for the siphon replacement is the first week following the Thanksgiving holiday (approximately November 30) to mid-April (approximately April 15) each year. Both the Bureau of Reclamation and the Unit B Irrigation District must be notified prior to commencement of work on the siphon replacement. If the work is done during active irrigation activity, bypass pumping will be required and is incidental to the work herein.

**504.2 Materials** is modified to add the following:

Pipe for the siphon replacement shall be polyvinyl chloride (PVC) C905 pipe, DR 18, Pressure Rating 235 psi, meeting or exceeding the requirements of AWWA Standard C905 "Polyvinyl Chloride (PVC) Water Transmission Pipe." All pipe shall be made from quality PVC resin, compounded to provide physical and mechanical properties that equal or exceed cell class 12454 as defined in ASTM D1784. The Contractor shall furnish and install the PVC C905 pipe of the size(s) and at the locations where shown on the plans.

The pipe shall either be purple in color to denote that it is a non-potable irrigation water line (preferred), or shall be installed inside a purple inert polyethylene plastic sleeve per MAG Section 616.4 (Identification).

**504.4 Method of Measurement** is modified to add the following:

The measurement for this item is at a lump sum (LS) amount for one complete siphon replacement unit, in place. No additional measurements for removal, excavation, and backfill will be made.

**504.5 Basis of Payment** is modified to add the following:

Payment will be made once the siphon replacement construction is accepted at the lump sum (LS) unit price bid, complete in place. The lump sum amount shall be considered full compensation for the all work associated with this bid item, whether specifically stated or not.

Bid Item:           **5040992    FURNISH AND CONSTRUCT IRRIGATION SIPHON REPLACEMENT**

#### **SECTION 607 ROADSIDE SIGN SUPPORT**

The work under this section shall conform to the requirements of Section 607 of the ADOT Standard Specifications for Road and Bridge Construction, 2008 Edition.

**607.1.0 Description:** the first paragraph of the Standard Specifications is revised to read: The work under this section shall consist of furnishing and installing roadside sign supports in accordance with the details shown on the plans and the requirements of the specifications.

**607.2.03 Perforated Sign Posts** is revised to add: All sign posts shall be square tube posts furnished and installed in accordance with ADOT Signing and Marking Standard Drawings. Size of sign posts shall be denoted on the plans. Standard ADOT breakaway foundations are included in and incidental to this item of work.

**607.2.05 Concrete:** the last paragraph of the Standard Specifications is revised to read: Reinforcing steel bars for breakaway sign post foundations shall conform to the requirements of ASTM A 615. Unless otherwise specified, steel bars meeting the requirements of ASTM A 706 may be substituted for ASTM A 615 steel bars. When ASTM A 706 bars are used, tack welding of the reinforcement will not be permitted unless approved in writing by the Engineer. Reinforcing steel wire shall conform to the requirements of ASTM A 82.

**607.2.3 'New Traffic Pattern Ahead' signs:** shall be mounted on Type 2S galvanized square tube posts with foundations, are to be placed on each approach approximately 750 LF in advance of the painted stop bar location. The signs are temporary in nature and shall be in place prior to completion of construction and shall remain in place for 45 calendar days after completion of construction. Salvage of the sign panel and square tube sign post shall be to Yuma County and the salvaged sign and post shall be delivered to and unloaded at a location specified by the County Inspector. The Contractor shall remove and dispose of the sign post foundation at a landfill or other approved and legal disposal site. The work to furnish and install the square tube sign post for these signs shall be measured and paid for under this section.

**607.4.0 Method of Measurement:** Breakaway sign posts will be measured by the lineal foot for each size of post furnished and erected. The length of each size of post will be measured from the bottom of the upper base plate to the top of the post, measured to the nearest 0.1 feet. The total length of all posts of the same size will be rounded to the nearest foot. Perforated sign posts will be measured by the linear foot of each type of post furnished and installed. The length of each type of post will be measured from the top of the concrete post foundation to the top of the post, measured to the nearest 0.1 feet. The total length of all posts of the same type will be rounded to the nearest foot. Telescoping post members will be considered as one post after installation and will not be measured separately. U-channel posts will be measured as each. Foundations for signposts will be measured by the unit for each type of foundation constructed, except that concrete and excavation, when required for setting U-channel base posts, will be considered as part of the post.

**607.5.0 Basis of Payment:** The accepted quantities of breakaway posts, perforated posts, U- channel posts and foundations for the sign posts, measured as provided above, will be paid for at the contract unit prices complete in place.

The contract unit price paid per linear foot for each size of breakaway sign post, each type of perforated sign post and each installation of U- channel post designated in the bidding schedule shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in furnishing and erecting the sign posts, complete in place, including galvanizing and furnishing all metal plates and hardware, all as shown on the plans and as specified herein.

The contract unit price paid per unit for each type of sign foundation designated in the bidding schedule shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in constructing foundations, complete in place, including the steel stub posts, lower base plate and steel reinforcement ( except for stub posts S 3 x 5. 7 and S 4 x 7. 7) for the breakaway sign post foundation; the portion of perforated post within the foundations; galvanizing the posts; and excavation, all as shown on the plans and as specified herein.

Bid Item:	<b>6070038</b>	<b>SLIP BASE (ADOT DTL S-3)</b>
	<b>6070057</b>	<b>SIGN POST (PERFORATED) (2 1/2 T)</b>
	<b>6070060</b>	<b>FOUNDATION FOR SIGN POST (CONCRETE)</b>

## **SECTION 608 SIGN PANELS**

The work under this section shall conform to the requirements of section 608 of the ADOT Standard Specifications for Road and Bridge Construction, 2008 Edition.

**608.1 Description** of the Standard Specifications is revised to read:

The work under this section shall consist of furnishing and installing sign panels in accordance with the details shown on the plans and the requirements set forth herein.

The sign panels shall be of the following types:

- (A) Extruded Aluminum Sign Panels with Direct-Applied, Digitally-Imaged, or Demountable Characters
- (B) Flat Sheet Aluminum Sign Panels with Direct-Applied, Digitally-Imaged, Electronic-Cut, or Screen-Printed Characters (includes street name signs)
- (C) Warning, Marker, and Regulatory Sign Panels
- (D) Route Shields for Installation on Sign Panels
- (E) EXIT ONLY Panels for Installation on Sign Panels

**608.2.01 General:** of the Standard Specifications is modified to add: signs shall be fabricated in accordance with the recommendations established by the manufacturer of the sign sheeting. All processes and materials used to make a sign shall in no way impact the performance, uniform appearance (day and night), or durability of the sheeting, or invalidate the sign sheeting manufacturers' warranty.

All sheeting used for background and legend shall be from the same manufacturer. Sign panels shall not be overlaid.

All text and numerals shall all be installed at the same orientation: either zero degrees or 90 degrees.

Design of letters and numbers shall be in accordance with the project plans with a tolerance of  $\pm 1/16$ th of an inch.

The contractor shall not paint the bolts or the washers unless otherwise specified.

**608.2.02 Extruded Aluminum Sign Panels with Demountable Characters:** the title and the third paragraph of the Standard Specifications is revised to read:

**608.2.02 Extruded Aluminum Sign Panels with Direct-Applied, Digitally-Imaged, or Demountable Characters**

The letters, numerals, symbols, borders and other features of the sign message shall be direct-applied, digitally-imaged, or demountable, and shall conform to the requirements of Subsection 608-2.14, Demountable Characters, Subsection 608-2.15, Screen-Printed, Direct-Applied, or Electronic-Cut Characters, or Subsection 608-2.16, Digitally-Imaged Characters.

**608.2.07 Flat Sheet Aluminum Sign Panels with Direct-Applied or Silk-Screened Characters:** the title and text of the Standard Specifications are revised to read:

**608.2.07 Flat Sheet Aluminum Sign Panels with Direct-Applied, Digitally-Imaged, Electronic-Cut, or Screen-Printed Characters:**

Panels, including street name signs, shall be fabricated from 0.125-inch thick 5052-H36, or 5052-H38 Aluminum Alloy conforming to the requirements of ASTM B 209.

Panel facing shall be prepared and covered with retroreflective sheeting in accordance with the recommendations of the sheeting manufacturer. The color of the sheeting shall be as specified on the plans or as shown in the Manual of Approved Signs.

All surfaces not covered shall be etched to reduce glare from reflected sunlight.

The retroreflective sheeting shall conform to the requirements of Section 1007. Splicing of retroreflective sheeting shall not be allowed on sign panels having a minimum dimension up to and including four feet.

Messages shall be reflectorized white or, if called for on the plans, opaque black, and shall be produced by screen printing, direct-applying, digital imaging, or electronic cutting, as specified under Subsections 608-2.15 and 608-2.16.

**608.2.09 Warning, Marker, and Regulatory Sign Panels:** of the Standard Specifications is revised to read: Panels shall be fabricated from flat sheet aluminum and shall be reflectorized as specified herein.

Panels shall be fabricated in one piece from 0.125-inch thick 5052-H36, 5052-H38, or 6061-T6 Aluminum Alloy conforming to the requirements of ASTM B 209.

All surfaces of panels to be covered with retroreflective sheeting shall be prepared in accordance with the recommendations of the sheeting manufacturer. Surfaces not covered shall be etched to reduce glare from reflected sunlight. Retroreflective sheeting shall conform to the requirements of Section 1007.

Warning signs shall be reflectorized with fluorescent yellow retroreflective sheeting.

Regulatory signs shall be reflectorized with white retroreflective sheeting.

Reflectorized red signs shall be reflectorized with white retroreflective sheeting. The red color shall be produced by screen printing.

Regulatory signs with reflectorized red circles and slashes shall be reflectorized with white retroreflective sheeting. The red color shall be produced by screen printing.

Interstate route markers shall be cut to shape. The colors and legend shall be as shown on the plans and shall be reflectorized with white retroreflective sheeting. The Interstate route colors shall be screen-printed. The numerals may be screen-printed, electronic-cut, or direct-applied characters.

United States, State Route, and Cardinal Direction markers shall be reflectorized with white retroreflective sheeting unless otherwise shown on the plans.

Splicing of retroreflective sheeting shall not be allowed on sign panels having the minimum dimension up to and including four feet.

**608.2.13 Retroreflective Sheeting, Inks and Opaque Film:** the second and third paragraphs of the Standard Specifications are hereby deleted.

**608.2.14(A) General:** the second paragraph of the Standard Specifications is revised to read:

Flat sheet aluminum substrates used for characters and borders shall be either aluminum alloy 3105-H14, 3003-H14, 5052-H36, or 5052-H38 as specified in ASTM B 209. Characters produced from the flat sheet aluminum alloy shall sit flat on the face of the sign panel without visible gap or deformation.

**608.2.14(B) Sheeting and Colors:** the third, fourth, and fifth paragraphs of the Standard Specifications are revised to read:

The color for demountable letters, numbers, symbols, and route shields on green, blue, and brown background signs shall be white, and shall conform to the requirements of Section 1007. Demountable legends on white and yellow background signs shall be black, and shall be opaque and non-reflective. Black characters shall be finished with laminated black opaque acrylic film.

When borders are used with demountable characters, white legend and border shall be used on green, blue, or brown sign backgrounds, and black legend and border shall be used on white or yellow sign backgrounds. Sign sheeting conforming to Section 1007 shall be used for white borders. Black borders shall be laminated black opaque acrylic film.

Laminated black opaque acrylic film to be used for characters or borders, as specified above, shall be applied in accordance with the coating manufacturer's recommendations. The contractor shall provide copies of any warranties provided by the manufacturer to the Engineer.

**608.2.15 Silk-Screened or Direct-Applied Characters:** the title and text of the Standard Specifications is revised to read:

**608.2.15 Screen-Printed, Direct-Applied, and Electronic-Cut Characters:** Screen-printed letters, numerals, arrows, symbols, and borders, shall be applied on the retroreflective sheeting background of the sign by direct or reverse screen process. Messages and borders of a color darker than the background shall be applied to the retroreflective sheeting by direct process. Messages and borders of a color lighter than the sign background shall be produced by the reverse screen process.

Opaque or transparent colors, inks, and paints used in the screen process shall be of the type and quality recommended by the manufacturer of the retroreflective sheeting.

The screening shall be performed in a manner that results in a uniform color and tone, with sharply defined edges of legends and borders and without blemishes on the sign background that will affect intended use.

Signs, after screening, shall be air dried or baked in accordance with the manufacturer's recommendations to provide a smooth hard finish. Any signs on which blisters appear during the drying process will be rejected.

Direct-applied letters, numerals, symbols, borders, and other features of the sign message shall be cut from black opaque or retroreflective sheeting of the color specified and applied to the retroreflective sheeting of the sign background in accordance with the instructions of the manufacturer of the retroreflective sheeting.

Direct-applied legend may be moved vertically 1/2 inch to avoid placing only a small amount of material over the adjacent extruded panel. The bottom of all characters for a line of legend shall line up within 1/8 of an inch.

Electronic-cut characters shall be cut from translucent acrylic sheeting using computerized automated cutting processes.

**608.2 Materials:** of the Standard Specifications is modified to add:

**608.2.16 Digitally-Imaged Characters:** Digitally-imaged characters shall consist of characters produced through ultraviolet jet-printing or thermal transfer. Signs with digitally-imaged characters shall be manufactured using matched component ink, transparent electronic-cuttable film, and/or overlay film as supplied by the reflective sheeting

manufacturer. For digitally-imaged copy on white sheeting, the coefficient of retroreflection shall be not less than 70 percent of the original values for the corresponding integral color. When characters are spread over two adjacent extruded panels, the characters shall align with each other within 1/16th of an inch.

**608.3.01 Fabrication:** of the Standard Specifications is modified to add:

During fabrication of the sign panels, the contractor shall ensure the bolt holes on each sign panel are placed so the holes will not coincide with any legend and any bolts, washers, or other hardware used will not cover any portion of the legend. If the bolt holes on a sign panel do not comply with these requirements, the Engineer may reject the sign panel or accept the sign panel and require the contractor to paint the bolts, washers, and any hardware coinciding with the sign legend to match the color of the legend.

**608-3.02 Installation of Sign Panels:** of the Standard Specifications is revised to read:

The sign panels shall be installed on overhead sign structures and roadside sign supports in accordance with the details shown on the plans and in accordance with the recommendations of the manufacturers of the sign panel components.

Minor scratches and abrasions resulting from fabrication, shipping and installation of panels may be patched; however, patching shall be limited to one patch per 50 square feet of sign area with the total patched area being less than five percent of the sign area. Panels requiring more patching than the specified limit will be rejected. Patches shall be edge sealed by a method approved by the retroreflective sheeting manufacturer.

Sign panels shall be attached to the posts with hex head bolts as shown in the Standard Drawings; slotted head bolts shall not be used. A cadmium-plated or zinc-plated fender washer shall be placed between the bolt head and panel face.

For flat sheet panels, bolts shall be fastened with a cadmium-plated or zinc-plated fender washer and two standard nuts. Nylon washers shall not be used. The fender washer shall be placed against the sign post, the first nut shall be tightened against the fender washer, and the second nut shall be tightened against the first nut. Bolts shall be tightened from the back by holding the bolt head stationary on the face of the panel. Twisting of the bolt head on the panel face will not be allowed.

The contractor shall provide two copies of a detailed list of all new signs installed on the project to the Engineer. The list shall include the sign identification code, the date each sign was installed (month and year), the fabricator of the sign, and the materials used to make the sign (manufacturer, type of sheeting, ink and film). The list shall be provided in a commonly used electronic spreadsheet format, such as EXCEL, and the two copies shall be submitted on CD-ROM disks. Signs shall be listed in numerical order by route, direction, and milepost and, where more than one sign is installed at the same general location, a letter subscript.

Sign panels within the same sign assembly shall be placed at the same orientation along the roadway so that the entire legend of the signs appear uniform under normal viewing conditions, both day and night.

Upon fabrication or installation of each sign, the contractor shall place information on the back of the sign showing the sign identification code, the sign fabricator, the manufacturer of the sheeting used, and the month and year of the installation. The formatting of the required information shall be as shown on the standard drawings. The information shall be positioned to be readily visible from a vantage point outside the flow of traffic and not obstructed by sign posts, extrusions, stringers or brackets. All letters shall be made of a long-life material such as a black opaque acrylic film. Signs not marked as required will not be eligible for payment.

Temporary traffic control signs are exempt from the installation information requirement unless noted otherwise on the project plans.

New Traffic Pattern Ahead Signs shall be mounted on Type 2S galvanized square tube posts with foundations, are to be placed on each approach approximately 750 LF in advance of the painted stop bar location. The signs are temporary in nature and shall be in place prior to completion of construction and shall remain in place for 45 calendar days after completion of construction. Salvage of the sign panel and square tube sign post shall be to Yuma County and the salvaged sign and post shall be delivered to and unloaded at a location specified by the County Inspector. The Contractor shall remove and dispose of the sign post foundation at a landfill or other approved and legal disposal site. The work to furnish and install the sign panel on the square tube sign posts shall be measured and paid for under this section.

**608.3.04 Inspection:** the second paragraph of the Standard Specifications is revised to read:

Each sign panel face shall be cleaned thoroughly just prior to the inspection by a method recommended by the manufacturer. The cleaning material shall in no way scratch, deface or have any adverse effect on the sign panel components.

**608.4 Method of Measurement:** of the Standard Specifications is revised to read:

Sign panels will be measured by the square foot for each type or types of sign panels furnished and installed. Individual sign panels will be measured to the nearest 0.1 square foot. The total area of each type of sign panel will be summed and rounded to the nearest square foot.

The area of each sign panel, except for warning, regulatory and marker sign panels, will be measured per plans dimensions.

For warning, regulatory and marker sign panels, the area of each sign panel will be determined as follows:

- (A) The areas of each rectangular, square or triangular sign panel will be determined from the dimensions shown on the plans.
- (B) The area of irregular shaped signs, such as stop signs and route markers, will be determined by multiplying the maximum height in feet by the maximum width in feet, using the dimensions shown on the plans.

This work item includes the temporary duration New Traffic Pattern Ahead sign panels per ADOT Section 607.

**608.5 Basis of Payment:** first and second paragraphs of the Standard Specifications are revised to read:

The accepted quantities of each type of sign panel designated in the bidding schedule, measured as provided above, will be paid for at the contract unit price per square foot, complete in place, regardless of the type of sheeting or type of character used on the sign panel. Payment shall be made on the total area of each type of sign panel to the nearest square foot.

No additional payment will be made for signs with sheeting applied to both sides, the cost being considered as included in the contract unit price for the sign panel.

No measurement or payment will be made for Route Shields and EXIT ONLY Panels (for installation on sign panels), the cost being considered as included in the contract unit price for the sign panel.

This work item includes the temporary duration New Traffic Pattern Ahead sign panels per ADOT Section 607. This work item also includes the street name signs to be mounted on the traffic signal poles at the locations shown on the plans.

- Bid Items:    **6080001    FURNISH AND INSTALL REGULATORY AND WARNING SIGN PANEL, TYPE XI SHEETING, ADOT SPEC 608 & 1007**  
                  **6080120    FURNISH AND INSTALL STREET NAME SIGNS ON TRAFFIC SIGNAL POLE**

## **SECTION 701 MAINTENANCE AND PROTECTION OF TRAFFIC**

The work under this section shall conform to the requirements of Section 701 of the ADOT Standard Specifications for Road and Bridge Construction, 2008 Edition. This Section is incorporated by Reference.

### **701.2.05 Temporary Pavement Markings:**

### **701.3.06 Obliteration of Existing Pavement Markings**

### **701.4 Method of Measurement is revised:**

**701.4.04 (I)** Obliterate Pavement Markings will be measured by the linear foot along the centerline of the pavement stripe. Skips in dashed lines will not be included in the measurement. Length of pavement markings will be based on a 4-inch-wide stripe. Measurement for striping with a plan width greater or less than the basic 4 inches as shown on the plans or directed by the Engineer will be made by the following method:

Plan Width of Striping (inches) x Linear Feet  
4 (inches)

**701.4.04 (L) is revised:** No measurement or direct payment will be made for temporary pavement markers with the cost being incidental to Furnish and Install Interim Pavement Marking.

**701.5.01 Obliterate Pavement Marking** is replaced with: Obliterate Pavement Marking measured as provided above, will be paid for at the unit bid price per linear foot, which price shall be full compensation for the work, complete, including furnishing all labor and equipment required and restoring the pavement surface to a condition acceptable to the Engineer.

Bid Item: **7015052 OBLITERATE PAVEMENT MARKING**

**SECTION 704 THERMOPLASTIC PAVEMENT MARKINGS**

The work under this section shall conform to the requirements of Section 704 of the ADOT Standard Specifications for Road and Bridge Construction, 2008 Current Edition (Stored Specifications).

**704.1 Description:** of the Standard Specifications is revised to read:

The work under this section shall consist of cleaning and preparing pavement surfaces and furnishing and applying either white or yellow thermoplastic reflectorized pavement markings using extrusion or ribbon dispensing devices of the required shape and thickness to the prepared pavement surface at the locations and in accordance with the details shown on the project plans, the manufacturer's specifications, and the requirements of these specifications.

