

ADA COUNTY HIGHWAY DISTRICT

1131 – Illumination, Traffic Signal Systems and Electrical

ACHD Supplemental Provisions

11/25/2014

This section outlines ACHD's traffic supplemental provisions for illumination, traffic signal systems and electrical requirements for relevant work in Ada County.

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1131.01 — GENERAL REQUIREMENTS

(Revised: 11/5/2013)

A. Description of Work

The work to be performed shall consist of the installation of a complete and operable traffic signal, illumination for intersection safety lighting and related electrical systems. All work performed shall conform to the latest version of the **National Electrical Code (NEC)**, all applicable state and local regulations and these supplemental provisions.

The Contractor shall install all electrical conduit, wiring, traffic signal and pedestrian poles, vehicle and pedestrian signal heads, pedestrian push buttons, luminaires, Opticom detectors, video detection cameras, junction boxes, traffic signs mounted on the signal poles or mast arms, and other incidental materials as required to comply with the plans and these Supplemental Provisions. All materials necessary for the complete installation shall be furnished by the Contractor with the exception of materials specifically noted to be furnished by Ada County Highway District (ACHD) or other agencies. Contractor shall contact the ACHD Traffic Operations Supervisor a minimum of 30 calendar days in advance to schedule pick up of items supplied by ACHD. Contractor shall verify pick up time, date and location a minimum of two business days in advance of pick up.

The materials to be incorporated in the installation of traffic signals and intersection safety lighting shall be listed in the bid package. All materials and methods required under this section, unless otherwise superseded herein, shall conform to the current **Manual on Uniform Traffic Control Devices (MUTCD)** and to the **ATSSA Quality Standards for Work Zone Traffic Control Devices**.

B. Restrictions on the Scope of Work

1. Mast Arm Erection Timing

Mast arms shall not be erected more than ten days prior to energizing the signal system. Variance from this requirement shall require prior approval by the ACHD Traffic Engineer.

2. Signal Head Installation and Covering

All vehicle and pedestrian heads shall be securely and completely covered with opaque material between installation and signal turn on. Signal head covers shall be made of heavy, waterproof material and shall be securable by braided nylon rope. Contractor shall monitor the signal heads to ensure that the covers are securely and completely covering the signal heads while the signal is not in operation.

3. Work in Roadway

The roadway shall be kept open to traffic at all times, except when specific tasks that require construction in the roadway or lane closures are approved by ACHD. All roadway trench crossings shall be conducted at night between 7:00 pm and 6:00 am, unless otherwise approved by the ACHD Traffic Engineer. All other work within the traveled way of any roadway shall be limited to the hours between 9:00 am and 4:00 pm, unless otherwise directed by ACHD. At least one lane in each direction shall remain open to traffic on every leg of all intersections during working hours, except

for mast arm erection. Exceptions will require a two business day advanced approval from the ACHD Traffic Engineer.

4. Traffic Control during Construction

During the erection of mast arm assemblies, the Contractor, with the authorization of the ACHD Traffic Engineer, may block all traffic lanes for a maximum of five minutes between 9:00 am and 2:00 pm any day of the week.

Construction activities that require lane closures longer than five minutes will require a detailed traffic control plan that has been approved by ACHD. Contractor shall not begin such activities until after receiving written approval from ACHD.

The Contractor shall furnish flaggers for traffic control during all roadway work performed at night, for all roadway work performed within 150 feet of an intersection, and for all other conditions where the ACHD Traffic Engineer deems it necessary for safety and traffic operation. All flaggers shall be certified by ATSSA, or other ACHD approved association. All flagging certifications shall be current. Payment for the flaggers shall be made as set forth in the contract.

5. New Traffic Signal Turn-On and Temporary Signal Modifications

Signal turn-on to full operation or in a modified configuration (generally associated with work zone traffic control) shall not be allowed on Mondays, Fridays, weekends or holidays and shall be completed between the hours of 9:00 am and 3:00 am on the day of the turn-on. Exceptions may be allowed by the ACHD Traffic Engineer on a case by case basis. No turn-on shall be allowed until all of the requisite pavement markings and signs, as shown on the Plans and/or specified in these Supplemental Provisions, are installed.

The Contractor shall not energize or deactivate the signal system or any of its parts that are visible to motorists; only an ACHD Electronic Technician or designated representative is permitted to perform either function. The Contractor shall provide for the proper control of traffic during the turn-on procedure as directed by ACHD.

The ACHD Traffic Operations Engineer shall be responsible for entering all signal timing parameters, and shall certify that the intersection is operating and functioning in accordance with the Plans and these Supplemental Provisions. Before the controller is connected and the traffic signal made operational, the Contractor shall perform all field tests as specified in these Supplemental Provisions. The Contractor shall be present during the turn-on with adequate equipment and personnel to repair any deficiencies in the signal operation.

The ACHD Traffic Operations Engineer shall be notified a minimum of five business days in advance of the desired turn-on date. No turn-on will be allowed until the ACHD Electronic Technician or designated representative has completely checked the installation (independent of the Contractor's tests) and approved turn-on.

6. Inspection of Work

The Contractor shall complete and document all work in a manner that provides the ACHD Resident

Project Representative or the ACHD Traffic Engineer with full knowledge of the construction. Work shall proceed in accordance with the approved construction schedule supplied at the preconstruction meeting, and as approved by ACHD. The ACHD Resident Project Representative, ACHD Traffic Engineer or ACHD Inspector may, at their option, require work completed without their knowledge or inspection to be dismantled, at the Contractor's expense, so that it can be inspected for conformance to the specifications.

