

**ATTACHMENT 26-1**  
**AMENDMENTS TO THE STANDARD SPECIFICATIONS**

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# AMENDMENTS TO THE STANDARD SPECIFICATIONS

## General

The 2014 edition of the Department's *Standard Specifications for Road and Bridge Construction* (Standard Specifications) is hereby amended with the additional provisions in this Attachment 26-1.

## Amended Standard Specifications

The language in the following sections is hereby incorporated into the Department's Standard Specifications.

### SECTION 212 – LANDSCAPE AND AESTHETICS

**212.01.01 General.** This work consists of painting new concrete surfaces.

**212.03.12 Painting.** Thirty days prior to beginning paint application, apply paint test sections on approved test panels. The Engineer may require different shades of the colors or variance of shades on the same test panel to make a selection. Prior to test paint application, blast and pressure wash the test panels as specified below. Perform additional surface preparation as recommended by the paint manufacturer. Allow the test panel to fully dry. Apply test paint in accordance with the manufacturer's recommendations using a manufacturer certified applicator. Demonstrate that the paint penetrates the surface and is immediately absorbed. Do not begin application of paints on the project until the paint colors have been approved and application methods demonstrate successful results.

Give notification not less than 72 hours prior to the commencement of application of paint.

Do not paint concrete surfaces until they have cured a minimum of 28 days. Schedule the paint application with earthwork and backfilling operations of any given wall to insure that the walls are treated to the minimum distance below finished grade.

Remove laitance, curing compounds, form release agents and other substances detrimental to the finish coating performance prior to painting with the following steps:

1. Hot water pressure blast.
2. Chemical wash with trisodium phosphate, copper sulfate, or any detergents specially formulated for removal of form release agents, curing compounds and all laitance involved with the construction procedure. Apply with vigorous scrubbing or an approved mechanical method.
3. Hot water pressure blast to remove cleaning agents and remaining laitance.
4. Perform field test as described below.

The above steps are based on early form removal and the necessity for the application of curing compounds. In areas where curing compound has not been applied, hot water pressure blasting accompanied with field testing may be all that is required for complete surface preparation.

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Field testing will consist of applying water on a dried section of prepared concrete surface. If any water beading and/or differential absorption into the concrete surface is noted, then perform the above Steps 2 and 3.

Hot water pressure blasting and equipment shall consist of the following:

- a) Provide equipment capable of producing between 2000 - 3000 psi when applied at a rate of 3-4 gpm. Vary the blasting pressure until laitance removal is observed. Do not operate pressure so high that etching of the concrete surface occurs. Maintain water temperature between 185 °F and 200 °F. Make any adjustments necessary to the satisfaction of the Engineer.
- b) Use a fan nozzle that produces a 0 to 15 degree spray pattern.
- c) The hot water pressure blasting removal pattern shall provide a clean concrete surface. Hold the nozzle perpendicular and 12-24 inches away from the concrete surface. Overlap each spray pass to obtain maximum removal of laitance. Spray patterns may be up and down or side to side. If the laitance is difficult to remove, both up and down and side to side may be necessary for complete surface preparation.

All surface preparation shall be performed to the satisfaction of the Engineer.

Apply the concrete paint according to the manufacturer's recommendations using a manufacturer certified applicator. Apply paint with the number of coats, and application rates, recommended by the manufacturer.

Apply paint when the ambient and surface temperature is 7 °C (45 °F) and rising. Do not apply paint when temperatures are above 35 °C (95 °F).

Do not apply paint when winds are 8 mph or greater or when there are dusty conditions. Do not apply paint during fog, mist, the relative humidity exceeds 85%, at temperatures less than 5 degrees above the dew point, or when precipitation is imminent.

Provide drop cloths or other forms of protection for surrounding surfaces of overspray and splashing. Protect traffic and pedestrians from overspray.

#### **212.03.14 Aesthetic Patterning.**

- (a) General. Use prefabricated form liners to provide aesthetic patterning to formed concrete surfaces as shown on the plans.

Prior to fabrication, submit shop drawings for all form work incorporating form liners for approval. The shop drawings shall show the location of construction joints, use of special form liner materials, and type and location of form ties. Include a material list of all form liner types, showing location, including panel size, layout of each panel, form liner joints, seams, and method of attachment. Included in shop drawing and material list shall be any materials used to construct reveals, elevation/relief transitions, edges, and any required special graphic features.

- (b) Materials. The form liner manufacturer shall have a minimum of five years experience in manufacturing form liners of equal complexity to this project. Submit proposed form liner material for approval. Provide a 36" x 36" sample of each proposed pattern/texture, including the reverse positive of each, indicating use, location, and attachment method. Include materials that will be used to produce reveals, chamfers, and transitions in relief elevations and textures. Provide evidence that materials have been used successfully on similar projects using construction photos, dates, and names. Submit a minimum of 3 photos demonstrating such patterning.

The form liners shall be able to withstand concrete pour pressure without deflection and distortion and be removable without causing concrete surface deterioration or weakness in the substrate.

Use release agents compatible with form liner surface finish and color system to be applied.

Wood forming or foam form inserts will be allowed.

- (c) Installation. Upon approval of form liner materials and shop drawings, construct full size mockup panels using approved form lining materials. Construct panels to provide a sampling of all form liner material types and textures, construction joints, form liner seams, reveals, colors and portions of any special art features. The form liner used shall produce the same pattern that is intended for use on the finished structure and shall be incorporated into final work. The mockup test panels shall be un-reinforced, vertically cast, concrete constructed to determine the surface texture resulting by use of form liners. Panels to be oriented with the aesthetic patterns facing south. Remove unsatisfactory panels and replace with satisfactory panels. Dispose of test panels after completion of finished concrete wall or as directed. Do not begin construction until proposed materials and construction methods indicate satisfactory results.

Securely attach liner to forms per manufacturer's recommendation. Coordinate wall ties with approved shop drawings.

Apply form release agent per manufacturer's recommendation.

Make free of build-up prior to each pour. Visually inspect each liner for blemishes and/or tears and repair per manufacturer's recommendation.

Form liner seam joints shall be finished and carefully blended into the final concrete surface. Finished texture and pattern shall be continuous without visual disruption.

**SECTION 496 - POLYMER CONCRETE**

DESCRIPTION

**496.01.01 General.** This work consists of preparing concrete surfaces and furnishing and placing polymer concrete consisting of a premixed composition of polyester resin binder and dry aggregate.

**496.01.02 Submittals.** Submit a list of at least 3 previous projects in which polymer concrete has been placed by the Contractor and satisfactory performance has been obtained. The previous projects must have been completed within the last 5 years and have been open to traffic for not less than 1 year. Include in the submittal, location of bridge (state, route, and bridge identifier), product name and manufacturer of each resin, approximate date of project opening to traffic, owner, and contact person with phone number.

MATERIALS

**496.02.01 Polymer Concrete.** Use a polymer concrete system listed in the QPL. Make no substitutions for the listed polymer concrete system components.

Give notification at least 20 days before placement of the polymer concrete so it can be determined if a sample of the polyester resin will be required.

Aggregate shall conform to one of the following gradation requirements:

Sieve Size	Percent Passing by Mass	
	Gradation 1	Gradation 2
12.5 mm (1/2 in.)	---	100
9.5 mm (3/8 in.)	100	83-100
4.75 mm (No. 4)	62-85	65-82
2.36 mm (No. 8)	45-67	45-64
1.18 mm (No. 16)	29-50	27-48
600 µm (No. 30)	16-36	12-30
300 µm (No. 50)	5-20	6-17
150 µm (No. 100)	0-7	0-7
75 µm (No. 200)	0-3	0-3

Aggregate retained on the 2.36 mm (No. 8) sieve shall have a maximum of 45 percent fractured faces as determined by Test Method No. Calif. 205. Aggregate passing the 2.36 mm (No. 8) sieve shall consist of natural sand only.

Aggregate absorption shall not exceed 1.0 percent as determined by Test Method No. Calif. 206 and 207.

The moisture content of the aggregate, as determined by Test Method No. Nev. T112 (Method A), shall not exceed 50 percent of the aggregate absorption capacity at the time of mixing with the resin.

The pre-bagged aggregate may be furnished in two or more sizes. The combined proportions of each size shall meet the above requirements.

The promoter/initiator system for the methacrylate resin shall consist of a metal drier and peroxide. If supplied separately from the resin, at no time shall the metal drier be mixed with or

allowed to contact the peroxide directly. Do not store the containers in a manner that will allow leakage or spillage from one material to contact the container or material of the other.

Accompany each shipment of high molecular weight methacrylate resin, polyester styrene resin, promoter and initiator with a Material Safety Data Sheet.

## CONSTRUCTION

**496.03.01 General.** Before placing polymer concrete, furnish the following:

1. Skilled technical service relating to application of materials, including a representative present during the initial placement of polymer concrete.
2. Health and safety training for personnel who are to handle the materials. In addition, provide a soap and water wash station for the workers at the job site.
3. Submit proposed locations of the longitudinal and transverse joints for approval. Do not locate the longitudinal joints in wheel lines.

Mix one or more trial batches of polymer concrete for various percentages of resin binder as directed. The percentage of polyester resin binder to use will be determined from the trial batches.

The materials used in the trial batches shall be the same as those intended for use in the trial overlay. If at any time different materials are to be used, new trial batches will be required.

**496.03.02 Trial Batches and Overlay.** When the polymer concrete will be used for an overlay application, place one or more trial overlays on a previously constructed concrete base to demonstrate the effectiveness of the proposed mixing, placing, and finishing equipment. Each trial overlay shall be 3.6 meters (12 feet) wide, at least 1.8 meters (6 feet) long, and the same thickness as the overlay to be constructed.

Place trial batches under similar conditions anticipated to be encountered during placement of the permanent overlay.

Remove and dispose of all materials used in the trial batches and overlays, including the concrete base, according to Subsection 107.14.

**496.03.03 Bridge Deck Preparation.** After removal of any bituminous surfacing and before deck preparation, repair bridge decks as provided for in Subsection 502.03.15. After repairs are complete, scarify the bridge deck by shot blasting. Use of scabblers, milling machines, or sand blasting will be at the discretion of the Engineer. If shot blasting is utilized, use a 75-horsepower (hp) minimum self-propelled machine equipped with vacuum recovery.

The scarifying procedure shall produce a uniform rough texture, removing concrete and exposing the coarse aggregate to a depth not to exceed 6 millimeters (mm) (1/4 inch). The prepared surface shall be sound.

Adequately isolate expansion joints and weakened plane joints before overlaying, or saw them by approved methods within 4 hours after overlay placement. The exact time of sawing will be determined.

Immediately before applying the prime coat, sweep the surface clean with compressed air to remove accumulated dust and loose material.

**496.03.04 Concrete Placement.** Before applying the prime coat, the concrete area to receive the prime coat shall be dry when tested according to ASTM D4263. The concrete surface temperature shall be between 10 °C (50 °F) and 38 °C (100 °F) during application of the prime coat. Methods proposed to heat or cool the concrete surface shall be subject to approval.

Apply the prime coat to the concrete surface prior to placement of polymer concrete.

Apply the prime coat at an approximate rate of 0.40 L/m<sup>2</sup> (0.09 gal/yd<sup>2</sup>). Flood concrete surfaces with the prime coat allowing penetration into the concrete and filling of all cracks. Redistribute the applied prime coat in cracks by squeegees or brooms. The quantity of initiated, promoted resin shall be no more than what is needed to apply a prime coat. A noticeable increase in viscosity prior to placement will be cause for rejection. If the primed surface becomes contaminated, or if there is a failure of the material, clean the contaminated or failed area by abrasive blasting and re-prime. Do not allow traffic on the primed surface.

The surface temperature of the concrete to receive polymer concrete shall be between 10 °C (50 °F) and 38 °C (100 °F).

Mix polymer concrete in mechanically operated mixers. The polyester resin binder in the polymer concrete shall be approximately 12 percent by mass of dry aggregate. The exact rate will be determined. Use a sufficient amount of initiator in the polymer concrete to produce set times between 30 and 120 minutes after placement. Determine set times according to Test Method No. Calif. 551. Accelerators or inhibitors may be required to achieve proper set times and shall be used as recommended by the resin supplier.

Initiate and thoroughly blend the polyester resin binder before introduction of aggregate to the binder. Mix the polymer concrete a minimum of 2 minutes before placing. If directed, reduce mixing time below 2 minutes, or take other corrective action to avoid entrapment of air in the mix.

Place and finish polymer concrete before gelling or within 15 minutes following addition of the initiator, whichever occurs first. Discard polymer concrete not placed within this time.

Use finishing equipment that strikes off the polymer concrete to the established grade, cross section, and nominal depth. Fit finishing equipment with vibrators or other means of consolidating the overlay material. Construct longitudinal joints parallel to the roadway alignment. Construct vertical joints perpendicular to the deck surface. Saw cut vertical joints not perpendicular to the deck surface.

Apply abrasive sand finish to polymer concrete surfaces which will not be covered with a plantmix bituminous overlay. The sand shall be commercial quality blast sand, conforming to the absorption capacity and moisture content requirements of polymer concrete aggregate specified herein. Provide sand such that 95 percent shall pass the 2.36 mm (No. 8) sieve, and 95 percent shall be retained on the 850 µm (No. 20) sieve. Apply the sand finish by mechanical means immediately after overlay strike-off. Broadcast sand uniformly onto the surface before gelling occurs at a minimum rate of 0.8 kg/m<sup>2</sup> (1.5 lb/yd<sup>2</sup>).

Protect the finished polymer concrete overlay from moisture, equipment, and public traffic for not less than 4 hours after finishing.

Do not contaminate concrete surfaces during clean-up of tools and equipment. Do not dump or spill polymer concrete materials or cleaning solvents in areas that will cause environmental or fire hazards.

Provide the necessary equipment and supplies for conducting pull off tests on the completed polymer concrete overlay. Perform pull off tests according to ACI 503R - Appendix A of the ACI Manual of Concrete Practice. Pull off test shall exhibit cohesive failure within existing concrete. Pull off tests shall obtain a 1725 kPa (250 psi) minimum pull off. Perform tests at a frequency of one test per every 50 m<sup>2</sup> (60 yd<sup>2</sup>) of deck surface. Prime and patch test holes with polymer concrete immediately after testing.

Where the polymer concrete is not to be covered with a plantmix overlay and will be the wearing surface, the finished surface shall be uniform, shall have a Skid Number (SN) of not less than 55, and shall conform to Subsection 502.03.16. Test the finished surface of the polymer concrete for the specified SN according to ASTM E274. Grind or groove, parallel to the centerline, any portions of surfaces that do not meet the above requirements according to Subsection 502.03.16 until the finished surface requirements are met.

Where the polymer concrete is to be covered by a plantmix bituminous overlay, the surface of the concrete shall not vary more than 7.5 mm (0.3 in.) from the lower edge of a 3.6 m (12 ft) straightedge laid in any direction. Remove all high areas in the hardened surface to within specified tolerances as indicated. Correct all high areas in the plantmix bituminous surface according to Subsection 402.03.05 and 403.03.04 to meet the aforementioned surface tolerances. Perform removal by abrasive means.

After any required grinding by abrasive means has been performed, the surface of the concrete shall not be smooth or polished but shall have a satisfactory surface texture. Produce ground areas of uniform texture and of neat and approximately rectangular patterns which extend laterally to the nearest lane line and longitudinally so that the grinding begins and ends at lines normal to the centerline.

## SECTION 497 - THIN BONDED MULTILAYER OVERLAY

### DESCRIPTION

**497.01.01 General.** This work consists of preparing concrete surfaces and furnishing and placing a thin bonded multilayer overlay consisting of multiple layers of a polymer resin binder and broadcast dry aggregate.

### MATERIALS

**497.02.01 General.** Use one of the following thin bonded multi-layer resins with the aggregate combinations listed below:

Poly-Carb, Inc.  
Product, Poly-carb Mark 163 Flexogrid  
Mr. Ruolei Wang  
33095 Bainbridge Rd.  
Solon, Ohio 44139  
Email: [rwang2@dow.com](mailto:rwang2@dow.com)  
Phone: (800) 225-5649  
Phone: (440) 914-3038

E-Bond Epoxies, Inc.  
Product, E-Bond 526 (Bridge Bond 34 - private label version)  
Mr. Steve Frank  
3491 Old Cobble Court  
San Diego, California 92111  
Email: [Stevepolymerdek@aol.com](mailto:Stevepolymerdek@aol.com)  
Phone: (858) 571-5043  
Phone: (858) 442-8185

Unitex By Dayton Superior  
Product, Pro-Poxy Type III D.O.T.  
Mr. David Minor  
3101 Gardner Ave.  
Kansas City, Missouri 64120  
Email: [davidminor@daytonsuperior.com](mailto:davidminor@daytonsuperior.com)  
Phone: (800) 821-5846  
Phone: (970) 286-9229

The combined aggregate shall consist of 50% calcined bauxite and 50% steel slag by mass.

The calcined bauxite aggregate shall be from one of the following distributors or an approved equal:

Newport Industries Ltd  
Calcined Bauxite  
Mr. Mark C. Isaacs  
3<sup>rd</sup> Floor Merlin House  
20 Belmont Terrace  
Chiswick, London W4 5UG  
Phone: (919) 522-8113

Great Lakes Minerals, LLC  
Paul Ormond  
1200 Port Road  
Wurtland, Kentucky 41144  
Email: [paulormond@glmin.com](mailto:paulormond@glmin.com)  
Phone: (606) 585-4327

The calcined bauxite aggregate shall conform to ASTM D5711-03 and not exceed 1.0%, and shall conform to the following gradation:

Sieve Size	Percent Passing by Mass
No. 4 .....	100
No. 8 .....	30-75
No. 16 .....	0-5
No. 30 .....	0-1
No. 200 .....	0-0.2

The steel slag shall be from one of the following distributors or an approved equal:

Earthwork Solution LLC  
Mr. Patrick Malfitano  
5595 East Bijou Street  
Colorado Springs, Colorado 80916  
Email: [Patrick@ewslag.com](mailto:Patrick@ewslag.com)  
Phone: (719) 492-0706

Harsco Metals  
Norm Whinery  
PO Box 247  
Armored, AR 72310  
Email: [NWhinery@harsco.com](mailto:NWhinery@harsco.com)  
Phone: (870) 763-6506

Schmidt Construction  
Tom Blair  
51445 West Twelve Mile Road  
Wixom, Michigan 48393  
Email: [tblair@edwclevy.net](mailto:tblair@edwclevy.net)  
Phone: (248) 675-0103

The steel slag shall conform to the same gradation specified above for calcined bauxite.

## CONSTRUCTION

**497.03.01 General.** Before placing the overlay, have the resin supplier furnish the following:

1. A technical representative to provide on-site training to contractor personnel on equipment and procedures for preparing concrete surfaces and placing the thin bonded multilayer overlay. The technical representative shall be present for the initial application of the overlay. As directed, the technical representative shall also be present for subsequent applications of the overlay.
2. A letter from the resin manufacturer denoting the specific contractor personnel that the technical representative has provided job specific training to and is deemed qualified to supervise installation of the overlay.
3. Health and safety training for personnel who are to handle the materials.

Provide shielding or tenting to protect public traffic from bridge deck preparation and overlay placement operations. Protect existing expansion joints, relief joints, and adjacent surfaces.

**497.03.02 Bridge Deck Preparation.** After removal of any bituminous surfacing and prior to deck preparation, repair decks and approach slabs according to Subsection 502.03.15. After repairs are complete, scarify concrete surfaces by shot blasting using a 75 hp minimum self-propelled machine equipped with vacuum recovery. Do not use shot blasting equipment that causes ravels, aggregate fractures, spalls, or disturbance of joints. The scarifying procedure shall produce a uniform rough texture, removing concrete and exposing the coarse aggregate to a depth not to exceed 1/4 inch. The prepared surface shall be sound.

As necessary, use multiple passes of shot blasting equipment to completely remove pavement marking materials until they are no longer visible.

Complete the deck preparation by following all of the resin manufacturer's surface preparation recommendations.

Immediately prior to the first application of the overlay resin, clean prepared surfaces with oil-free compressed air or by air vacuuming. Do not permit public traffic or nonessential construction traffic on surfaces readied for overlay placement.

**497.03.03 Overlay Placement.** Follow all recommendations of the resin manufacturer for placement and curing of the thin bonded multilayer overlay system. Conform to the resin,

surface, and ambient temperature limitations indicated in the resin manufacturer's published product data sheets.

Submit for approval proposed methods to heat or cool overlay materials and concrete surfaces.

Use special equipment capable of metering, mixing, and distributing the resin. Distribute resin to the bridge deck in a continuous, uninterrupted operation such that unanticipated cold joints are not introduced. Use machinery that is approved by the manufacturer. Use an application machine that features positive displacement volumetric metering pumps controlled by a hydraulic power unit. Use motionless, in-line mixing so as to not overly shear the material or entrap air in the mix. Maximize material working time by mixing it immediately before dispensing.

Use truck-mounted equipment capable of dispensing the aggregate onto the deck in a uniform manner as directed or approved by the manufacturer. Broadcast the aggregate to cover the surface so that no wet spots appear and before the resin begins to gel. Drop the aggregate vertically so the level of the liquid is not disturbed. Ensure that the aggregate is broadcast within the time limits provided by the manufacturer according to the current ambient temperatures.

Remove excess aggregate between lifts and from the final cured overlay by air vacuuming or other approved means. Remove loose aggregate from expansion joints, relief joints, and deck drains.