**704.2.01 General Requirements:** the second and third paragraphs of the Standard Specifications are revised to read:

Only thermoplastic materials currently shown on the Department's Approved Products List (APL) shall be used. Copies of the most recent version of the APL are available on the internet from the ADOT Research Center through its Product Evaluation Program.

Certificates of Compliance conforming to the requirements of Subsection 106.05 shall be submitted along with precertification test results from the ADOT Central Laboratory for samples from each batch of material obtained for precertification at the production line of the manufacturer.

**704.2.02 Composition:** of the Standard Specifications is revised to read:

**(A) General:**

The thermoplastic composition shall conform to the following requirements:

Component	Percent by Weight	
	White	Yellow
Binder (Min.) (Note 1)	20	20
Titanium dioxide (Min.)	10	1.75
Yellow Lead-Free Pigment (Min.)	-----	1.5
Reflective glass inter-mix beads (Min.) (Note 1)	20/ M 247 T1 & 20/ M 247 T3	20/ M 247 T1 & 20/ M 247 T3
Calcium carbonate or equivalent filler (Max.)	30	36.75
Note 1: As described in 704-2.05(C), for precertification purposes, thermoplastic material will be tested for binder content and glass bead content according to ASTM D4797.		

The ingredients of the thermoplastic composition shall be thoroughly mixed and in a solid or sectionalized block, or free-flowing granular form. When heated in a melting apparatus, the material shall readily liquefy into a uniform solution. This solution shall be free from all skins, dirt, foreign objects or any other ingredient which would cause bleeding, staining, blotting, or discoloration when applied to the bituminous or concrete pavement surfaces.

The thermoplastic formulation shall utilize an alkyd binder. The alkyd binder shall consist of a mixture of synthetic resins, at least one of which is solid at room temperature, and of high-boiling-point plasticizers. At least one third of the binder composition and no less than 8 percent by weight of the entire material formulation shall be solid maleic-modified glycerol ester resin or solid maleic-modified pentaerythritol ester resin. The alkyd binder shall not contain any petroleum-based hydrocarbon resins.

**(B) Reflective Glass Beads:**

In addition to incorporating glass beads in the thermoplastic mix, glass beads shall be evenly applied to the surface of the molten material as specified in Subsection 704-3.02 (G).

**(C) Filler:**

The filler shall be a white calcium carbonate or equivalent filler with a compressive strength of at least 5,000 pounds per square inch.

**(D) Titanium Dioxide:**

Titanium Dioxide shall conform to the requirements of ASTM D476 for Type II (92 percent).

**(E) Yellow Pigment:**

The yellow pigment shall be heat resistant and lead free. The type of yellow pigment shall be at the option of the manufacturer provided that the material conforms to all color requirements in a stable and durable fashion as specified herein.

**704.2.03 Physical Characteristics of the Composition:** of the Standard Specifications is revised to read:

**(A) General Requirements:**

The thermoplastic material shall not exude fumes which are toxic, injurious, or require specialized breathing apparatus when heated to the temperature range specified by the manufacturer for application. The material shall remain stable when held for four hours at this temperature, or when subjected to four reheatings, not exceeding a total of four hours, after cooling to ambient temperature. The temperature viscosity characteristics of the plastic material shall remain constant throughout the reheatings and shall show like characteristics from batch to batch. There shall be no obvious change in color of the thermoplastic material as a result of reheating, and the color of the material shall not vary from batch to batch.

**(B) Color:**

The thermoplastic material, after heating for four hours  $\pm$  five minutes at  $425 \pm 3$  degrees F and cooled to  $77 \pm 3$  degrees F, shall meet the following:

White: Daylight reflectance at 45 degrees - 0 degrees shall be 70 percent minimum.

Color shall match Federal Test Standard Number 595, color chip no. 17925.

Yellow: Daylight reflectance at 45 degrees - 0 degrees shall be 43 percent minimum.

Color shall match Federal Test Standard Number 595, color chip no. 13538.

**(C) Retroreflectance:**

All white and yellow pavement marking materials shall have the following minimum retroreflectance values when measured by the Department, as described in Subsection 704-3.02(G), in accordance with ASTM E1710 within 30 days of application, but no sooner than three days after application to the roadway surface.

Product	Retroreflectance (millicandelas)	Retroreflectance on Chip Seals millicandelas)
White	350	250
Yellow	200	175

**(D) Softening Point:**

After heating the thermoplastic material for four hours  $\pm$  five minutes at  $425 \pm 3$  degrees F and testing in accordance with ASTM D36, the thermoplastic materials shall have a softening point of  $215 \pm 15$  degrees F.

**(E) Water Absorption and Specific Gravity:**

The thermoplastic material shall not exceed 0.5 percent by weight of retained water when tested in accordance with the requirements of ASTM D570.

The specific gravity of the material, as determined by AASHTO T 250, shall be between 1.85 and 2.15.

**(F) Impact Resistance:**

After heating the thermoplastic material for four hours  $\pm$  five minutes at  $425 \pm 3$  degrees F and forming test specimens, the impact resistance shall be not less than 10 inch-pounds when tested in accordance with AASHTO T 250.

**(G) Bond Strength:**

After heating the thermoplastic material for four hours  $\pm$  five minutes at  $425 \pm 3$  degrees F, the bond strength to Portland cement concrete shall be not less than 180 pounds per square inch. The bond strength shall be determined in accordance with the procedures specified in AASHTO T 250.

**(H) Abrasion Resistance:**

The abrasion resistance of the thermoplastic material shall be determined by forming a representative lot of the material at a thickness of 125 mils on a 4-inch square monel panel (thickness  $50 \pm 1$  mil), on which a suitable primer has been previously applied, and subjecting it to 200 revolutions on a Taber Abraser at 25 degrees C, using H-22 calibrated wheels weighted to 250 grams. The wearing surface shall be kept wet with distilled water throughout the test.

The maximum loss of thermoplastic material shall be 0.5 grams.

**(I) Cracking Resistance at Low Temperature:**

After heating the thermoplastic material for four hours  $\pm$  five minutes at  $425 \pm 3$  degrees F, applying to concrete blocks, and cooling to  $15 \pm 3$  degrees, the material shall show no cracks when observed from a distance exceeding 12 inches. Testing for low temperature crack resistance shall be in accordance with the procedures specified in AASHTO T 250.

**(J) Flowability:**

After heating the thermoplastic material for four hours  $\pm$  five minutes at  $425 \pm 3$  degrees F, and testing for flowability in accordance with AASHTO T 250, the white thermoplastic shall have a maximum percent residue of 18, and the yellow thermoplastic shall have maximum percent residue of 21.

**(K) Yellowness Index:**

The white thermoplastic material shall not exceed a yellowness index of 0.12 when tested in accordance with ASTM D 4960. As described in Subsection 704-2.05(C), for precertification purposes, thermoplastic material will be tested for yellowness index. The material will be prepared and tested in accordance with ASTM D4960. The yellowness index will be calculated using ASTM E313.

**(L) Flowability (Extended Heating):**

After heating the thermoplastic material for eight  $\pm$  1/2 hours at  $425 \pm 3$  degrees F, with stirring the last six hours, and testing for flowability in accordance with AASHTO T 250, the thermoplastic shall have a maximum percent residue of 28.

**(M) Flash Point:**

The thermoplastic material shall have a flash point not less than 475 degrees F when tested in accordance with the requirements of ASTM D92.

**(N) Storage Life:**

The materials shall meet the requirements of this specification for a period of one year from the date of manufacture. The month and year of manufacture shall be clearly marked on all packages of thermoplastic material. The thermoplastic material must also melt uniformly with no evidence of skins or unmelted particles for this one year period. Any material which does not meet the above requirements, or which is no longer within this one year period at the time of application, shall not be used. The contractor shall replace any outdated material with material meeting the above performance and time requirements at no additional cost to the Department.

**(O) Primer-Sealer:**

Primer-sealers shall be used on Portland cement concrete, or existing hot mix asphaltic concrete surfaces prior to application of the thermoplastic material, and shall be applied as recommended by the thermoplastic material manufacturer. The primer-sealer shall be compounded specifically for use with the specified thermoplastic material.

Application of primer-sealer will not be required on newly placed hot-mix asphaltic concrete surfaces prior to application of the thermoplastic material.

**(P) Color Stability:**

Using accelerated weathering per ASTM G155, Cycle 1, white color stability shall be measured for no color change after 500 hours of exposure, and yellow color stability shall be measured for no color change after 1000 hours of exposure.

**704.2.04 Physical Requirements for Glass Beads:** the second paragraph of the Standard Specifications is revised to read:

The intermix beads shall conform to AASHTO M 247 for Type 1 and Type 3, and may be coated or uncoated as recommended by the manufacturer. If uncoated beads are used, the thermoplastic formulation shall be configured to minimize settling of the intermix beads when the material is heated and applied.

Drop-on beads shall conform to the gradation requirements of AASHTO M 247 for Type 1, Type 3, and Type 4. Type 4 drop-on glass beads will only be considered for use on chip seal pavement surfaces.

**704.2.05 Precertification of Thermoplastic Material:** is hereby added to the Standard Specifications:

**(A) General:**

As described in Subsection 704-2.01, the contractor shall provide to the Engineer a Certificate of Compliance from the manufacturer and test results from the Central Laboratory for samples from each batch of material obtained for precertification at the production line of the manufacturer. If the material fails the precertification testing by Central Laboratory, the manufacturer shall not supply any thermoplastic material represented by the failing test results to ADOT projects.

**(B) Precertification Sampling:**

Sampling of thermoplastic material for precertification must be for an active ADOT project. The manufacturer shall obtain a sample of thermoplastic material from each batch of production that will be shipped to an ADOT project. The manufacturer shall select three equal sized bags, representative of thermoplastic material from the batch. It is recommended that the three bags be pulled from the initial, middle, and final portions of each batch or truck load. The manufacturer shall prepare a composite 1-gallon sample from these three bags in accordance with ASTM D7307. The manufacturer shall ship the composite sample to the Central Laboratory at 1221 N. 21st Avenue Phoenix, AZ 85009, along with a Certificate of Analysis, for precertification testing. The manufacturer shall identify the thermoplastic material with the batch number, the batch quantity, the batch date, the manufacturer's name, and the product name. Such identification shall be shown on the side of the container.

**(C) Central Laboratory Precertification Testing Responsibilities:**

The Central Laboratory is responsible for coordinating precertification for each batch of thermoplastic material that is to be precertified.

For precertification purposes, thermoplastic material will be tested for binder content and glass bead content according to ASTM D4797. For yellowness index, the material is prepared and tested in accordance with ASTM D4960. The yellowness index will be calculated using ASTM E313.

Upon completion of testing, the Central Laboratory will provide the manufacturer with a copy of the test results for each tested batch. Typically, testing will be completed within three working days of receipt of the sample. If the material fails the precertification testing, the manufacturer shall not supply any thermoplastic material represented by the failing test results to ADOT projects.

**704.3.01 Equipment:** the second, third, and fourth paragraphs of the Standard Specifications are hereby deleted.

**704.3.01 Equipment:** the eighth paragraph of the Standard Specifications is revised to read:

The bead dispenser shall be capable of evenly distributing glass beads at the required application rate immediately after the application of the thermoplastic. The bead dispenser on truck-mounted units shall be equipped with an automatic cut-off which is synchronized with the cut-off of the thermoplastic material.

**704.3.02(A) Placement Locations:** the first paragraph of the Standard Specifications is revised to read:

Survey layout for pavement markings shall be provided in accordance with Subsection 925-3.01. On projects that include no-passing zones, the contactor shall coordinate with the ADOT No Passing Zone Crew as described in Subsection 925-3.01.

Pavement markings shall be positioned as defined on the plans and in the specifications. When it becomes necessary for proper installation, the Engineer may revise individual marking locations as necessary to accommodate the following requirements:

**704.3.02(B) Material Selection and Compatibility:** the second, third, fourth, and fifth paragraphs of the Standard Specifications are revised to read:

All materials shall be properly packaged and stored. Each container to be used on the project shall be clearly labeled to indicate the following information:

- Nature, type, and formulation of the material;
- Manufacturer, batch number, and date of manufacture;
- Application requirements and constraints; and

Preparation and application equipment shall be in accordance with the plans and specifications, and shall conform to the recommendations of the materials manufacturer.

Incompatible materials shall not be used together. The contractor shall not combine alkyd and hydrocarbon materials in preparation or application equipment.

**704.3.02(D) Pavement Surface:** the first paragraph of the Standard Specifications is revised to read:

The contractor shall remove all dirt, dust, loose surfacing materials, poorly adhered existing markings, or other detrimental material from the road surface prior to application of the thermoplastic material.

**704.3.02(F) Pavement Temperatures:** of the Standard Specifications is revised to read:

Extruded ribbon-gun application procedures shall not be used if the wind chill factor is below 65 degrees F.

For other application procedures, the road surface temperature at the time of application shall be a minimum of 55 degrees F and rising.

If at any time during marking operations the air or pavement temperature falls below these requirements, all marking operations shall stop.

**704.3.02(G) Thermoplastic Application:** of the Standard Specifications is revised to read:

The thermoplastic pavement marking material shall be placed after 30 calendar days but before 60 calendar days after completion of the final pavement surface, or as directed by the Engineer.

The thermoplastic pavement marking material shall be extruded on to the pavement surface at a material temperature between 385 and 415 degrees F, depending on manufacturer's recommendations, ambient air and pavement temperatures, and the nature of the pavement surface. The contractor shall verify temperature requirements with a non-contact infrared thermometer as directed by the Engineer.

The thermoplastic material temperatures shall not exceed 450 degrees F. Material temperatures exceeding 440 degrees F shall be allowed for short periods of time; however, in no case shall the material be held for more than four hours at temperatures above 440 degrees F. Total heating time for any batch of material shall not exceed six hours. The contractor shall note in the temperature log the time when each batch of thermoplastic material is first heated. The start of heating time shall also be marked on the side of the kettle to which it applies.

Drop-on glass beads shall be mechanically deposited into the thermoplastic material immediately after the thermoplastic marking is applied, using a double drop method. One drop shall be Type 1 glass beads and the other drop shall be Type 3 glass beads. Double drop methods using all Type 1 or Type 3 beads for both drops will not be allowed. Prior to the application of thermoplastic material, the contractor shall provide to the department, in writing, the drop-on bead mix package that includes the type of glass beads as described in AASHTO M 247 and the drop rate in pounds per 100 square feet used in each drop.

The dispensers shall evenly distribute the beads in the thermoplastic material. Glass beads shall be embedded in the surface of the thermoplastic to a depth of between 50 and 60 percent of the bead diameter. If the glass beads do not adhere to the thermoplastic marking, operations shall be stopped until the problem has been corrected.

Unless otherwise specified, all thermoplastic pavement markings shall be extruded, and shall be a minimum of 90 mils thick. The thermoplastic thickness shall be uniform and consistent throughout the total length of the marking project.

For thermoplastic measured 80 mils or less in thickness, a second application of extruded 90 mil thick thermoplastic meeting all the requirements of the specifications shall be placed over the original application.

For chip seal pavement surfaces, thermoplastic pavement markings shall be extruded and shall be a minimum of 120 mils thick. The thermoplastic thickness shall be uniform and consistent throughout the total length of the marking project. The drop-on glass beads shall be mechanically deposited into the thermoplastic material immediately after the thermoplastic marking is applied, using a double drop method. One drop shall be Type 1 glass beads and the other drop shall be Type 3 or Type 4 glass beads. Double drop methods using only one type of glass beads for both drops will not be allowed. Prior to the application of thermoplastic material, the contractor shall provide to the department, in writing, the drop-on bead mix package that includes the type of glass beads as described in AASHTO M 247 and the drop rate in pounds per 100 square feet used in each drop.

For chip seal pavement surfaces, for thermoplastic measured 120 mils or less in thickness, a second application of extruded 80 mil thick thermoplastic meeting all the requirements of the specifications shall be placed over the original application.

The contractor shall perform periodic spot checks of thermoplastic material to verify that the required thickness has been attained.

The finished thermoplastic line shall have well defined edges and be free from waviness. Lateral deviation of the thermoplastic line shall not exceed 1 inch in 100 feet. The longitudinal deviation of a painted segment and gap shall not vary more than 6 inches in a 40-foot cycle. The actual width of line shall be within the limits specified in the following table, according to the width of line called for on the plans:

Plan Width	Actual Width
4 inches	4 to 4-1/2 inches
6 inches	6 to 7 inches
8 inches	8 to 9 inches
Over 8 inches	± 1 inch

After application and sufficient drying time, the thermoplastic marking shall show no appreciable deformation or discoloration under local traffic conditions with air and road temperatures ranging from -10 to 180 degrees F. The drying time shall be defined as the minimum elapsed time, after application, when the thermoplastic pavement markings shall have and retain the characteristics required herein, and after which normal traffic will leave no impression or imprint on the newly applied marking. When applied within a temperature range of  $400 \pm 15$  degrees F and thickness of 0.090 inches, the material shall set to bear traffic in not more than two minutes when the air and pavement surface temperatures are approximately  $50 \pm 3$  degrees F and not more than 10 minutes when the air and road surface temperatures are approximately  $90 \pm 3$  degrees F. The Engineer may conduct field tests in accordance with ASTM D711 to verify actual drying times.

**704.3.03 Sampling and Testing of In-Place Thermoplastic Material:** is added to the Standard Specifications:

**(A) Thickness Testing:**

Random spot checks of the thermoplastic thickness will be made by the Engineer to ensure conformance with the required criteria. Suggested spot check procedures include the following:

**Wet:** Thickness can be field tested immediately after the thermoplastic marking is applied by inserting a thin, graduated machinist rule or similar instrument into the molten thermoplastic to the depth of the pavement surface. The thickness is then determined visually by noting on the scale the depth of the penetration or coating of the instrument.

**Dried:** Thickness can be field tested by placing a small flat sheet of metal or duct tape with a known thickness immediately ahead of the striping apparatus. After striping, remove the sample and use a suitable measuring device, such as a caliper or micrometer, to determine the thickness of the dried marking.

Thickness will be tested at a minimum of two locations, randomly selected in any given mile, using the "Dried" method. The thickness measurement includes glass beads. Thickness sampling locations do not require reapplication over the gaps created when removing tape/plate.

Thickness will be measured with a digital caliper capable of measuring to the nearest thousandth of an inch.

**(B) Retroreflectance Testing:**

The Department will notify the contractor 72 hours prior to testing. Retroreflectance testing will be performed every 0.2 mile, with four readings taken at each location. The four readings will be taken randomly within a 10-foot section. The average of the four readings shall be the result for that location. Should the average of these readings not meet the required retroreflectance values, a second test of four readings will be performed 50 foot forward from the failing test. The higher average value of the two tests will determine the results for that location. The Department will provide raw test results to the contractor.

Retroreflectance testing will be performed in the direction of traffic. On roadways where yellow stripes separate opposing traffic, testing is done in both directions (two locations per 0.2 miles, one in each direction).

Transverse and symbol markings will not be subject to retroreflectance testing.

Longitudinal lines less than 0.2 miles (such as 12-inch white turn lanes), regardless of length, must be tested. A single test of four readings shall be taken at the approximate midpoint of each line. Should the average of these readings not meet the required retroreflectance values, a second test of four readings will be performed at the approximate half way point between the midpoint and the end. The higher average value of the two tests will determine the results for that location.

All markings that fail to meet these minimums will require reapplication and retesting of striping materials. Reapplication shall start from the location of a passing test, across the failure area(s), to the next passing test location. For thermoplastic sections applied on asphalt determined to be deficient in retroreflectance, a second application of 80 mils shall be applied. The reapplication does not require removal of the deficient section. For thermoplastic applied on both PCCP and concrete bridge decks that are determined to be deficient in retroreflectance, the failing application shall be removed and reapplied.

Depending on the extent of failing pavement markings, it may not be practical to retest with the reflectometer. In that case, the Department may perform a visual nighttime inspection. If the striping appears as bright as or brighter than the adjacent striping that meets the required retroreflectance, the Engineer may accept the reapplication.

Should retests for the reapplication of thermoplastic pavement markings fail to meet the required minimum retroreflectance, the contractor shall remove the entire stripe down to the road surface.

**(C) Verification Sampling for Composite Testing of In-Place Thermoplastic:**

At the discretion of the Engineer, thermoplastic material may be sampled on the project at any time during the construction of the project for verification testing. The thermoplastic material shall be field sampled utilizing a 4 inch x 12 inch galvanized sheet metal plate during thermoplastic application. The galvanized sheet metal plate shall be sprayed with thermoplastic material without additional application of glass beads. When sampling behind a striping truck, the sample will be obtained randomly from the drop nozzle after at least 150 feet of striping has been placed. Once the sample is no longer in a molten state and has cooled sufficiently, it shall remain attached to the sampling plate and be stored in a plastic bag.

For molten samples taken in the field for verification testing, the contractor shall perform the sampling under the observation of the Engineer.

**704.4 Method of Measurement:** the first paragraph of the Standard Specifications is revised to read:

Thermoplastic pavement longitudinal markings (i.e. edge lines, lane lines, and gore lines) and transverse markings (i.e. cross-walks, stop bars, cross hatch, chevron lines, and railroad markings) will be measured by the linear foot along the center line of the pavement marking line and will be based on a 4-inch-wide line. Measurement for striping with a plan width greater or less than the basic 4 inches as shown on the plans or directed by the Engineer will be made by the same method and then adjusted by the following factor:

**704.4 Method of Measurement:** the seventh paragraph of the Standard Specifications is revised to read:

Removal of curing compound from new Portland cement concrete pavement and the application of primer-sealer, will be measured along the centerline of the line of curing compound being removed or the line of primer-sealer being applied or by the unit each for symbols and legends, as appropriate. Measurement of a line of removal of curing compound or a line of application of primer-sealer will be based on a 4-inch wide line, and shall be measured by the linear foot, and in accordance with the items of work established in the bid schedule. Measurement for lengths of removal of curing compound or application of primer-sealer with a plan width greater than 4 inches as shown on the plans or directed by the Engineer will be made by the same method and then adjusted by the following factor:

$$\frac{\text{Plan Width (inches) x Linear Feet}}{4 \text{ (inches)}}$$

The plan width will include an extra 4 inches – 2 inches on each side – beyond the plan width of pavement marking and will be based on a continuous length of pavement marking lines unless indicated on the project plans.

- |            |                |   |
|------------|----------------|---|
| Bid Items: | <b>7040003</b> | <b>FURNISH AND INSTALL PAVEMENT MARKING, WHITE (4" Equivalent), 0.090" THICK THERMOPLASTIC</b>  |
|            | <b>7040005</b> | <b>FURNISH AND INSTALL PAVEMENT MARKING, YELLOW (4" Equivalent), 0.090" THICK THERMOPLASTIC</b> |
|            | <b>7040074</b> | <b>FURNISH AND INSTALL PAVEMENT SYMBOL OR LEGEND, 0.090" THICK EXTRUDED THERMOPLASTIC ALKYD</b> |

## **SECTION 706 RAISED PAVEMENT MARKERS**

### **706.1 Description:**

The work under this section shall consist of cleaning and preparing the pavement surface; furnishing all materials, equipment, tools and labor; and placing raised pavement markers of the type specified at the locations and in accordance with the details shown on the plans and the requirements of these specifications.

The work under this section consists of furnishing and installing Type D and Type G Raised Reflective Markers at the locations and at the spacing shown on the plans.

### **706.2 Materials:**

#### **706.2.01 General :**

Certificates of Compliance, for raised pavement markers and adhesive, conforming to the requirements of Subsection 106.05 shall be submitted to the Engineer at least 10 days prior to use. A minimum of one sample per lot per type of marker shall be taken by the Engineer. The pavement marker samples shall be tested to determine conformance to the applicable standard drawings and these specifications.

The base of the pavement markers shall be free from glass glaze or from substances which may reduce its bond to the adhesive. The base shall be flat and its deviation from a flat surface shall not exceed 0.05 inches.

#### **706.2.02 Reflective Pavement Markers:**

Reflective pavement markers shall be of the following type:

Type C, Clear, red

**Type D, Yellow, two-way**

Type E, Clear, yellow

**Type G, Clear / White, one-way**

Type H, Yellow, one-way

Reflective pavement markers shall be of the prismatic reflector type consisting of a molded methyl methacrylate or suitably compounded acrylonitrile butadiene styrene (ABS) shell filled with a mixture of an inert thermosetting compound and filler material. The exterior surface of the shell shall be smooth and shall contain one or two prismatic reflector faces of the color specified.

When illuminated by an automobile headlight, the color of the reflectors shall be an approved clear / white, yellow, or red as designated. Reflectors not meeting the required color may be rejected.

Permanent reflective pavement markers will be tested for compressive strength, abrasion resistance, and specific intensity. Permanent reflective pavement markers shall have thin untempered glass or other abrasion resistant material bonded to the prismatic reflector face to provide an extremely hard and durable, abrasive resistant reflector surface.

The glass, or other abrasion resistant surface, is not required on the red faces of two-way (Clear/Red) permanent reflective markers. The area covered by the glass, or other abrasion resistant surface, shall not be less than three square inches.

Temporary reflective pavement markers will be tested for compressive strength and specific intensity. Temporary reflective pavement markers, or permanent reflective pavement markers used as temporary, will not be tested for abrasion resistance.

The strength by compressive loading shall be at least 2,000 pounds for both permanent and temporary reflective pavement markers.

The original specific intensity of each reflecting surface for both temporary and permanent reflective markers shall not be less than the following:

Reflectance: degrees incidence	Specific Intensity: candelas/foot-candle		
	Clear	Yellow	Red
0	3.0	1.8	0.75
20	1.2	0.72	0.30

Permanent reflective pavement markers shall be subject to an abrasion resistance test as follows:

Steel Wool Abrasion Procedure: Form a one-inch diameter flat pad using No. 3 coarse steel wool per Federal Specification FF-W1825. Place the steel wool pad on the reflector lens face. Apply a force of 50 pounds and rub the entire lens surface 100 times. After the lens surface has been abraded, the specific intensity of each clear and yellow reflective surface shall be not less than that required above for the original specific intensity.

**706.2.03 Non-Reflective Pavement Markers and Reflectorized Dagmars:**

Non-reflective pavement markers shall be of the following types:

Type	Color
A	white
AY	yellow

Reflectorized Dagmars shall be of the following types:

- Type J - white
- Type JY - yellow

Non-reflective pavement markers and reflectorized dagmars shall consist of a heat- fired, vitreous ceramic base and a heat- fired, opaque glazed surface which will produce the required properties. Markers shall be produced from any suitable combination of intimately mixed clays, shales, flints, feldspars, or other inorganic material which will meet the properties herein required. Markers shall be thoroughly and evenly matured and free from defects which will affect appearance or serviceability.

The top surface of the marker shall be in reasonably close conformity with the configuration shown on the plans. Markers shall be convex and the radius of curvature shall be between 3-1/2 and six inches, except that the radius of the 1/2 inch nearest the edge may be less. All edges shall be rounded and any change in curvature shall be gradual. The top and sides shall be smooth and free of mold marks, pits, indentations, air bubbles, or other objectionable marks or discolorations.

Non-reflective pavement markers and dagmars shall meet the following requirements:

Glaze Thickness: Inches	0.005 Minimum
Moh Hardness:	6 Minimum
Directional Reflectance: (White Only)	
Glazed Surface	75 Minimum
Body of Marker	70 Minimum
Yellowness Index: (White Only)	
Glazed Surface	0.07 Maximum
Body of Marker	0.12 Maximum
Color (Yellow Only):	
Purity: percent, range	75 - 96
Dominant Wave Length: mu, range	579 - 585
Total Luminous Reflectance (Y valve)	0.41 Minimum
Compressive Strength: pounds	1,500 Minimum
Water Absorption: percent	2.0 Maximum
Autoclave	Glaze shall not spall, craze or peel

Reflectorized dagmars shall have encapsulated lens reflectors conforming to standard manufacturing practices.

#### **706.2.04 Jiggle Bars:**

##### **(A) General :**

Types K and KY jiggle bars shall be concrete or ceramic, at the option of the contractor, and shall be shaped to conform to the details shown on the plans. The same type of jiggle bar shall be used throughout any one project.

Jiggle bars shall be painted either white or yellow and shall be reflectorized, as shown on the plans. The color shall be uniform.

The bottom surface of the jiggle bars shall be of a roughness comparable to at least that of fine grade sandpaper. The bottom surface shall not be grooved such that air will be trapped in the grooves when it is pressed into the adhesive.

##### **(B) Concrete:**

Concrete jiggle bars shall be made of Class B concrete conforming to the requirements of Section 1006 (ADOT).

Markers shall not be installed when the temperature of the pavement surface or the atmosphere is less than 40 degrees F, when the relative humidity is 80 percent or higher, or when the pavement surface is not dry.

All markers shall be installed to the line approved by the Engineer and in such manner that the reflective face of the markers is perpendicular to a line parallel to the roadway centerline. No pavement markers shall be installed over longitudinal or transverse joints of the pavement surface.

#### **706.4 Method of Measurement:**

Pavement markers will be measured as a unit for each (EA) marker furnished and placed.

#### **706.5 Basis of Payment:**

The accepted quantities of pavement markers, measured as provided above, will be paid for at the contract unit price for each (EA) of the type designated in the bidding schedule, complete in place, including adhesive and surface preparation.

Bid Items: **7060001   INSTALL RAISED PAVEMENT MARKERS, REFLECTORIZED, TYPE D, YELLOW, 2-WAY**  
**7060002   INSTALL RAISED PAVEMENT MARKERS, REFLECTORIZED, TYPE G, WHITE, 2-WAY**

#### **SECTION 708 PERMANENT PAVEMENT MARKINGS**

**708.1 Description:** The work under this section shall conform to the requirements of Section 708 of the ADOT Standard Specifications for Road and Bridge Construction, 2008 Current Edition (Stored Specifications).

**SECTION 708 PERMANENT PAVEMENT MARKINGS:** the title and text of the Standard Specifications are revised to read:

#### **SECTION 708 WATERBORNE PAVEMENT MARKINGS:**

##### **708.1 Description:**

The work under this section shall consist of cleaning and preparing the pavement surface, furnishing all materials, and applying white or yellow, waterborne, lead-free, fast-dry or rapid-dry traffic paint, and reflective glass beads at the locations and in accordance with the details shown on the plans, MUTCD, and associated ADOT Supplement, the requirements of these specifications, or as directed by the Engineer.

##### **708.2 Materials:**

## **708.2.01 Pavement Marking Paint:**

### **(A) General:**

All material used in the formulation of the pavement marking paint shall meet the requirements specified herein. Any materials not specifically covered shall meet the approval of the Engineer.

Only waterborne traffic paint that has been reviewed, evaluated, and approved by the ADOT Product Evaluation Program or equal, prior to the bid opening of each respective project, shall be used.

Copies of the most recent version of the Approved Products List (APL) are available on the internet from the ADOT Research Center through its Product Evaluation Program.

Certificates of Compliance conforming to the requirements of Subsection 106.05 shall be submitted along with precertification test results from the ADOT Central Laboratory for samples from each batch of material obtained for precertification at the production line of the manufacturer.

### **(1) Waterborne Pavement Marking Paint: Type I (Standard):**

Type I (Standard) waterborne pavement marking paint shall be the traffic paint for long line and short line striping, arrows, symbols, and legends. Type I shall be used:

- (a) For temporary traffic control;
- (b) At the end of the construction work shift if the roadway is open to traffic over an intermediate layer of pavement while the final lift or layer of pavement has not been placed yet;
- (c) As a primer on the final lift or layer of pavement 30 days prior to the application of the durable pavement marking materials;
- (d) During Construction on pavement that will not be resurfaced. Two applications of waterborne paint may be used, allowing 30 to 60 days between applications.

Type I paint shall be capable of performing as specified herein when subjected to high traffic volumes and severe wear conditions such as repeated crossing, starting, stopping, and turning movements.

### **(2) Waterborne Pavement Marking Paint: Type II (High-build):**

Type II (High-build) waterborne pavement marking paint shall be used for long line and short line striping, arrows, symbols, and legends. Type II shall be used for temporary traffic control that needs to be in place for at least 180 days, and between two construction seasons.

Type II paint shall be capable of performing as specified herein when subjected to two-season projects, high traffic volumes, and severe wear conditions such as repeated crossing, starting, stopping, and turning movements.

### **(B) Composition Requirements:**

The pavement marking paint shall be a ready-mixed, one component, waterborne traffic line paint of the correct color, to be applied to either asphaltic or Portland cement concrete pavement. The composition of the paint shall be determined by the manufacturer. It will be the manufacturer's responsibility to produce a pigmented waterborne paint containing all the necessary co-solvents, dispersant, wetting agents, preservatives and all other additives, so that the paint shall retain its viscosity, stability and all of the properties as specified herein.

Lead concentrations shall not exceed 0.009 percent by weight (90 ppm) using test method ASTM D3335-85a.

The manufacturer shall certify that the product contains no detectable concentrations of:

- Antimony
- Arsenic
- Cadmium
- Mercury
- Chromium, Inorganic
- Chromium, Hexavalent

Toluene,  
 Chlorinated solvents,  
 Hydrolyzable chlorine derivatives,  
 Ethylene-based glycol ethers and their acetates,  
 A carcinogen as defined in 29 CFR 1910.1200.

**(C) Manufacturing Formulations:**

The manufacturer shall formulate the pavement marking paint in a consistent manner and notify the Engineer of any change of formulation. The formulation of the paint shall be determined by the manufacturer. It will be the manufacturer's responsibility to formulate paint which will meet the quantitative and qualitative requirements of this specification. Any change in the formulation of the paint shall be approved by the Engineer.

**(D) Quantitative Requirements of Mixed Paints:**

<b>Table 708-1</b>		
Characteristic	White	Yellow
Pigment: Percent by weight, ASTM D 3723, Allowable variation from the qualifying sample	± 2.0	± 2.0
Non-Volatile Content/Non-Volatile Vehicle Percent by weight, ASTM D 2369, Allowable variation from the qualifying sample	± 2.0	± 2.0
Viscosity: Krebs Units at 77± 1°F, ASTM D 562	70 – 85	70 – 85
Weight per Gallon: Pounds per gallon 77± 1°F, ASTM D 1475, Allowable variation from the qualifying sample	± 0.3	± 0.3
Vehicle Composition: Vehicle Infrared Spectra, ASTM D 2621, allowable variation from the qualifying sample	None	None
PH: ASTM E 70, Allowable variation from the qualifying sample	± 1.0	± 1.0
Fineness of Dispersion: HEGMAN, minimum, ASTM D 121	3.0	3.0
Volatile Organic Compounds: Pounds per gallon of paint, maximum, ASTM D 3960 according to 7.1. 2.	2.1	2.1
Flash Point: Degrees F., minimum, ASTM D 93, Method A	100	100
Dry Time to No Pick Up: With no beads: minutes, maximum, ASTM D 711	10	10

<b>Table 708-1</b>		
Characteristic	White	Yellow
Dry Through Time: Minutes, ASTM D 1640 except no thumb pressure is used when thumb is rotated 90° on the paint film	20	20
Flexibility: ASTM D 522, Method B: Flexibility shall be tested per ASTM D 522, Method B. Draw down the paint to a wet film thickness of 0.005 inches (0.13mm) on a clean bare cold-rolled steel panel. Air-dry for 24 hours at standard conditions then bake for 5 hours at 221 °F +/- 3 °F (105 °C +/- 2 °C) and finally condition the panel for 30 minutes at standard conditions. When tested as specified the paint film shall not crack, chip, or flake after the test panel is bent over a ½ inch (13 mm) diameter, cylindrical mandrel.	Pass	Pass

**(E) Qualitative Requirements:**

**(1) Color of Yellow Paint:**

The color of the yellow paint shall closely match Federal Standard 595b, Color No. 33538.

**(2) Dry Opacity:**

Dry opacity for the paint will be determined using a black-white Leneta Chart, Form 2C Opacity, or equal, and a calibrated reflectance meter capable of determining reflectance to the nearest 1 percent. Using a 10 mil gap doctor blade, a film of paint is drawn down, covering both black and white portions of the chart on a vacuum plate. The film shall be allowed to dry 24 hours. After calibrating the meter according to the manufacturer's instructions, measure the reflectance over the white and black portions according to the manufacturer's instructions. Dry Opacity for both white and yellow paint shall be at least 0.90.

**(3) Yellowness Index:**

Yellowness Index for white paint will be determined as described for dry opacity, only use a 15-mil gap doctor blade to draw down the paint. Calculate the Yellowness Index in accordance with ASTM E313. Yellowness Index for the white paint shall be a maximum of 10.

**(4) Reflectance:**

Reflectance for both white and yellow paint will be determined using the same 15-mil draw-down film as for the Yellowness Index. For white paint the same sample may be utilized for both the Yellowness Index and Reflectance. Measure the reflectance of the paint film using the reflectance meter according to the manufacturer's instructions. Reflectance for the white paint shall be at least 85. Reflectance for the yellow paint may range from 42 to 59, inclusive.

**(5) UV Color Durability:**

UV Color Durability shall be determined using a QUV Weatherometer, with Ultra Violet Light and Condensate Exposure according to ASTM G154, for 300 hours total. The repeating cycle shall be four hours UV exposure at 140 degrees F (60 degrees C) followed by four hours condensate exposure at 104 degrees F (40 degrees C). After 300 hours of exposure, the Yellowness Index for white paint shall not exceed 12, and yellow paint shall closely match Federal Standard 595b, Color No. 33538.

**(6) Static Heat Stability:**

To determine static heat stability for the paint, place one pint of paint in a sealed can and heat in an air circulation oven at  $120 \pm 1$  degrees F (49 degrees C) for a period of one week. Remove the paint from the oven and check the viscosity in Krebs Units at  $77 \pm 1$  degrees F (25 degrees C) according to ASTM D 562. The viscosity measured shall be in the range from 68 to 90 Krebs Units, inclusive. Also, check for any signs of instability.

**(7) Heat-Shear Stability:**

To determine heat-shear stability for the paint, one pint of the paint is sheared in a Waring Blender at high speed to 150 degrees F (66 degrees C). The blender should have a tight fitting lid taped onto it to minimize volatile loss. When the paint reaches 150 degrees F (66 degrees C), stop the blender, immediately pour the paint into a sample can, and apply a cover to seal the can. Let the paint cool overnight and examine for jelling or other signs of instability. Measure viscosity in Krebs Units at  $77 \pm 1$  degrees F (25 degrees C), according to ASTM D 562. The viscosity measured shall be in the range from 68 to 95 Krebs Units, inclusive. If not within the upper limit, run total solids on the sheared paint and adjust solids, if necessary, by adding water to reach the original solids content. If the solids content required adjustment, again check the viscosity of the paint. The viscosity shall be in the range from 68 to 95 Krebs Units, inclusive.

**(8) Scrub Resistance:**

Scrub Resistance will be determined according to ASTM D 2486. Use an appropriate doctor blade to provide a dry film thickness of 3 to 4 mils. Allow the paint to cure for 24 hours. Perform the scrub resistance test at  $77 \pm 1$  degrees F (25 degrees C) and  $50 \pm 5$  percent humidity. Record the number of cycles to remove the paint film. The number of cycles recorded shall be at least 800.

**(9) Spraying Properties:**

The paint shall be applied, in the field, at a 15 mils wet film thickness for Type I paint and 25 mils wet film thickness for Type II. Both Type I and Type II paint shall show the following properties at ambient temperatures of 50 to 100 degrees F (10 to 38 degrees C) with paint spray temperature of 150 degrees F, (66 degrees C) maximum.

For Type I paint, 6 to 10 pounds of Type 1 beads shall be post-applied per gallon of paint. For Type II paint, 10 to 12 pounds of Type 3 beads shall be post-applied per gallon of paint. Beads shall conform to subsection 708-2.02 of these specifications.

- (a) For rapid-dry paint applied in a mobile operation and not protected by temporary traffic control, dry to a no-track condition in 60 seconds or less when the line is crossed over in a passing maneuver with a standard-sized automobile.
- (b) For fast-dry paint applied within an established work zone behind temporary traffic control, dry to a no-track condition in five minutes or less when the line is crossed over in a passing maneuver with a standard-sized automobile.
- (c) Produce a clean-cut, smooth line with no overspray or puddling.
- (d) Paint immediately after application shall accept glass beads so that the spheres shall be embedded into the paint film to a depth of 50 percent of their diameter.
- (e) Paint when heated to the temperature necessary to obtain the specified dry time, shall show no evidence of instability such as viscosity increase, jelling, or poor spray application.

**(10) Freeze-Thaw Properties:**

The paint viscosity or consistency shall not change significantly when the paint is tested for resistance to five cycles of freeze-thaw according to ASTM D 2243.

**(11) Road Service Rating:**

Test stripes of the paint shall be applied transversely across the road, 4 inches in width and approximately 12 feet long at a location approved by the Engineer.

Wet film thickness of the test stripes shall be approximately 15 mils for Type I and 25 mils for Type II paint as determined according to ASTM D 4414 and ASTM D 713 prior to test stripe application. To aid in obtaining the correct

film thickness, a length of roofing paper placed by the side of the road can be used. Place a rigid metal test panel on the roofing paper in the path of a test line. Immediately after the test line is applied by the striper, measure the wet film thickness. If not satisfactory, adjust the spray pressure and repeat until the target wet film thickness is attained. It is important that no glass beads be present that would give a false wet film thickness. When the wet film thickness is correct, apply a test line across a tared metal test panel. After this, apply another test line across a different tared metal test panel, this time also adding the beads. These samples are necessary to determine the initial bead retention.