## SECTION 501 - PORTLAND CEMENT CONCRETE

**501.02.01 General.** Class S and SA concrete may be substituted for selected applications for Classes A, AA, D, DA, PAA, Modified A, AA, Modified D, DA, as approved by the Engineer. When the option of Class S or SA concrete is approved, submit details of a representative test section (mockup) for approval. Produce a trial batch of Class S and SA concrete, conforming to the proposed mix design. Place a test section when the atmospheric conditions approximate the conditions anticipated for placing the final work. Finish and cure the mockup according to this Section. If it is determined that the trial batch is not workable or not able to be properly placed or finished, modify the mix design or batching sequence. Submit the revised mix design and batching sequence and place another test section. Repeat the submittal and trial pour process until a workable and finished trial batch is produced. Do not place Class S or SA concrete until the mockup pour has been accepted.

Prepare a Concrete Quality Control Plan (CQCP) that addresses the production, informational quality control testing, transport, contingency plans for equipment breakdown or inclement weather, placement, finish, and cure of Portland cement for foundations, abutments, superstructures, decks, drainage structures, pavement and all other pours over 100 cubic yards. The submittal of a quality control plan, revisions, and weekly reports shall be considered as a necessary portion of the work; therefore, partial payments or portions thereof, as set forth under Subsection 109.06 may not be forthcoming until this requirement is complied with. Submit a weekly report each Monday whenever there was testing or inspections performed in the previous week. Include all necessary test results and inspection reports in the weekly report.

Submit the CQCP 20 working days before the start of work. The quality control plan shall include a specific description for concrete placement in foundations, abutments,

superstructures, decks, drainage structures, pavement and all other pours over 100 cubic yards. The quality control plan shall include the Department's pre-pour agenda information with a pre-pour inspection checklist form for each major structural pour. Do not proceed with major concrete work until the quality control plan has been submitted and approved. Approval of the CQCP does not imply any warranty by the Department that the plan will result in consistent contract compliance. Be responsible to demonstrate such compliance. Deviations from the plan shall be approved in writing. Failure to comply with the quality control plan may result in work suspension.

The CQCP shall include identification of sources and producers of all components used in the mix, aggregate production, informational quality control testing, delivery, placement, finish, and curing equipment and methods. Include personnel and their specific duties. Describe procedures to be followed in preparation of the pour, the event of equipment breakdown or inclement weather during placement, finishing, and curing. When pumping concrete for major structural pours, include, as part of the CQCP, a detailed plan addressing corrective measures to be taken to ensure in-place concrete properties meet the specified requirements. Curing procedures shall include when and how the concrete and the curing system are to be placed, frequency for monitoring, maintaining, and re-wetting the curing system. Include methods of protecting the covers from displacement from wind or weather, and method of preventing heat and moisture loss. In addition, describe the method to be used to protect pedestrian and vehicular traffic under structures.

Designate a quality control supervisor who shall be responsible for the preparation, submittal, implementation, and oversight of the quality control plan. The quality control supervisor shall be an employee of the Contractor, under the direct supervision of the superintendent, solely dedicated to the Contract and shall not be responsible for other day-to-day operations on the project. The quality control supervisor shall have the authority to stop any and all work outlined in the quality control plan if the work is not properly performed. The quality control supervisor shall be available for contact 24 hours a day during the placement and cure of any concrete. The quality control supervisor shall be capable of being on-site within 45 minutes of notification.

The quality control supervisor shall perform and document a pre-pour inspection 24 hours prior to the pour and at least 4 concrete inspections the day of the pour. The inspections shall be made before placement, during placement, when curing begins, and during curing. Inspect concrete forms, reinforcing steel adequately tied and supported, concrete quality control testing reports, fogging, and curing process and equipment. Submit a completed pre-pour inspection checklist 24 hours prior to each major structural pour. Include these quality control inspection reports in the weekly report and provide them within 24 hours of end of concrete placement, if requested.

The quality control supervisor shall also perform and document at least 6 daily cure inspections during the required cure period for each bridge deck pour, at a maximum of 4 hours between inspections. The inspections shall be made at the beginning of primary shift, at approximate time of high temperature, at approximate time of low temperature, and at the end of primary shift. Prepare a daily inspection report which includes date and time of inspection, weather conditions, locations of bridge deck where curing was checked (at least 3 representative locations), moisture condition of deck and burlap, surface temperature of deck concrete, and condition of curing equipment. Include the daily cure inspection reports in the weekly report and provide them within 24 hours, if requested.

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The CQCP shall include performance of informational quality control testing by contractor personnel. Furnish personnel, laboratory, equipment, and materials needed to perform the required tests. Personnel, including the Quality Control Supervisor, shall require qualification as Western Alliance for Quality Transportation Construction (WAQTC) or Nevada Alliance for Quality Transportation Construction (NAQTC), as well as qualification as ACI Field Testing Certification, Grade I. Include test results in the weekly report and provide them within 24 hours of completion of each concrete pour, if requested. Material that does not meet contract requirements shall not be incorporated into the work. The quality control testing and required frequencies are as follows:

<b>CONCRETE AGGREGATES</b>		
<b>Test</b>	<b>Test Method</b>	<b>Minimum Sample Frequency</b>
Moisture Content	Nev. T112	One per 100 yd <sup>3</sup> or fraction thereof
Sieve Analysis	Nev. T206	One per 300 yd <sup>3</sup> or fraction thereof
Sand Equivalent	Nev. T227	One per 300 yd <sup>3</sup> or fraction thereof
Cleanness Value	Nev. T228	One per 300 yd <sup>3</sup> or fraction thereof
Specific Gravity and Absorption (Coarse)	Nev. T492	One per 500 yd <sup>3</sup> or fraction thereof
Specific Gravity and Absorption (Fine)	Nev. T493	One per 500 yd <sup>3</sup> or fraction thereof

<b>PORTLAND CEMENT CONCRETE (Except Class S and SA)</b>		
<b>Test</b>	<b>Test Method</b>	<b>Minimum Sample Frequency</b>
Air Content	Nev. T431	One per 50 yd <sup>3</sup> or fraction thereof
Unit Weight	Nev. T435	One per 50 yd <sup>3</sup> or fraction thereof
Slump	Nev. T438	One per 50 yd <sup>3</sup> or fraction thereof

<b>CLASS S AND SA CONCRETE</b>		
<b>Test</b>	<b>Test Method</b>	<b>Minimum Sample Frequency</b>
Slump Flow	Nev. T417	One per 50 yd <sup>3</sup> or fraction thereof
Visual Stability Index	Nev. T417	One per 50 yd <sup>3</sup> or fraction thereof
J-Ring	Nev. T418	One per 50 yd <sup>3</sup> or fraction thereof
Unit Weight	Nev. T416	One per 50 yd <sup>3</sup> or fraction thereof
Air Content	Nev. T416	One per 50 yd <sup>3</sup> or fraction thereof

Sample concrete aggregates from each stockpile to be used in pour in accordance with Test Method No. Nev. T200.

Sample Portland cement concrete in accordance with Test Method No. Nev. T425.

Sample and perform all tests for Class S and SA concrete within the first two trucks for the first sample frequency.

**501.02.04 Admixtures.** Class S and SA concrete admixture systems shall conform to AASHTO M194 (ASTM C494) Type F or Type G, or ASTM C 1017 requirements.

Include viscosity modifying admixtures (VMA) in the mix design. The mix design shall outline the dosage rate in oz/cwt. VMA's shall conform to ASTM C494, Type S. Adjust the dosage rate within the manufacturer's recommended range in order to obtain the desired flow and segregation characteristics while maintaining the required VSI.

**501.02.05 Concrete Making Properties.** Add the following to the table on the top of page 209 of the Standard Specifications:

Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression ... ASTM C469  
 Permeability ..... ASTM C1202

For Class S and SA concrete, the unit weight, air content, and compressive strength will be tested according to Test Method No. Nev. T416.

Concrete used in bridge decks, approach slabs, and bridge deck rail shall have a maximum permeability of 2000 Coulombs at 56 days.

The requirement for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression will be specified on the plans.

In addition to meeting the requirements of this Subsection, Class S and SA concrete shall meet the additional following requirements:

TEST	TEST DESIGNATION	REQUIREMENTS
Slump Flow	Nev. T417	(a)
J-Ring	Nev. T418	(b)
Column Static Segregation	Nev. T420	Segregation Index 10% Max.

- (a) The slump flow shall be a single value between 18 and 28 inches and shall be shown on the mix design. The slump flow of the tested concrete shall be within  $\pm 2$  inches of the value specified on the mix design. The maximum Visual Stability Index shall not exceed 1.
- (b) The difference in slump flow values between Test Method No. Nev. T417 and Test Method No. Nev. T418 shall not exceed 2 inches.

Add the following to item "9." in the first paragraph on page 210 of the Standard Specifications:

Not applicable for Class S and SA concrete, except for extended time slump requirements for concrete used in drilled shafts as specified in Subsection 509.02.01.

Add the following to the first paragraph on page 210 of the Standard Specifications:

- 22. The permeability of concrete (if required).
- 23. The modulus of elasticity of concrete (if required).

For Class S and SA concrete, add the following to the first paragraph on page 210 of the Standard Specifications:

- 24. The slump flow, visual stability index, j-ring measurement, and column static segregation index.

**501.03.01 Equipment.** For Class S and SA concrete, internal rodding or vibrating shall not be performed without prior approval.

**501.03.06 Mixing.** Prevent cement balling (intermittent clumping) and mix foaming by controlling the batch sequence, mixing speed, and mixing time.

Segregated concrete, as determined by Test Method No. Nev. T417 or Test Method No. Nev. T418, shall not be incorporated into any component of the concrete work.

For Class S and SA concrete, when delivering the concrete to the work site, completely discharge each delivery truck within 60 minutes. The discharge time can be extended to 90 minutes for drilled shafts. In hot weather, or under conditions contributing to quick stiffening of the concrete, a delivery time of less than 60 minutes may be required. The Contractor may propose delivery time exceeding 60 minutes if they can demonstrate during a trial pour that all required fresh concrete properties are maintained for the maximum proposed delivery time. The trial pour shall be completed in similar weather conditions to the anticipated placement conditions.

For Class S and SA concrete, completely discharge each delivery truck within 20 minutes. Place the concrete in continuous layers. When it is necessary by reason of emergency or other delay to place less than a complete horizontal layer in one operation, terminate the layer by using a vertical bulkhead. Do not rod or vibrate the concrete to attempt to restore the fluidity to the mix.

**501.03.10 Trial Slab and Process Control Testing.** If silica fume is used in bridge deck concrete, construct a trial slab at least 30 days prior to placement of concrete on a bridge deck. Submit a written plan for the casting of the trial slab. The written plan shall include, but is not limited to, the location of the slab, the equipment and personnel used for construction, and disposal of the slab. Prior to placement of the trial slab, conduct a pre-construction conference.

Use approved mix designs. Place concrete at a location other than the bridge deck, but under conditions similar to those that exist during bridge deck concrete placement. The trial slab shall have a minimum length and width of 50 feet and have a depth of 8 inches. Reinforce slab with a top and bottom mat of # 5 bars spaced 6 inches longitudinally and transversely. Place top mat at a depth 2.5 inches from the top of the slab. Place bottom mat at a depth 1.5 inches from the bottom of the slab. The trial slab shall be wet-cured as specified for bridge decks according to Subsection 501.03.08. Use personnel such as the superintendent, key operators, and finishers that are the same personnel who will be involved in the construction of the bridge deck. Demonstrate the use of equipment, proficiency of personnel, and techniques for mixing, transporting, placing, and curing of the concrete during the trial. Fifteen days after placement of the trial slab, conduct a post construction critique of the trial slab placement.

Do not commence placement of the bridge deck concrete until after issues from the post construction critique of trial slab construction have been resolved to the satisfaction of the Engineer.

Upon notification, remove and dispose of trial slabs according to Subsection 107.14.

## SECTION 502 - CONCRETE STRUCTURES

**502.03.23 Portable Precast Concrete Barrier Rail.** Paint portable precast concrete barrier rail white with paint conforming to Subsection 714.03.03.

## SECTION 506 - STEEL STRUCTURES

**506.01.01 General.** This work also consists of furnishing and installing approach slab restrainer units.

**506.02.01 General.** The approach slab restrainer units are shown in their entirety in the details shown on the plans. The items that make up the restrainer units are shown on the above-mentioned details and shall conform to the specifications shown on the plans.

**506.03.28 Restrainer Units.** Install the restrainer units in the structures according to the details shown on the plans.

Technical Provisions – Attachment 26-1  
Amendments to the Standard Specifications

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**ATTACHMENT 26-2**  
**CITY OF LAS VEGAS SPECIAL PROVISIONS**

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Technical Provisions – Attachment 26-2  
City of Las Vegas Special Provisions

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Hansen Number 56966

**SPECIAL PROVISIONS**

MAY 2015

**PROJECT NEON DESIGN BUILD**

PREPARED BY:

**CITY OF LAS VEGAS**

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**SECTION 506****STEEL STRUCTURES****DESCRIPTION****506.01.01 GENERAL*****ADD THE FOLLOWING TO THIS SUBSECTION:***

This work shall include construction of metal handrails.

**CONSTRUCTION*****ADD THE FOLLOWING SUBSECTION:*****506.02.02 STEEL SURFACE TREATMENT**

All steel shall be:

**Painted.** The paint system shall be a 3-coat system suitable for the intended use as recommended by the paint manufacturer and approved by Engineer. Application shall be in accordance with the recommendations of the paint manufacturer. Applicator shall be certified by the paint manufacturer for the approved paint system. Color shall be as selected by Owner from manufacturer's standard colors similar to the colors identified for the Grand Central Industrial bridge over UPRR in the Project NEON DB1-4 Landscape & Aesthetic Requirements; provide 3 color samples for Owner's review. All painted surfaces shall be blast cleaned in accordance with Society for Protective Coatings Surface Preparation Specifications No. 7, latest edition, (SSPC-SP10) Near White Blast Cleaning. Painted bridges shall be configured such that all surfaces and connections are either fully sealed or allow access for adequate paint coverage. Sealing shall be accomplished by welding except that long continuous seams may be sealed with caulk prior to painting. All surfaces shall be painted, with the exception of expansion joint cover plates, teflon surfaces, bolted connections, and faying surfaces. Touch up paint shall be provided to paint outer surfaces of bolted splices and areas of damaged paint.

**END OF SECTION 506**

**ADD THE FOLLOWING SECTION TO DIVISION II – CONSTRUCTION DETAILS****SECTION 622 – CONSTRUCTION SURVEYING BY THE CONTRACTOR****DESCRIPTION****622.01.01 GENERAL**

- A. The Contractor shall, under supervision of a Professional Land Surveyor, registered in the state of Nevada, furnish and set construction stakes establishing locations, lines, and slope stakes for roadway, storm drain, drainage structures, sewer, laterals, and for all other improvements for project necessary to ensure conformance of work to lines, elevations, locations, and grades as shown on the Plans and in these Special Provisions. Any horizontal or vertical discrepancies shall be reported to Engineer prior to commencement of construction. Any revisions or changes approved by Engineer that affect lines, grades, elevations or locations of any improvement shall be indicated on As-Built (Record) Drawings.
- B. If necessary, the Contractor shall also perform and provide to the Engineer those items described in subsection 203.04.01 of the USS. Any revisions or changes approved by the Engineer that affect the lines, grades, elevations or locations of any improvement shall be indicated on the As-Built (Record) Drawings.
- C. Contractor shall preserve property line and corner survey points. If their destruction is determined by Engineer to be unavoidable, and their replacement is not called for on the plans, Owner shall replace or pay for their replacement under this contract as determined by Engineer. Markers that are disturbed or destroyed by Contractor's operations without prior approval by the Engineer shall be replaced by Contractor at no additional cost to the Owner. Replacement shall be done only by a Nevada Professional Land Surveyor and in accordance with the USS. A monument tie sheet for replacement of permanent survey monuments shall be submitted to Engineer for approval.
- D. When a permanent survey marker and/or monument is located within the construction area of any roadway, storm drain, drainage structures, sewer line or channel improvement, the Contractor shall adjust the cover or replace the monument as noted on the plans. The cost of replacement or adjustment of said monuments shall be included in the lump sum bid for Construction Survey. If monuments are to be installed as part of the work, they shall be placed in accordance with the USD numbers 239 through 243 and Section 621 of the USS.
- E. The Contractor shall, under the supervision of a Professional Land Surveyor, prepare and provide GPS location and mapping of as-built conditions for all proposed sanitary sewer and storm drainage facilities as described on the Project Drawings and in this Section.

**MATERIALS****622.02.01 BLANK****CONSTRUCTION****622.03.01 GENERAL**

- A. Prior to all work in this section, the Contractor shall carefully inspect all installed work and verify that all such work is complete to a point where this installation may properly commence.
- B. The Contractor shall verify that all work can be installed in accordance with all pertinent codes and regulations, Contract Drawings and referenced standards.
- C. The Contractor shall verify that there are no conflicts with existing utilities prior to the start of work.
- D. In event of a discrepancy, the Contractor shall immediately notify the Engineer in writing.
- E. Installation of work in areas of discrepancy shall not proceed until all such discrepancies have been fully resolved.
- F. After stakes and marks have been set, it shall be the responsibility of the Contractor to protect the stakes and marks. Should any of the stakes or marks be destroyed or disturbed by the Contractor's operations or otherwise, the costs of replacing said stakes or marks shall be paid by the Contractor.
- G. The Engineer, at his discretion, may periodically have survey work performed to verify conformance to the construction plans. Any nonconformity found to be the fault of the Contractor, or the Professional Land Surveyor, shall be corrected at no additional cost to the Owner.
- H. Upon completion of the project and as a condition for final payment authorization, the Contractor shall furnish to the Engineer a Record of Survey/monument tie map and a certification attested to by the Professional Land Surveyor that the work performed for this contract has been constructed to the lines and grades as described in the As-built (Record) Drawings. When requested, the Contractor shall also provide the Engineer with copies of all field notes, computations, and other related work performed by the Professional Land Surveyor.

**622.03.02 FINAL ACCURACY**

- A. Surface Drainage Structures (including all concrete or asphalt gutters and drains) shall be installed within 0.05 feet horizontally and 0.05 feet vertically from the location taken from the project plans, and shall not vary more than 10 percent of the gradient shown on the plans.

- B. Monument Cases and Brass Caps shall be centered to within 0.01 feet horizontally of the position as called for on the plans, and the ties to that monument.
- C. Sanitary and Storm Drainage Sewer Systems shall be installed within 0.05 feet horizontally and 0.05 feet vertically of the exact location taken from the project plans. In addition, the gradient of any 10-foot section of pipe shall not vary by more than 10 percent of the gradient shown the project plans

### **622.03.03      INSTALLED/EXPOSED UTILITY SURVEYING**

- A. After construction of the approved plans and before backfilling, survey shall be conducted indicating the size, horizontal and vertical location, and configuration of any utility constructed with this project or utility exposed during construction, and utility encasement if applicable. Utility final location information shall be described by coordinates which shall be based on the official horizontal and vertical control networks of the City of Las Vegas and be certified by a Nevada professional land surveyor to have positional certainties within +/- 0.3-ft.
- B. Survey measurements for utilities constructed or exposed during the course of construction including but not limited to pipes, manholes, drop inlets, conduits, cables, encasements, boxes, vaults and appurtenances shall be located to the extent possible within the excavation area. Measurements shall be taken at a minimum of 100-ft intervals, at all exposed angle points, deflections of the utility exceeding +/- 0.5-ft, at all exposed points that enter/exit the excavation or the public right-of-way, and sufficient measurements to accurately define curving layout.
- C. Potholes performed by the contractor prior to or during construction shall be surveyed indicating the size, location, burial depth, and configuration of the utility. Pothole location information shall be tied to the official horizontal and vertical control networks of the City of Las Vegas and be certified by a Nevada professional land surveyor.
- D. Utility final location information shall be submitted on paper and in electronic form, on a form specified by the City Surveyor.
- E. Interim survey progress reports shall be submitted to the Engineer certifying sufficient survey measurements have been performed prior to backfilling as required by this section on a weekly basis or as directed.

## SECTION 623

## TRAFFIC SIGNALS AND STREET LIGHTING

## DESCRIPTION

## 623 G.01.01 GENERAL

**ADD THE FOLLOWING PARAGRAPHS TO THIS SUBSECTION:**

- I. The Contractor shall provide all labor, materials, equipment, transportation and services required to install the street lighting, traffic control system, and related items on the plans and in the specifications resulting in complete and operational systems, to include fully functional opticom, video detection, pedestrian detection, and loop detection system complete with the manufacturer's latest versions of firmware.
- J. All equipment shall function as designed. All lighting standards shall be fully operational within fifteen (15) days after installation. The luminaries shall be leveled before they are energized.
- K. The Contractor shall maintain the new lighting system and traffic signal system from the date energized until the entire project has been accepted by the City of Las Vegas. The Contractor shall repair or replace any defective component of the systems within 24 hours after notice in writing by the Engineer if of a non-hazardous nature. If public safety is endangered, the Contractor shall take immediate steps to correct the problem after verbal notice by the Engineer.
- L. The contractor shall have a lighting representative present at the time the City inspects the street lighting installations.

## MATERIALS

## 623 G.02.04 CONDUCTORS AND CABLE

**DELETE PARAGRAPH "A.4" AND REPLACE WITH THE FOLLOWING:**

- A. 4. Electrical cable for traffic signals shall be IMSA 20-1 approved signal cable of proper size for the required installation unless otherwise specified in the Contract Documents. All traffic signal cable shall be 25-conductor, No. 14 AWG solid copper wire traffic signal cable or as specified in the Contract Documents or directed by the Engineer.