Glass beads conforming to the requirements of Subsection 708-2.02 of these specifications (moisture proof type) shall be applied after the paint has been applied, but during the same striping operation at a rate such that the initial bead retention on the test line is at least 6 pounds of beads per gallon of wet paint for Type I paint and at least 10 pounds of beads per gallon of wet paint Type II. The initial bead retention will be determined analytically by the ADOT Construction and Materials Group concurrently with the determination of the dry paint thickness utilizing tared metal test panels. The paint shall accept the glass beads so that the spheres are embedded into the paint film to a depth of 50 percent of their diameter. Test stripes will be observed for a period of 180 days from date of application. Paints will be evaluated for wear according to ASTM D913.

After 180 days of service, on a visual rating scale of 0 to 100 percent, paints shall have a rating of 90 percent or better to be acceptable. All ratings will be taken in the wheel track area. Glass beads shall show no more than a 30 percent loss after 180 days of test. This will be determined by taking close-up, before and after photographs of the paint film and by count determining the average bead loss.

The road service test may be waived at the option of the Engineer or evaluated for a period of time less than 180 days.

## **(12) Workmanship:**

Paint shall be free from foreign materials, such as dirt, sand, fibers from bags, or other material capable of clogging screens, valves, pumps, and other equipment used in a paint striping apparatus.

The paint pigment shall be well ground and properly dispersed in the vehicle. The pigment shall not cake or thicken in the container, and shall not become granular or curdled. Any settlement of pigment in the paint shall result in a thoroughly wetted, soft mass permitting the complete and easy vertical penetration of a paddle. Settled pigment shall be easily redispersed, with minimum resistance to the sidewise manual motion of a paddle across the bottom of the container, to form a smooth uniform product of the proper consistency. If the paint cannot be easily redispersed, due to excessive pigment settlement as described above or due to any other cause, the paint shall be considered unfit for use.

The paint shall retain all specified properties under normal storage conditions for 12 months after acceptance and delivery. The contractor shall be responsible for all costs and transportation charges incurred in replacing paint that is unfit for use. The properties of any replacement paint, as specified herein, shall remain satisfactory for eight months from the date of delivery and acceptance.

## **(F) Manufacturing Requirements:**

### **(1) Inspection:**

The manufacturer of the paint shall furnish the Engineer free access to all parts of the plant involved in the paint manufacture, and shall furnish every reasonable facility for sampling both the paint and the raw materials during the process of manufacturing.

All materials used in formulation shall meet the requirements herein specified. Any materials not specifically covered shall meet the approval of the Engineer.

All manufactured paint shall be prepared at the factory ready for application.

When paint is shipped to a distributor or paint applicator who will store the paint prior to its use, the distributor or paint applicator shall furnish the Engineer free access to all parts of the facility where paint is stored and shall furnish every reasonable facility for sampling the paint.

Paint may also be sampled at the place of storage either at a warehouse or on the site prior to application of the paint. Application of the paint will not be permitted until the paint has been approved by the Engineer. It is the contractor's responsibility to notify the Engineer at least 14 working days prior to any traffic painting operation and to allow access at that time for paint sampling at the storage location.

At least one paint sample shall be obtained from each lot of paint.

Check-samples of finished paint while being applied will be taken at intervals as determined by the Engineer.

**(2) Precertification of Pavement Marking Paint:**

All tests will be conducted as specified herein.

**(a) General:**

As described in Subsection 708-2.01(A), the contractor shall provide to the Engineer a Certificate of Compliance from the manufacturer and test results from the Central Laboratory for samples from each batch of material obtained for precertification at the production line of the manufacturer. If the material fails the precertification testing by Central Laboratory, the manufacturer shall not supply any pavement marking paint represented by the failing test results to ADOT projects. If the material fails the precertification testing by the Central Laboratory, the manufacturer shall not supply any pavement marking paint represented by the failing test results to ADOT projects.

**(b) Precertification Sampling:**

Sampling of pavement marking paint for precertification shall be for an active ADOT project. The manufacturer shall provide a 1 pint or 1 quart sample in a metal can of pavement marking paint from each batch of production that will be shipped to an ADOT project. The manufacturer shall ship the composite sample to the Central Laboratory at 1221 N. 21st Avenue Phoenix, AZ 85009, along with a Certificate of Analysis, for precertification testing. The manufacturer shall identify the pavement marking paint with the batch number, the batch quantity, the batch date, the manufacturer's name, and the product name. Such identification shall be shown on the side of the container.

**(c) Central Laboratory Precertification Testing Responsibilities**

The Central Laboratory is responsible for coordinating precertification for each batch of pavement marking paint that is to be precertified.

For precertification purposes, pavement marking paint at a minimum will be tested for color, total non-volatile percentage, pigment, non-volatile vehicle, weight per gallon, viscosity, dry time, and dry opacity in accordance with the procedures described in 708-2.01(D) and (E).

Upon completion of testing, the Central Laboratory will provide the manufacturer with a copy of the test results for each batch tested. Typically, testing will be completed within five working days of receipt of the paint sample. If the material fails the precertification testing, the manufacturer shall not supply any pavement marking paint represented by the failing test results to ADOT projects.

Evidence of adulteration or improper formulation shall be cause for rejection.

**(d) Packaging:**

All shipping containers for paint shall comply with the Department of Transportation Code of Federal Regulations, Hazardous Materials and Regulation Board, Reference 49 CFR. The container and lids shall be lined with a suitable coating so as to prevent attack by the paint or by agents in the air space above the paint. The lining shall not come off the container or lid as skins.

Containers shall be colored white, including lids, and containers shall have an identifying band of the appropriate color around and within the top one third of the container.

All containers shall be properly sealed with suitable gaskets, shall show no evidence of leakage, and shall remain in satisfactory condition for a period of 12 months after delivery to a distributor or paint applicator. The contractor shall be responsible for all costs and transportation charges incurred in replacing paint and containers.

**(e) Labeling:**

All containers of paint shall be labeled showing the manufacturer's name, date of manufacture, paint color, product code, manufacturer's batch number, and quantity or weight of paint on both the side of the container and also the lid. Containers shall be clearly labeled Rapid Dry or Fast Dry lead-free Waterborne Type I or Type II Traffic Paints.

All containers of paint shall be labeled to indicate that the contents fully comply with all rules and regulations concerning air pollution control in the State of Arizona, Yuma County.

The manufacturer of the paint shall be responsible for proper shipping labels with reference to whether the contents are toxic, corrosive, flammable, etc., as outlined in the U. S. Department of Transportation, Hazardous Materials Regulations; Reference 49 CFR.

**(f) Unused Paint:**

Disposal of unused quantities of traffic paint shall be the responsibility of the contractor and shall meet all applicable Federal regulations for waste disposal. Paint which is saved to be used later shall be packaged as specified and shipped to a storage location. Unused paint shall be identified on the container. Unused paint may be utilized on a future project provided the paint still conforms to all specifications contained herein.

**708.2.02 Reflective Glass Beads (Spheres):**

**(A) General:**

The term "glass bead" shall be synonymous with the term "glass sphere" as used herein.

The beads shall be manufactured from glass of a composition designated to be highly resistant to traffic wear and to the effects of weathering.

The glass beads shall be moisture-proof; contain less than 0.25 percent moisture by weight; and be free of trash, dirt, or other deleterious materials.

Beads shall be essentially free of sharp angular particles showing milkiness or surface scoring or scratching. Beads shall be water white in color.

Certificates of Compliance conforming to the requirements of Subsection 106.05 shall be submitted.

**(B) Physical Requirements:**

**(1) Gradation:**

The gradation for the drop-on beads shall conform to AASHTO M 247 Type 1 and Type 3.

**(2) Roundness:**

Glass beads shall conform to AASHTO M 247, Type 1 and Type 3. Beads retained on any screen specified in the gradation requirements shall contain at least 80 percent true spheres.

**(3) Index of Refraction:**

Glass beads shall conform to AASHTO M 247, Type 1 and Type 3.

**(4) Specific Gravity:**

The specific gravity of the beads shall be in the range 2.40 to 2.60 when tested in accordance with the following procedures:

Place 100 grams in an oven at 230 degrees F (110 degrees C) for one hour.

Remove beads and place in a desiccator until the sample is cool.

Remove approximately 60 grams of beads from the desiccator and weigh the sample accurately.

Pour the beads slowly into a clean 100-milliliter graduated cylinder containing 50 milliliters of isopropyl alcohol. Make certain that air is not entrapped among the beads.

The total volume reading on the graduated cylinder, minus 50, will give the volume of the beads. Calculate the specific gravity as follows:

$$\text{Specific Gravity} = \frac{\text{Weight of the Sample}}{\text{Volume of the Sample}}$$

**(5) Chemical Stability:**

Beads which show any tendency toward decomposition, including surface etching, when exposed to atmospheric conditions, moisture, dilute acids, or alkalis or paint film constituents, may be required to demonstrate satisfactory reflectance behavior, prior to acceptance, under such tests as may be prescribed.

**(6) Hazardous Constituents:**

Each lot shall be tested for heavy metal concentration as specified in the following table, tested by an independent laboratory approved by the Engineer, using EPA Method 3052 and EPA Method 6010B.

Table 708-2	
Heavy Metal	Concentration
Arsenic	< 75 ppm
Antimony	< 75 ppm
Lead	<100 ppm

The manufacturer shall certify that the product contains no detectable concentrations of other hazardous constituents, including:

- Cadmium
- Barium
- Mercury
- Chromium, Inorganic
- Chromium, Hexavalent
- A carcinogen as defined in 29 CFR 1910.1200.

**(C) Bead Coating:**

All glass beads shall have a moisture-proof adhesion enhancing overlay, consisting of a properly formulated material which prevents bead clumping and clogging and promotes proper embedment and adhesion to the applied paint. Water repellent material applied during the process of bead manufacture. The beads so treated shall not absorb moisture in storage and shall remain free of clusters and lumps and shall flow freely from dispensing and testing equipment.

The beads shall conform to AASHTO T 346, "Glass Beads Used in Pavement Markings".

**(D) Acceptance of Glass Beads:**

**(1) Preapproval Sampling of Glass Beads:**

Sampling of glass beads shall be for an active ADOT project. For preapproval of glass beads, the Structural Materials Testing Section will obtain a sample from each lot at the striping contractor's yard as requested by the striping contractor. At least a 1-gallon sample taken from a "super sack" shall be sampled for each lot. When sampling a lot consisting of multiple super sacks, no less than four super sacks shall be sampled, and the samples combined to make one sample. A field sample shall consist of at least a 1-gallon sample taken from the striping truck for each lot.

Each field sample shall be identified with the manufacturer's lot number. When sampling from the striping truck, the sample shall be obtained from the drop nozzle after 500 feet of striping has been placed. Unless the inspector suspects contamination of the glass beads, no field samples will be required for preapproved lots.

**(2) Preapproval Testing of Glass Beads:**

Glass beads will be tested in accordance with 708-2.02(B) and (C) of these specifications for gradation, roundness, refraction, and moisture resistance coating. For each lot of glass beads that is to be preapproved, the Structural Materials Testing Section will perform the sampling and testing. A test report with the lot number will be issued for each project the glass beads are to be used for. Upon completion of testing for preapproval, the Structural Materials Testing Section will provide the striping contractor with a copy of the test results.

For glass beads that have not been preapproved, the Structural Materials Testing Section will test field samples submitted by the project. The issuance of a test report and the maintaining of a log of all lots tested will be completed as described for glass beads tested for preapproval. The Structural Materials Testing Section will immediately notify the project of any failing test results.

**708.3 Construction Requirements:**

**708.3.01 Equipment** The traffic paint and beads shall be placed on the pavement by a spray-type, self-propelled pavement marking machine except that temporary striping during construction may be placed with other equipment designed for application of paint and beads.

The application equipment to be used on roadway installation shall have, as a minimum, the following characteristic and/ or apparatus:

**(A) Capable of applying clear-cut lines of the width specified on the project plans.**

**(B) Equipped with a mechanical device capable of placing a broken reflectorized line with a 10-foot painted segment and a 30-foot gap.**

**(C) Equipped with an air-operated glass bead drop-in dispenser controlled by the spray gun mechanism.**

A glass bead dispenser which is capable of placing the glass beads into the paint line as the paint is applied to the pavement shall be utilized. This dispenser shall provide satisfactory marking and delineation.

**708.3.02 Application** Painted markings shall be applied when the pavement surface is dry and the weather is not foggy, rainy, or otherwise adverse to the application of markings. The surface shall be free from excess asphalt or other deleterious substances before traffic paint, beads, or primer are applied. The contractor shall remove dirt, debris, grease, oil, rocks or chips from the pavement surface before applying markings. The method of cleaning the pavement surface and removal of detrimental material is subject to approval by the Engineer and shall include sweeping and the use of high-pressure air spray. The placing of traffic markings shall be done only by personnel who are experienced in this work.

Painting shall not be performed when the atmospheric temperature is below 50 degrees F when using waterborne paint, nor when it can be anticipated that the atmospheric temperature will drop below 50 degrees F (10 degrees C) temperature during the drying period. Waterborne paints shall not be applied if rain is expected within one hour of its application, unless otherwise approved by the Engineer. Waterborne paint shall not be heated to a temperature greater than 150 degrees F (66 degrees C) to accelerate drying.

The volume of paint in place shall be determined by measuring the paint tank with a calibrated rod. At the discretion of the Engineer, if the striping machine is equipped with air-atomized spray units (not airless) and paint gauges, the volume of paint may be determined by utilizing said gauges.

The quantity of glass reflectorizing beads in place shall be determined by measuring the glass reflectorizing bead tank with a calibrated rod.

The contractor shall provide the necessary personnel and equipment to divert traffic from the installation area where the work is in progress and during drying time when, in the opinion of the Engineer, such diversion of traffic is necessary.

Painted markings placed below the final surface shall be placed immediately after a change in long-term traffic patterns/configurations, when the need arises, or as directed by the Engineer. On intermediate lifts of overlay projects, painted markings shall consist of at least 4-inch-wide by 4-foot-long strips of reflective material, placed at 40-foot intervals. In situations involving severe degree of curvature, the Engineer may direct that the length and spacing be adjusted to 2 feet and 20 feet, respectively. These requirements apply to white lane lines separating traffic moving in the same direction and to yellow center lines for two-lane, two-way roadways in areas where passing is permitted. Painted markings shall be placed on each subsequent pavement course.

Curing compound shall be removed from new concrete surfaces before the placement of painted markings.

Tolerances for Placing Paint, Beads, and Primer:

The length of painted segment and gap shall not vary more than 6 inches in a 40-foot cycle.

The finished line shall be smooth, aesthetically acceptable and free from undue waviness.

Painted lines shall be 4, 8, or 12 inches wide as shown on the plans with a tolerance of  $\pm 1/8$  inch and shall be placed at a minimum rate of 16 gallons per mile for a solid 4 inch line and 4 gallons per mile for a broken 4 inch line, based on a 10 foot stripe and a 30 foot gap (40 foot cycle aggregate).

Glass reflectorizing beads shall be applied on the wet paint. For Type I paint, 6 to 10 pounds of Type 1 beads shall be post-applied per gallon of paint. And, For Type II paint, 10 to 12 pounds of Type 3 beads shall be post-applied per gallon of paint.

Wet thickness shall not be less than 15 mils wet film thickness for Type I paint and 25 mils wet film thickness for Type II, unless otherwise shown on the plans.

#### **708.4 Method of Measurement:**

Pavement marking paint will be measured by the linear foot along the centerline of the pavement stripe. Skips in dashed lines will not be included in the measurement. Length of pavement markings will be based on a 4-inch-wide stripe. Measurement for striping with a plan width greater or less than the basic 4 inches as shown on the plans or directed by the Engineer will be made by the following method:

$$\frac{\text{Plan Width of Striping (inches)} \times \text{Linear Feet}}{4 \text{ (inches)}}$$

Symbols and legends will be measured by each unit applied. Each legend, regardless of the number of letters, will be considered as a single unit.

#### **708.5 Basis of Payment:**

Pavement striping of the type specified, measured as provided above, will be paid for at the contract price per linear foot for the total length of painted line applied to the nearest foot, which price shall be full compensation for the work complete, including glass beads, as described and specified herein and on the project plans.

Pavement symbols and legends measured as provided above, will be paid for at the contract price for each painted symbol or legend, which price shall be full compensation for the work complete, including glass beads, as described and specified herein and on the project plans.

Bid Items:	<b>7080001</b>	<b>FURNISH AND INSTALL INTERIM PAVEMENT MARKING, YELLOW STRIPE, 4" WIDE</b>
	<b>7080002</b>	<b>FURNISH AND INSTALL INTERIM PAVEMENT MARKING, WHITE STRIPE, 4" WIDE</b>
	<b>7080003</b>	<b>FURNISH AND INSTALL INTERIM PAVEMENT SYMBOL OR LEGEND</b>

## **SECTION 710 ASPHALT CONCRETE**

The work under this section shall conform to the requirements of Section 710 Maricopa Association of Governments (MAG) Uniform Standard Specifications and Details for Public Works Construction 2020 Edition and is included in these standards by this reference.

**710.3 Mix Design Requirements** is revised to add:

### **710.3.2.4 Previously Used Mix Designs Approved by Yuma County:**

A previously used mix design older than two years from the date it was formulated, sealed, signed, and dated shall not be allowed for use. Once approved for use on a project, a mix design may be used for the duration of the project.

An approved mix design may be included in the County approved product list for an additional year from the date the mix was formulated, sealed and signed upon receiving evidence that the type of bituminous material, the type of mineral admixture, and the source and methods of producing mineral aggregate have not changed since the formulation of the previous mix design. The submittal shall include the above noted evidence and also provide test results for the aggregates and the mix, to include a maximum theoretical (Rice) density, and running a Marshall point at the recommended asphalt content, a test for the coarse and fine aggregate specific gravities to assure that the aggregate source has not significantly changed, and a sand equivalent test.

## **SECTION 711 PAVING ASPHALT**

The work under this section shall conform to the requirements of Section 711 Maricopa Association of Governments (MAG) Uniform Standard Specifications and Details for Public Works Construction 2020 Edition and is included in these standards by this reference.

## **SECTION 731 STRUCTURAL SUPPORTS AND FOUNDATIONS FOR TRAFFIC SIGNAL AND HIGHWAY LIGHTING**

The work under this section shall conform to the requirements of Section 731 of the ADOT Standard Specifications for Road and Bridge Construction, 2008 Current Edition (Stored Specifications).

**Section 731** of the Standard Specifications is revised to read:

### **731.1 Description:**

The work under this section shall consist of furnishing all materials and constructing new supports and foundations for traffic signal and highway lighting systems or modifying poles and mast arms of existing systems at the locations shown on the project plans and in accordance with the details shown on the plans and the requirements of these specifications.

Pole foundations shall include all conduit, elbows, anchor bolts, grounding wire and reinforcing steel. Cabinet foundations shall include conduit, elbows, anchor bolts and clearance pad.

### **731.2 Materials:**

Excavation and backfill shall conform to the requirements of Subsection 203-5.03. Concrete shall conform to the requirements of 1006 and 601. Reinforcing steel and wire mesh shall conform to the requirements of sections 605 and 1003.

Concrete for all foundations shall be Class S and shall have a required 28-day compressive strength of 3,500 pounds per square inch.

#### **731.2.01 Blank**

#### **731-2.02 Standard Steel Poles:**

##### **(A) General:**

Standard steel poles for traffic signals and highway lighting shall include pole shafts and pole bases.

Material standards for traffic signal and lighting supports shall be in conformance with the 2013 edition of the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals. All pole supports shall be designed to withstand 90 miles per hour wind, and a 3-second Gust. Fatigue analysis is to be per Fatigue Category 2, without galloping. Truck Induced velocity shall be 55 mph wind speed. Metal parts of standard steel poles and hardware shall conform to the details shown on the plans and the following specifications. Welding shall conform to the requirements of the American Welding Society, Structural Welding Code - Steel, D1.1, latest edition.

**(B) Pole Shafts:**

Tapered pole shafts shall be fabricated from sheet steel of weldable grade which shall meet a minimum yield stress, after fabrication, of 50,000 pounds per square inch. A taper rate of approximately 0.14 inches in diameter per linear foot shall be required unless otherwise specified.

Standard pipe pole shafts shall be fabricated from standard weight structural steel which conforms to the minimum strength requirements of ASTM A53, or A500 Grade B. Each section shall be fabricated from not more than two pieces of sheet steel. When two pieces are used, the longitudinal welded seams shall be directly opposite one another. When the sections are butt-welded, seams shall be directly opposite one another. When the sections are butt-welded together, the longitudinal welded seams on adjacent sections shall be placed to form continuous straight seams from base to top of pole. Pole shafts shall be straight, with a permissive variation not to exceed 1 inch measured at the midpoint.

Pole shafts shall be galvanized in accordance with the requirements of ASTM A123. The visual appearance of the galvanized finish shall be uniform. Discoloration of the galvanized finish such as dark areas, dark streaks, dark rings or transportation handling marks which are considered excessive by the Engineer shall not be allowed. Pole shafts that have a finish unacceptable to the Engineer shall either be repaired or replaced to the satisfaction of the Engineer at no additional cost to the Department.

Hand holes in the base of the poles shall conform to the details shown on the Standard Drawings. All welds shall be continuous and any exposed welds, except fillet welds, shall be ground flush with the base metal.

A metal tag shall be permanently attached to the pole above the hand hole stating the manufacturer's name, pole type per the Department's plans, pole drawing number, shaft length and gage number.

**(C) Steel Pole Extensions and Twin Luminaire Brackets:**

Pole extensions and twin luminaire brackets shall be fabricated from new pipe conforming to the requirements of ASTM A53 or A500. All welding shall conform to the requirements of the American Welding Society, Structural Welding Code - Steel, D1.1, latest edition. Pole extensions and twin luminaire brackets shall be fully galvanized in accordance with the requirements of ASTM A123. Fabrication of the pole extensions and twin luminaire brackets shall be in accordance with the dimensions as specified in the plans.

**(D) Standard Bases:**

Poles shall have standard bases unless break-away bases are specified. Standard bases shall be fabricated from structural steel plates conforming to the minimum strength requirements of ASTM A36. Exposed surfaces shall be finished smooth and all exposed edges shall be neatly rounded to a 1/8-inch radius. Standard bases shall be galvanized in accordance with the requirements of ASTM A123.

**(E) Break-Away Bases:**

Break-away bases shall be fabricated from 356-T4 or SG-70AT6 aluminum alloy. The base shall be heat-treated in accordance with the requirements of ASTM B108, temper designation T6, before shipment. The break-away base shall have all the necessary hardware to make a complete and functional unit. Bolts, washers and nuts shall meet or exceed ASTM A153 minimum strength requirements and shall be fully galvanized in accordance with ASTM A153.

Break-away bases shall be certified by the manufacturer to meet or exceed the change in momentum requirements of the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, and to be acceptable for use on Federal Aid projects. The manufacturer shall also certify that the break-away base has been tested and approved by the Federal Highway Administration and that the castings have the same chemistry, mechanical properties, and geometry as the castings used in the tests.

Break-away bases shall be used where specified on the project plans.

**(F) Bolts, Nuts and Washers:**

All anchor bolts shall be threaded at the top and shall conform to the plans.

Standard anchor bolts, washers, and nuts shall be fabricated from steel conforming to the strength requirements of ASTM F1554 Grade 55. The anchor bolts, washers, and nuts shall be fully galvanized in accordance with the requirements of ASTM A153.

High strength bolts, washers and nuts shall be fabricated from steel which meets or exceeds the minimum requirements of ASTM F3125 Grade A325, and shall be electro-galvanized in accordance with the requirements of ASTM B 633. Welding shall not be performed on any portion of the body of these bolts. Certificates of Analysis conforming to the requirements of Subsection 106.05 shall be submitted for high strength bolts, washers and nuts.

**731.2.03 Wood Poles:**

**(A) General:**

Wood poles shall consist of full length, pressure treated material. Unless specified herein, material, treatment, and preservatives shall be in accordance with the latest revisions of the AWPA Book of Standards.

No deviations from these specifications will be allowed without the written approval of the Engineer.

Wood poles shall be used for service or temporary traffic signal or roadway lighting installations when specified. The lengths of the poles shall be 25 feet for service poles and 35 feet for other poles and shall be Class 3, unless otherwise specified.

**(B) Definitions:**

**AWPA:** American Wood Preservers Association.

**Supplier:** The person, partnership, association, or corporation furnishing the material covered by these specifications.

**Check:** A separation of the wood along the grain, the greater part of which occurs across the annual growth rings. A through check extends from surface to surface of the pole, usually through the pith center.

**Compression Wood:** Abnormal wood that often forms on the lower side of branches and inclined trunks of coniferous trees. Characteristics include:

- (a) relatively wide annual ring, usually eccentric;
- (b) relatively high proportion of summerwood (frequently more than 50 percent of the width of the annual ring in which it occurs);
- (c) exhibits very little contrast in color between springwood and summerwood; and
- (d) shrinks excessively lengthwise as compared with normal wood.

**Cross-Break (Crack):** A separation of the wood cells across the grain. Such breaks may be due to internal strains resulting from unequal longitudinal shrinkage or to external force.

**Dead Knot:** A knot left by a branch that dies before the tree is cut. An encased knot is a dead knot in which the growth layers are not intergrown with those of the surrounding wood. Dead knots may contain soft fibers (decay) that usually do not extend deeper than 1 to 2 inches from the pole surface. They are distinct from rotten or decayed knots in which the loose or soft fibers (decay) may extend the full length of the knot into the pole, and which are frequently associated with heart rot.

**Dead Streak:** Any portion of sapwood in which the life processes had ended prior to the cutting of the tree. A dead streak starts from the butt and differs from a wound, such as a catface or scar, where the growth of new wood shows that life processes are still acting to repair the injured part.

**Decay:** Decay or rot (advanced decay) is the disintegration of wood substance due to the action of wood destroying fungi.

**Face of Pole:** The concave side, or the side of greatest curvature in poles having reverse or double sweep, between the ground line and top of pole.

**Ground Line Section:** That portion of a pole between 1 foot above and 2 feet below the ground line as defined in the pole dimension tables.

**Hollow Heart:** A hollow in the heartwood of a living tree caused by insects or fungi.

**Hollow Pith Center:** A small hole at the pith center of the trunk or of a knot, caused by disintegration of the pith (small soft core occurring in the structural center of a tree or branch).

**Insect Damage:** The result of boring in the pole by insects or insect larvae. Scoring or channeling of the pole surface is not classed as insect damage.

**Knot Diameter:** The diameter of a knot on the surface of the pole measured in a direction at right angles to the lengthwise axis of the pole.

**Red Heart:** A fungus caused by *Fomes Pini* occurs in the living tree, and is characterized in the early stages of infection by a reddish or brownish color in the heartwood. This is known as "firm red heart". Later, the wood, in the case of the living tree, disintegrates (decays) in small, usually distinct, areas that develop into white-line pockets.

**Sap Satin:** A discoloration of the sapwood caused by the action of certain molds and fungi that is not accompanied by softening or other disintegration of the wood. Refer to Subsection 731-2.03(D)(2)(a) for blue stain.

**Scar (Catface):** A depression in the surface of the pole resulting from a wound where healing has not re-established the normal cross section of the pole.

**Shake:** A separation along the grain, the greater part of which occurs between the rings of annual growth.

**Short Crook:** Any localized deviation from straightness, in a 5-foot section or less, shall be classified as a short crook.

**Spiral Grain (Twist Grain):** A type of growth in which the fibers take a spiral course around the bole of a tree instead of the normal vertical course. The spiral may extend right-handed or left-handed around the tree trunk. The amount of spiral grain in a pole is measured as the distance in feet, along the axis of the pole, in which one complete twist of the spiral occurs, and is expressed as a ratio; for example, "1 in 30" (one twist in 30 feet).

**Split:** A lengthwise separation of the wood due to the tearing apart of the wood cells, extending from surface to surface of the pole.

**Sweep:** The deviation of a pole from straightness.

**(C) Acceptance Species:**

(1) **Douglas Fir (*Pseudotsuga menziesii*, MIRB. Franco):**

(2) **Southern Pines:**

(3) **Western Pine:**

- (a) Loblolly (Pinus taeda)
- (b) Longleaf (Pinus palustris)
- (c) Pond (Pinus rigida serotina)
- (d) Shortleaf (Pinus echinata)
- (e) Slash (Pinus caribaea)
- (f) Ponderosa (Pinus ponderosa laws)

**(D) Defects:**

**(1) Prohibited Defects:**

Pole exhibiting any of the following defects will not be accepted:

- Bird Holes
- Breaks
- Catface (Scars)
- Compound through checks
- Decay
- Double Sweep (poles having sweep in two planes)
- Hollow butts or tops
- Improper Framing
- Nails or other metal not authorized by the Engineer
- Plugged holes (other than increment borer)
- Small Butt
- Small Top
- Spike knots or any knot with bark inclusion
- Split top
- Worm or insect holes

**(2) Limited Defects:**

The following defects are acceptable subject to the limitations stated:

**(a) Blue Stain:**

The core used to check penetration of preservative will be checked for blue stain. Any core with 50 percent or more blue stain in sapwood will be rejected. Additional cores may be taken to determine extent of the stain.

**(b) Check:**

Any check more than 1/8 inch wide and extending down from the top of the pole more than 12 inches and within 30 angular degrees from the axis of the face of the pole directly above the brand will be unacceptable.

Through checks or splits in the butt surface are permitted, provided their height from the butt along the side surface does not exceed 2 feet.

A check is considered to be continuous if it is not separated by at least 1/2 inch of wood. Maximum acceptable dimensions of checks are as follows:

Length of Pole	Maximum Width	Maximum Length
30 feet and shorter	1/4 inch	5 feet
35 and 40 feet	5/16 inch	5 feet
45 feet and longer	3/8 inch	8 feet

**(c) Compression Wood:**

Compression wood in the outer 1-1/2 inch of pole.

**(d) Insect damage:**

Insect damage consisting of surface scoring or channeling are permitted; all other forms of insect damage are prohibited.

**(e) Insufficient Sapwood:**

Sapwood thickness less than the following:

Douglas Fir	1 inch
Pine	3 inches

**(f) Knot:**

The following criteria applies:

All knots shall be measured at right angles to lengthwise surface, including the sapwood as well as the heartwood portions. All end grained, completely concentric annual rings surrounding the prominent heartwood portion of the knot shall be included in the measurement.

The diameter of any single knot or the sum of the diameters of all knots in any 1-foot section shall not exceed the limits set up in the following table. Knots 1/2 inch or less in diameter shall be ignored in applying the limitations for the sum of diameters.

<b>Length/Class of Pole</b>	<b>Diameter of Any Single Knot</b>	<b>Sum of Diameters of Knots in Any 1-Foot Section</b>
45 feet and shorter	2.5 inches	8 inches
50 feet and longer	3.0 inches	10 inches

Maximum single knot in any sworl shall be 2 inches in diameter.

Maximum sum of knots in any sworl shall not exceed 20 percent of the pole circumference at the point of the sworl or more than the amount shown in the table above under the column heading "Sum of Diameters of Knots in Any 1-Foot Section."

**(g) Mechanical Damage:**

Poles are not acceptable if they have abrasions or damage caused by forklifts, dragging along the ground, indentation of chains, cables, cant hooks, peaveys, pole tongs, or other mechanical damage penetrating the pole more than 3/4 inch.

**(h) Pilodyn:**

The pilodyn can be used to check hardness of poles. The test will normally be taken at the ground line and any measurement 22 millimeters and over on ponderosa pine will result in that pole being rejected. Additional tests may be taken at any point on the pole to determine extent of softness.

**(i) Ring Count**

The average annual ring count shall be not less than six rings per inch average measured in the outer three inches on the butt face.

**(j) Sapstain:**

Stain that is not accompanied by softening or other disintegration (decay) of the wood is permitted.

**(k) Shake:**

Shakes in the butt surface extending through an arc of not more than 90 degrees are permitted, provided they are at least 2 inches from the outside diameter of butt.

**(l) Short Crook:**

Any localized deviation from straightness in a 5-foot section or less shall be classified as a short crook, and the deviation from straightness shall not exceed 1-1/2 inches.

**(m) Spiral Grain:**

Spiral grain is permitted provided it does not exceed 1/2 turn in 15 feet or one complete turn in any 30 feet of the pole.

**(n) Sweep:**

Where sweep is in one plane and one direction only, a straight line connecting the surface of the pole at a point located 6 feet from the butt, and the edge of the pole at the top shall not be separated from the surface of the pole at any point by more than 1 inch for each 10 feet of length between these points.

Where sweep is in one plane and two directions (reverse sweep), a straight line connecting the midpoint at a point located 6 feet from the butt with the midpoint of the top shall not deviate from the center line of the pole more than 1/4 the diameter of the pole at the point of widest deviation.

**(E) Dimensions:**

**(1) Length:**

Poles less than 50 feet in length shall be not more than 3 inches shorter or 6 inches longer than nominal length.

Poles 50 feet or more in length shall be not more than 6 inches shorter or 12 inches longer than nominal length.

The minimum lengths for the wood species shown are as follows:

Wood Species	Minimum Length of Pole
Douglas Fir	50 feet
Western Pine	45 feet
Southern Pine	30 feet

**(2) Classification:**

The pole circumference at the top and at a point 6 feet from the butt shall not be less than the dimensions shown below:

Pole Dimensions, Class 3			
Minimum Circumference at Top is 23 inches		Minimum Circumference at 6 Feet from Butt (Inches)	
Length of Pole (Feet)	Groundline Distance from Butt (Feet)	Western Pine	Douglas Fir and Southern Pine (all types)
20	4	29.5	27.0
25	5	32.5	29.5
30	5.5	35.0	32.0
35	6	37.5	34.0
40	6	39.5	36.0
45	6.5	41.5	37.5
50	7	43.5	39.0
55	7.5	45.0	40.5
60	8	46.5	42.0

**(F) Manufacturing Requirements:**

**(1) Bark Removal:**

Poles shall be smoothly trimmed by machine; the depth of the cut shall be kept to a minimum consistent with proper removal of the bark. Beveling the top or butt, excessive trimming around knots which results in separation in wood structure (knot pop-up), prominent spiral ridges on pole surfaces, rough or feathery surfaces, exposed heartwood (except at knot areas), patches of inner bark more than 1/2 inch wide and 6 inches long, and abrupt changes in contour due to shaving are evidences of improper removal of bark. Individual poles with such defects shall be rejected.

**(2) Marking:**

The following marks shall be burn-branded legibly on the butt and on the face of the pole per AWPA Standard M6 at a point 12 feet ± 2 inches tolerance:

- The supplier's code or trademark.
- The Plant location and the year of treatment.
- Code letters denoting pole species and preservative used.
- The circumference class numeral and numerals showing the length of the pole.

**(3) Treating Charge Number:**

Code numerals indicating the treating charge number must be placed on the butt either by stamping or on metal tags.

**(G) Preservatives:**

**(1) Preservative Requirements:**

The type of preservative to be used shall be Penta-Volatile Petroleum Solvent (Cellon or Dow process).

**(2) Penta-Volatile Petroleum Solvent:**

The pentachlorophenol shall conform to AWPA Standard P8. The carriers shall be hydrocarbon solvents Type B or D conforming to AWPA Standard P9.

**(H) Treatment:**

**(1) Poles:**

Poles shall be treated in accordance to AWPA Standards C1 and C4.

**(2) Moisture Content:**

Prior to treatment, poles shall be sufficiently air-seasoned, boultonized or kiln-dried to minimize checking after treatment and to permit maximum penetration and retention of preservative. Moisture content of the sapwood shall be below 25 percent. The moisture content may be determined by electrical resistance type moisture meters and shall have insulated needles driven 2 inches in fir or 2-1/2 inches in pine.

**(3) Retention:**

Douglas fir - The treating process must produce not less than 1 inch penetration at any point on the pole. If the sapwood thickness exceeds 1 inch between the butt and standard ground line, 85 percent of the sapwood shall be treated. The assay zone shall be 1/4 to 1 inch.

Cellon or Dow Process - Retention shall be not less than 0.90 pounds per cubic foot in the assay zone.

Western and Southern Pines - The treating process must produce complete sapwood penetration. The assay zone shall be 0.5 to 2.0 inches.

Cellon or Dow Process - Retention shall be not less than 0.60 pounds per cubic foot in the assay zone.

**(4) Penetration:**

Not less than one increment core shall be taken in the ground line area. All increment borer holes shall be plugged with tight fitting cylindrical wood plugs treated with the same preservative used to treat the pole. Penetration shall be determined by the following methods.

Cellon or Dow Process - Penta Check or Wetzal Stain.

**(5) Cleanliness - After Treatment:**

Cellon or Dow Process - Poles shall be washed or brushed so they are clean and free of surface crystals.

**(6) Retreatment:**

All poles which fail to meet the treating requirements of this specification may be treated one time after initial inspection. Temperature and pressure must conform to AWPA Standard C1 for retreatment.

Stored Poles - All poles showing brands or marks indicating treatment within any calendar year three years or more previous to the year of shipment shall be retreated one time conforming to AWPA Standard C1.

Cut Back Poles - All poles that are shortened or trimmed shall be retreated within seven days conforming to AWWA Standard C1.

**(I) Inspection:**

Inspection shall be made upon delivery. The Contractor shall provide the necessary assistance and facilities to enable safe and efficient inspection of the work. A Certificate of Compliance shall be furnished to the Engineer upon delivery to the job site or other approved locations.

**731.2.04 Mast Arms and Tie Rods:** Tapered mast arms shall be fabricated from sheet steel conforming to the requirements of ASTM A36, except for the types K and R pole mast arms. The mast arms for the types K and R poles shall be constructed of sheet steel with a minimum yield stress of 50,000 pounds per square inch after fabrication. Mast arms shall be fabricated according to the thickness requirements shown on the plans. A taper rate of approximately 0.14 inches change in diameter per linear foot shall be required unless otherwise specified. All bolts, washers, and nuts for mast arms shall be fabricated from steel conforming to the requirements of ASTM F3125 GR A325, and shall be electro-galvanized in accordance with the requirements of ASTM B633.

Tie rods shall be fabricated from weldable structural steel pipe and steel rod and shall have no kinks or bends. All dimensions of the tie rods shall be as specified in the plans, except that the mast arms and tie rods for wood pole installations shall conform to the details shown on the project plans.

Mast arms and tie rods shall be galvanized in accordance with the requirements of ASTM A123. The visual appearance of the galvanized finish shall be uniform. Discoloration of the galvanized finish such as dark areas, dark streaks, dark rings or transportation handling marks which are considered excessive by the Engineer shall not be allowed. Mast arms and tie rods that have a finish unacceptable to the Engineer shall either be repaired or replaced to the satisfaction of the Engineer at no additional cost to the Department.

A metal tag shall be permanently attached on the side of the mast arm near the base stating the manufacturer's name, pole type and name as shown on the plans, mast arm or pole drawing number, length, and gage number.

**731.3 Construction Requirements:**

**731.3.01 Shop Drawings:** The contractor shall furnish shop drawings for approval by the Engineer prior to fabrication of the traffic signals and highway lighting structures material. Shop drawings shall be prepared in accordance with the requirements of Subsection 105.03.

**731.3.02 Foundations:** The excavations required for the installation of foundations and other items shall be performed in such a manner as to avoid any unnecessary damage to streets, sidewalks, landscaping, and other improvements. The trenches shall not be excavated wider than necessary for the proper construction of the foundations and other equipment. Excavation shall not be performed until immediately before construction of foundations. The material from the excavation shall be placed in a position that will minimize obstructions to traffic and interference with surface drainage.

All surplus excavated material shall be removed and properly disposed of within 48 hours by the contractor, as directed by the Engineer. After each excavation is completed, the contractor shall notify the Engineer for inspection, and under no circumstances shall any underground materials or equipment be covered with fill without the approval of the Engineer.

Excavation and backfill shall be in accordance with the requirements of Subsection 203-5. At the end of each working period, all excavations shall be barricaded or covered, or both, to provide safe passage for pedestrian and vehicular traffic.

Excavations in the street or highway shall be performed in such a manner that not more than one traffic lane is restricted at any time, unless otherwise provided in the Special Provisions.

Sidewalk and pavement excavations shall be kept well covered and protected to provide safe passage for pedestrian and vehicular traffic until permanent repairs are made.

Signal and lighting pole foundations shall be set flush with the existing or new curb and sidewalk or flush with the finished grade where there is no curb or sidewalk, except in sloped areas they shall be as shown on the project plans. The dimensions and locations of foundations shall be as specified on the project plans; however, the Engineer may direct that changes be made in locations due to obstructions or other existing conditions. The contractor shall verify top of foundation elevations with the Engineer prior to foundation construction.

Concrete shall be placed in holes which have been augered against undisturbed earth. If the material in the bottom of the hole is not firm and stable, it shall be compacted or treated as directed by the Engineer. The walls and the bottoms of the holes shall be thoroughly moistened prior to placing the concrete.

If the soil is not stable and a hole cannot be augered, forms shall be used. They shall be of the proper size and dimensions and shall be rigid and securely braced. The forms and the bottoms of the holes shall be thoroughly moistened prior to placing the concrete.

If the Engineer requires foundations to be larger or deeper than on the plans because of soil conditions, the additional work will be paid for in accordance with the provisions of Subsection 109.04.

Anchor bolts and conduit stubs shall be placed and held in proper alignment, position, and height during the placing and vibrating of concrete. All pole foundations shall set for three days prior to pole installation except for types J, K, Q and R pole foundations which shall set for seven days.

Before the concrete for cabinet foundations has set, depressions shall be made around the anchor bolts for adjustment of the cabinet leveling nuts.

**731.3.03 Base Plates and Poles:** Anchor bolts, washers, and nuts required for relocating existing poles shall be furnished by the contractor.

Poles shall be drilled and tapped for mounting hardware as shown on the Standard Drawings. Use of through bolts will not be permitted. Poles will be rejected if holes are not properly positioned for the required mounts.

All steel poles shall be plumbed to the vertical with all mast arms, signal heads and luminaires installed. Sidewalks, curbs, gutters, pavement, base material, lawns, plants, and any other improvements removed, broken, or damaged by the contractor's operations shall be replaced or reconstructed with materials in accordance with these specifications. The replaced or reconstructed improvements shall be left in a serviceable condition satisfactory to the Engineer, and shall conform to these specifications where applicable.