## CONSTRUCTION

## 623 G.03.01 MAINTENANCE OF EXISTING AND TEMPORARY ELECTRICAL SYSTEMS

**ADD THE FOLLOWING TO PARAGRAPH "H" OF THIS SUBSECTION:**

Prior to start of work, Contractor shall submit drawings stamped by a Nevada Professional Engineer showing support of facilities covered by Section 623 for approval by City Traffic Engineer

for all trenches that will expose greater than eight feet of conduit. The Contractor shall submit the support system to be used for all trenches exposing up to 8 feet of conduit for approval prior to trenching. Conduit support systems, at a minimum shall support all joints in the conduit, prevent the decoupling of joints, and prevent deflection greater than 6 inches.

Some signalized intersections may require temporary signalization in lieu of support.

**ADD THE FOLLOWING PARAGRAPHS TO THIS SUBSECTION:**

- J. All equipment and materials shall be as manufactured or modified by the manufacturer and installed by the Contractor in the manner for which it was designed and intended. No equipment may be modified by the Contractor unless prior written permission is provided by the Engineer.
- K. Existing service shall remain fully operational during construction. Outages required shall be scheduled with the Owner and timing devices reset after resumption of service. The Contractor shall field verify wiring connections and routing prior to disconnecting any conductors. The modification, extension or removal of the existing conductors and equipment shall be inspected by and accepted by the Engineer. Electrical work shall be in accordance with the requirements of the National Electrical Code.
- L. The data indicated on the plans and in these specifications is as exact as could be secured, but its absolute accuracy is not guaranteed. Exact locations, distances, levels, and other conditions will be governed by unforeseen obstacles in the field.
- M. The Contractor shall use the plans and these specifications for guidance, and secure the Engineer's approval for all changes of location or scope of work. The Engineer should be consulted regarding the exact locations of pullboxes, poles and cabinets for the traffic signal system.
- N. Once the Contractor commences work on the Project, the Contractor shall provide all maintenance for existing traffic signal facilities that are to be modified or replaced, except that the City will pay for power. The Contractor shall provide the above maintenance until the City gives written notice that the City accepts signals back for maintenance at the end of the Project. The above maintenance does not include any prior damage such as burned out signal displays, non-operative detection, or other malfunctioning equipment. The Contractor shall provide written documentation of all non-functioning and malfunctioning traffic signal equipment before commencing work on the project. This malfunctioning equipment shall be inspected by both the Contractor and the Engineer, or Engineer's Designee, prior to the commencement of work. In the event that the Engineer does not receive written notice and the Contractor begins work on the project, this will suffice as evidence that all equipment is functional and operational. If any traffic signal equipment fails or malfunctions during the course of the Project, the Contractor shall repair or replace traffic signal facilities as necessary to provide a fully functioning system before final acceptance for maintenance by the City. For traffic signals, repair work by qualified electricians shall commence within one hour of notification via the Contractor's 24-hour emergency response phone number, at which time the Contractor will have two hours to correct the noted violation. The City will program for the Traffic Signal Controller and the Malfunction Management Unit (MMU).

- 1.If the repair is not completed within the two-hour time limit, the **Contractor will be assessed \$200.00 per hour until the repair is complete.**
- 2.This condition may cause the Project to "Stop Work"; this will not be grounds for a time extension of the contract.

### **623 G.03.05 EXCAVATION AND BACKFILLING**

#### ***ADD THE FOLLOWING PARAGRAPHS TO THIS SUBSECTION:***

- M. All trenching and backfill shall comply with applicable portions of the USS, USD and plans. All trenching shall be deep enough to insure a minimum of twenty four inches (24") of cover over the conduit measured from the top of conduit to finish grade, *with the exception* of interconnect conduit which shall have a minimum of thirty inches (30") of cover over the conduit. The backfill in street areas shall be Type II gravel compacted to 95% relative density or controlled low strength material (CLSM) Fill. No trench shall be left open after established working hours without approval of the Engineer.
- N. Conduit locations on the plans are for reference only. Actual locations are to be determined by the Contractor as to the most economical location --either behind the curb or in front of the lip of the gutter--but in either case, the conduit must remain parallel to the back of curb or the edge of pavement between the lighting standards, and the location shall be approved by the Engineer. "As Built" marked prints showing installed locations shall be given to the Engineer by the Contractor.
- O. All conduit that is terminated, stubbed and capped for future use shall be marked by a "+" a minimum of 3 inches high and directly above the conduit, cut into the face of the curb, wall, concrete paving, etc.

### **623 G.03.07 FOUNDATIONS**

#### ***ADD THE FOLLOWING PARAGRAPHS TO THIS SUBSECTION:***

- B. 3. Crash caps above foundations shall be sloped away from poles. All traffic signal poles shall be plumb AFTER the signal heads are in place. Any leveling shall be made before the grout cap is poured over the foundations.
- C. 6. Foundations shall be excavated without disturbing surrounding material. All loose material shall be removed before concrete is placed into the opening. Foundations shall not be over-excavated.

### **623 G.03.08 WIRING AND CONDUIT**

#### ***ADD THE FOLLOWING PARAGRAPHS TO "E" OF THIS SUBSECTION:***

1. Chair lugs shall be used for termination of solid conductors.
2. Solid conductors shall not be terminated with crimp-on connections.

**ADD THE FOLLOWING PARAGRAPH TO THIS SUBSECTION:**

- V. When new conduit is to be joined to existing conduit, the Contractor shall verify the integrity of the existing conduit and make necessary repairs. The Engineer shall approve any additional repair work prior to commencing.

**623 G.03.09 ELECTRICAL SERVICE****ADD THE FOLLOWING PARAGRAPHS TO "A" OF THIS SUBSECTION:**

Each service provided by the Contractor shall have a 200 amp rating for traffic signal system, streetlight circuits, or combined services.

Services shall be 200 amp pad mount (unless otherwise noted in the plans) and shall be equipped with one 60 amp single pole breaker for the signal and one 40 amp single pole breaker for the intersection streetlights. In addition, other breakers as may be shown in the service panel schedule in the plans will be required.

The Contractor shall obtain all addresses for new services from the City of Las Vegas, Department of Planning and Development, 333 Rancho Drive, (702) 229-5408.

**ADD THE FOLLOWING PARAGRAPH TO "B" OF THIS SUBSECTION:**

It shall be the Contractor's responsibility to coordinate all work associated with service point connections required by this contract with Nevada Energy.

**623 G.03.10 PULL BOXES****ADD THE FOLLOWING PARAGRAPH TO THIS SUBSECTION:**

- E. The interior of pull boxes shall be void of any other materials except conduit risers and necessary wiring. All excess materials shall be removed to promote drainage.

**ADD THE FOLLOWING SUBSECTION:****623 G.03.13 SALVAGING ELECTRICAL EQUIPMENT**

- A. Where shown on the plans or ordered by the Engineer, existing electrical equipment to be removed, including controller units, cabinets, signal heads, luminaires, standards, mast arms, ballasts, transformers, service equipment, pull boxes, and detector contact units shall be salvaged for reuse by the maintaining agency.
- B. Care shall be exercised in removing and salvaging electrical equipment so that it will remain in its original form and existing condition whenever possible. Attention is directed to the provisions in subsection 107.11, "Responsibility for Damage Claims", and 107.12 "Protection and Restoration of Property and Landscape". The Contractor will be required to replace, at his expense, any of the above-mentioned electrical equipment, which, as determined by the Engineer, has been damaged or destroyed by reason of his operations.

- C. Unless otherwise specified, underground conduit, conductors, foundations, and detector frames not reused shall become the property of the Contractor and shall be removed from the City right-of-way, except if not interfering with other construction, said materials, except foundations, may, with the written approval of the Engineer, be abandoned in place. Certain other materials, where shown on the plans, shall also become the property of the Contractor.
- D. Unless otherwise specified, foundations to be abandoned shall have the top 18" below the crash cap removed and the resulting excavation backfilled. Attention is directed to the provisions in subsection 623 G.03.05, "Excavating and Backfilling", regarding foundations to be abandoned.
- E. Holes formed by removing pull boxes and foundations shall be filled with material equivalent to the surrounding material.
- F. All street lighting and traffic signal equipment removed and / or designated to be salvaged shall be delivered by the Contractor to the appropriate CLV Service Yard with a means to unload. A 48-hour notice of delivery is required. Call 229-6331 to set up delivery time. Repair of any damage to equipment during this process will be the contractor's responsibility, at no additional cost to the City.

**ADD THE FOLLOWING SUBSECTION:**

**623 G.03.14 REINSTALLING SALVAGED ELECTRICAL EQUIPMENT**

- A. When salvaged electrical equipment is to be reinstalled, the Contractor shall furnish and install all necessary materials and equipment, including signal mounting brackets, anchor bolts, nuts, washers, and concrete as required to complete the new installation.
- B. All traffic signal, flashing beacon, and lighting fixtures to be reinstalled shall be cleaned and relamped.
- C. Existing materials required to be relocated and found to be unsatisfactory by the Engineer shall be replaced by new material and the cost therefore will be paid for as extra work as provided in subsection 104.03, "Extra Work".

**ADD THE FOLLOWING SUBSECTION:**

**623 G.03.15 STOCKPILING SALVAGED ELECTRICAL EQUIPMENT**

- A. Existing equipment removed and not reused shall be salvaged, dismantled and returned to the maintaining agency during normal working hours. Call the maintaining agency to arrange for a time and location to stockpile the salvaged electrical equipment. An inventory of salvaged material shall accompany each delivery.

**TRAFFIC SECTION**

**623 T.02.01 TRAFFIC SIGNAL CONTROLLER CABINETS**

**DELETE PARAGRAPH “D” OF THIS SUBSECTION AND REPLACE WITH THE FOLLOWING:**

- D. Unless otherwise specified, all cabinets shall be painted with two coats of white enamel both inside and out. Unpainted, Polished aluminum cabinets are not acceptable.

**ADD THE FOLLOWING TO PARAGRAPH “E” OF THIS SUBSECTION:**

The lifting tabs shall be bolted in place.

**DELETE PARAGRAPH “F.3” AND REPLACE WITH THE FOLLOWING:**

There shall be 3 aluminum shelves provided with all cabinets.

**DELETE PARAGRAPH “J” AND REPLACE WITH THE FOLLOWING:**

Cabinets shall have 2 light fixtures with lamps mounted in the cabinet interior.

**DELETE PARAGRAPH “J.1” AND REPLACE WITH THE FOLLOWING:**

One fluorescent or LED equivalent light shall be mounted over the door, at a location least likely to be damaged, and shall be a minimum of 20 inches in length.

**DELETE PARAGRAPH “J.2” AND REPLACE WITH THE FOLLOWING:**

The second light fixture shall be a 15 watt fluorescent or LED equivalent fixture and shall be attached to the bottom of the lowest shelf above the back-panel and field terminals.

**ADD THE FOLLOWING PARAGRAPH TO “L.3” OF THIS SUBSECTION:**

The AutoCAD format used shall be compatible with the current version of AutoCAD used by the city.

**DELETE PARAGRAPH “L.5.i ” AND REPLACE WITH THE FOLLOWING:**

Two dual-circuit, solid state, NEMA flashers having a flash rate of 50 to 60 flashes per minute (see NEMA TS-1, Section 8, “Solid State Flashers”) shall be installed.

**DELETE PARAGRAPH “L.5.i.1” AND REPLACE WITH THE FOLLOWING:**

The red position of the load switch bays shall be operated from the flasher contacts as follows:

Flasher 1, contact A - phases 1, 5, and OLA

Flasher 1, contact B - phases 2, 6, and OLC

Flasher 2, contact A – phases 3, 7 and OLB

Flasher 2, contact B – phases 4, 8 and OLD

**DELETE PARAGRAPHS “L.5.j.3” AND REPLACE WITH THE FOLLOWING:**

Two single, fourplex, U-ground type of convenience outlets shall be furnished for video equipment and other electronic test equipment.

**DELETE PARAGRAPHS “L.5.j.3.b” AND REPLACE WITH THE FOLLOWING:**

The outlets will be located no more than 12 inches from the roof of the cabinet, one on each side panel of the cabinet interior.

**DELETE PARAGRAPH “L.5.j.4” AND SUBPARAGRAPHS.**

**DELETE PARAGRAPH “L.5.k.3.c”.**

**DELETE PARAGRAPH “L.5.l.2.d”.**

**DELETE PARAGRAPH “L.5.l.4.a”.**

**DELETE PARAGRAPH “L.5.l.6.d.3” AND REPLACE WITH THE FOLLOWING:**

The toggle switches shall place a call into the controller for the associated pedestrian or vehicular phase when placed in the down (Test) position. This position shall be a momentary position.

**ADD THE FOLLOWING PARAGRAPHS TO “L.5.l.6” OF THIS SUBSECTION:**

- 8) An EXTERNAL MINIMUM RECALL (identified EMR) switch shall be provided on the interior of the cabinet door for troubleshooting purposes. It will be a single pole-single throw switch and will apply logic ground to the EMR input to the controller. An LED circuit will also be wired to indicate the switch is activated.

**DELETE PARAGRAPHS “L.5.m” AND REPLACE WITH THE FOLLOWING:**

All cabinets shall be equipped with power input filters as manufactured by **Innovative Technologies, Inc** model number **HS-P-SP-120-60-RJ** or approved equal, and for telecommunications line protection shall be Model MDF 6 95V or MF 25 95V.

**ADD THE FOLLOWING PARAGRAPHS TO “L.5.” OF THIS SUBSECTION:**

- n. Solid state load contactor switch.
- o. All cabinets shall be equipped with a fourplex auxiliary power outlet and a duplex GFCI power outlet.

**ADD THE FOLLOWING PARAGRAPHS TO THIS SUBSECTION:**

- M. All field cables and interconnect cable entering the traffic controller cabinet shall be permanently labeled in the cabinet with their location and destination point in the intersection (i.e. “NW Corner – XX-A Pole”). Interconnect cables shall be labeled with their direction of

travel (i.e. “Interconnect – From South” or “Interconnect – To North”). Wherever possible, the phase shall be noted on the label (i.e. “NE Corner – XX-A Pole – phase 8”).

The wires shall be identified using 1-inch wide UV resistant marking tape and the tape manufacturers recommended permanent black ink marker. Once marked, a suitable diameter piece of clear heat shrink tubing shall be installed and shrunk to protect the marking tape. The tubing shall extend 1-inch past the extent of the label in each direction along the wire to prevent moisture and dirt penetration.

## **623 T.02.02 TRAFFIC SIGNAL CONTROLLER CABINET EQUIPMENT**

### ***ADD THE FOLLOWING PARAGRAPH TO “C” OF THIS SUBSECTION:***

4. When Audible Tactile Pedestrian Push Buttons (PPB) are specified, an Audible Tactile interface panel shall be provided and mounted on the middle left side wall above the loop detector terminal panel. Central Control Unit (CCU) and failsafe cables shall be provided, neatly installed and terminated per manufacturer instructions. A CCU shall be provided for all cabinets configured for Audible Tactile PPBs.

### ***DELETE PARAGRAPH “E” AND SUBPARAGRAPHS AND REPLACE WITH THE FOLLOWING:***

#### **E. Loop Detection:**

1. When specified, the cabinet shall be wired with a one (1) 12 slot rack-mounted loop detection unit. There shall be enough capacity for 12-two (2) channel amplifiers (Total of 24 vehicle detector channels). The rack will be wired with the breakdown as follows:
  - a. There shall be two (2) channels in the detector rack assembly for each of the phases 1, 3, 5, and 7, wired for left turn operation. These will be wired as presence loops, with each conductor independently terminated onto an individual terminal elsewhere within the cabinet, which can readily be moved. The “Relay Common” must terminate, and then it must be wired to logic ground.
  - b. There shall be three (3) channels in the detector rack assembly for each of the phases 2, 4, 6, and 8 wired for thru-traffic operation. These will be wired as presence loops, with each conductor independently terminated onto an individual terminal elsewhere within the cabinet, which can readily be moved. The “Relay Common” must terminate, and then it must be wired to logic ground.
  - c. There shall be one (1), channel in the detector rack assembly for each of the phases 2, 4, 6, and 8 wired for thru-traffic “call loop” operation. These will be wired not to output a call during the detected phase green service, with each conductor independently terminated onto an individual terminal. The “Relay Common” must terminate independently, then it must then be wired to the red and yellow output from the controller (this must be diode isolated). Any other

method of “call loop operation” must be approved by Traffic Engineering & Field Operations before acceptance.

- d. All detector rack slots must be clearly marked as to the appropriate phase to which it belongs.
  - e. The panel to be used for field input wiring (loop lead-ins) shall be installed on the lower left sidewall.
2. When specified, the cabinet shall be wired with a two (2) 12 slot rack-mounted loop detection units. There shall be enough capacity for 24-two (2) channel amplifiers (Total of 48 vehicle detector channels). One rack will be wired as specified in Paragraph E.1.a., b., and c, above. The second rack will be wired with the breakdown as follows:
- a. There shall be two (2) channels in the detector rack assembly for each of the phases 1, 3, 5, and 7, wired for left turn operation. These will be wired as presence loops, with each conductor independently terminated onto an individual terminal elsewhere within the cabinet, which can readily be moved. The “Relay Common” must terminate, and then it must be wired to logic ground.
  - b. There shall be four (4) channels in the detector rack assembly for each of the phases 2, 4, 6, and 8 wired for thru-traffic operation. These will be wired as presence loops, with each conductor independently terminated onto an individual terminal elsewhere within the cabinet, which can readily be moved. The “Relay Common” must terminate, and then it must be wired to logic ground.
  - c. All detector rack slots must be clearly marked as to the appropriate phase to which it belongs.
  - d. The panel to be used for field input wiring (loop lead-ins) shall be installed on the lower left sidewall.
3. All cabinets shall be provided with a complete set of two (2) channel rack mount detectors and appropriate number of power supply(s) to fully populate the rack detector assemblies. Two channel rack detector amplifiers shall be Eberle Design Inc., Model 622T (or equivalent) with vehicle extend and delay capability. Detector rack power supply shall be Eberle Design Inc., Model PS 175 (or equivalent).

***DELETE PARAGRAPH TO “F.1” AND REPLACE WITH THE FOLLOWING:***

All cabinets shall be equipped with encoded Global Traffic Technologies (GTT) Opticom compatible Emergency Preemption.

***DELETE PARAGRAPH TO “F.3” AND REPLACE WITH THE FOLLOWING:***

Provide one 4 channel rack mounted phase selector card and model 760 rack.

**DELETE PARAGRAPH "F.4" AND SUBPARAGRAPHS AND REPLACE WITH THE FOLLOWING:**

Cabinets shall be wired with an opticom green-sense harness terminated on the field terminals.

**DELETE PARAGRAPH "F.5" AND SUBPARAGRAPHS AND REPLACE WITH THE FOLLOWING:**

5. The wiring from the phase selector to the back panel shall be as follows:

Channel A to Controller Plug A, Pin q.

Channel B to Controller Plug A, Pin y.

Channel C to Controller Plug B, Pin W.

Channel D to Controller Plug B, Pin X.

**DELETE PARAGRAPH "G" AND SUBPARAGRAPHS AND REPLACE WITH THE FOLLOWING:**

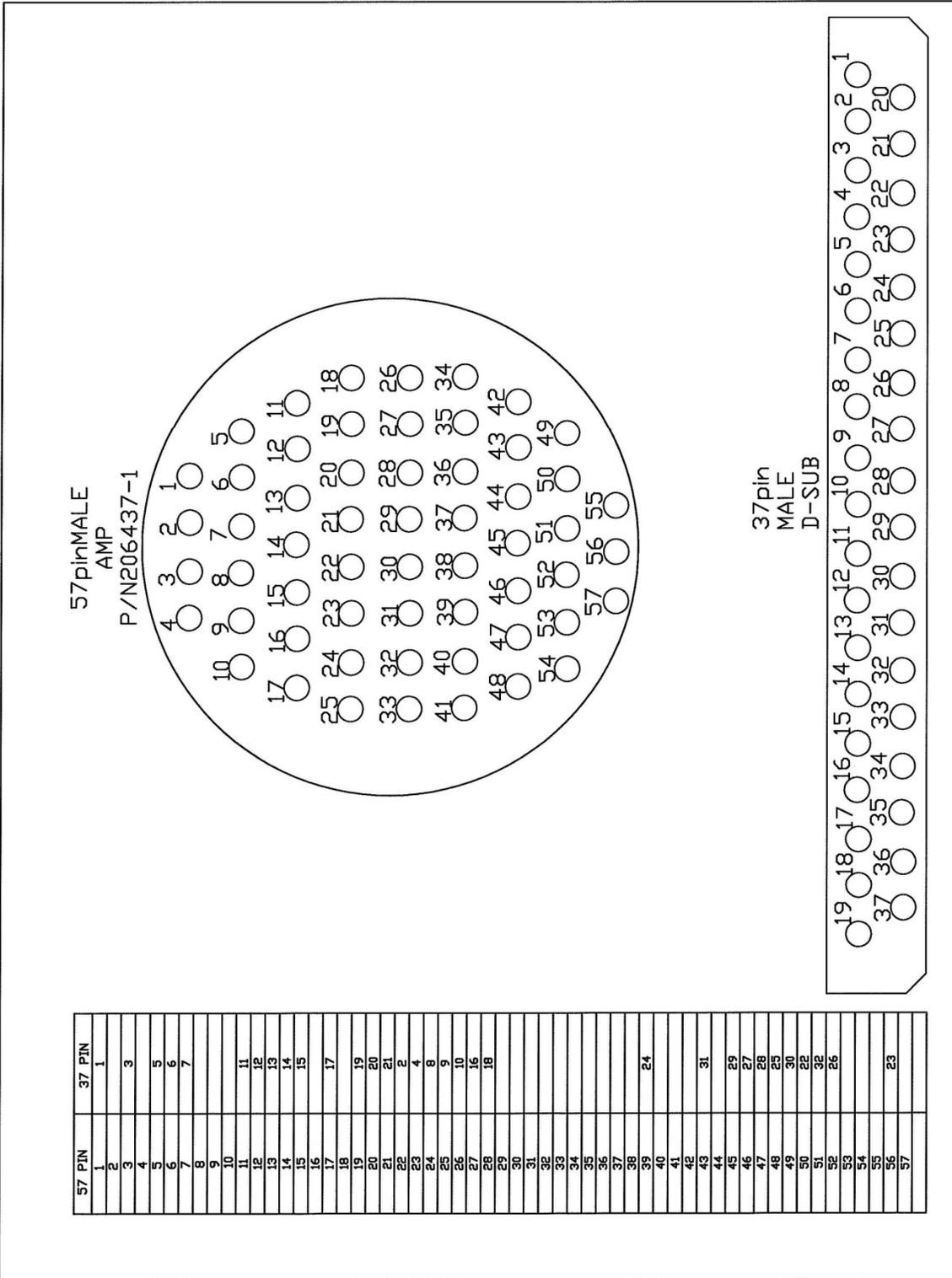
- G. Supplemental D Plug Interface Panel:

1. The cabinet shall be equipped with a D panel complete with wiring harnesses to connect the D panel to the D plug on the controller. The cabinet shall be wired to route each of the 48 detector inputs separately into the controller.