Where existing pole installations are to be modified, materials and equipment shall be used, salvaged, or disposed of as specified in the Special Provisions and as directed by the Engineer.

Wood poles shall be placed in the ground to a depth of at least 6 feet. After each wood pole is set in the ground, the pole shall be backfilled with selected backfill. Backfill shall be free of large rocks and debris, and placed in layers of no more than 6 inches before compaction. Each layer shall be moistened and thoroughly compacted to the satisfaction of the Engineer.

Existing poles shall be either relocated or used in place as specified in the project plans. The contractor shall inspect the poles and provide the materials and work necessary to recondition the poles so they can be reused. Holes left in the shafts of existing poles, due to removal of items such as signal mounting assemblies, shall be repaired and painted with a zinc galvanized paint.

If any poles are damaged by the contractor's operations, such repairs or replacements shall be at no additional cost to the Department. If the Engineer orders additional work to be done following the contractor's inspection of the poles, such work will be paid for as provided in Subsection 109.04.

New poles that are damaged by improper drilling of holes will be rejected.

**731.3.04 Removing and Replacing Improvements:** Wherever a part of a section or slab of existing concrete or sidewalk or curb is damaged by the contractor, the entire section between expansion joints shall be removed and the concrete reconstructed as directed by the Engineer.

All areas of concrete sidewalks and driveways and all areas of Portland cement concrete and asphaltic concrete pavements to be removed shall be outlined and cut to a minimum depth of 1-1/2 inches with an abrasive type saw prior to removing the material. The cut for the remainder of the required depth may be made by any method satisfactory to the Engineer. Saw cuts shall be neat and true with no shattering or chipping of concrete adjacent to the outside of the removal area.

**731.4 Method of Measurement:**

The structural supports and foundations for traffic signals and highway lighting will be measured as a unit for each type of support and foundation furnished and installed.

Modification of existing poles and mast arms will be measured as a unit for each pole or mast arm modified.

**731.5 Basis of Payment:**

The accepted quantities of supports and foundations for signals and lighting, measured as provided above, will be paid for at the contract unit price each, for the type of support or foundation designated in the bidding schedule, complete in place, which price shall be full compensation for the work described and specified herein and on the plans, including all hardware, wire, excavation, backfill and incidentals necessary to complete the work.

The accepted quantities of modify pole and modify mast arm, measured as provided above, will be paid for at the contract unit price each, for the type of pole or mast arm designated in the bidding schedule to be modified, which price shall be full compensation for the work described and specified herein and on the plans, including all parts, hardware and incidentals necessary to complete the work.

No measurement or direct payment will be made for anchor bolts, the cost being considered as included in the unit price paid for foundations.

- Bid Items:    **7310130    INSTALL DEPARTMENT FURNISHED TYPE Q POLE WITH FOUNDATION, ADOT DETAIL TS 4-13**
- 7310131    INSTALL DEPARTMENT FURNISHED TYPE R POLE WITH FOUNDATION, ADOT DETAIL TS 4-15**
  
- 7310551    INSTALL DEPARTMENT FURNISHED TAPERED LUMINAIRE ARM, 20' LONG, ADOT DETAIL TS 4-29**
- 7310590    INSTALL DEPARTMENT FURNISHED STRAIGHT TRAFFIC SIGNAL MAST ARM, 35 LONG', ADOT DETAIL TS 4-13**
- 7310610    INSTALL DEPARTMENT FURNISHED STRAIGHT TRAFFIC SIGNAL MAST ARM, 45' LONG, ADOT DETAIL TS 4-15**

**SECTION 732 ELECTRICAL UNDERGROUND MATERIALS**

The work under this section shall conform to the requirements of section 732 of the ADOT Standard Specifications for Road and Bridge Construction, 2008 Edition with the following modifications.

**Section 732 ELECTRICAL UNDERGROUND MATERIALS** is modified to add the following:

**732.1 Description:**

This work under these items shall consist of furnishing and placing conduits as shown on the Plans, as detailed herein and as directed by the Engineer.

**732.2 Materials:**

PVC conduit and materials shall be in accordance with Section 732-2.02, of the ADOT Standard Specifications. Unless otherwise shown on the Plans, bends, conduit fittings, expansion joints, 36-inch sweeps and other conduit accessories not specifically mentioned shall be from a material similar to the connecting conduit.

Conduit elbows used for fiber optic cable installations (including future installations) shall be a minimum of 36-inches. All other conduit elbows shall be a minimum of 24- inches.

**Pull boxes:** Pull Boxes shall be Traffic Rated with Steel Lid with "TRAFFIC SIGNAL" marked on the lid.

### **732.3 Construction Requirements:**

Conduit shall be placed in accordance with the lines, grades, details and dimensions as shown on the Plans or as otherwise approved by the Engineer. Unless otherwise shown on the Plans, underground conduit shall be installed with a minimum cover depth of 30-inches.

The Contractor shall follow the blue stake requirements and provide sufficient vertical and horizontal clearances from existing utilities as described in Section 107. The FMS conduits shall be concrete encased to avoid existing utilities. ABC slurry or half-sack slurry shall be used to install the conduits to meet utility company requirements and ADOT requirements.

Backfill compaction shall be in accordance with Section 203-5.03(B)(4) of the ADOT Standard Specifications.

The contractor shall rake the existing decomposed granite (DG) back away from the work area of conduit, pillbox and foundation installations and removals to prevent mixing (to remain clean) with native earth and replaced after installation. The use of dirty DG in landscape restoration will not be allowed and the contractor will replace any dirty DG with clean DG of like kind and color at no additional cost to the Department.

The proposed Directional Drill (DD) profile shall be submitted to the Engineer, after the contractor has completed the necessary potholing, and approved prior to beginning the Directional Drill operation at each location. All DD conduit installations shall be in accordance with ASTM F 1962.

The contractor's DD operations shall utilize the "walkover" locating system or other Engineer approved equivalent for determining the location of the bore head. A sonde, behind the bore head shall register the depth, angle, rotation and directional data. At the surface, a receiver compatible with the sonde shall be used to gather the data and relay the information to the DD equipment operator.

No more than 1 week prior to installation of cable, all new and existing conduit runs in which cable is to be installed shall be cleared/cleaned by pulling through a metal-disc mandrel with a diameter of 90 percent of the conduit diameter, or a ball mandrel with a diameter of 80 percent of the conduit diameter. The conduit may be brushed or swabbed, if deemed necessary, prior to pulling the mandrel through the conduit. No direct measurement or payment will be made for this activity, as it is considered included in payment for conduit.

All final bore profiles shall be submitted to the Engineer.

All utility conduit installed by trenching shall be provided with a 3" color coded warning tape per Bureau of Reclamation engineering guidelines and requirements.

Detectable warning tape is required over below-ground utilities situated within Reclamation's ROW and should be a minimum of 18 inches above the utility and between 18 and 30 inches below the ground surface. Warning tapes should conform to the following specifications:

For electrical, street lighting, and traffic signal conduit(s), the warning tape should be a 3-inch-wide red detectable tape imprinted with "CAUTION BURIED (type) CONDUIT."

### **732.4 Method of Measurement:**

Measurement of Electrical Conduit will be made in a straight line from center of pull box to center of pull box, center of pull box to center of foundation, center of foundation to center of pull box, etc., for each linear foot (LF) of conduit furnished and installed. Directional drilling limits are approximately as shown on the project plans or per the direction of the Engineer. Each item shall include all elements of installation as described below. Pull tape or tracer wire shall be considered incidental to this work.

Vertical conduits and conduit sweeps, conduit in pull boxes, conduit reducers, conduit in foundations, concrete encasement of conduits, and clearing and grubbing are not measured or paid. The contractor shall account for these conditions in the unit prices bid for other items. The contractor is alerted to the fact that hand digging may be required in the installation of trenches and pull boxes. Hand digging shall be considered incidental to this work. No additional payment for potholing to identify the existing utilities and coordination with utility companies shall be considered incidental to this work.

The use of ABC slurry and half-sack slurry to meet utility company requirements and ADOT requirements (if required) shall be considered incidental to the conduit installation.

No additional payment for restoring decomposed granite or landscape to existing conditions before construction or wall graphics to its existing conditions before construction activities.

Pull boxes will be measured as a unit for each (EA) pull box installed in place for traffic rated pull boxes with steel lids with "TRAFFIC SIGNAL" marked on the lid.

Conductors (for signals and lighting) shall be measured as lump sum (LS) amount for a complete unit of work. The quantities for signal and lighting conductors may be determined from the information shown in the signal conductor schedule on the project plans.

**732.5 Basis of Payment:**

The accepted quantity of conduit, measured as provided above, will be paid at the contract unit price per linear foot (LF), which will be full compensation for the conduit described and specified herein and on the Plans, complete and in place including labor, materials, potholing, concrete encasement, restoration of landscaping items, excavating, hand digging, backfilling, removal of spoilage and incidentals required to complete the work.

The accepted quantities for pull boxes, measured as provided above, will be paid for at the contract unit price each (EA), which shall be full compensation for the work, complete in place, including any excavating and backfilling necessary to complete the work.

Conductors (for signals and lighting), measured as provided above, will be paid for at the contract lump sum (LS) price, which price shall be the full compensation for the work, complete in place

Bid Items:	<b>7320056</b>	<b>FURNISH AND INSTALL 2" DIA SCHEDULE 40 PVC ELECTRICAL CONDUIT WITH PULL CORD IN TRENCH</b>
	<b>7320060</b>	<b>FURNISH AND INSTALL 2.5" DIA SCHEDULE 40 PVC ELECTRICAL CONDUIT WITH PULL CORD IN TRENCH</b>
	<b>7320071</b>	<b>FURNISH AND INSTALL 3" DIA SCHEDULE 40 PVC ELECTRICAL CONDUIT WITH PULL CORD IN TRENCH</b>
	<b>7320074</b>	<b>FURNISH AND INSTALL 3" DIA SCHEDULE 40 PVC ELECTRICAL CONDUITS WITH DIRECTIONAL DRILLING</b>
	<b>7320420</b>	<b>FURNISH AND INSTALL NO 7 HD PULL BOX, 12" DEPTH, ADOT TS 1-2</b>
	<b>7320421</b>	<b>FURNISH AND INSTALL NO 7 HD PULL BOX, 24" DEPTH, ADOT TS 1-2</b>
	<b>7320650</b>	<b>FURNISH AND INSTALL TRAFFIC SIGNAL CONDUCTORS, ADOT TS 1-7</b>

**SECTION 733 SIGNAL INDICATIONS AND MOUNTING ASSEMBLIES**

The work under this section shall conform to the requirements of Section 733 of the ADOT Standard Specifications for Road and Bridge Construction, 2008 Edition.

**SECTION 733 SIGNAL INDICATIONS AND MOUNTING ASSEMBLIES** is modified to add the following:

**733.1 Description** The work under this section shall consist of furnishing and installing traffic signal indication assemblies and mounting assemblies at the locations shown on the project plans and in accordance with the details shown on the plans and the requirements of these specifications. Reference ADOT Detail TS 02 Note 6.

All 12-inch signal faces shall have five inch wide (5") louvered back plates with reflective 3M DG3 yellow tape along the front edges of the back plates. Anodized aluminum sheet, 16 gauge, shall be used for back plates.

All signal heads shall be McCain or Eagle/Siemens.

**733.4 Method of Measurement** Traffic signal faces and traffic signal mounting assemblies will be measured for each (EA) unit for each type of signal face or mounting assembly installed.

**733.5 Basis of Payment:**

The accepted quantities of traffic signal faces and traffic signal mounting assemblies, measured as provided above, will be paid at the contract unit price each (EA) for each type of signal face and mounting assembly, which will be full compensation, complete and in place.

Bid Items:	<b>7330060</b>	<b>FURNISH AND INSTALL TYPE F TRAFFIC SIGNAL FACE ASSEMBLY, 12"LENS, LED, ADOT DETAIL TS 8-1</b>
	<b>7330070</b>	<b>FURNISH AND INSTALL TYPE G TRAFFIC SIGNAL FACE ASSEMBLY, 12" LENS, LED, ADOT DETAIL TS 8-3</b>

**7330310 FURNISH AND INSTALL TYPE II MOUNTING ASSEMBLY, ADOT DETAIL TS 9-1**  
**7330360 FURNISH AND INSTALL TYPE VII MOUNTING ASSEMBLY, ADOT DETAIL TS 9-1**

**SECTION 734 TRAFFIC CONTROLLER ASSEMBLY**

The work under this section shall conform to the requirements of section 734 of the ADOT Standard Specifications for Road and Bridge Construction, 2008 Current Edition.

**SECTION 734 TRAFFIC CONTROLLER ASSEMBLY** is modified to add the following:

**734.2.01(D) Pre-Approval of Controller Equipment:** of the Standard Specifications is modified to add: The following controller equipment has been pre-approved by the Yuma County Engineering Department as of January 2014:

- (1) Type MPS Controllers: Special Programmable and System Applications (TS2, Type 2 - Downward Compatible TS1):  
 Colbalt with the following special programs:

	ADOT Basic Program Configuration
MPS-SI	Computer Supervised Unit
MPS-P	Pre-emption
MPS-T-C	Time Base and Traffic-Actuated Coordination
MPS-M	Arterial Master Controller

- (a) Controller shall be COBALT ATC TRAFFIC CONTROLLER WITH ECONOLITE CABINET POWER SUPPLY PS-2412-5A
- (b) Traffic Signal Controller Cabinet shall be Econolite 77" "R" cabinet, ADOT Type V (ADOT T.S. 3-9) Cabinet. 76.75"H X 44.25"W X26"D). TS 2-1 configuration. UPS shall be located within the TS cabinet.
- (c) Pedestal shall be Myers Pedestal Meug16A-M100 and Foundation.

**734.4 Method of Measurement** Traffic signal controller cabinets and meter pedestal will be measured as each (EA) controller assembly unit or control cabinet unit furnished and installed.

**734.5 Basis of Payment:**

The accepted quantities of traffic signal control cabinets and meter pedestal cabinets, measured as provided above, will be paid at the contract unit price each (EA) for each type of controller assembly or control cabinet designated in the bidding schedule, complete and in place, which price shall be full compensation for the work described and specified herein and on the project plans, including service terminal boxes, cabinet mounted service enclosures, meter sockets, breaker panels, foundations, conduit, elbows, anchor bolts, clearance pad, auxiliary signal controls, external logic modules and other components necessary to provide a complete functional assembly for controlling the operation and timing of traffic control signals.

Bid Item:       **7340101 FURNISH AND INSTALL COBALT ATC TRAFFIC CONTROLLER AND ECONOLITE P44 TS2 TYPE IV CONTROL CABINET, ADOT TS 3-9**  
                       **7340105 FURNISH AND INSTALL CONTROL CABINET FOUNDATION, ADOT TS 2-4**  
                       **7340120 FURNISH AND INSTALL METER PEDESTAL, CABINET, AND FOUNDATION, ADOT TS 2-6**

**SECTION 735 FURNISH AND INSTALL VIDEO IMAGE VEHICLE TRACKING AND DETECTION SYSTEM (VIVTDS)**

**735.1 Description**

Video Image Vehicle Tracking and Detection System shall be GRIDSMART VIVTDS.

Included are the minimum requirements for a system that views, captures, and derives data based on the vehicles that pass within the sensor field of view along a highway, road, ramp, or other commonly used transit pathway via processing video images. The detection of vehicles by a VIVTDS can be accessed and used by and for a large number of applications, including:

- Vehicle detection and actuation at intersections
- Highway flow monitoring
- Ramp metering
- Advanced detection
- PED crossing extensions
- Temporary construction zone detection
- Situational awareness of location area, including an intersection center
- Automated alerts and reports of potentially unsafe conditions, incidents, malfunctions, or signal timing inefficiencies
- Collecting and archiving traffic data for future analysis to improve performance by optimizing timing plans at intersections

The system shall have a modular electrical design and use Ethernet to connect and network with the different system components. Streaming video images, alerts, and data shall be transmitted from the field back to a Traffic Operations Center (TOC) via the systems client software and to the VIVTDS's cloud by using any or combination of the following

- Fiber optic
- Microwave
- WAN
- TCP/IP
- Internal modem
- Any other means of commonly used communication practices and standards for digital content and information.

The VIVTDS client software shall provide graphical user interfaces between the administrator(s) and permissioned users of the system and the VIVTDS sensor(s) itself. The software shall allow the user to configure sites, conduct maintenance, monitor information relayed from the sensor(s), and provide access to real-time data, system and user defined alerts, and access to historical data collected by the sensor(s). The client software should be installed on a single personal computer or across a network of computers. One or more users will be able to access VIVTDS simultaneously.

## **735.2 Materials**

### **(A) System Hardware**

The required hardware shall include the following:

- One VIVTDS processor capable of connecting with 1 to 5 sensors
- One or more VIVTDS sensors, with at least one sensor having a fisheye lens for omnidirectional viewing of the roadway or intersection.
- One 1.5" straight-thread, swivel bracket, and surge protector junction unit, per each fisheye sensor
- One surge protector junction unit, per each advanced/stopline sensor
- One mounting pole and bracket (90° pole per each fisheye sensor; or straight, vertical pole per each advanced/stopline sensor)
- One Ethernet Protection Module (surge protector located in the traffic cabinet), per each VIVTDS sensor
- VIVTDS interface cables to the traffic signal controller based on model/type.
- Optional portable field computer to configure and monitor system operations
- Optional computer to configure and monitor system operations at the TOC or other remote location
- Optional Ethernet Repeater to extend VIVTDS sensors beyond 100 meters
- Optional POE Powered Switch for use with more than two sensors

### **(B) Sensor Hardware**

#### **Fisheye Sensor**

The VIVTDS should have at least one downward-facing fisheye sensor capable of seeing the center of the intersection and have an omnidirectional line of site to track vehicles entering and exiting the intersection.

Other required features shall include the following:

- Color images outputted into digital format as MJPEG images
- Horizontal resolution of at least 2560 lines and vertical resolution of at least 1920 lines.
- A five (5) megapixel CMOS camera with an active-pixel sensor (APS)
- Camera lens shall not require adjustment and is always in focus
- A thermostatically controlled heater residing inside the enclosure to reduce the effects of ice and condensation
- Any plastics used in the enclosure shall have ultraviolet inhibitors
- A waterproof and dust tight aluminum enclosure.

The sensor dimensions excluding connectors shall not exceed 9.9" x 7.9" (height x diameter). The weight of the sensor including the enclosure shall not exceed eight (8) lbs. The VIVTDS sensor manufacturer shall provide a lifetime "always in focus" guarantee on the iconic bell shaped fisheye camera.

#### Optional VIVTDS Sensors

Certain projects will have special requirements or needs, such as advanced or stopline detection. In these instances, an additional VIVTDS sensor with a field of view of either 30° - 50° for stopline detection or a field of view of 9° - 18° for advanced detection should be used. The sensor dimensions excluding connectors and mounting bracket shall not exceed 8" x 15" x 3.5" and the weight should not exceed eight (8) lbs.

Other required features are the following:

- Color images outputted into digital format as MJPEG images
- Horizontal resolution of at least 2560 lines and vertical resolution of at least 1920 lines.
- A 5 – 50 mm varifocal lens set for the specific application
- A five (5) megapixel CMOS camera with an active-pixel sensor (APS)
- A thermostatically controlled heater residing inside the enclosure to reduce the effects of ice and condensation
- A sun shield to minimize lens exposure to the sun
- A waterproof and dust tight powdered coated aluminum housing

The sensor's mounting bracket should be easily mounted to a standard 1.5" vertical pole and allow for the installer to adjust the sensor's horizontal position with one hand and tighten the bracket without having to support the sensor simultaneously. The VIVTDS shall also support thermal imaging sensors for use in specific situations.

#### **(C) Processor Hardware**

The VIVTDS processor shall support 1 or 2 fisheye sensors, or if equipped with 1 fisheye sensor the VIVTDS processor should, at a minimum, be capable of simultaneously supporting up to four (4) additional VIVTDS sensors for special requirements such as advance detection or underpass detection.

The VIVTDS processor shall comply with NEMA standards, TS-1 Type 1, and 2; TS- 2; 170/2070; and ITS. The VIVTDS processor shall provide the following inputs and outputs:

- Type Inputs Outputs TSI 24 24
- TS2 16 64
- 170/2070 8 24
- ITS 16 64
- The VIVTDS processor will have at a minimum four (4) USB 3.0 ports for expansion flexibility and have a built-in modem.

The VIVTDS processor shall be no more than 1U high with dimensions, excluding connectors, not to exceed 8.5" x 11.5" x 1.75" and weigh no more than 5.2 lbs. The unit shall have flexible mounting options including the ability to lie flat on a cabinet shelf, be mounted in a standard traffic cabinet rack with optional mounting ears, or be installed vertically with optional base. The outer enclosure shall be a powdered coated aluminum.