The D Panel shall have an integral plug and shall be supplied with two 6 foot connector cables that that can connect the D-panel to the D-plug in either a Naztec 980 ATC or Siemens M53 controller.

The integral plug on the D panel shall be a 57 pin female Amphenol flange mount P/N 206438-1 or approved equal. The connector cables shall each have a 57 pin male Amphenol P/N 206437-1 plug on one end to connect to the interface panel.

The opposite end of one cable will have a 37 pin male D-sub plug to connect to an M53 controller, and the opposite end of the second cable will have a 57 pin male Amphenol P/N 206437-1 plug to connect to an ATC controller (see diagram below).



***DELETE PARAGRAPH “H.1” AND REPLACE WITH THE FOLLOWING:***

Unless otherwise specified in the Contract Documents, all traffic control cabinets shall be supplied with a Malfunction Management Unit (MMU) with 16 channels.

***DELETE PARAGRAPH “H.2” IN ITS ENTIRETY***

***DELETE PARAGRAPH “H.3” AND REPLACE WITH THE FOLLOWING:***

Each MMU shall be furnished with the program card fully programmed for standard NEMA 8-phase operation.

***DELETE PARAGRAPH “H.4” AND REPLACE WITH THE FOLLOWING:***

Harnesses shall be wired in accordance with the diagram shown below.

## CONFLICT MONITOR PANEL

1	DMA-AA	SPARE 1	TB31
2	DMA-AB	SPARE 2	
3	DMA-AC	SPARE 3	
4	DMA-AD	SPARE 4	
5	DMA-AE	SPARE 5	
6	DMA-AF	SPARE 6	
7	DMA-AG	SPARE 7	
8	DMA-AH	SPARE 8	

9	DMA-B	RLY 1 NO.	TB32
10	DMA-P	RLY 1 NC.	
11	DMA-W	RLY 1 COM	
12	DMA-Q	RLY 2 NO.	
13	DMA-C	RLY 2 NC.	
14	DMA-X	RLY 2 COM	
15	DMA-C	START-ILY RLY NO.	
16	DMA-U	START-ILY RLY NC.	
17	DMA-B	START-ILY RLY COM.	
18	DMA-A	AC+ I	
19	DMA-A	AC+ II	
20	DMA-CC	CAB INTERLOCK A	
21	DMA-DD	CAB INTERLOCK B	
22	DMA-T	LOGIC GND	
23	DMA-V	AC-	
24	DMA-U	CHAS GND	
25	DMA-S	+24 VDC MONITOR I	
26	DMA-n	+24 VDC MON INHIBIT	
27	DMA-R	+24 VDC MONITOR II	
28	DMA-BB	PLACES PANEL FLASH SWITCH	
29	DMA-n	EXTERNAL RESET	
30	DMA-n	CONT VOLT MONITOR	
31	DMA-o	RED ENABLE INPUT(AC+)	

1	DMB-N	1R	TB33
2	DMB-N	2R	
3	DMB-Z	3R	
4	DMB-L	4R	
5	DMB-K	5R	
6	DMB-J	6R	
7	DMB-H	7R	
8	DMB-C	8R	
9	DMB-F	9R	
10	DMB-V	10R	
11	DMB-E	11R	
12	DMB-D	12R	
13			
14	DMA-z	1W	
15	DMA-y	2W	
16	DMA-l	3W	
17	DMA-ff	4W	
18	DMA-w	5W	
19	DMA-ee	6W	
20	DMA-v	7W	
21	DMA-u	8W	
22	DMA-t	9W	
23	DMA-a	10W	
24	DMA-s	11W	
25	DMA-r	12W	

CONFLICT MONITOR INPUTS (AC+)

1	DMA-R	1G	TB34
2	DMA-P	2G	
3	DMA-N	3G	
4	DMA-M	4G	
5	DMA-L	5G	
6	DMA-K	6G	
7	DMA-J	7G	
8	DMA-H	8G	
9	DMA-G	9G	
10	DMA-F	10G	
11	DMA-E	11G	
12	DMA-D	12G	
13			
14	DMA-k	1Y	
15	DMA-j	2Y	
16	DMA-h	3Y	
17	DMA-x	4Y	
18	DMA-g	5Y	
19	DMA-f	6Y	
20	DMA-e	7Y	
21	DMA-d	8Y	
22	DMA-c	9Y	
23	DMA-b	10Y	
24	DMA-z	11Y	
25	DMA-y	12Y	

CONFLICT MONITOR INPUTS (AC+)

**DELETE PARAGRAPH “H.5” IN ITS ENTIRETY****DELETE PARAGRAPH “H.6” IN ITS ENTIRETY AND REPLACE WITH THE FOLLOWING:**

The wiring harness for the MMU shall have independent termination points.

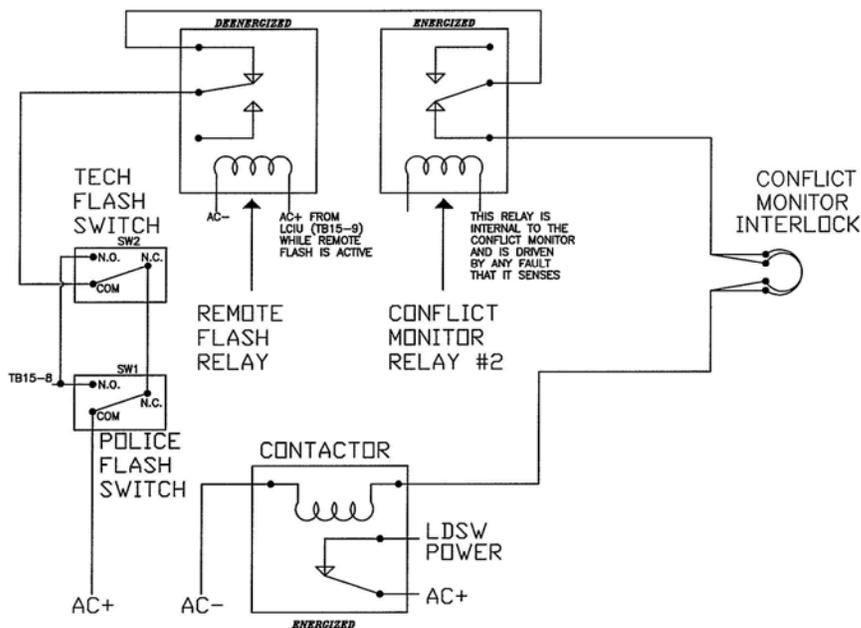
**DELETE PARAGRAPH “H.9” AND REPLACE WITH THE FOLLOWING:**

Unused wires shall be terminated on a separate back panel terminal that is easily accessible from the front of the cabinet without removing other panels.

**DELETE PARAGRAPH “I” AND SUBPARAGRAPHS AND REPLACE WITH THE FOLLOWING:**

- I. All conflict monitors shall be NEMA standard, meeting all requirements of Section 6 of the latest edition of NEMA TS 2 and shall meet the following requirements:
  2. Malfunction Management Units shall have 16 channels.
  3. Malfunction Management Units shall be capable of monitoring “Flashing Yellow Arrow” operations.
  4. Malfunction Management Units shall be model MMU-1600GE as manufactured by Reno A&E, or model MMU2-16LEip as manufactured by Eberle Design, Inc., or approved equal.
  5. Malfunction Management Units shall be wired per the “Interlock Diagram” shown below with the appropriate relays.

NOTE: ALL COMPONENTS ARE DRAWN IN NORMAL OPERATING MODE.



**INTERLOCK DIAGRAM**

**623 T.02.03 TRAFFIC SIGNAL CONTROLLERS**

**DELETE "B.3" OF THIS SUBSECTION IN ITS ENTIRTY.**

**DELETE "B.6.d" OF THIS SUBSECTION AND REPLACE WITH THE FOLLOWING:**

The contractor shall be responsible for configuring all electronic equipment to provide a fully functioning system which includes opticom, video and/or loop detection as applicable and pedestrian pushbutton configuration. The video detection equipment manufacturer shall provide a technical representative at the intersection during the turn-on and testing period if necessary. The contractor shall also furnish and install all Ethernet cables necessary to connect all IP capable electronic equipment to the IP switch in the cabinet.

**DELETE "C" AND "D" OF THIS SUBSECTION AND REPLACE WITH THE FOLLOWING:**

- C. Traffic signal controllers shall be one of the following:
  1. **NAZTEC 980 ATC TS2 Type 2 NTCIP Compliant Signal Controller.**
  2. **Eagle M53 controller.**
- D. The Contractor shall supply the controller to the City of Las Vegas Traffic Signal Repair Shop, fourteen days prior to signal turn-on, for testing. The Contractor shall deliver the

controller to 2824 E. Charleston Boulevard. Contractor shall notify the Traffic Signal Repair Shop (229-6075) seven days prior to installation.

#### **623 T.02.04 MAGNETIC INDUCTION LOOP DETECTORS**

##### ***ADD THE FOLLOWING TO "A.1":***

The term "loop leads" and "home runs" refers to two (2) conductors from the loop detector in the roadway to pull box. The term "loop lead in" refers to the conductors from the conductors from the pull box to the traffic signal controller cabinet.

##### ***DELETE "A.4" AND "A.5" OF THIS SUBSECTION AND REPLACE WITH THE FOLLOWING:***

- A. 4. Loop leads shall be properly marked in the pull box and the cabinet as to the location and which vehicular phase of the traffic signal is associated with that loop as well as a lettered designation corresponding to the designation shown on the contract drawings. For example, a loop lead for the eastbound thru movement might be labeled as either 4B, 4C, 4D, or 4E.
- A. 5. A minimum of 5 feet of loop wire and 5 feet of loop lead-in shall be provided and stored in the pull box for slack.

##### ***DELETE "A.7" OF THIS SUBSECTION IN ITS ENTIRETY.***

##### ***ADD THE FOLLOWING PARAGRAPH TO "B.7." OF THIS SUBSECTION:***

- B. 7. Prefomed loops shall by one of the following manufacturers:
  - a. Reno A & E,
  - b. Never-Fail Loop Systems, or
  - c. Approved equal.

##### ***ADD THE FOLLOWING PARAGRAPH TO "B" OF THIS SUBSECTION:***

- 8. *(This installation should be used when pavement is to be milled/overlay or as an alternative installation method for full-depth pavement replacement)*

*[When constructing new asphalt concrete pavement] [For milling and overlay pavement operations],* prefomed loops shall be installed prior to the final lift of pavement in saw cut loop slots made in the dense grade pavement (i.e. prior to the final lift of dense grade asphalt concrete, open grade, or U.T.A.C.S. pavement). There shall be a minimum cover of two inches measured from the bottom of the final finish grade pavement surface to the top of the prefomed loop.

When installing loops in existing asphalt concrete or portland cement concrete pavements not being milled or replaced, saw cut slots in the pavement shall be a

minimum of three inches in depth and there shall be a minimum cover of two inches measured from the finish grade pavement surface to the top of the preformed loop.

When constructing new portland cement concrete pavement, preformed loops shall be installed prior to placement of the pavement at the interface between the concrete pavement and base course material.

Sawed slots shall be spaced a minimum of six inches (150 millimeters) apart and shall be blown clean of all loose material and dried prior to the installation of the preformed loop. The preformed loop shall be carefully placed into the saw slot using special tools to avoid inflicting damage to the preformed loop assembly. When more than one loop terminates in a pull box, each loop shall have a separate sawed slot for its leads and leads shall be properly marked as specified below. Loop slots shall be sealed prior to paving. Polymeric sand may be used in lieu of sealant with the approval of the Engineer. The saw cuts shall be blown clean after wire installation and before placement of sealant. The loop lead-in cable shall be as specified below. Each loop system (i.e. advanced detection, left turn movements, thru movements, and right turn movements) shall have at least one separate lead-in to the controller cabinet.

Loop leads shall be properly marked in the pull box and the cabinet as to the location and which vehicular phase of the traffic signal is associated with that loop as well as a lettered designation corresponding to the designation shown on the contract drawings. For example, a loop lead for the eastbound thru movement might be labeled as 4B, 4C, 4D, or 4E. A minimum of five (5) feet of loop wire and five (5) feet of loop lead-in shall be provided and stored in the pull box for slack. All loop wire home run to pull box shall clearly identify the direction of the cables windings for ease of installation.

Loop wire installation shall be tested using a megohmmeter both prior to the placement of loop wire sealant, as well as after installation, in the presence of a City representative. Insulation resistance readings shall not be less than 100 megohms at 1000 volts.

***DELETE "C" OF THIS SUBSECTION AND REPLACE WITH THE FOLLOWING:***

C. Cable-in-Duct System.

1. The loop system shall be wired with a cable-in-duct assembly, defined as No. 12 AWG minimum, meeting IMSA Specification No. 51-5 as indicated in the Standard Drawings, directly installed in sawcut slots.
2. When constructing new asphalt concrete pavement, loop wires shall be installed prior to the final lift of pavement in saw cut loop slots made in the dense grade pavement (i.e. prior to the final lift of A.C.). There shall be a minimum cover of two inches measured from the bottom of the final asphalt concrete surface to the top of the loop.

3. When installing loops in existing asphalt concrete or Portland Cement concrete pavements not being milled or replaced, or in new Portland Cement concrete pavement, saw cut slots in the pavement shall be a minimum of three inches in depth and there shall be a minimum cover of two inches measured from the finish grade pavement surface to the top of the loop.
4. The loop or loops shall be installed in the saw cut slots in the pavement and shall be oriented and color-coded or taped in accordance with the Standard Drawings and plans. Sawed slots shall be blown clean of all loose material and dried. Loop wire shall be carefully placed into slot, avoiding damage to the wire insulation. When more than one loop terminates in a pull box, a maximum of two loop home runs shall be installed per single slot and leads shall be properly marked as specified below. Loop home runs assigned to different signal phases shall not share the same slot with loop home runs for another phase.
5. Sawed slots shall be spaced a minimum of six (6) inches (150 millimeters) apart.
6. Loops slots shall be sealed with detector sealant flush with pavement surface.
7. Each loop system shall have a separate lead-in to the controller cabinet.
8. All loops shall be megohmmeter tested.

**ADD THE FOLLOWING PARAGRAPHS TO “F” OF THIS SUBSECTION:**

Multiple Conductor Loop Lead-In Cable for connection of Multiple Loop Systems:

When multiple conductor loop lead-in cable is specified on the contract drawings, use cable that conforms to the following specifications to connect multiple loop systems to the terminal blocks in the controller cabinet:

- 1) NEC / (UL) Specification TC or CM, certified for use in underground conduit or as an aerial cable supported by a messenger
- 2) 18 AWG stranded tinned copper conductors, polypropylene or polyethylene insulation. Six twisted pairs with insulation colors that match table below
- 3) Each twisted pair individually shielded with an aluminum foil shield that provides 100% coverage and a 20 AWG tinned copper drain wire
- 4) Outer jacket of polyvinyl chloride (PVC) or polyethylene (PE), cable rated for 300 volts minimum

**6-Pair Loop Lead-in Cable Assignments**

Pair Number	Color	Phase Letter Designation
1	Black & Red	A
2	Black & White	B
3	Black & Green	C
4	Black & Blue	D

5	Black & Yellow	E
6	Black & Brown	F

**REPLACE EACH OF THE FOLLOWING SENTENCES OF “H” OF THIS SUBSECTION WITH THE FOLLOWING:**

*For Downtown pole mount cabinets, use two shelf mount detector amplifiers with 4 channels per loop detector amplifier.*

2. All detectors shall be of the rack mounted type.
9. There shall be 2 channels per each loop detector.

**ADD THE FOLLOWING PARAGRAPH TO “H” OF THIS SUBSECTION:**

20. Turning off a loop amplifier shall not place a call.

**623 T.02.05 EMERGENCY VEHICLE PRIORITY CONTROL SYSTEM (INTERNAL PREEMPTION)**

**ADD THE FOLLOWING PARAGRAPH TO THIS SUBSECTION:**

**Optical Preemption units shall be Global Traffic Technologies (GTT)** (encoding capable), using a Model 764 phase selector installed in a Model 760 card rack with a Model 768 Auxiliary Interface Panel mounted in the cabinet and fully wired for green sense capabilities. Optical sensors shall be Model 721 and will be interfaced to the traffic signal controller cabinet using an M-138 cable. **No other optical preemption units will be accepted.** This is necessary to facilitate area-wide vehicle encoding.

**623 T.02.06 TRAFFIC SIGNAL VIDEO IMAGE DETECTION SYSTEMS**

**ADD THE FOLLOWING TO THIS SUBSECTION:**

- A. All cabinets shall be wired for a Video Detection System with appropriate cameras (minimum one per vehicular direction) and cables mounted according to the manufactures specifications for each direction of vehicular travel. The following requirements must be met by the supplier of the equipment:
  1. **All vehicle detection will be by video image detection using either Iteris Edge 2 with Edgeconnect Pac (IP addressable), or Peek Videotrak IQ (with Ethernet port) video detection systems, or TRAFICON VIP 3D.2 with VIEWCOM E MAX+ (IP ADDRESSABLE) in a TRAFICON detector rack.** The Video Detection System shall be an above ground vehicle detection system that utilizes machine vision when interfaced with standard color CCD cameras to provide complete intersection and roadway detection
  2. A single NEMA certified chassis shall be supplied for each Video Image Detection System, which will allow expandability to provide for a minimum of six camera inputs for vehicle detection. All interface equipment including interface panels, connectors, and cabling shall be provided and wired in the controller cabinet to accommodate a minimum of six camera operation, or as shown on the Contract Drawings.

3. Each Video Detection System will include a minimum of 4 standard color cameras, or as shown on the Contract Drawings. All cameras shall be equipped with adjustable lenses, allowing the user to modify the apparent size of the lens angle. These are also referred to as “zoom lenses”. Each direction/camera shall have a minimum of 24 user programmable detection zones (not lines or “probes”), and include heater, sunshield and mounting brackets. Each camera will have power and video directly from the cabinet. Coaxial cable will be type 8281 (solid center conductor). Camera connections that use a prefabricated cable integrating power and coaxial cable into a single weatherproof connector are acceptable. An in-line filter (CX06-BNCY or equivalent) will be provided for each camera coaxial cable input. The in-line filters will be mounted on a panel (panel to be attached to the inner side wall of the cabinet). “BNC” connectors are the only acceptable termination of coaxial cables. Cameras shall be mounted per the manufacturer’s recommendations and per the CLV Traffic Engineer approval. Cameras shall be mounted using a 72” extension bracket on signal mast arms. Cameras should be centered over the lane line between the left turn lane and the through lane for the approach being detected. The contractor should contact the city Traffic Signal Supervisor prior to mounting cameras for approval of the mounting locations.
4. All delay and extension functions for an approach must be performed within the video unit.
5. The units must be capable of simultaneously detecting all vehicles 300 feet from the stop bars on every approach.
6. The Video Image Detection System shall have an internet protocol (IP) port for remote access capability to transmit video and detector information to a computer. The Video Image Detection System shall have the capability to remotely reconfigure detection zones and transmit video via phone line, twisted pair, coaxial cable and fiber optic interconnect.
7. The Contractor shall provide a fully functioning and programmed system complete with latest version of manufacturer’s software. All software and hardware for installation, operation and maintenance will be supplied to the City along with necessary technical support upon setup, if needed.
8. The Video Detection System shall utilize standard 24 volt logic signal outputs to interface with NEMA TS1/TS2, 170/179, 2070, or other future ATC controllers.
9. The Video Image Detection System must provide logic ground to all detector outputs that shall be active during programming of detection zone layouts.
10. All of the system’s micro-processing functions must be performed in the video unit, which must be located within the controller cabinet.
11. All equipment schematics and technical material must accompany any equipment supplied to the City of Las Vegas Traffic Electrical Field Operations, upon turn-on of the signal.

**623 T.02.08 VEHICLE SIGNAL FACES****ADD THE FOLLOWING PARAGRAPH TO “A” OF THIS SUBSECTION:**

5. Vehicle signal faces shall be ETL compliant. The ETL Listed Mark indicates that the manufacturer’s production site conforms to a range of compliance measures and is subject to periodic follow-up inspections to verify continued conformance, and the product meets the minimum requirements of widely accepted product safety standards as determined through independent testing of a Nationally Recognized Testing Laboratory.

**623 T.02.10 PEDESTRIAN SIGNAL FACES****ADD THE FOLLOWING PARAGRAPH TO “A.1” OF THIS SUBSECTION:**

All pedestrian signal faces shall provide “Walking Person”, “Hand”, and “Countdown” messages as provided by **Duralight model #JXM-400-VIEIL** or **Dialight model #430-6479-001X** or approved equal (must be ETL compliant for consideration).

**623 T.02.11 PEDESTRIAN PUSH BUTTONS:****DELETE THIS SUBSECTION IN ITS ENTIRITY AND REPLACE WITH THE FOLLOWING:**

- A. Mounting height of the pedestrian push button shall be 42” above the sidewalk.
- B. All pedestrian push buttons **shall be either Campbell Company Advanced Accessible Pedestrian System, part numbers AAPS APB912 (buttons) with AAPS APC (controller), or Polara Navigator 2-Wire System** Audible-Tactile Pedestrian Push Button type, or approved equivalent, in accordance with the request from the Nevada Bureau of Services to the Blind and Visually Impaired. Equivalent systems shall conform to the audible-tactile pedestrian system specifications below.

**C. AUDIBLE-TACTILE PEDESTRIAN SYSTEM SPECIFICATIONS****1. GENERAL DESCRIPTION**

- a) The Audible-Tactile pedestrian system shall consist of all electronic equipment, mounting hardware, power supplies, push buttons, and sign faces, which are designed to provide both a raised vibrating tactile arrow along with a variety of audible sounds for different traffic signal functions. The system shall consist of a Control Unit and Pole Mounting Assembly, as described below. Additionally, documentation shall include shop drawings for all equipment, electronic schematics, required voice setup software/ hardware, and installation/operations manuals.

**2. FUNCTIONAL REQUIREMENTS**

- a) The system shall vibrate the tactile arrow during every time the WALK interval indication is displayed.

- b) The system shall have the field-selectable function known as “Locating Beep.” This means that during the Flashing DONT WALK and the DONT WALK intervals, the system shall provide a steady, non changing, (constant dB level) pole locating tone that emanates directly in the vicinity of the Pedestrian Push Button.
- c) The system shall have the field-selectable function known as “Extended Push Activation.” This means that the audible WALK message will only be activated and sound during the WALK interval if the button is depressed for a minimum of three (3) seconds. This audible WALK message shall be able to be field set to allow for automatically adjusting to ambient noise levels via control circuitry.
- d) The system shall have the function referred to as “Voice Location Message.” This means that the location of the street to cross, and the intersection will be vocalized only when the button is depressed for a minimum of three (3) seconds. This shall be a field-settable option, and the volume shall be automatically adjusted to ambient noise levels
- e) The audible messages must be easily programmable by City staff, with the needed hardware and software to be supplied by the system’s vendor.
- f) Automatic volume adjustments for ambient noise shall be field selectable.

### 3. CONTROL UNIT

#### GENERAL DESCRIPTION

The equipment needed for the Control Unit must be able to be mounted in the Pedestrian Head Housing on the Traffic Signal Pole. It shall be powered from the 120 VAC, WALK/DONT WALK lamp indications in the housing. The unit shall conform to the following specifications.

- a) POWER REQUIREMENTS: 115 VAC, 60Hz, (100 ma, typical)
- b) Separate power inputs for “WALK” and “DONT WALK”, two ¼ AMP fuses mounted on the board
- c) POWER SUPPLIED TO VIBRATOR: 12 VAC, .3A Typical, to operate during WALK interval only
- d) AUDIO AMPLIFIER POWER OUTPUT: 10 W RMS into 8 ohms
- e) VOLUME CONTROL: On board trimming potentiometer for overall adjustment
- f) VOLUME CONTROL AUTOMATIC ADJUSTMENT RANGE: 28 Db
- g) MICRPHONE FOR AMBIENT NOISE: Mounts in Pedestrian head housing. Frequency range: 170 Hz to 2.3 Khz
- h) PED PUSH BUTTON INTERFACE: Accepts 12 to 24 Volts AC/DC imposed by connection to push button which will be terminated in an existing traffic signal controller cabinet
- i) JUMPER SELECTABLE OPTIONS:
  - i. Chirp
  - ii. Cuckoo
  - iii. Walk Message
  - iv. Location Message if Available
  - v. Extended Push Button Triggering
  - vi. Locating Tone

- j) MOUNTING: Mounts inside the pedestrian head housing using existing threaded holes in the rear wall on 9 ¼" centers. Designed to clear reflector in standard housing of dual incandescent pedestrian head. Not for use within the older, neon/transformer assemblies. The assembly shall accommodate a standard 9" X 12" pedestrian sign.
- k) AUDIBLE LOCATING TONE: 880 Hz plus harmonics, 0.1 second duration, 1 second interval. Operates during flashing DONT WALK and solid DONT WALK indications, only

#### 4. POLE MOUNTING ASSEMBLY

GENERAL DESCRIPTION: This equipment is the part that will be visible to the pedestrians. It is commonly referred to as the "Pedestrian Push Button Assembly." This shall contain the 2" ADA-compliant Pedestrian Push Button, the directional tactile arrow, the weatherproof speaker, and the appropriate informational sign for each location.

- a) VIBRATOR POWER: 12 VAC, .3 A Typical
- b) SPEAKER: 8 Ohms, 15 Watt maximum, weather-proof
- c) PUSH BUTTON: Mounting height of the pedestrian push button shall be 42-inches above the sidewalk

#### 5. MESSAGE MARKING

The Message Sign shall be an R10-3E sign, 9"x12" (size modified), per MUTCD 2009 edition, and shall be porcelain enameled metal.

### 623 T.02.12 FLASHERS

#### **ADD THE FOLLOWING TO THIS SUBSECTION:**

#### H. Solar Pedestrian Crosswalk Flashing Beacon System

Each system unit shall consist of a solar / battery system, an electronic control module, a wireless communication system to synchronize the flash for multiple system units, and a 12" circular yellow Light Emitting Diode (LED) signal indication and housing. A single unit may include two beacons, one for each direction. The number and configuration of Flashing Beacon units for each Pedestrian Crosswalk shall be as indicated on the contract drawings.

The system units shall be **Carmanah Model R820C Solar powered pedestrian activated flashing beacons, JSF Technologies Models AB-2412 (double head) or JSF Technologies Models AB-1412 (single head) Pedestrian activated crosswalk beacons**, or approved equal.

Other manufacturer units may be acceptable to the City of Las Vegas that meet or exceed the following specifications:

#### 1. LED Module

- a) The lens shall be 12 inches in diameter per latest edition of the MUTCD Section 4D.15
- b) LEDs shall be color emitted
- c) Lens may be same color or clear
- d) LED power peak consumption to be 6 watts

## **2. Electronic Module**

- a) Electronics to be housed in a weatherproof metal casing with theft resistant locking hardware
- b) Flash pattern and rate shall have multiple patterns with one pattern and rate to meet MUTCD, latest edition, Section 4K.01
- c) System shall include energy management system to continuously monitor battery and solar intensity and shall have the ability to increase brightness in sunny conditions and increase longevity in overcast or night time conditions
- d) System to continue to operate for a minimum of 30 days, without solar recharging with a set flash rate meeting the MUTCD specified flash pattern

## **3. Solar Panel Module**

- a) The solar system shall include one or more solar panels with a total solar collection surface area to be no larger than 16" x 16" for single flashing beacon units
- b) Solar panel visibility to be discrete from ground level to reduce theft or threat of vandalism
- c) Solar panel collection to be omni-directional as to not be dependent on orientation for maximum collection efficiency

## **4. Battery Module**

- a) System shall use commercial available lead-acid, cell batteries that are field replaceable
- b) Battery module shall have a battery cooling system
- c) Battery housing to be white for heat reflection, if external on flasher unit
- d) Battery housing to be theft resistant
- e) Battery housing shall have a hinged lid for battery access with theft resistant locking hardware
- f) Batteries shall be mechanically secured within the battery housing

## **5. Flasher Unit**

- a) Flasher unit to be integrated with no external connected parts
- b) Flasher housing to be black in color, or as specified in the Contract Drawings.
- c) Flasher unit shall be powder coated cast aluminum
- d) Complete flasher unit weight shall not exceed 60 lbs, including batteries
- e) Flasher units shall have detachable metal backplates which shall be flat black in color
- f) Flasher units shall have metal tunnel visors which shall be flat black in interior color

- g) Flasher units shall be equipped with hardware and be capable of mounting to the top of a Clark County Area Standard 1-A pole with a 4.5" O.D. post top collar, or to the side of a Clark County Area Standard streetlight pole Flasher unit shall follow the provisions of the MUTCD, latest edition, Chapter 4K, Flashing Beacons

## 6. Activation and Operation

- a) Each flashing beacon unit or units of a system shall be capable of being activated by a pedestrian push button, and shall operate for a set flash duration upon activation. System shall reset flash duration upon activations that occur mid-cycle. The flash duration shall be user configurable in the field from 5 – 60 seconds, in increments of 5 seconds or less. Each unit shall be able to transmit a wireless activation signal to other flashing beacon units in the system upon pedestrian activation. The wireless technology shall maintain a coordinated flash pattern (either alternating or unison) with all the beacons in the system throughout the duration of the activation
- b) System coordination must be repeatable upon testing for at least 50 activations. Both sides must be activated, flash, and stop flashing at the same time consistently
- c) System must be able to power and be activated by a compatible pedestrian pushbutton. The button shall be capable of providing an audible tone and/or beep and a visible momentary or latched LED light to notify the user the switch was activated. The pedestrian pushbutton shall be vandal resistant.

## 7. Environmental Specifications

- a) The system shall be able to withstand and operate at temperature extremes of 10 deg F to 165 deg F
- b) The system shall be designed and constructed to withstand wind loads in conformance with the requirements of the AASHTO publication, "Standard Specifications for Structural Supports of Highway Signs, Luminaries and Traffic Signals", 4th Edition, with latest interims
- c) The electronic circuit board housing, wire harnessing and connectors shall be designed in accordance to IEC International Standard 60529, Ingress Protection IP67 requiring that the enclosure be dust tight and remain completely sealed when immersed in water to a depth of 1 meter for 1 hour
- d) The LED Module shall meet the following environmental tests as specified in the ITE Vehicle Traffic Control Signal Heads, Light Emitting Diode (LED) Circular Signal Supplement:  
 Mechanical vibration: MIL-STD-883  
 Temperature cycling: MIL-STD-883  
 Moisture resistance: MIL-STD-810F

## 8. Warranty

- a) The system, including battery pack, solar panel, LED module and all components, shall be guaranteed by the manufacturer for a minimum of three years

- b) Warranty shall include all parts of the unit including batteries

**623 T.02.13 TRAFFIC SIGNAL POLES:**

***DELETE PARAGRAPH "A" IN ITS ENTIRETY AND REPLACE WITH THE FOLLOWING:***

- A. All traffic signal poles shall consist of continuous, tapered round steel pole shaft of the length specified, pole cap, anchor bolt cover, and hand hole covers(s), with the bolts, nuts, and washers necessary to complete the installation of the pole shaft. Multi-sided steel traffic signal poles are not accepted.

***DELETE PARAGRAPH "B" IN ITS ENTIRETY AND REPLACE WITH THE FOLLOWING:***

- B. The traffic signal and luminaire mast arms shall consist of continuous, tapered round steel tubes of the length specified, mast arm end caps and bolts, nuts, and washers necessary to complete the installation of the mast arms. Multi-sided steel traffic signal and luminaire mast arms are not accepted.

***DELETE PARAGRAPH "K" IN ITS ENTIRETY AND REPLACE WITH THE FOLLOWING:***

- K. The pole shafts shall be of round cross section, with a minimum outer diameter at the base as shown in the Uniform Standard Drawings for the type of pole specified, and shall uniformly decrease in diameter at the rate of 0.14 inches per foot of length.
1. Pole shafts shall be straight, with a permissive variation not to exceed  $\frac{1}{4}$  inch for each 10 feet of pole shaft.
    - a) A 30-foot pole would have  $\frac{3}{4}$  inch allowable deviation at the midpoint of the pole shaft.
    - b) A 20-foot shaft would have a  $\frac{1}{2}$  inch allowable deviation.
    - c) A 10-foot shaft could deviate a maximum of  $\frac{1}{4}$  inch at the midpoint.

***ADD THE FOLLOWING PARAGRAPHS TO THIS SUBSECTION:***

W. Tenons

1. The mast arm is to be fabricated with end tenon only. The end tenon shall be factory installed and the remaining tenons shall be fabricated in the field at the locations shown on the plans or as directed by the Traffic Engineer and/or his authorized representative.
2. For tenon fabrication details see Clark County Area Uniform Standard Drawing No. 808 and No. 810.

X. Welds

1. All welding shall conform to AWS D 2.0, "Specification for Welded Highway and Railway Bridges", and to any additional requirements in this subsection.

2. All exposed welds, shall be painted as provided for repairing damaged galvanized surfaces.
3. All welders must be certified by the American Welding Society (AWS) or similar organization in the welding of steel and galvanized steel.
4. All exposed weld joints shall be treated with rust inhibitors (i.e. Chemtrek or equivalent) and shall be painted as provided for repairing damaged galvanized surfaces.

#### **623 T.02.16 INTERNALLY ILLUMINATED STREET NAME SIGNS**

##### ***REPLACE SENTENCES 3 THROUGH 9 OF PARAGRAPH "C" WITH THE FOLLOWING:***

3. Sign lettering shall be as shown on the contract plans and shall conform to the 2009 edition of the M.U.T.C.D.
4. The sign face shall have the compass direction of the location marked in the upper left corner of each sign panel with a 5-inch upper case letter (N, S, E or W).
5. The street name suffix (Street, Way, Blvd., and so forth) shall be displayed in the upper right corner of the sign panel.
6. The street address number of the location shall be shown at the lower right corner in 5-inch upper case letters and numerals.
7. Engineer approval is required for the sign faces prior to fabrication.

##### ***ADD THE FOLLOWING PARAGRAPHS TO THIS SUBSECTION:***

- G. Internally Illuminated street name signs shall be wired to the luminaries photocell for control with No. 10 AWG THW copper stranded wire. In the event there is no luminaire on the traffic signal pole, a 1000 watt photoelectric control shall be mounted on the pole cap.
- H. Internally Illuminated street name signs shall be LED and shall be one of the following products, or approved equal:
  - NUART LIGHTING LED EDGE LIT SERIES** with ASTM Type IX retroreflective sheeting, and bandable mounting with L-brackets;
  - TEMPLE EDGE-LIT 96" Model R409A** with ASTM Type IX retroreflective sheeting, and under-hang mast arm mount;
  - SOUTHERN MANUFACTURING Part No. CP818DTJNNAAD1** with 8' x 18" Double Face Viewable Clean Profile LED; Top Mount, bandable mounting with L- brackets, "L" Adapter, No Photocell, Monarch Black, DG-Reflective / EC Film (Green); **Overall size: 8' x 21"**

##### ***ADD THE FOLLOWING SUBSECTION TO THIS SECTION:***

**623 T.02.19 LUMINAIRE ON SIGNAL POLES**

- A. Luminaires on all signal poles shall be [an approved LED equal to a 400 Watt High Pressure Sodium cutoff luminaire, G.E. M400A, with MC-111 distribution, or other approved LED light to satisfied \(HIGH Pedestrian\) light level as shown on USC 300.S3.](#)

TABLE 2

REQUIRED ILLUMINANCE VALUES FOR SIGNALIZED INTERSECTIONS							
ROADWAY CLASS	R.O.W. WIDTHS	MIN. AVE. ILLUMINANCE BY PEDESTRIAN AREA CLASSIFICATION			SIDEWALK / WALKWAY LIGHTING LEVELS		
		HIGH	MEDIUM	LOW	MIN. AVG. ILLUMINANCE	MIN. ILLUMINANCE	UNIFORMITY AVG./ MIN.
ARTERIAL / ARTERIAL	100' OR GREATER BY 100' OR GREATER BY	3.4 FC	2.6 FC	1.8 FC	2.0 FC	1.0 FC	4:1
ARTERIAL / MAJOR COLLECTOR	100' OR GREATER BY 80' OR GREATER BY	2.9 FC	2.2 FC	1.5 FC	2.0 FC	1.0 FC	4:1
ARTERIAL / MINOR COLLECTOR - RESIDENTIAL	100' OR GREATER BY 79' OR LESS	2.6 FC	2.0 FC	1.3 FC	2.0 FC	1.0 FC	4:1
MAJOR COLLECTOR / MAJOR COLLECTOR	80' - 99' BY 80' - 99'	2.4 FC	1.8 FC	1.2 FC	2.0 FC	1.0 FC	4:1
MAJOR COLLECTOR / RESIDENTIAL	80' - 99' BY 79' OR LESS	2.1 FC	1.6 FC	1.0 FC	2.0 FC	1.0 FC	4:1

B. Special lighting requirements

1. Downtown Centennial area

- a) Signal pole luminaires shall be [an approved LED equivalent to a Gardco CA22L-LED light, or other approved LED light to satisfied \(HIGH Pedestrian\) light level as shown on USC 300.S3.](#)

**CONSTRUCTION**

**623 T.03.01 PAINTING**

**ADD THE FOLLOWING SUBSECTION TO THIS SECTION:**

B. Special City of Las Vegas Areas

1. Unless otherwise specified, traffic signal system equipment located within the “special areas” noted below shall be finished with the color as indicated:
  - a) Downtown Centennial Plan area: **RAL 6012 “Black Green”**.
2. The following signal system components located in the special areas noted above shall be painted accordingly:
  - a) Traffic signal pole
  - b) Traffic signal mast arm
  - c) Traffic signal tenons
  - d) Traffic luminaire arm
  - e) Traffic signal luminaire head (reference Subsection 623 T.02.19 LUMINAIRE ON SIGNAL POLES of these special provisions)
3. Traffic signal poles, mast arms, luminaire arms and other elements specified to be painted shall be factory finished with a high-build, acrylic polyurethane enamel. Alternatively, a polyester TGIC or urethane polyester powder coat finish may be used. Equipment to be painted/coated shall be prepared and painted per manufacturer’s specifications.
4. The traffic signal mast arm shall be delivered with no tenons mounted to the mast arm. After the traffic signal pole foundation is constructed, the tenons shall be fabricated in the field at the locations shown on the plans or as directed by the Traffic Engineer. All welding shall conform to 623 T.02.13 of the CCAUSS and these Special Provisions. After installation of the tenons, the mast arm shall be shop painted and finished to match the traffic signal pole. No brushes or rollers shall be used to apply primers or paint except as approved by the Engineer.

## STREET LIGHTING SECTION

### 623 L.02.03 STREET LIGHTING LUMINAIRES

***DELETE THIS SECTION IN ITS ENTIRETY AND REPLACE WITH THE FOLLOWING:***

- A. The standard luminaire shall be as specified in the Contract Drawings.