## **(D) Electrical**

The VIVTDS sensor(s) will use five (5) watts nominally and a maximum of fifty (50) watts with active heaters. The sensor(s) will be Power Over Ethernet (POE) and will only require a shielded, burial grade, gel-filled RJ45 CAT5e cable for both power and data.

Each VIVTDS sensor shall have its own surge protector junction unit and EPM surge protection unit in the traffic cabinet.

The VIVTDS processor shall operate within a range of 89 to 240 VAC, 60Hz single phase. Power to the VIVTDS processor is from the transient protected side of the AC power distribution system in the traffic control cabinet where the VIVTDS processor is installed.

## **(E) Cabling and Surge Protection Units**

CAT5e cabling shall be a high performance shielded direct burial data cable capable of 350MHz bandwidth for data applications. The cabling shall consist of a 24 AWG solid bare copper wire with 8 conductors in a gel filled core. The jacket shall consist of linear low-density polyethylene (LLDPE) that is UV resistant and have a cable diameter of no more than 6.5 mm. The cable shall have easily identifiable striped pairs as follows:

- Orange-White, Orange
- Green-White, Blue
- Blue-White, Green
- Brown-White, Brown

The cable shall be rated at a minimum for 50 V.

The surge protector junction unit for the VIVTDS sensor shall be no more than three (3) ft. from the VIVTDS sensor and shall provide protection against a transient pulse with a pulse shape of 8/20 $\mu$ s and a max current of 75A. The unit shall weigh no more than two (2) lbs.

The EPM, surge protection unit for the VIVTDS sensor, shall have at most a max impulse discharge current of 40 KA and an impedance of at least 100 ohms. The unit should have at least Line-Line and Line-Ground protection options, and the POE current should not exceed 1.8A.

## **(F) Environmental**

The VIVTDS sensors and processor will need to meet or exceed the NEMA standard of -29 $^{\circ}$  F up to 149 $^{\circ}$  F and meet or exceed a 5-30Hz vibration test as well as a 10G shock test.

The VIVTDS processor shall have at least 0% to 95%, non-condensing. The VIVTDS sensor(s) shall have at least 0% to 100% relative humidity.

## **(G) System Software**

Each VIVTDS system will include client software for up to 8 sensors for detecting and counting the vehicle's entrance and exit of the intersection. The VIVTDS system will also include software for communicating with the traffic controllers and other electronic devices.

The client software shall be included with each VIVTDS system and should be downloaded and run on any personal computer with a Windows 7 or newer operating system. The client software at minimum should include management tools to perform the following:

- View, diagnose, configure, and reset individual sensor outputs
- View the status of inputs to enable setup and troubleshooting in the field
- Configure and view calls and phases
- The ability to create and define, as well as edit, vehicle zones, road masks, object masks, and pedestrian zones by drawing arbitrary shaped polygons using a computer
- View the site's configuration history
- Publish and revert back to previous configuration
- View video and images from the sensor within the software's interface
- Optionally access and use an API that is documented online and that uses HTTP
- Provide System Alerts for diagnostic and administrative events

The VIVTDS system will need to have optional data packages for purchase that provide count data, access to real time data, and system and user defined alerts. The count data shall be accessible directly from the processor or from a remote computer with a network connection. The count data will include at least the following type of reports:

- Turning movement counts, including U-turns
- Length based vehicle classifications
- Incidents reporting
- Volume
- 7 Day Volume
- Occupancy on Green
- Occupancy on Red
- Percentage of Arrivals on Green
- Percentage of Arrivals on Red

All reports should be exportable and downloadable in any of the following formats:

- PDF
- Excel
- Rich Text Format
- TIFF Image
- Web Archive

The alerts/notifications package for purchase should include at a minimum the following types of alerts:

- Wrong way vehicle detection
- Loss of visibility event
- Volume Exceeded

#### **(H) Vehicle Detection**

VIVTDS system shall provide real time vehicle detection (within 500 milliseconds (ms) of vehicle arrival). The system should detect the presence of vehicles for up to 64 detection zones per VIVTDS sensor. The detection zones shall be sensitive to the direction a vehicle travels and the direction to be detected by each detection zone shall be programmable by a client software user.

#### **(I) Detection Zone Placement**

The VIVTDS system should provide a flexible detection zone placement anywhere within one hundred (100) meters of the VIVTDS sensors. Preferred presence detector configurations shall be arbitrarily shaped polygons, including simple boxes, drawn across lanes of traffic or placed in line with lanes of traffic. A single VIVTDS sensor should replace one or more conventional detector loops.

#### **(J) Detection Zone Programming**

Placement of detection zones will be done by means of a graphical interface using the MJPEG image of the roadway. The client software displays images of the detection zones overlaid on the video image of traffic while the VIVTDS processor is running. The detection zones, when operating, shall display outlined or filled, with a visible change indicating activation.

A laptop should be used to draw detection zones. Alternatively, a mouse, keyboard, and monitor may be connected directly to the processor to configure a site. The detection zones should be capable of being sized and shaped to provide optimal road coverage and detection. It should be possible to upload detector configurations to the VIVTDS processor and to retrieve the sensor configuration that is currently running in the VIVTDS processor through the client software. The configuration should also be retrievable from the VIVTDS system's cloud if properly backed up.

The user will be able to edit previously defined detector configurations in order to fine tune the detection zone placement size and shape. Once a detection configuration has been created, the system will provide a graphic display of the new configuration on its monitor. While this fine-tuning is being done, the sensor will be required to continue to operate from the sensor configuration, currently in place. A user should be able to use a system command to revert to previous configurations stored in the client software or on the VIVTDS system's cloud if properly backed up.

When a vehicle occupies a detection zone, the detection zone on the live video will indicate the presence of a vehicle, thereby verifying proper operation of the system.

The presence of the vehicle as well as the signal states will be indicated via colored LED lights on the front panel of VIVTDS processor. With the absence of images, the VIVTDS processor's display shall indicate proper operation of the detection zones. Detection zones shall be sensitive to the direction of vehicle travel. The direction will be capable of being detected by each detection zone and will be programmable by the user. The vehicle detection zones will not activate if a vehicle is traveling in any direction other than the one specified for detection in the zone. Cross-street and wrong way traffic shall not cause a false detection.

Detection zones will be capable of an optional user defined call to detect a side entrance (90° or less angled entrance).

### **(K) Design Field of View**

The VIVTDS system will be able to reliably detect vehicle presence in the design field of view. The design field of view shall be defined as the sensor view when the image sensor is mounted thirty (30) feet (9 meters) or higher above the roadway, when the sensor is in front of all stop lines, no more than seventy-five (75) feet from the intersection center, and the beginning of the detection area is not greater than one hundred and fifty (150) feet from the image sensor. Within this design field of view, the VIVTDS processor should be capable of setting up a single detection zone for point detection (equivalent to the operation of a 6' x 6' inductive loop). A VIVTDS sensor, placed at the proper mounting height, is able to monitor up to and including five (5) traffic lanes per approach simultaneously. A single fisheye lens VIVTDS sensor, placed at the proper mounting height, should be able to monitor detection zones in an intersection of at a minimum of five (5) approaches.

### **(L) Detection Performance**

Detection accuracy of the VIVTDS system shall be comparable to properly operating inductive loops. Detection accuracy should include the presence of any vehicle in the defined detection zone regardless of the lane the vehicle is occupying. Occlusion produced by vehicles in the same or adjacent lanes shall not be considered a failure of the VIVTDS processor, but a limitation of the VIVTDS sensor placement.

Detection shall be 98% accurate in good weather conditions with slight degradation possible under adverse weather or road conditions (i.e. rain, snow, fog). Detection will be expected for the entire design field of view on a lane by lane or by approach basis.

Equipment failure, either sensor or VIVTDS processor, shall result in constant vehicle detection on affected detection zones. The VIVTDS system will be required to have the ability to place a constant call to a specific zone, if said zone loses visibility, while simultaneously making calls in the traditional manner in the remaining zones.

### **(M) System Software Operation**

The VIVTDS must transmit and receive all information needed for sensor setup, to monitor vehicle detection, to view vehicle traffic flow, and to interpret stored data. The remote communications link between the VIVTDS processor shall not interfere with the on-street detection of the VIVTDS processor.

The user should be able to view the detection area in a horizon to horizon fisheye view or in a configurable four (4) pane flattened view on the same screen. Each view should be able to be customized by the user, with the ability to digitally pan-tilt-zoom.

### **(N) Installation and Training**

The supplier of the VIVTDS system shall supervise the installation and testing of the sensors, processor, and other sensor components.

System installers will be required to be certified by the system manufacturer. A manufacturer's instructional guide will not be considered an adequate substitute for practical, classroom training and formal certification by an approved agency.

However, the manufacturer shall provide an online user guide and an electronic copy of the user guide within the client software and on board the VIVTDS processor for reference.

Formal levels of factory authorized training are required for installers, contractors and system operators. All training must be certified by the VIVTDS system manufacturer.

**(O) Warranty, Maintenance and Support**

The video detection system must be warranted to be free of defects in material and workmanship for a period of 3 years from date of shipment from the manufacturer's facility. During the warranty period, the system manufacturer will be required to repair with new or refurbished materials, or replace at no charge, any product containing a warranty defect provided the product is returned FOB to the supplier's factory or authorized repair site. Return product, product for repair, or product to be replaced under warranty by the supplier shall have prepaid transportation. This warranty does not apply to any products damaged by accident, improperly operated, abused, serviced by unauthorized personnel or unauthorized modification.

Ongoing software support by the manufacturer includes updates of the VIVTDS processor's engine and updates to the client software shall be provided free of charge for the life of the system.

**735.4 Method of Measurement:**

Video Image Vehicle Tracking and Detection System (GRIDSMART VIVTDS) will be measured as a lump sum (LS) complete system for each detection system furnished and installed.

**735.5 Basis of Payment:**

Video Image Vehicle Tracking and Detection System (GRIDSMART VIVTDS) will be will be paid for at the contract lump sum (LS) price for each detection system furnished and installed as designated in the bidding schedule, complete in place, which shall be full compensation for the work described and specified herein and on the plans.

No measurement or payment will be made for horizontal directional drilling, the cost being considered as included in the associated contract items.

Bid Item:     **7350101     FURNISH AND INSTALL VIDEO IMAGE VEHICLE TRACKING AND DETECTION SYSTEM (VIVTDS)**

**SECTION 736 HIGHWAY AND SIGN LIGHTING**

The work under this section shall conform to the requirements of section 736 of the ADOT Standard Specifications for Road and Bridge Construction, 2008 Current Edition (Stored Specifications).

**SECTION 736 HIGHWAY AND SIGN LIGHTING:** the title and text of the Standard Specifications is revised to read:

**SECTION 736 HIGHWAY LIGHTING:**

**736.1 Description:**

The work under this section shall consist of furnishing and installing or modifying highway lighting systems at the locations shown on the project plans and in accordance with the details shown on the plans and the requirements of these specifications.

The work as described above shall include furnishing and installing all materials and equipment designated on the project plans necessary for the installation of future systems.

**736.2 Materials:**

**736.2.01 Highway Lighting Materials:** Highway lighting materials shall be Light Emitting Diode (LED), conforming to the requirements of this section and be of the type and size specified. The LED shall have a nominal Correlated Color Temperature (CCT) equal to 4,000 degrees K ± 300 degrees K, or as specified in the project plans.

LED luminaires shall be listed by a National Recognized Laboratory (NRTL) as defined by US Department of Labor. The testing laboratory must be listed by OSHA in its scope of recognition for the applicable tests being conducted as required by this specification. A list of recognized testing labs for products sold in the United States may be found on the US Department of Labor website at <http://www.osha.gov>.

#### **(A) Requirements:**

**Luminaires:** Luminaires shall be LEOTEK MODEL GCL1, 135W, 4000K or equivalent for rural areas.

Each luminaire shall be furnished with an instruction sheet which clearly shows installation procedures and instructions for adjusting the luminaire. Each luminaire should meet the following requirements:

- (1) Listed by NRTL as being in compliance with Underwriters Laboratories (UL) 1598 and suitable for use in wet locations.
- (2) Shall have an International Electro-Technical Commission (IEC) 529 Ingress Protection (IP) 65 or greater for the optical assemblies of the luminaire.
- (3) Comply with Electro Magnetic Interference (EMI) requirements as defined by FCC47 Sub Part 15; CISPR15, CISPR22 Class A (120 volt minimum), EN61000-3-2, -3-3, -4-4, -4-5.
- (4) Shall be tested according to the most current version of Illuminating Engineering Society of North America (IESNA) LM-79
- (5) Shall have lumen maintenance measured in accordance with the most current version of IESNA LM-80
- (6) Shall have long term lumen maintenance documented according to most current version of IESNA TM-21
- (7) Shall have LM-79, LM-80 and in-situ temperature testing conducted by US Department of Energy Lighting Facts Program LED Lighting Facts approved testing laboratories

#### **(B) Luminaire Housing**

The luminaire housing shall be made of cast aluminum grade A383, A380 or A360, and painted to increase corrosion resistance; the color of the paint shall be gray unless specified otherwise. The luminaire housing shall serve as a passive heatsink for the LED array; no fans shall be allowed. All cast aluminum parts shall be subjected to the following tests:

- (1) 1000 hours salt spray fog exposure in accordance with ASTM B117; and
- (2) Corrosion Resistance Performance test in accordance with ASTM D1654.

The luminaire housing shall be compliant with American National Standard (ANSI) IEEE C136.31, Table 2 Roadway Lighting Equipment -Luminaire Vibration for both normal applications and bridge and overpass applications. Luminaire housing shall be rated IP65 per ANSI C136.37.

The luminaire housing shall be designed to allow water shedding. A passive cooling method shall be employed to manage thermal output of LED light engine and power supply. The luminaire housing shall have a label that states operating voltage, wattage and current range. The label must be clearly visible on the inside of the housing.

The luminaire housing shall have a National Electrical Manufacturers Association (NEMA) standard decal with black lettering identifying wattage and light type compliant with ANSI C136.15-2015.

Each luminaire shall be furnished with an instruction sheet which clearly shows installation procedures and instructions for proper luminaire aiming adjustments and maintenance instructions.

#### **(C) Electrical Requirements**

The luminaire shall fully operate in a temperature range -40 degrees C to 40 degrees C (-40 degrees F to 104 degrees F).

The LED engine which is composed of LED modules, optical system, electronic driver and heatsink shall have a minimum expected life of 100,000 hours at 25 degrees C and 70 percent of initial lumen output (L70) as calculated according to TM21-11

The luminaire shall have an integral dimming electronic driver that will operate for the following voltage ranges, as specified in the project plans:

- (1) 120 to 240 VAC (rms)  $\pm$  10 percent at 60 hertz or the voltage option of 480 VAC (rms)  $\pm$  10 percent at 60 hertz, as specified in the project plans.
- (2) The electronic driver shall have the following:
  - (a) A power factor of .90 or greater at full load.
  - (b) A total harmonic distortion of 20 percent or less at full load. ANSI C82.77, Harmonic Emission Limits.
  - (c) Thermal overload protection.
  - (d) 10 kA overload/overcurrent protection.
  - (e) A shielded and replaceable 20 kV surge protective device, compliant with ANSI C62.41 Category C.
  - (f) NRTL certified dimming driver that is terminated with quick disconnect wire harnesses. Wire nut termination is not acceptable.

**(D) LED Performance Requirements:**

The luminaire shall have a minimum luminaire efficacy of:

- (1) 120 volt, 174 watt, 20,100 lumens, 115 lumens/watt
- (2) 4,000 degrees K CCT
- (3) Dusk to dawn photo cell control

The luminaire shall meet the chromaticity requirements as follows:

- (1) The colors shall conform to the following color regions based on the 1931 CIE chromaticity diagram.
- (2) The luminaire shall have a minimum Color Rendering Index (CRI) of 70. Chromaticity as stated above must be confirmed by an Independent test lab or shown on the LM 79 test report.

**(E) Optical Requirements:**

The luminaire shall have a completely sealed optical system with an IEC IP rating of 65 or better.

The luminaire shall have a light distribution pattern at the road surface that has an evenly dispersed appearance.

The luminaire shall not have a perceptible light level flicker to the unaided eye over the voltage range as specified in the Electrical Requirements.

**(F) Warranty:**

The entire LED unit including auxiliary equipment shall have a factory warranty of five years against defects in workmanship or materials. The warranty shall cover repair or complete replacement.

**(G) Light Level Calculations:**

The light level calculations shall be performed in accordance with current adopted Roadway Lighting Design Guide by the Department or latest IES RP-8, and must be documented through lighting design software using the Light Loss Factor (LLF) equation below:

$$LLF = LLD \times LDD \times LATF$$

Where:

LLD (Lamp Lumen Depreciation Factor) = the specified percentage of LED lumen maintenance at 70,000 hours at 25 degrees C (77 degrees F) from the TM-21 Report

LDD (Luminaire Dirt Depreciation) = 0.90

LATF = LED Ambient Temperature Factor

The LLD and LATF factors shall correspond to 40 degrees C. The TM-21 Report must show the drive current used for the submitted luminaire.

Product submittal shall be accompanied by IESNA TM-21 compliant test reports from a Caliper qualified or NVLAP accredited testing laboratory for the specific model being submitted.

**736.2.02 Horizontally Mounted LED Luminaries:** Horizontally mounted LED luminaries shall meet the requirements of Subsection 2.01 and as specified herein. The luminaries shall be LED type 15L, 25L, or 40L as specified. Products listed on the Approved Products List (APL) are available on the internet from the ADOT Research Center through its Product Evaluation Program. Luminaries not currently on the APL may be considered, but must be submitted to and reviewed by the Engineer prior to approval for use on the project. The contractor shall allow sufficient time for review and approval.

Based on Type V optical distribution and CCT of 4,000 degrees K:

- Type 15L is intended to define an LED fixture with lumen output equal or greater than 13000 lumens but less than 21,000 lumens. **The LED luminaires proposed for this project fall under this type category.**
- Type 25L is intended to define an LED fixture with lumen output equal or greater than 21000 lumens but less than type 40L
- Type 40L is intended to define an LED fixture with lumen output equal or greater than 29000 lumen.

**(A) Luminaire Housing:**

The luminaire housing shall have a slip fitter type mounting on nominal 1½ inch (1⅔ inch outside diameter) to 2 inch (2⅔ inch outside diameter) by minimum 4 inch pipe (Tenon); provided with stainless or zinc plated clamps fixed by four 2 inch by ⅜ inch zinc plated hexagonal bolts with spring washers. The housing shall include integral bubble level indicator and enable luminaire tilt adjustment of ± 5 degrees in 2.5 degree increments.

The luminaire housing shall allow tool less entry with a hinged, removable door that opens downward to allow access to electronic components and terminal block. The door shall be secured to prevent accidental opening or dropping.

The maximum weights for each type when fully assembled shall be as follows:

- **Type 15L shall not weigh more than 30 pounds (applicable for this project);**
- Type 25L shall not weigh more than 40 pounds;
- Type 40L shall not weigh more than 45 pounds.

The luminaire housing shall have an Effective Projected Area (EPA) of no more than 1.5 square feet (when viewed from either side or either end).

The luminaire housing shall be equipped with a seven-pin photo-electric control receptacle (PECR) conforming to ANSI Standard C136.10, and shall be provided with a shorting cap.

**(B) Electrical Requirements:**

The terminal block shall be 3-station, tunnel lug terminal board that will accommodate American Wire Gauge (AWG) #6 thru #12

**(C) Optical Requirements:**

The luminaire shall have an IESNA Backlight, Up light and Glare (BUG) rating as follows:

- (1) Backlight rating shall not exceed 3.
- (2) Up light rating shall not exceed 0.
- (3) Glare rating shall not exceed:
  - (a) 3 for Type 15L and 25L
  - (b) 4 for Type 40L

**736.2.03 High Mast LED Luminaries:** High mast LED luminaries shall meet the requirements of Subsection 2.01 and as specified herein. The luminaries shall be LED, specifically engineered and designed by the manufacturer for high mast lighting applications.

Luminaries must be submitted to and reviewed by the Engineer prior to approval for use on the project. The contractor shall allow sufficient time for review and approval.

**(A) Luminaire Housing:**

The luminaire housing shall have a slip fitter type mounting on nominal 1½ inch (1⅔ inch outside diameter) to 2 inch (2⅞ inch outside diameter) by minimum 4 inch pipe (Tenon); provided with stainless or zinc plated clamps fixed by four 2 inch by ⅜ inch zinc plated hexagonal bolts with spring washers. The housing shall include integral bubble level indicator and enable luminaire tilt adjustment of ± 5 degrees in 2.5 degrees increments.

The luminaire housing shall have a hinged, removable door.

The maximum weight for the high mast fixture when fully assembled shall not exceed 60 pounds.

The luminaire housing shall have an EPA of no more than 2.1 square feet (when viewed from either side or either end).

The luminaire housing shall be equipped with a seven-pin PECR conforming to ANSI Standard C136.10, and shall be provided with a shorting cap.

**(B) Electrical Requirements:**

The terminal block shall be 3-station, tunnel lug terminal board that will accommodate AWG #6 thru #12

**(C) Optical Requirements:**

The luminaire shall have an IESNA Up light rating of zero.