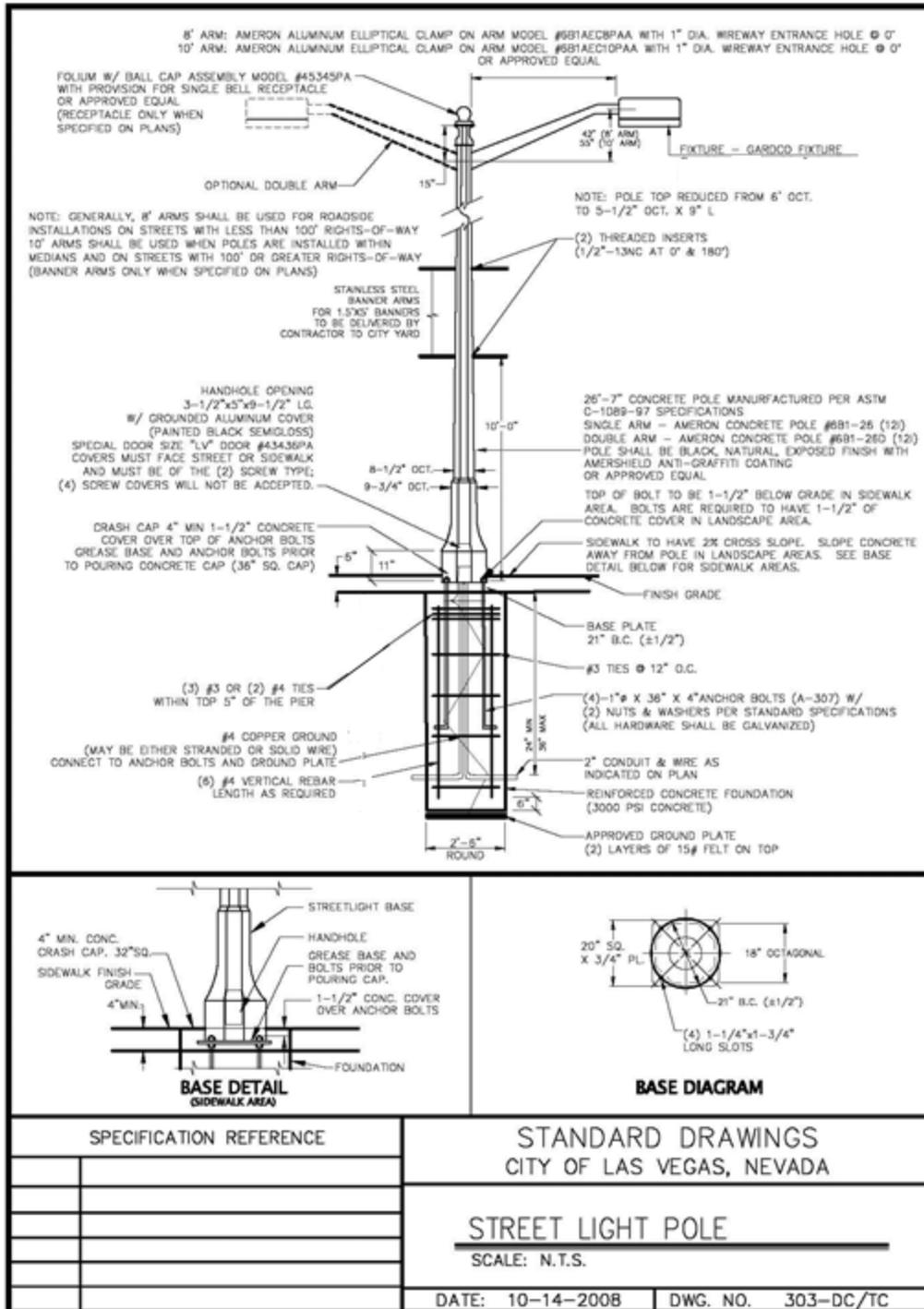
*Streetlight luminaires shall be LED and provide light level to meet the requirement as specified on USD 300.S3. For the Cobra head style, the luminaire can be GE EVOLVE LED ROADDWAY SCALABLE SPEC GRAD COBRAHEAD, PHILIPS HADCO LED COBRAD HEAD, or approved equal by the Engineer. Roadway light fixture should be type III distribution. Lighting study will be required.*

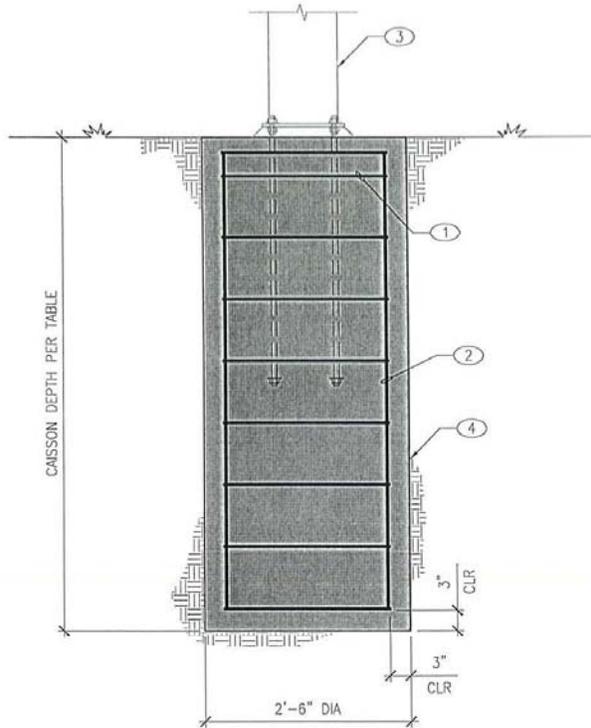
TABLE 1

REQUIRED ILLUMINANCE VALUES FOR ROADWAYS					
ROADWAY CLASS	R.O.W. WIDTHS	ROADWAY LIGHTING ILLUMINANCE LEVELS		SIDEWALK / WALKWAY ILLUMINANCE LIGHTING LEVELS	
		MIN. AVG.	UNIFORMITY AVG./MIN.	MIN. ILLUMINANCE	UNIFORMITY AVG./ MIN.
ARTERIAL	100' OR GREATER	1.58 FC	3:1	0.2 FC	4:1
MAJOR COLLECTOR	80' TO 99'	0.84 FC	4:1	0.2 FC	4:1
MINOR COLLECTOR	60' TO 79'	0.38 FC	6:1	0.08 FC	6:1
RESIDENTIAL	51' OR LESS	0.38 FC	6:1	0.08 FC	6:1

*In DOWNTOWN CENTENNIAL area, all streetlight shall be concrete black pole with single or dual LED lighting (Roadway side 160w led and Pedestrian side lighting 110w led – rotated 180degree). The street light pole can either be the Ameron or Stresscrete - 26'-3" pole. The length of streetlight pedestrian side arm varies with the sidewalk width. For sidewalk of 10' (including amenity zone) – the arm length should be 4'. For 15' sidewalk, the arm length should be 6' and for greater than 15' sidewalk or meandering sidewalk, streetlight arm can be 8' to match the street side lighting. For area where sidewalk meander more than 15' from back of curb, trail lighting maybe required to meet the lighting level. The lighting fixtures are to be the Philips Gardco ROUND 10 – CA22L or other approved equal LED light that will meet the aesthetic and the light level requirement as specified on USD 300.S3. Additionally, for areas where high amounts of pedestrians are anticipated, the light level shall be increased to meet Table 4 of the ANSI/IES RP-8-14 (below). Lighting study will be required. Special foundations for the black concrete pole are also required see below.*

TABLE 4 - RECOMMENDED VALUES FOR HIGH PEDESTRIAN CONFLICT AREAS			
MAINTAINED ILLUMINANCE VALUES FOR WALKWAYS			
	$E_{avg}$ (lux/ft)	$E_{v_{min}}$ (lux/ft)	$E_{avg}/E_{min}$ *
Mixed Vehicle and Pedestrian	20.0/2.0	10.0/1.0	4.0
Pedestrian Only	10.0/1.0	5.0/0.5	4.0
$E_{avg}$ - minimum maintained average horizontal illuminance at pavement			
$E_{min}$ - minimum horizontal illuminance at pavement			
$E_{v_{min}}$ - minimum vertical illuminance at 1.5m above pavement			
*Horizontal only			





**KEYNOTES:**

1. (2) #4 TIES IN TOP 6" AND AT 9" O.C. (F<sub>y</sub> = 60 KSI)
2. (9) #6 VERTS DISTRIBUTED EVENLY AROUND PERIMETER. (F<sub>y</sub> = 60 KSI)
3. LIGHT POLE AND ANCHORAGE BY OTHERS
4. 4500 PSI MIN CONCRETE CAISSON

**NOTES:**

- A. LUMINAIRE EFFECTIVE PROJECTED AREA (E.P.A) = 1.9 FT<sup>2</sup>
- B. ALL LOADS DETERMINED USING AASHTO STD SPECS FOR STRUCTURAL SUPPORTS FOR HIGHWAY SIGNS, LUMINAIRES, AND TRAFFIC SIGNALS (2009 ED. W/ 2011 INTERIM REVISIONS)
- C. ALL POLE BANNER AREAS HAVE BEEN OMITTED FROM THE ANALYSIS. "BREAKAWAY HINGES" SHALL BE USED FOR THE ATTACHMENT OF THE BANNER TO THE POLE.

**LIGHT POLE CAISSON DEPTH (AASHTO METHOD)**

AMERON LIGHT POLE	BASE SHEAR (KIPS)	BASE MOMENT (K-FT)	SOIL TYPE			
			SAND/GRAVEL φ MIN - 30° γ = 110 PCF	STIFF CLAY (COHESION, C = 1.0 KSF)	MEDIUM CLAY (COHESION, C = 0.600 KSF)	SOFT CLAY (COHESION, C = 0.250 KSF)
6B1-21 DUAL 10' ARM	0.67	11.06	4'-8"	6'-6"	7'-4"	9'-6"
6B1-26 SINGLE 12' MAX ARM	0.72	13.23	5'-0"	6'-9"	7'-8"	10'-0"
6B1-26 DUAL 12' MAX ARM	0.88	18.30	5'-6"	7'-3"	8'-4"	11'-0"

**NOTES:**

- A. TABLE VALUES REFLECT A 3.0 FACTOR OF SAFETY USED IN THE BROHM'S DRILLED SHAFT DESIGN EQUATIONS.
- B. SOIL TYPE SHALL BE DETERMINED BY TAKING UNDISTURBED SAMPLES. PROJECT ENGINEER SHALL DETERMINE NUMBER OF REQUIRED SAMPLES.



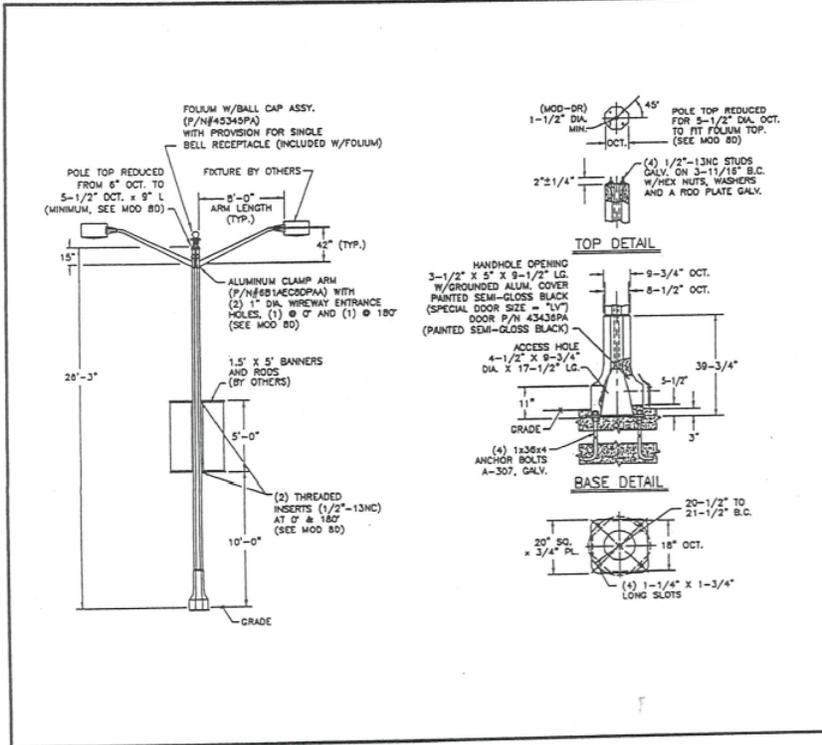
**LIGHT POLE CAISSON**

NO SCALE

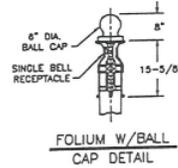
JUL 23 2012

 <p>ENGINEERING SYSTEM SOLUTIONS 7312 W. CHEYENNE AVE, STE #1 LAS VEGAS, NEVADA 89129 Phone: (702) 616-3197 Fax: (702) 616-3725 www.es2eng.com</p>	<p>PROJECT:</p> <p><b>LIGHT POLE CAISSON</b> LAS VEGAS, NV</p>	<p>PROJECT NUMBER: STR12.1026 ASA2</p> <p>DATE: 7/17/2012</p>	<p>SHEET NUMBER: <b>S1</b></p>
	<p>NO SCALE</p>		

REVISED PROPOSAL



REV.	DATE	DESCRIPTION	DRN.	APPR.
D	10/02	REDRAWN, ADDED DOOR P/N, CHG'D TO CLAMPS, & CHG'D TO MOD 8D	M.L.	



- ( ) POLES REQUIRED, EACH WITH 4334SPA & 8B1AEC0DPA ASSEMBLIES.
- NOTES:
1. CONCRETE MIX (12): BLACK, NATURAL, EXPOSED FINISH WITH AMERSHIELD ANTI-GRAFFITI COATING.
  2. Fc @ 28 DAYS = 5,000 PSI, USING SPUN CYLINDER TEST.
  3. Fc @ 28 DAYS = 5,000 PSI, USING ASTM C-31 CYLINDER TEST.
  4. POLES MANUFACTURED PER ASTM C-1089-97 SPECIFICATIONS.
  5. BASEPLATE ASTM A-36 FULLY PRESTRESSED WITH (8) 5/16" DIA. A-416 WIRES (7-STRAND CABLES).
  6. SPECIAL DOOR SIZE = "LV" (DOOR WITH GROUNDING BOLT).
  7. MOD DR: DRILL RACEWAY FOR MINIMUM CLEARANCE.
  8. MOD 8D: DOUBLE ARM CABLE ENTRANCE, DOUBLE BANNER INSERTS, & REDUCED TOP DIAMETER.
  9. DOOR PAINTED SEMI-GLOSS BLACK (PA).

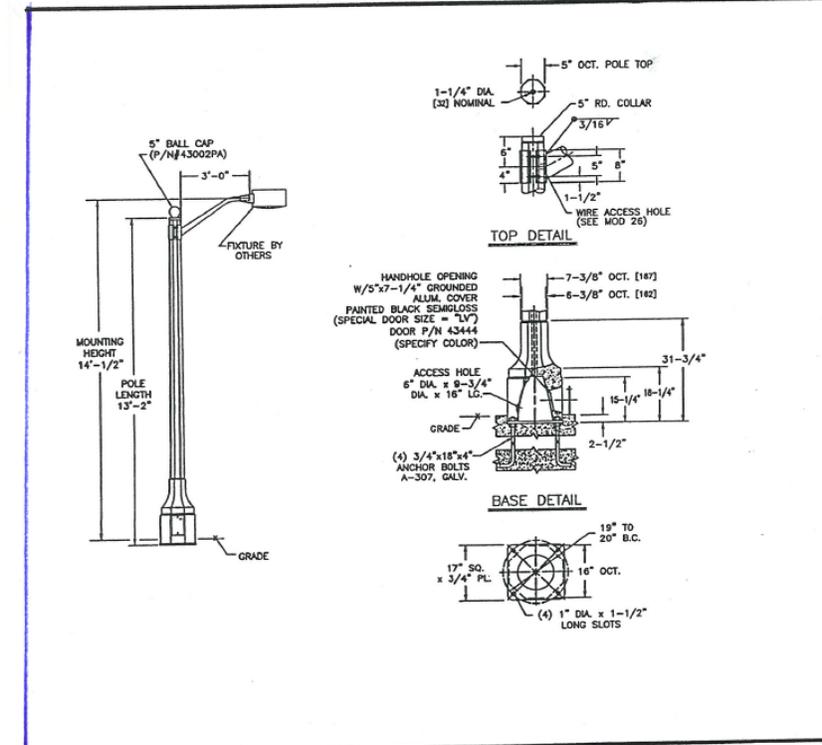
APPROVED BY \_\_\_\_\_ DATE \_\_\_\_\_

**Ameron** POLE PRODUCTS & SYSTEMS

PLS - CITY OF LAS VEGAS STANDARDS  
6B1-25 (12) POLE WITH DOUBLE 8' LMA ASSEMBLY

THIS DOCUMENT CONTAINS INFORMATION WHICH IS PROPRIETARY TO AMERON. IT SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO ANYONE WITHOUT THE PRIOR WRITTEN PERMISSION OF AMERON.

DRAWN: G.C.	07/98	SCALE	N.T.S.	DWG. NO.	SK074598	REV	D
CHK'D:							



REV.	DATE	DESCRIPTION	DRN.	APPR.
A	8/02	ADDED DOOR P/N	RS	JL

- ( ) POLES REQUIRED WITH MOAEC3PAA LMA ASSEMBLY.
- NOTES:
1. CONCRETE MIX (12): BLACK, NATURAL, EXPOSED FINISH WITH AMERSHIELD ANTI-GRAFFITI COATING.
  2. Fc @ 28 DAYS = 5,000 PSI, USING SPUN CYLINDER TEST.
  3. Fc @ 28 DAYS = 5,000 PSI, USING ASTM C-31 CYLINDER TEST.
  4. POLES MANUFACTURED PER ASTM C-1089-97 SPECIFICATIONS.
  5. BASEPLATE ASTM A-36 FULLY PRESTRESSED WITH (4) 5/16" DIA. A-416 WIRES (7-STRAND CABLES).
  6. SPECIAL DOOR SIZE = "LV" (DOOR WITH GROUNDING BOLT).
  7. MOD 26: WIRE ACCESS HOLE FOR CLAMP ARM.
  8. SPECIFY DOOR COLOR.

APPROVED BY \_\_\_\_\_ DATE \_\_\_\_\_

**Ameron** POLE PRODUCTS & SYSTEMS

PLS - CITY OF LAS VEGAS STANDARDS  
5B7-13 (12) POLE WITH 3' LMA ASSEMBLY

THIS DOCUMENT CONTAINS INFORMATION WHICH IS PROPRIETARY TO AMERON. IT SHALL NOT BE REPRODUCED, USED OR DISCLOSED TO ANYONE WITHOUT THE PRIOR WRITTEN PERMISSION OF AMERON.

DRAWN: M.L.	08/02	SCALE	N.T.S.	DWG. NO.	SK084802	REV	A
CHK'D:							

ITEM #16

**623 L.03.03 ELECTRICAL TESTING**

***ADD THE FOLLOWING PARAGRAPH TO THIS SUBSECTION:***

- B. The Contractor shall be required to submit record drawings prior to any inspections being performed. He and/or his representative shall be present at the project location during the maintaining agency's inspection of the streetlight installation.

**END OF SECTION 623**

## SECTION 628 – TRAFFIC STRIPING, PAVEMENT MARKINGS, AND CURB MARKINGS

### DESCRIPTION

#### 628.01.01 GENERAL

##### ***ADD THE FOLLOWING TO THIS SUBSECTION:***

- D. Prior to using any material, the Contractor shall provide the Engineer with a written “Certification of Compliance” from the manufacturer of the material. The certification shall include the manufacturer’s name, business address and location of the manufacturing plant. It shall identify the specifications and include one copy. It shall show the quantity of materials supplied for each color, batch number and date of manufacture.
- E. Manufacturer’s lab test results must be supplied upon request of the Engineer.

### MATERIAL

#### 628.02.01 MATERIALS FOR TRAFFIC STRIPING, PAVEMENT MARKING AND CURB MARKING

##### ***DELETE PARAGRAPH “E.2” AND REPLACE WITH THE FOLLOWING:***

- E. 2. If, for any reason, the markings fail to perform as specified, the Contractor, under this warranty, shall completely remove the old markings and apply new markings at no additional cost to the Contracting Agency. Removal shall be by wet sandblasting or other method authorized by the Engineer.

##### ***ADD THE FOLLOWING TO THIS SUBSECTION:***

- F. No pavement marking material shall be used which is not on the Qualified Products Lists (QPL) established by the Nevada Department of Transportation (NDOT) unless otherwise specified.
  - 1. Liquid Pavement Marking (LPM) shall be either a polyurea or epoxy paint formulation.
  - 2. Pavement Marking Film shall be Type II from the NDOT QPL
- G. The following materials are acceptable for parking lots:
  - 1. Ennis # 985691 Paint, Traffic RD White
  - 2. Ennis # 985697 Paint, Traffic RD Yellow
  - 3. Ennis # 985154 Paint, Traffic RD Red (for Curb)
  - 4. Vista Paint # 6800 On-Line Semi-Gloss Traffic Marking Paint Blue (for Handicap parking)
- H. The following materials shall be used for replacement of the existing green bike lane on Bonneville Avenue, east of Grand Central Parkway only:
  - 1. Catek, Inc., T-28 Acrylic Based Resin System and Anti-Skid Surfacing

- I. All other new green bike lanes constructed with the Project shall be Preformed Thermoplastic Green Bike Lane Material, shall be a minimum thickness of 90 mils (2.29mm), and per the NDOT QPL.

#### **628.03.02 EQUIPMENT**

##### ***DELETE PARAGRAPH "G" AND REPLACE WITH THE FOLLOWING:***

G. Preformed Thermoplastic markings require sealers and the use of a propane torch or radiant heater as recommended by the manufacturer to fuse markings to asphalt and Portland cement concrete pavements by means of heat.

### **CONSTRUCTION**

#### **628.03.04 PREPARATION OF EXISTING SURFACES**

##### ***ADD THE FOLLOWING TO THIS SUBSECTION:***

- D. Areas receiving slurry seal will be allowed to fully cure for a minimum of ten (10) days before application of the crosswalks, stop bars, arrows, epoxy or painted bike lanes and symbols and permanent raised pavement markers.

##### ***ADD THE FOLLOWING SUBSECTION TO THIS SECTION:***

#### **628.03.70 TEMPORARY MARKINGS**

- A. When otherwise not shown on the plans, detour transitional traffic line striping shall have a minimum taper of 20:1 for temporary striping and 30:1 for permanent striping. Temporary traffic lanes shall be at least ten (10) feet (3 meters) wide and no lane shall encroach within five (5) feet (1.5 meters) of an open excavation or within two (2) feet (0.7 meters) of longitudinal curb.

**END OF SECTION 628**

## SECTION 630 – SANITARY SEWERS

### DESCRIPTION

#### 630.01.01 WORK INVOLVED

***ADD THE FOLLOWING TO THIS SUBSECTION:***

- B. This work shall consist of construction of a wastewater collection pipe and sanitary sewer manholes as shown on the Contract Drawings.
- C. This work shall also consist of removing and replacement of an existing sewer manhole. In such case, the manhole will be removed in such a manner that the flow of the existing sewer is maintained.
- D. This work shall also consist of preparing utility final location information as described on the project drawings and in Section 622 of these Special Provisions.

***ADD THE FOLLOWING SUBSECTION TO THIS SECTION:***

#### 630.01.70 STANDARDS

- A. All sanitary sewer improvements shall be constructed in accordance with the Southern Nevada Design and Construction Standards for Wastewater Collection Systems, most recent edition.

### MATERIALS

***ADD THE FOLLOWING SUBSECTION TO THIS SECTION:***

#### 630.02.02 MANHOLES

- E. Cast-in-place and precast manhole bases will be allowed for new construction of sewer pipe.

### CONSTRUCTION

***ADD THE FOLLOWING SUBSECTION TO THIS SECTION:***

#### 630.03.70 MANHOLE ADJUSTMENT

- A. When adjusting manholes, all components must be set in a bed of grout: Burke Type V nonmetallic, nonshrink. Burke can be mixed with equal parts of sand and Type V cement for components, but shall be used full strength in pipe inverts.
- B. Range of grade ring height allowed for new manhole construction or existing manhole adjustment shall be 0 to 12 inches in accordance with the Design and Construction Standards for Wastewater Collection Systems, Drawing No. SD-5.

- C. Class A concrete collars for sanitary sewer manholes shall be constructed in accordance with the Design and Construction Standards for Wastewater Collection Systems, Drawing No. SD-4.
  
- D. When adjusting manholes, Contractor shall install plywood covers in sanitary sewer manhole inverts as well as steel plate covers over manholes (after manhole rings/frames are removed) to prevent debris from entering sewer manholes and corresponding lines. Debris in the manholes shall be removed prior to plywood removal. Plywood and steel covers for manholes shall be installed and removed in the presence of the CITY utilities inspector. All debris dropped into the sewer manholes and corresponding lines shall be retrieved at Contractor's expense. Contractor shall clean (e.g., jet vac or equivalent) the debris out of the affected manholes and/or sewer lines in the presence of the City's representative and approved by the Owner.

**END OF SECTION 630**

**SECTION 699**  
**SITE FURNISHINGS**

**DESCRIPTION**

**699.01.01 GENERAL**

- A. For Local Public Agency Infrastructure along Martin Luther King Boulevard, Grand Central Parkway, Charleston Boulevard, Alta Drive and other City maintained streetscapes, the Design Build Contractor shall follow the design Standards set forth in the City's Downtown Centennial Plan Standards with the exceptions set forth in this Special Provision and/or as shown on the plans.
- B. This special provision covers the quality and kind of materials to be used in the installation of:
1. Street Benches
  2. Trash Receptacles
  3. Bike Racks
  4. Tree Grate
  5. Sidewalk Concrete Finish

**MATERIALS**

**699.02.01 STREET BENCHES**

- A. Street benches shall meet the requirements of the attached detail herein.

**699.02.02 TRASH RECEPTACLES**

- A. Street benches shall meet the requirements of the attached detail herein.

**699.02.03 BIKE RACKS**

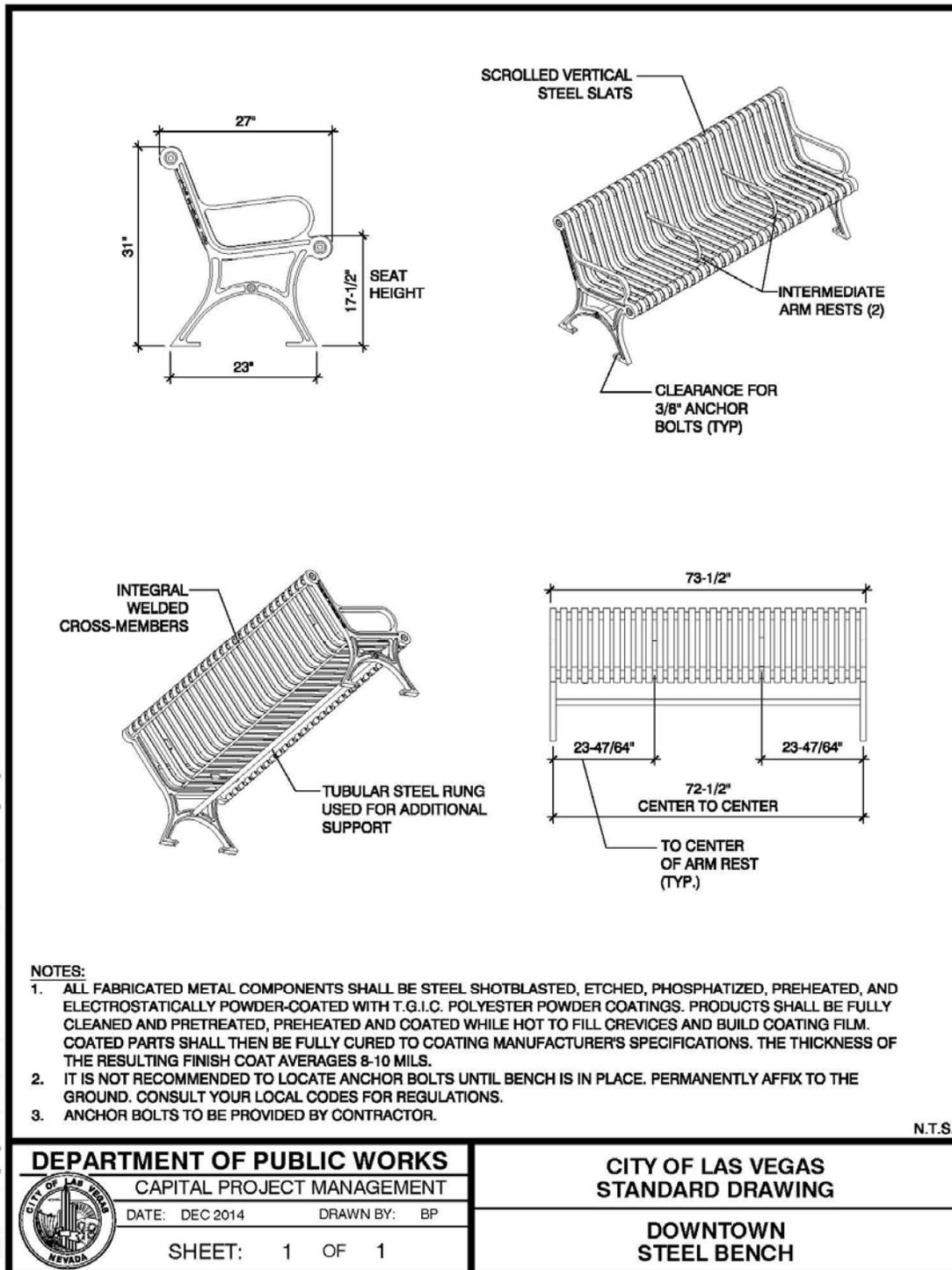
- A. Bike rack shall use "hoop rack" design, be powder coat finish with blue color manufactured by Dero Bike Rack Co., American Bicycle Security Company, or approved equal.

**699.02.04 TREE GRATE**

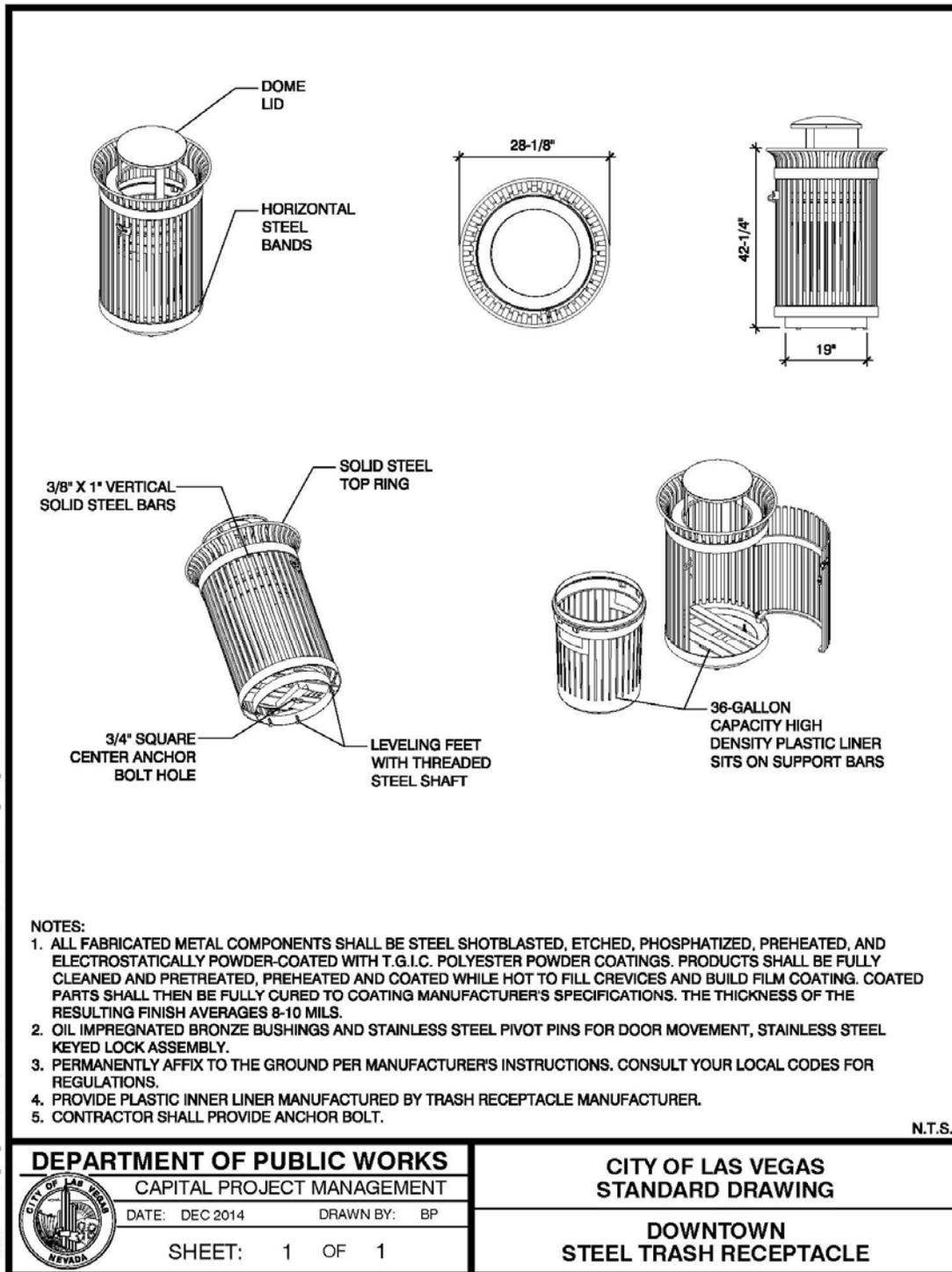
- A. Tree grates shall follow the City's Downtown Centennial Plan Standards.

**699.02.05 SIDEWALK AND ALLEY CONCRETE FINISH**

- A. Sidewalk panels shall be 5'x5' window pane style gray concrete with broom finish edging.



12/16/14 F:\PW\ENCL\DESIGN\DESIGN\CENTENNIAL STANDARDS\DWG\FOR GINALDOWN TOWN STEEL BENCH.DWG



12/16/14 F:\PW\ENG\DESIGN\DESIGN\CENTENNIAL STANDARDS\DWG\FOR GINALDOWN TOWN\_STEEL\_BENCH.DWG

END OF SECTION 699

**32 80 00 Irrigation**

**Irrigation.** Design irrigation systems, drainage, and turf layouts to prevent water from:

1. Staining, spotting, or otherwise creating a noticeable pattern on adjacent materials.
2. Causing deterioration of adjacent surfaces.
3. Draining through or over surfaces including all sporting and play activity surfaces.

**Irrigation Period.** Provide sufficient capacity and pressure to irrigate all turf areas during a 6-hour water window. (Drip irrigation may extend beyond this period if necessary)

**Irrigation Water Audit.** Include a landscape audit in the specifications if the design contains more than 1,000 square feet of turf. Include in the Construction Documents a requirement that the audit be conducted in the presence of the Owner's parks representative and approved by the Owner prior to the installation of any turf.

All overhead-irrigated landscape areas shall have a Landscape Irrigation Audit performed by a Certified Landscape Irrigation Auditor, certified and in good standing with the Irrigation Association (IA). The auditor shall be independent of the property owner and all contractors associated with the project. The audits will be conducted in accordance with the current edition of the IA's Landscape Irrigation Auditor's handbook. The minimum efficiency requirements to meet in the audit are 65% distribution uniformity for all fixed spray systems and 70% distribution uniformity for all rotary systems. The results of the audit shall be provided to the Owner in a report acceptable to the Owner and shall be signed by the Auditor. The report shall include controller number and location, station numbers, station locations, sprinkler head locations and distance between sprinkler heads, pressure reading per station, catch device readings and locations, distribution uniformity for individual stations, precipitation rates per station, and a 12 month irrigation schedule (runtimes per cycle, cycles per day, and days per week for each station). Compliance with this provision is required before the Owner will issue Final Payment to the Contractor.

**Rain Bird Rewards Program.** Insert the following language into the irrigation specification: The City of Las Vegas currently participates in the Maxicom Dollars Program. Under this rewards program, the City receives Maxicom Dollars for all Rain Bird products/components purchased for installation on City facilities, streetscapes and parks by its contractors/subcontractors. All invoices showing proof of purchase of Rain Bird products/components must be submitted to by the Contractor or landscape subcontractor to an Authorized Rain Bird Distributor (Horizon Distributors, 4224 Wynn Rd., 362-4224, formerly Turf Equipment Supply Company) on behalf of the City for acceptance of rewards. Purchases must be submitted within the same calendar year that the products listed are purchased. The Contractor or landscape subcontractor must submit a written receipt of confirmation from distributor that the guidelines for the program were followed and credits for rewards were issued to the City of Las Vegas, before the City will issue Final Payment to the Contractor. Failure of the Contractor to comply with this program will result in a reduction in the Contract Sum due the Contractor equal to 5% of value of all Rain Bird products used on the Project.

**Point of Connection.** Size of Service shall vary based upon the system requirements and demands. It is highly recommended that the size of the meter and mainline be sized adequately to run multiple valves concurrently. (See Irrigation Period Above) Refer to the Las Vegas Valley Water District's Uniform Design Standards for Water Distribution System Plate Numbers for installation. Review each site individually for adherence to a six-hour water window and future expansion.

**RPPA/Backflow Preventor.** Size of Reduced Pressure Principle Assembly/Backflow Preventor shall vary based upon the system requirements and demands. It is highly recommended that the RPPA/Backflow Preventor be sized adequately to run multiple valves concurrently. (See Irrigation Period Above) Refer to

the Las Vegas Valley Water District's Uniform Design Standards for Water Distribution System Plate Numbers for installation. Install all Reduced Pressure Principle Assembly/Backflow Preventor's upstream of the pump station.

In addition to the RPPAs required at the water meter connection locations, install on-site RPPAs upstream of any irrigation pumps to isolate the irrigation system from on-site potable water systems including water features, splash pads, pools, drinking fountains, and buildings. Do not use pressure vacuum breakers, double check valve assemblies or other less stringent methods of isolation for this purpose even if allowed by code. Double check valve assemblies are acceptable for hose connections to the potable water system.

If one water meter and RPPA is used for both irrigation and potable systems, it must be "upsized" to compensate for the two RPPAs that would otherwise be required.

**Master Valve.** Do not install master valves for parks.

**Flow Sensor.** Data Industrial IR-220B flow sensor, Smith-Blair model 315 service saddle (or approved equal) with 2" NPT tap for pipe connection. Install flow sensor in concrete valve box with metal lid. Flow sensor shall be installed in a straight run section of pipe, with 10 times pipe diameter upstream and 5 times pipe diameter downstream of the flow meter to achieve proper flow regime. Wire to output decoder installed in CCU per manufacturer's recommendations. Pump station to have GMP display built in.

**Sensor Cable.** Belden Model 9883, as recommended by the flow sensor manufacturer from the control system pulsed decoder to the flow sensor.

**Decoder.** Data Industrial Model 600-15 Pulse Output transmitter and Rain Bird Pulse Decoder. Install per manufacturer's requirements.

**Booster Pump.** [Link to typical setup.](#)

**General Note.** Provide adequate clearance for Owner's personnel to perform required maintenance.

**General Requirements.** Prefabricated pumping station, completely piped, wired, hydraulically and electrically tested on a structural steel skid before shipment to the job site. All components of the pumping system shall be designed to function in an outdoor environment exposed to all the elements. Furnish protective enclosure and cover as required for proper operation of the system. Pump station shall include skid assembly to support all components as the installed mounting base. Base shall be of sufficient size and strength to resist twisting and bending from hydraulic force and support the full weight of the pump and motor. Pump station manufacturer shall provide a factory-trained technician to supervise the installation of the pump station, pumps, and motors. Provide a minimum of one-day of training for Owner's staff in the operation, maintenance and programming of the system. Pump station components shall be supplied by and be the responsibility of one manufacturer, even though some components made are manufactured by others. Provide alternating starts for systems with two or more pump motors.

PSI shall be regulated by the use of variable frequency drives (VFD) or full size pressure reducing/sustaining valves (PRV, Clay or Bermad are acceptable.

**Variable Frequency Drives.** VFDs should be considered for pumps that are both:

- Used more than 1,000 hours per year, and
- 5 Horsepower or larger.
- Rated to 50° C
- Furnish a variable frequency drive that is IGBT based with selectable carrier frequency up to 15kHz. The VFD shall include terminals for incoming power, motor output power, and control terminals.

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- The VFD shall generate a sine-coded, variable voltage / frequency, three phase output for optimum speed control. The VFD shall incorporate power loss ride-through for a minimum of two seconds. VFD protective features shall include current limit, short circuit protection, electronic motor overload protection, and ground fault protection.
- The VFD shall be protected on the primary side by fuses of the appropriate amperage.

VFDs may be used for smaller less used pumps if the designer can demonstrate to the city that the advantages of a VFD for the application (power savings, soft starts and stops, future flow changes, single phase power use) outweighs the added cost. The designer is responsible to calculate that the life-cycle cost of the VFD is less than a PRV for the application.

Pump stations with less than 60 psi N.P.S. shall have secondary means of pressure regulation when primary means are VFD. If over 60 psi, a full main size bypass is required.

Select VFD pumps and motors that require:

- 
- Motor lead lengths within the manufacturer's recommendation (critical for smaller motors).
- A motor that is specifically designed for VFD applications (voltage spike insulation). Avoid 460V standard motors especially under 10 HP (230V standard motors may be acceptable).
- NEMA MG-1-1993, Part 31.40.4.2 (peak voltage of 1600 volts and a minimal rise time of 0.1 microseconds for motors rated less than 600 volts) when utilizing Insulated Gate Bipolar Transistors (IGBTs).

Pump Walled Enclosures. To be avoided, see Section 01 00 30 Park Design.

Acceptable Pump Manufacturers

Watertronics, 525 E Industrial Drive, Hartland, Wisconsin, 53029, 262-367-5000

Xylem Flowtronex Pumping Systems, 10661 Newkirk Street, Dallas, Texas 75220, 469-221-1200

Or Owner's approved equal

Pumps. Pumps shall be electric motor driven, close coupled, horizontal centrifugal with a self-adjusting type mechanical shaft seal. Pump and motor shall be constructed so that the motor and entire rotating element can be removed from the casing without disturbing the piping. All pump flanges shall have 150 PSI rating. Pump casing shall be constructed from cast or ductile iron. The impeller shall be enclosed, single piece bronze casting, completely machined on all outside surfaces, and statically balanced at the time of pump assembly. The impeller shall be keyed to the shaft and securely fastened. Bearings shall be roller or ball type of sufficient size to withstand the radial and axial thrust loads incurred during service. Shaft shall be stress-proof steel accurately machined and polished to transmit full fiver output. Shafts shall be protected by a renewable shaft sleeve. The coupling shall be designed to transmit full horsepower and torque load. Pump skid/base shall be of sufficient size and strength to resist twisting and bending from hydraulic forces and support the full weight of pumps and motors. Manufacturer shall provide and furnish performance data for the pumps.

Motors. Pump motors shall be squirrel cage induction horizontal solid shaft type. The temperature rise of the motor shall be to NEMA standard MG-1.12.42 for class B or class F insulation. Motors shall be inverter duty rated for continuous operation with a variable frequency drive controller. Furnish motors wired shall be capable of full voltage as required by local regulations. Motors shall be of proper size to drive the pump at any point on its operation curve without exceeding motor horsepower rating. Motors shall be manufactured under NEMA standards, or an approved equal.

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Piping. Pump piping shall conform to ASTM specifications A53 for Grade B welded or seamless pipe. All piping shall be Schedule 40. All welding flanges shall be forged steel with slip-on or welding neck type. All welding fittings shall be seamless, conforming to ASTM specification A234, with pressure rating not less than 150 PSI. All piping shall include vitaloc and ductile iron flange piping. Intake Piping: Furnish intake lines for all pumps constructed and fabricated from Schedule 40 carbon steel pipe, and equipped with isolation valves at each pump.

Dogleg Piping: Coat interior of all pump station dogleg drop piping using Scotch Kote 134 or equal fusion bonded epoxy coating prior to shipment of the skid. Apply coal tar epoxy coating and install polyethylene encasement (polywrap) on all steel piping below grade.

Electronic Ball Valves. Pump station manufacturer shall provide a simple switch by-pass back-up mode for constant pressure regulation in the event of VFD failure. The back-up mode shall automatically function on the fly during an event of a VFD failure, without loss of irrigation. The VFD back-up mode must provide constant pressure at variable flow without causing line surge. Utilizing the pressure relief valve is not an acceptable automatic back up mode due to its inability to provide surge free constant pressure regulation at variable flow demand. The automatic VFD by-pass mode shall be either controlled hydraulically through a pressure-regulating valve per pump or EBV (electronic butterfly valve(s)).

The pump station discharge pressure shall be regulated to provide surge-free constant pressure as programmed via the control panel operator interface. Discharge pressure shall be regulated by an Electronic Butterfly Valve, consisting of the following:

- a. Gradual entry of water from the EBV pump into the discharge manifold to allow for complete purging of pump column air and elimination of surges.
- b. Maintain programmed downstream pressure regardless of discharge flow.
- c. Up to six, user adjustable PID control settings to ensure accurate pressure regulation at all flows, programmed pressure, or connected pump combination.
- d. Adjustable pressure ramp-up and ramp-down to assure surge free pressure regulation.
- e. After a drop in pressure, gradually increase system pressure over a user adjustable period of time to eliminate surging.
- f. Rate of change of pressure control to anticipate and eliminate rapid pressure changes caused by changing system demand.