The luminaire shall have a rotatable optics assembly to enable proper light distribution alignment.

Optional 90 degree, 120 degree, and 180 degree shields shall be available for the luminaire upon request.

**736.2.04 Vertically Mounted LED Luminaries:** Vertically mounted LED luminaries shall meet the requirements of Subsection 2.01 and as specified herein. Vertically mounted luminaire shall be a pole-top-type fixture and shall be mounted with a vertical slip fitter, designed to illuminate roadways from offsets of up to 50 feet.

**(A) Luminaire Housing:**

The luminaire housing shall have a hinged, removable door.

The maximum weight for the high mast fixture when fully assembled shall not exceed 55 pounds.

The luminaire housing shall have a maximum EPA of no more than 3.5 square feet when tilted 45 degrees.

The luminaire housing shall be equipped with a seven-pin PECR conforming to ANSI Standard C136.10, and shall be provided with a shorting cap.

**(B) Mounting:**

The luminaire housing shall have a slip fitter mounting on nominal 1½ inch (1⅔ inch outside diameter) to 2½ inch (2⅞ inch outside diameter) by 5 inch pipe (Tenon); provided with stainless or zinc plated clamps fixed by four 2 inch by ⅜ inch zinc plated hexagonal bolts with spring washers.

The slip fitter mounting shall be equipped with a swivel joint support that enables tilting the fixture from 0 degrees to 45 degrees supplied with tilt angle indicator to enable correct aiming.

**(C) Electrical Requirements:**

The terminal block shall be 3-station, tunnel lug terminal board that will accommodate AWG #6 thru #12

**(D) Optical Requirements:**

At horizontal position, 0 degree tilt angle, the luminaire shall have zero up light.

Optional shields shall be available for the luminaire upon request; the shields shall be mountable to sides, front and back of the fixture.

**736.2.04 Underdeck Diode LED Luminaries:** Underdeck diode LED luminaries shall meet the requirements of Subsection 2.01 and as specified herein. The luminaries shall be LED, specifically engineered and designed by the manufacturer for ceiling or wall mount type applications for underdeck lighting that is purposed to operate during dark hours. Luminaries shall be submitted to and reviewed by the Engineer prior to approval for use on the project. The contractor shall allow sufficient time for review and approval.

**(A) Luminaire Housing:**

The luminaire housing shall have glass lens and hinged, removable door that opens downward to allow access to electronic components and terminal block. The door shall be secured to prevent accidental opening or dropping.

The underdeck luminaire housing shall be painted bronze or dark bronze.

Maximum luminaire weight shall not exceed 50 pounds.

**(B) Mounting:**

The luminaire housing shall be designed to mount directly on a wall or ceiling for surface wiring or over a recessed outlet box for embedded wiring. All mounting hardware shall be made from corrosion resistant material. Grommets shall be installed for all cable entry holes.

**(C) Electrical Requirements:**

The terminal block shall be 3-station, tunnel lug terminal board that will accommodate AWG #6 thru #12

**736.2.05 Lighting Controls**

**(A) Photo Electric Controls**

The photo electric controls, hereinafter referred to as PEC, shall comply with the electrical requirements specified in the standard drawings.

The nominal dimensions shall be as shown on the standard drawings. The operating temperature range shall be from -40 to +158 degrees F with zero to 100 percent relative humidity. A time delay shall be incorporated into the circuit to prevent the lights from being turned off at night by transient lights which might be focused on the control. The PEC shall be a conventional glass faced, hermetically sealed cell.

A switch to permit manual operation of the lighting circuit shall be provided for each PEC. The PEC shall work in conjunction with an external auxiliary load relay for handling the required lighting loads unless specified otherwise.

The PEC shall have a built-in lightning arrester and inrush current protection. The encapsulated surge protector shall have a spark-over value of two kilovolts and shall interrupt up to 10 kiloamperes of follow-through current without affecting the operating characteristics.

Voltage Rating	120 to 277 volts AC, 60 hertz
Load Rating:	8 A LED
Turn on:	1.5, ±0.5 foot candles.
Turn off:	2.25 foot candles
Time delay:	2 to 5 Seconds
Fail Mode:	ON
Power Consumption:	Less than 0.65 W
Water ingress protection:	NEMA 3, raintight
Life rated at full load:	No less than 10,000 On-Off operations.

Regulatory Listings shall include:

ANSI C131.10 and RoHS compliant  
UL 773 certified  
Tested to NEMA 410 LED Load Standards

**(B) Auxiliary Contactor**

Unless otherwise specified, an auxiliary contactor shall be used in conjunction with a PEC to control the required lighting loads. The contactor shall have contacts rated to switch the specified lighting loads and shall be normally open. The contactor shall be single-pole or double-pole as required. The contactor shall be installed as shown on the plans.

**(C) Manual-Off-Photo Switch:**

A manual-off-photo switch shall be installed, as shown on the Standard Drawing to manually activate the contactor to turn the lights on or off. The switch shall be the toggle-type having double-pole, double-throw contacts with the center position being the "off" position, and be rated at 10 amperes at 250 volts A.C. The switch shall be manually activated in the up position and shall be activated by the PEC in the down position.

**736.2.06 Load Center Cabinets:** Load Center cabinets, including pole mounted cabinets shall have photoelectric controls and shall also include a concrete foundation, conduit stub-outs, meter socket, rigid metal conduit riser, cabinet housing, panel, breakers, contactor, selection switch, fuses, dry transformer, internal wiring and other incidentals in accordance with the project plans and these specifications.

The load center cabinet housing shall be of NEMA 3R weather resistant construction and UL 508 listed. The cabinet and doors shall be made from 1/8 inch thick, 5052-H32 aluminum with mill finish. All exterior cabinets shall have continuous welding and be free of burrs. The cabinet top shall be sloped to prevent water accumulation; and shall be constructed to allow proper ventilation and be equipped with a washable or replaceable air filter. Doors shall be attached using continuous hinges, equipped Corbin locks, and keyed #2 with two keys. Doors shall also be equipped with two position door stops, three-point door latch with rollers for top and bottom strikes and pad-lockable handles.

Circuit breakers shall be molded case, thermal magnetic, bolt-on or plug-in type and shall be U.L. listed.

Load center cabinets shall have a dead front panel to isolate all live electrical circuitry. The panel shall be fabricated from aluminum sheeting and shall be painted the same as the cabinet. The dead front panels shall be hinged on one side and securely fastened on the other with bolts. Switches, breakers and other components shall have openings to operate from the front panel.

**(A) Uninterruptible Power Supply (UPS):**

**(1) Description:**

An Uninterruptible Power Supply (UPS) battery backup system shall be furnished and installed by the contractor in accordance with the project plans and these specifications.

The UPS shall be a solid-state single-phase system to provide regulated and conditioned power. The system shall protect the 120-volt circuits supporting the traffic signal controller, controller cabinet, vehicular signal indications, pedestrian signal indications and pushbuttons. The UPS system is not intended to support any roadway lighting or sign lighting unless otherwise specified on the project plans.

**(2) Materials:**

The UPS System shall include, but not limited to, inverter, charger, universal automatic transfer switch, and surge protection unit, batteries, power transfer relay, mounting hardware and interconnect wiring. The UPS system shall conform to the following requirements:

- During utility power interruption, provide a minimum of eight hours of full operation at 550 watts, when batteries are fully charged.
- When system is running on battery power, the UPS shall allow the user to select a desired duration after at which the UPS transfer from full operation mode to flash mode.
- In the event of inverter, charger or battery failure or complete battery discharge, the universal automatic transfer switch shall revert to the state where utility power is connected to the cabinet.
- The inverter and the batteries must be hot swappable. There shall be no disruption of power to the traffic signal, when removing the UPS batteries.
- During back up operation, the voltage output shall be 120 V AC  $\pm 2\%$  with a frequency of 60  $\pm 0.3$  Hz.

- The maximum transfer time, from utility power disruption to stabilized inverter line voltage shall not exceed 8 milliseconds. The same shall apply when switching from the inverter line voltage to utility power.
- The system shall operate over a temperature range of -40 to 160 degrees Fahrenheit.
- The UPS shall be UL 1778 listed.
- The UPS shall be ANSI/IEEE C62.41 Category A & B Lightning surge protection compliant.

### **(3) Cabinet**

The UPS system shall be contained within the traffic signal control cabinet. All equipment necessary for safe, efficient and reliable operation of the UPS shall be included within the traffic signal control cabinet.

### **(4) UPS Inverter module:**

The UPS Inverter shall provide sufficient output power to support the traffic signal system (Cabinet, vehicular signals, pedestrian faces and push buttons) or a minimum of 1100 watts; whichever is greater.

The module shall be equipped with an integral system to prevent battery from destructive discharge and overcharge. The module shall include a backlit LCD display for viewing all status and configuration information. The screen shall easily be viewed during daylight and include keypad for navigating system information.

The module shall include a reset front panel event counter display to indicate the number of times the unit was activated and an hour meter to display the total number of hours the unit has operated on battery power.

The UPS controller unit shall be provided with an internal Ethernet, RJ45 port. All configuration and system menus shall be accessible and programmable from RJ45 port.

### **(5) Monitoring**

#### **(a) Battery Charging Monitoring System (BCMS):**

The UPS shall include a battery charging management system that is capable of managing the battery string. The BCMS shall perform electrical compensation for differences in each individual battery in the string to distribute charging voltage equally across the batteries.

The device shall operate at a temperature range of -40 to 160 degrees Fahrenheit.

#### **(b) Remote Battery Monitoring System (RBMS):**

When specified, RBMS shall be installed in the cabinet to monitor all UPS batteries; it shall have the ability to monitor, read and record the battery string and individual battery voltages, admittance (internal battery resistance), individual battery temperatures and to provide a real-time evaluation of the battery bank health.

The RBMS shall have a built-in web interface for communications over Ethernet, it shall include software to automatically poll each intersection; it shall be capable of reading individual battery voltage and temperature, confirming each within its user programmable parameters. The system shall have the ability to program the intervals as to when each reading is taken, by days, weeks or months. The RBMS shall also perform as a battery balancer, continuously monitoring all batteries in the string and to interface with the UPSs charger voltage/current so to keep the batteries equal with all batteries within the battery string.

The device shall operate at a temperature range of -40 to 160 degrees Fahrenheit.

### **(6) Batteries**

**Battery:** Battery shall be ZINCBLUE BBS with 500W Battery.

Batteries shall have a minimum 5 years non-prorated warranty, shall be of sufficient amp-hour ratings to meet the requirements of these specifications. The contractor shall furnish calculations or other supporting documentation bearing evidence that the proposed batteries will meet or exceed this provision.

The batteries shall be completely sealed and maintenance-free; comprised of float cycle, GEL VRLA (Valve Regulated Lead Acid) or AGM (Absorbed Glass Mat), certified to operate at temperatures from -40 to 160 degrees Fahrenheit.

Batteries shall have terminal covers to protect from accidental contact with metallic terminal components.

Batteries shall be easily replaced with all needed hardware and shall not require any special tools for installation.

UPS units that are installed at locations where elevation is 5000 feet or higher, shall be furnished with a battery heater mat for keeping battery temperatures within operating range.

**(7) Universal Automatic Transfer Switch**

The universal automatic transfer switch shall enable providing continuous operation of the traffic signal system either with conditioned line power, battery backup power or direct utility power.

The switch should be a combination of automatic and manual transfer switch rated at 120 V AC – 30 AMP.

An inverter input breaker shall be provided and located on the transfer Switch to shut off utility power to the UPS input, allowing safely disconnecting and removing the inverter or allowing battery replacement. The Automatic Transfer Switch shall be equipped with a position indicator light.

**Warranty**

The UPS shall include a five-year warranty on parts and labor for the entire system.

**736.3 Construction Requirements:**

Luminaire shall be LEOTEK MODEL GCL1, 135W, 3000K OR EQUIVALENT. Each LED light shall be installed as a complete unit.

Battery shall be ZINCBLUE BBS WITH 500W BATTERY.

The contractor shall maintain full nighttime operation of the existing lighting system during the duration of the construction project, unless otherwise approved by the Engineer.

**736.4 Method of Measurement:**

Luminaires will be measured as a unit for each (EA) luminaire furnished, installed, and operational.

Uninterruptible Power Supply (UPS) battery backup systems will be measured as a unit for each (EA) type of cabinet furnished and installed.

Load center cabinets will be measured as a unit for each (EA) load center cabinet furnished and installed.

**736.5 Basis of Payment:**

The accepted quantities of luminaires and load center cabinets, measured as provided above, will be paid for at the contract unit price each, for the types of luminaires and load center cabinets designated in the bidding schedule, complete in place, which price shall be full compensation for the work described and specified herein and on the plans.

The accepted quantities of Uninterruptible Power Supply (UPS) battery backup systems, measured as provided above, will be paid for at the contract unit price each, for furnishing, assembling, installing and testing Uninterruptible Power Supply (UPS) battery backup systems, which price shall be full compensation for the work, complete in place, as described and specified herein and on the project plans, including cabinets, foundations, conduit, elbows, anchor bolts, maintenance pad, UPS controller unit, serial cable, surge protection devices, batteries and all other components necessary to provide a complete functional UPS system for controlling the operation of traffic control signals for the time periods and in the manner specified herein.

Bid Items:        **7360001    FURNISH AND INSTALL LED LUMINAIRE, HORIZONTAL MOUNT, TYPE 15L**  
                      **7360002    FURNISH AND INSTALL UNINTERRUPTIBLE POWER SUPPLY (BATTERY BACKUP)**

**SECTION 924 MISCELLANEOUS WORK**

**Establish Electrical Service**

**Description:** The work under this item shall consist of coordinating with and paying all necessary fees to the local utility company to design and install new complete functioning electrical services at the locations listed below:

**County 15<sup>th</sup> and Avenue A:**

Furnish 120/240 volt, 100 amp, single phase service for traffic signs and intersection lighting.

Refer to the signing and striping plans for exact points of electrical service.

The work shall consist of paying all necessary fees to the local utility company to design and install complete functioning electrical services at the locations as shown in the project plans.

The contractor shall contact the following representative of APS to set up a preconstruction meeting with an APS inspector for the purpose of coordinating this work:

- **ANTONIA MORALES, FIELD REPRESENTATIVE, APS-YUMA**  
**Antonia.Morales@aps.com**  
**520-227-3786**

The contractor shall provide to the Engineer, for review and approval, copies of all agreements between the utility company and the contractor. The contractor may proceed with those agreements after Engineer approval. If the contractor proceeds before or without Engineer approval, the Engineer may withhold reimbursement to the contractor.

Contractor is responsible for payment of electrical bills until completion of construction and the work is accepted by the County.

Upon billing, the contractor shall pay the cost for the electrical service hook-up installations. The contractor shall submit the paid invoice, with the allowable mark-up as specified in the Basis of Payment section to the Engineer. The contractor shall pay the monthly energy costs for all electrical services and submit copies of paid utility bills for reimbursement during the normal project billing cycle until the project is complete and accepted by the Engineer.

There will be no measurement or payment for coordination of this work other than electrical service hook-up design and installation, and monthly energy bills, the cost being considered as included in the cost of contract items.

**Method of Measurement and Basis of Payment:**

Force Account Work (FA) to establish electric service shall be paid for by the amount shown on the invoice submitted by the contractor plus a five percent mark-up, as follows:

$$\text{Subtotal} = \text{Invoice} \times 1.05$$

Also, an amount equal to 65 percent of the Subtotal, as determined above, multiplied by the applicable sales tax rate will be added to the Subtotal. Finally, an amount equal to 0.50 percent of the Subtotal will be added for the Performance and Payment Bond. The Total Contractor Payment (TCP) will be as follows:

$$\text{TCP} = (\text{Subtotal}) + (0.65 \times \text{Subtotal} \times \text{sales tax rate}) + (0.005 \times \text{Subtotal})$$

Such force account (FA) payment shall be full compensation by lump sum for providing electrical services, complete in place, as specified herein. The contractor shall provide copies of all invoices to the Engineer.

The accepted work will be paid for at the force account prices as set forth herein for the following pay item:

**Bid Items:      ITEM 9240001    ESTABLISH ELECTRICAL SERVICE**

**SECTION 1007 RETROREFLECTIVE SHEETING**

The work under this section shall conform to the requirements of section 1007 of the ADOT Standard Specifications for Road and Bridge Construction, Current 2008 Edition (Stored Specifications).

**1007.1 General Requirements:** the last two sentences of the first paragraph of the Standard Specifications are revised to read:

Sheeting shall conform to criteria listed in the most current version of ASTM D 4956 for the applicable type and class, unless otherwise specified.

**1007.2 Material Types:** of the Standard Specifications is revised to read:

Sheeting for permanent warning signs, regulatory signs, and overhead-mounted guide signs, including all sign legends and borders, shall be ASTM Type XI.

Sheeting for all warning signs with yellow backgrounds shall be Type XI fluorescent retroreflective yellow.

Sheeting for information signs, ground-mounted guide signs, and marker signs, including all sign legends and borders, shall be ASTM Type IX or XI.

Sheeting for permanent object markers and delineators on a rigid substrate with yellow backgrounds, including guardrail end treatments, guardrail markers, rigid delineators, and impact attenuators, shall be Type XI fluorescent retroreflective yellow.

Sheeting for permanent object markers and delineators on a rigid substrate in colors other than yellow, including guardrail end treatments, guardrail markers, rigid delineators, and impact attenuators, shall be ASTM Type IX or XI.

Sheeting for object markers and delineators on a flexible or plastic substrate, including flexible delineators and sand barrels, shall be ASTM Type VIII, IX or XI.

For temporary regulatory and guide signs on a rigid substrate with fluorescent retroreflective orange sheeting, ASTM sheeting Types VIII, IX, or XI shall be used.

For temporary regulatory and guide signs on a rigid substrate in colors other than fluorescent retroreflective orange, ASTM sheeting Types IV, VIII, IX, or XI shall be used.

For retroreflective orange temporary signs on a flexible or roll-up substrate, ASTM Type VI sheeting shall be used.

All temporary signs (rigid, flexible, or roll-up) with orange backgrounds shall use fluorescent retroreflective orange sheeting, except that non-reflective sign materials may be used for temporary signs where the signs will be clearly visible under available natural light.

For barricades and other temporary channelizing devices, ASTM sheeting Types IV, VIII, IX, or XI shall be used.

Sheeting for Adopt-A-Highway signs shall be ASTM Type I, IV, or XI.

Logo signs shall be ASTM Type I, IX, or XI.

When more than one sheeting type is allowed, the contractor may use any of the types listed, provided that materials used for a particular application shall be of the same ASTM type, manufacturer, and product for all signs of the same type in the project.

Opaque films used with sheeting shall be acrylic type films.

Direct-applied and demountable black characters shall be non-reflective.

**1007.3 Visual Appearance, Luminance and Color Requirements** of the Standard Specifications is revised to read:

Except as specified herein, the color of the sheeting, ink or film shall conform to the ADOT Manual of Approved Signs, the Manual on Uniform Traffic Control Devices (MUTCD), and the plans.

All sheeting, inks and film used shall be uniformly colored so there is no visual variation in their appearance on the same sign or from sign to sign of the same colors.

Standard colors specified for sheeting, processing inks, and films shall, as applicable, match visually and be within the color tolerance limits required by Highway Tolerance Charts issued by the Federal Highway Administration. Additionally, for the retroreflective sheeting, unless otherwise noted, the Luminance Factor (Daytime Luminance) and Color Specification Limits (Daytime) shall conform to the applicable requirements of ASTM D 4956.

In addition to the luminance and color requirements, fluorescent orange sheeting and fluorescent yellow sheeting shall have the capacity to effectively fluoresce outdoors under low light conditions. For all applications requiring fluorescent orange sheeting or fluorescent yellow sheeting, the contractor shall provide a letter to the Engineer from the manufacturer certifying that the sheeting to be used is fluorescent.

**1007.6 Adhesive:** the first paragraph of the Standard Specifications is revised to read:

Reflective sheeting and film adhesives shall be Class I as specified in ASTM D 4956 and as modified herein.

The third paragraph is hereby deleted:

**1007.8 Durability Requirements:**

The second and third paragraphs of the Standard Specifications are revised to read:

Sheeting shall be weather-tested as specified above in Subsection 1007-7. Sheeting weather-testing periods and durability ratings shall be as specified in Table 1007-8. In all cases, the related inks and films shall be tested along with the respective sheeting, and shall be subject to the same durability requirements as the sheeting.

**TABLE 1007-8**

<b>ASTM Sheeting Type</b>	<b>Color</b>	<b>Weather-testing period, months</b>	<b>Durability rating, years</b>
XI	Fluorescent yellow	42	7
XI	Fluorescent orange	18	3
XI	All other colors	60	10
IX	Fluorescent orange	18	3
IX	All other colors	60	10
VIII	Fluorescent orange	18	3
VIII	All other colors	30	5
VI	Fluorescent orange	18	3
IV	All colors	30	5
I	All colors	30	5

\*\*\* End of Special Provisions \*\*\*