Adjustment of regulated downstream pressure shall be accomplished through the control panel operator interface. Individual pressure regulating valves shall be butterfly type with electric motor gear actuation. The maximum allowable pressure drop across the butterfly valve at full pump capacity shall not exceed one PSI. The Butterfly Valve shall be rated for not less than 285 PSI.

Drain Valves. Drain valves shall be provided at all low points in the system. Drain relief valves shall be piped to the outside of the pump enclosure, so that no water drains on the deck floor/skid plate.

Check Valves. Pump check valves shall be silent operating, non-slam type, cast iron bodied with bronze and stainless steel trim. Sealing surfaces shall utilize resilient Buna-N rubber. The valve design shall incorporate a center guided, spring loaded poppet, guided at opposite ends and having a short linear stroke that generates a flow area equal to the pipe diameter. Valves shall be sized to permit full pump capacity to discharge through them without exceeding a pressure drop of 2.5 PSI. Furnish check valves on the discharge of each pump.

Isolation Valves. Valves shall be butterfly type with the position lever or gear hand wheels and rated at 200 PSI working pressure. Trim shall include stainless steel stem, bronze streamlined disc, and full faces resilient seat. Isolation valves shall be installed on each pump inlet and outlet and on the discharge manifold.

Pump Bypass. Furnish pump bypass piping to operate the system for quick coupler requirements or in the event of power failure. Bypass shall be sized to full main line diameter with positive closing gate valve accessibility.

Gauges. Provide pressure gauges at appropriate location to read inlet pressure and discharge manifold pressure. Gauges shall be liquid filled, at least 2.5" in diameter, constructed with a stainless steel case, brass or bronze internals, and are vibration/pulsation dampened. Furnish ball valves installed below each gauge to provide total isolation of pressure gauges.

Electrical Enclosures. The electrical controls shall be mounted in a self contained NEMA 4 enclosure fabricated from not less than 12 gauge steel. Door gasket seals shall be neoprene sponge, sufficient to protect interior components from weather and dust. Door panels shall be constructed from 12-gauge steel with integral locking screws and latches. Operating handle for power disconnect shall be provided on the front of the panel. All external-operating devices shall be dust and weatherproof. All internal components of the enclosure shall be mounted on removable back panels. Mounting screws for components shall not be tapped in the panel enclosure. All internal wiring within, and interconnecting between, the panels shall be complete and no field wiring within the panels shall be required. Wiring troughs and cables raceways shall be self-contained within the enclosure and no external cable trays or wiring troughs are permitted. No pressure gauges, pressure switches, water activated devices, or water lines of any sort shall be installed in any electrical control panel.

Pump Motor Starters, Disconnect and Electrical Switch Gear. Pump motor starters shall be contained within a single NEMA 12 enclosure with a single access door and main disconnect. Each starter shall be protected on each power leg by a time delay fuse of the appropriate amperage. Motor starter coils shall be 240-460 volt operated. Overload relays shall be ambient-compensating type installed on each power leg and shall be set to trip at 105% of motor full-load current rating.

Master Control and Display Panel. Master control and display panel shall be NEMA 4 enclosure separate from the high voltage control panel and fabricated from not less than 12 gauge steel and equipped with a gasketed enclosure door. The incoming power shall be isolated by means of a circuit breaker or fused disconnect. The controller shall receive inputs from a flow sensor and pressure transducer and the 24 volt pump station relay located on the discharge manifold. Pump starting circuits, time delay circuits, stations safety shutdown circuits and any optional equipment control circuits shall have an operating voltage not exceeding 120 volts. All time delay control relays shall be plug-in type for easy replacement. The control panel shall be equipped with the following switches and displays: Manual on/off auto selector switches with green and red indicator lamps, individual pump elapsed time hour meters, digital LED discharge pressure display. Data flow industrial controller shall provide GPM information and Low/No flow emergency shut down.

Skid Wiring. Wiring from control panels to motors shall be in liquid-tight conduit with copper conductor rated not less than 600 volts AC and of proper size to carry the full load amperage of the motors without exceeding 70% capacity of the conductor. A grounding cable shall be included in the liquid-tight conduit. There shall be no splices between the motor starters and the motor connection boxes. Provide multi-conductor shielded cable suitable for Class II low voltage controls for wiring to flow sensors, and pressure transducers. Wiring should be rated for direct burial.

All wiring shall conform to the National Electrical Code Standards. Flexible conduit sections shall be under 5' in length to meet code. All conduit to devices shall be attached securely to avoid trip hazards.

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Lighting Arrestor. Main power supply feeding the pumping station shall be equipped with a 3 phase secondary lighting arrestor having a breakdown current rating of not less than 60,000 amps at 14,000 volts discharge. Power supplies, 300 volts and less, shall use 300 volt rated arrestor with 800-volt spark-over voltage. Power supplies 301-600 volts shall use 600 volt rated arrestors with a 1,000-volt spark-over voltage.

VFD Cooling fan. Sized to cool the VFD to a minimum of 50C.

Heater. 3Kw skid mounted thermostatically controlled. Steel housing, phased wiring to match pump drive, meets all UL, NEC and OSHA requirements.

Misc. Electrical Components. A three-pole main station disconnect shall be mounted in a separate NEMA 12 enclosure to completely isolate the electrical system from incoming power. The disconnect shall conform to the requirements of the NEC and applicable local codes. The disconnect shall have an operating handle on the front of the panel. Single-pole secondary distribution fuses with appropriate ratings shall supply power to each pump starter coil circuit, the control system, and to other circuits as specified. Each pump motor starter shall be equipped with an elapse time meter reading up to 999.9 hours in tenths of hours. The meter shall be installed in the electrical control cabinet. Corrosion inhibiting modules shall be installed in all electrical enclosures in accordance with the manufacturer's recommendations. The station shall be equipped with the following alarms: Low voltage safety shutdown, low discharge pressure safety shutdown, high discharge pressure safety shutdown, high temperature safety shutdown, starter failure cutout and VFD fault and bypass. Provide three phase monitors.

Standards. All wiring shall conform to the National Electrical Code Standards. Flexible conduit sections shall be less than 5' in length to meet code. All conduit devices shall be attached securely to avoid trip hazards. All controls and electrical equipment shall be thoroughly inspected and tested before shipment.

Pressure Transducer. Provide a solid-state pressure transducer to provide a noise free, linear output proportional to discharge pressure. Transducer shall be solid-state, strain gauge type with integral voltage regulating and output accuracy not less than .25%. Transducer shall be constructed of stainless steel and rated for the maximum pump station discharge pressure.

Flow Sensor. The pump station discharge manifold shall incorporate an insertion type, pulse frequency output flow sensor for continuous output to the pump station controls. Flow sensor output pulse shall be conditioned and fed directly to the PLC interrupt input for conversion and display in gallons per minute. For accuracy and security considerations, conversion to an analog signal prior to PLC input shall not be accepted. Flow sensor accuracy shall be no less than 2% for flow velocities ranging from 1-30 feet per second. Provide an optical isolator board, Rain Bird decoder, and two terminal connections for flow sensor reading by the irrigation controller.

Painting. Paint of the entire pump station shall consist of a multi-step coating system that includes metal preparation, rust inhibitive prime coat, and a two part polyurethane finish having a total dry film thickness of not less than 4 mils. Paint with manufacturer's standard colors. All electrical enclosures, tanks and accessory panels shall be painted to a minimum thickness of 3 mils and baked at 160-180 F. No exposed aluminum will be permitted.

**Operation.** Operation:

The pump station shall have two operating points.

When water is being supplied to the irrigation system from the lake and vertical turbine pumping system, the booster pumping system will be programmed not to operate.

When the municipal (potable) water service is connected to the booster pump and supplying water directly to the irrigation system the booster pump operation point shall be as shown on the drawings.

The pump station controls shall provide automatic pressure regulation based on variable flow. The controls shall be capable of changing the regulated downstream pressure while in operation based on flow or a discrete input signal.

The pump system controls shall be capable of up to six user adjustable pressure regulation set points based on flow or one additional set point based on a discrete input.

In addition to adjustment of downstream pressure, the controls shall be capable of up to six pressure regulation algorithms to insure accurate pressure regulation regardless of the regulated pressure or discharge flow.

**Valve Locations.** Locate all valves outside of asphalt and concrete surfaces.

**Gate/Isolation Valves.** Provide gate/isolation valves so that open space areas/fields can be shut down without interrupting service to remaining areas.

- For gate/isolation valve 2" and greater, install resilient wedge model gate valve conforming to AWWA C-509 standards. Valve shall be equipped with square operating nut. Nominal size of gate/isolation valve shall match mainline size.
- For gate/isolation valve on lines less than 2", install threaded bronze gate/isolation valve with solid wedge, non-rising stem, Nibco T113 or approved equal. Nominal size of gate/isolation valve shall match mainline size.
- For valves located more than 2 feet below grade, install no valves less than 2" in size regardless of pipe size, with square operating nut.
- Install gate/isolation valve above grade in pump enclosure or bury below grade in round concrete valve box with metal lid. 6 Inch PVC class 200 sleeve, length as required, shall be installed from the gate/isolation valve (mainline) up to within 2 inches of the valve box lid per provided detail.

**Quick Coupler Valves.** Rain Bird 44 NP, 1", 30 GPM. Contractor shall provide 44K, 1", Corresponding Valve Key and SH-1, 1", Hose Swivel. Provide one set of Key and Hose Swivel to the Owner's maintenance staff for each five quick coupler installed. Install quick coupler valve, including filling the valve box with concrete, per provided detail.

Sports Fields Quick Couplers. Connect quick couplers at sports fields to not less than 1-1/2" PVC line size and at least one isolation valve per sports field quick coupler feed.

**Ball/Flush Valve.** Schedule 80 PVC Ball Valve with ABS handle shall be installed at all Remote Control/Drip Valve Assembly locations and in all piping under pressure (mainline). Schedule 40 PVC Ball Valve with ABS handle shall be installed at all flush valve locations (lateral/drip).

**Automatic Control Valve.** Rain Bird Electric Remote-Control Valve PEB-Series, 100 for 1" line and 200 for 2" line. Install below grade in pre-cast concrete valve box with metal lid. Valve shall be numbered with Christy identification tag (T. Christy Enterprises, Inc., Anaheim, CA). Install automatic control valve per provided detail including Schedule 80 PVC ball valve and fittings.

**Automatic Control Valve with Drip Assembly.** Rain Bird Electric Remote-Control Valve 100-PEB Series, Rain Bird Wye Filter RBY-100-200MX, Rain Bird Pressure Regulator PSI-M30X-100. Install automatic control valve with drip assembly below grade in pre-cast concrete jumbo valve box (25" x 15" minimum size) with metal lid. Install automatic control valve with drip assembly per provided detail including Schedule 80 PVC ball valve and fittings.

**Concrete Valve Boxes.** Pre-cast concrete rectangular valve box with metal lids, size adequately to house valve, plus components. For control valve with drip assembly, jumbo valve box with metal lid is required. For quick coupler or drip lateral flush valves, a 10" round concrete valve box with a round metal lid is required. Turf and drip valve boxes shall be installed level, lined-up, flush with grade in planting areas where possible. Valve boxes shall not be placed in sports playing fields.

The designer is to verify with the Owner whether locks are to be specified on valve boxes when located in the right-of-way. Locks on valve boxes are not required in parks.

**Site Satellite Controller.** Rain Bird ESP-Site Satellite Controller. This controller combines all features of the ESP-Sat Controller and the Cluster Control Unit (CCU) into one. The control unit shall be stainless steel, pedestal mount. This control unit shall be used on small sites, when one satellite/CCU is required. Communication from the central computer shall be hardwire when possible. Contractor shall install 1" conduit with pull-string from telephone terminal board (TTB) location to the control unit. Electrical requirements for operation are 120 VAC with toggle disconnect/switch. Provide 1" conduit with pull-string from the electrical service panel to the control unit. Provide 1" conduit with pull-string from the site satellites to the pump. Label each station on the controller lid with waterproof card and provide waterproof reduced color-coded site plan complete with station identification.

**Cluster Control Unit (CCU).** Rain Bird Cluster Control Unit (CCU). The CCU is the interface between the central control and the field satellites for the Maxicom<sup>2</sup> system. The unit shall be stainless steel, pedestal mount, located adjacent too, and in-line with the field satellites when grouped together. Size shall vary based upon the number of field satellites required for the project. Contractor shall install 1" conduit with communication wire from telephone terminal board (TTB) location to the CCU. Communication from the central computer shall be hardwired rather than cell phone whenever possible. Install 1" conduit with maxi wire between the CCU and the field satellites. Electrical requirements for operation are 120 VAC with toggle disconnect/switch. Provide 1" conduit with pull string from the electrical service panel to the CCU and 1" conduit with pull string from the CCU to the pump. Provide waterproof reduced color-coded site plan complete with controller location.

**Field Satellites.** Rain Bird ESP-SAT Field Satellite Controller. The field satellites interface with the CCU. The satellite controller shall be stainless steel, pedestal mount, located adjacent too, and in-line with other satellites and CCU when grouped together. Station number requirements, and the number of satellites shall vary based upon project size and valve quantities. Contractor shall install 1" conduit with maxi wire between the field satellites and CCU. Electrical requirements for operation are 120 VAC with toggle disconnect/switch. Provide 1" conduit with pull-string from the electrical service panel to the field satellites. Provide 1" conduit with pull-string from the field satellites to the pump. Label each station on the controller lid with waterproof card and provide waterproof reduced color-coded site plan complete with station identification.

**Hand-Held Remote Control Unit.** Hand-held Remote Control System shall be TRC Commander, as manufactured by Remote Control Technologies, 18342 Redmond Way, Redmond, WA 98052, 800-275-8558. The Hand-held Remote Control Features shall include the following: Automatic resetting fuse on receiver, multiple station capabilities, operates on 24 VAC-solenoids, master valve or pump disable, programmable time duration, receiver built-in safety default, direct controller interface ready. Included with the system shall be the carrying case, transmitter, receiver-32 stations, 32 station PCC, two antennas, one 9-volt alkaline battery and accessory pack. Mount antenna to provide communication with all areas of the project. Provide one remote per each 20 acres of project site area.

**Control Wire.** UF-UL American Wire Gauge 12/14 Solid Copper Direct Burial Wire. Follow mainline piping where possible. Wire color shall be continuous over entire length. All splicing of wire shall occur within the valve box at valve locations using 3M-DBY/DBR wire connectors. Intermediate splicing may occur, but the splice shall be placed in a valve box. Use white wire for common ground wire. Use easily distinguished colors for control wire. Install 3 spare wires looped through each valve location. If multiple

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controllers are required for the project, the wire colors shall be the following:

Controller "A" Control wire: Red	Common wire: White with red stripe
Controller "B" Control wire: Brown	Common wire: White with brown stripe
Controller "C" Control wire: Blue	Common wire: White with blue stripe
Controller "D" Control wire: Green	Common wire: White with green stripe

**Communication Wire (maxi wire).** Anixter F-03P19BPD Direct Burial Wire, or approved equal, between the Cluster Control Units and the Field Satellites. All splicing of communication wire shall occur within the valve box at valve locations using 3M-DBY wire connectors or DBR. Intermediate splicing may occur, but the splice shall be placed in a valve box.

**Pipe and Valve Over Sizing.** Designer shall design the irrigation system to utilize no more than 70 percent of the maximum design capacity of the pipe and valves in all lines (oversize the pipe). Provide no PVC pipe less than 1 inch in size. Indicate, at each valve location on the drawings, both the design flow and maximum capacity in GPM.

**Mainline Pipe.** Provide minimum cover of 24 inches over pipe to finish grade.

For pipe sizes over 3 inches, provide Class 200 PVC, SDR-21, rated at 200 PSI, conforming to the dimensions and tolerances established by ASTM D2241, with an integral belled end suitable for solvent welding.

For line sizes up to 3 inches, provide Schedule 40 PVC conforming to the dimensions and tolerances established by ASTM Standard D 1785, with an integral belled end suitable for solvent welding.

**Pipe Saddles.** Provide ductile iron saddle clamps for lateral connections to pipes 4 inch and larger.

**Thrust Blocks.** Thrust blocks shall be required on pipe greater than or equal to 3-inch diameter or for all rubber gasketed pipe. Thrust blocks shall be 3000 PSI cast-in-place concrete bearing against undisturbed soil. Wrap fitting with 2 mil. plastic to protect bolts, joints, and fittings from concrete. No. 4 rebar with mastic coating shall be installed where pipe shall be anchored to the thrust blocks, and at all location where mainline pipe changes directions. Install thrust blocks so the horizontal and vertical dimensions of the thrust blocks are approximately equal. Size thrust blocks per provided detail to be included in the construction drawings by the designer.

**Lateral Pipe.** Schedule 40 PVC conforming to the dimensions and tolerances established by ASTM Standard D1785, with an integral belled end suitable for solvent welding. (Minimum cover- 12" over pipe to finish grade)

**Fittings/Nipple.** Schedule 80 PVC fittings/nipples shall be installed unless otherwise noted. Lateral pipe may use schedule 40 PVC fittings unless otherwise noted.

**Drip Lateral Pipe/PVC Hose.** Schedule 40 PVC conforming to the dimensions and tolerances established by ASTM Standard D 1785, with an integral belled end suitable for solvent welding. PVC hose shall be ½" IPS Excalibur (no substitutions). Maximum length of the PVC hose shall be 48". (Minimum cover- 12" over pipe to finish grade.)

**Valve Box Pipe.** Provide a minimum of 24" of straight pipe outside of valve boxes for all pipe entering and exiting valve boxes, with no changes in size pipe size from the valve to 24" outside of the box.

**Sleeving.** Schedule 40 PVC conforming to the dimensions and tolerances established by ASTM Standard D 1785, with an integral belled end suitable for solvent welding. Sleeving diameter shall be a minimum of twice that of the pipe or wiring bundle passing through the sleeve, or larger is noted otherwise. (Minimum cover-24" over pipe to finish grade.)

**Backfill.** Prior to backfill, all mainline and lateral pipe shall be reviewed by the Owner's representative and corrections made by the Contractor. All mainline shall be bedded with masonry sand 4" below and 4" above the pipe. All pipe trench backfill shall be 1 inch minus, clean, native material.

**Irrigation Heads.**

**Spray Heads.** Rain Bird 1806 Heads with plastic matched precipitation nozzles. Heads shall be installed plumb with swing joints. Install using side inlet with head flush with grade. (Note: 1806 SAM (seal-automatic) heads shall be installed when there is severe elevation change across the site. SAM heads require installation through the bottom inlet.)

**Impact Rotor Heads.** Rain Bird 41-51 Series brass impact rotors with high-impact plastic cases and color-coded plastic nozzles for heavy-traffic large turf applications. Heads shall be installed plumb with swing joints.

**Gear Rotor Heads.** Rain Bird 5500, 7005 and 8005 gear driven rotors with integral rubber cover and Rain Curtain nozzles or Hunter I-20's and I-25's gear driven rotors with integral rubber cover and plastic color-coded nozzles. Head shall be installed plumb with swing joints.

**Drip Emitters.** Bowsmith drip pressure compensation 1 or 2 GPH emitters. Install emitters on the uphill side of the root ball at slope locations. Equally space the required number of emitters around the perimeter of the plant at the edge of the root ball.

Emitters shall be installed on black male ½" threaded adaptors, which shall be solvent welded to the PVC hose. PVC hose shall be ½" IPS Excalibur (no substitutions). Maximum length of the PVC hose shall be 48".

**Drip Line.** Netafim (no substitutions) may be used in roadway medians for all irrigation and in parks for trees only. Drip line shall be laid in equal rows, not rings, on-surface and covered with two inches of decomposed granite, do not bury. Do not use push-plug connectors at the lateral connection. Netafim USA, 5470 East Home Ave., Fresno, CA 93727, 559.453.6800.

**Swing Joint.** Swing joints shall be schedule 80 PVC nipples and Marlex street ELLs per provided detail. ([linked detail scan](#))

**Mainline/Hydrostatic Test.** Upon completion of the irrigation main, and prior to the installation of any automatic control valves, test the entire main or portions of the main for proper operation. Flush all air from the mains being tested and check all components for proper operation. After completion of the flushing operation, test the mainline with 150-PSI hydrostatic pressure for a minimum of 2 hours. After the pressure within the mains has stabilized, no pressure loss will be allowed for the test period. Remove and/or replace any item or component of the system which does not comply with the test, and test the entire system again until satisfactory test result are obtained. Contractor shall request observation by the Owner's representative 48 hours prior to testing. The test shall be made in the presence of the Owner's representative, signed and dated.

**Coverage Observation.** Upon completion of the irrigation system and with the Owner's representative present, Contractor shall perform a coverage test on all components of the system to verify 100% coverage. The Contractor shall perform all work and furnish all materials necessary to correct any inadequacies and adjust heads/emitters as required.

**Baseball/Softball- Special Irrigation Requirements (both turf and skinned infields).**

Provide quick couplers and pop-up heads per the provided detail. [Click for link to details.](#)

**Football/Soccer- Special Irrigation Requirements.** None.

**Warranty.** Provide one-year minimum warranty from commencement of substantial completion on all irrigation material, equipment and workmanship against defects and failure. Fill and repair all depressions and settling of irrigation trenches and excavations. Repair damage to all premises/facilities caused by defective items. Repairs shall be made with three days of notification from the Owner.

**Extra Materials.** Provide the following spare materials to the Owner to match those used on the Project:

- 1 Field Satellite Controller if any used.
  - 5 Irrigation Heads of each type and model used.
  - 5 Quick Coupler Valves if any used. Also provide keys and hose swivels as previously stated in the quick coupler section.
  - 5 Automatic Control Valves, Remote-Control Valves, Wye Filters, and Pressure Regulators if any used.
- 5 PVC Ball/Flush Valves of each type and size used.

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