Any inspection and associated testing is for the sole benefit of the ACHD and shall not relieve the Contractor of the responsibility of providing quality control measures to assure the work complies with the contract requirements.

7. Permits

The Contractor shall be responsible for coordinating, obtaining, and paying for all permits necessary to complete all work in a timely fashion.

C. Operational Field Testing

Any item furnished by ACHD and installed by the Contractor, which fails due to no fault of the Contractor, will be corrected by ACHD at no expense to the Contractor.

D. Removal and Salvage

All existing equipment, signs, traffic signal devices, street lighting and other materials designated by ACHD to be removed and salvaged shall remain the property of ACHD. These items shall be delivered by the Contractor immediately upon their removal to an ACHD facility as designated on the Plans or as directed by the ACHD Signal Inspector. Any material damaged or destroyed due to Contractor's negligence shall be replaced by the Contractor at his expense.

E. Removal of Unwanted Material

The Contractor shall be responsible for removal and disposal of all other unwanted material created by the required removal of items shown on the Plans or specified herein. Unless otherwise directed by the ACHD Traffic Operations Engineer or shown on the Plans, all foundations and junction boxes not to be reused shall be removed entirely. The conduits connecting to the foundation shall either be cut off and capped or removed, as directed by ACHD.

When a foundation is to be abandoned, the top of the foundation, anchor bolts, and conduits shall be removed to a depth not less than six inches below the surface of sidewalk or unimproved ground. The resulting hole shall be backfilled with material equivalent to the surrounding material.

F. Bonding and Grounding

Bonding and grounding shall conform to the latest edition of the **National Electrical Code (NEC)**, all applicable State and local regulations and these supplemental provisions.

1131.01.01.A – TRAFFIC SIGNAL AND ILLUMINATION SYSTEM – RECTANGULAR RAPID FLASHING BEACON (RRFB)

(Revised: 2/18/2014)

A. General Requirements

The work for this item shall include all costs associated with furnishing and installing Rectangular Rapid Flashing Beacon (RRFB) systems as shown on the Plans and as specified in the Standard Specifications and these Special Provisions.

1. The contractor shall install RRFB crosswalk systems, which shall be fully compliant with MUTCD and FHWA guidelines and standards, shall be approved by ACHD, and shall be installed at locations indicated on the Plans.
2. Each RRFB shall consist of two (2) or more rapidly and alternately flashed rectangular yellow indications having LED array based pulsing light sources, shall be designed, located, and operated as shown on the Plans, and shall be in full compliance with MUTCD and FHWA guidelines and standards.
3. Each RRFB shall be a complete two-directional crosswalk warning installation consisting of RRFBs, pedestrian notification lights, push buttons with signs, RRFB controller, electrical components, conduit and pull boxes, and all required hardware for installation on ACHD- supplied poles as shown on the Plans.

B. Functional Requirements

1. Each RRFB shall be AC powered as shown on the Plans.
2. Each RRFB shall be activated by ADA compliant push buttons.
3. The RRFB shall rest in dark mode. It shall initiate operation only upon pedestrian actuation and shall cease operation after a predetermined time limit.
4. On multilane facilities (four or more vehicular travel lanes), each side of the street shall operate independently (i.e. RRFBs for crossing of north half of street will activate when north side push buttons are triggered; RRFBs for crossing of south half of street will activate when south side push buttons are triggered). On facilities with three or fewer travel lanes, the RRFB may actuate with both directions running simultaneously. This determination should be specified on the plans or in consultation with the ACHD Traffic Engineer.
5. All RRFB control equipment shall be housed in one aluminum cabinet if both directions run simultaneously. Two cabinets may be required if each direction runs independently or if otherwise specified on the Plans.
6. A small light directed at and visible to pedestrians in the crosswalk shall be installed integral to the RRFB to give confirmation to the pedestrians that the RRFB is in operation.
7. Each RRFB shall provide a unidirectional indication to motorists according to the appropriate direction of travel for each side of the street.
8. All RRFB elements shall meet the Society of Automotive Engineers (SAE) J595 requirements for Class 1 peak luminous intensity (candelas).

C. Mechanical Construction Requirements

1. Each RRFB indication shall be a minimum size of 5 inches wide by 2 inches high.
2. Beacons shall have LED bulbs and be highly visible from a minimum of 500 feet in advance of

the crosswalk during the day and 1,000 feet in advance of the crosswalk at night. No dimming of the LED elements shall be permitted during daylight hours.

3. LEDs shall be recessed in the flash bar with an additional polycarbonate shield for vandal resistance.
4. RRFB display head cabinet shall be durable, corrosion resistant, powder-coated aluminum.

D. Controller

1. Enclosure: Controller unit shall be housed in a NEMA 3R rated, pole mounted, aluminum cabinet with a stainless steel hinge (or approved equal).
2. Controller unit shall operate as described under section B.4 of these Standard Provisions.
3. Power: Controller unit shall be AC powered through a direct power connection as shown on the Plans and operate at 120V.

E. Warranty

1. All RRFB system equipment shall be supported by a minimum 2-year warranty.
2. LEDs shall be rated for a minimum of 10 years.

1131.02 – REMOVED

1131.03 – VIDEO DETECTION SYSTEM

(Revised: 12/28/2011)

A. Description

The following specification describes the minimum requirements for providing a complete Video Detection System. Initially, the system shall be capable of providing presence vehicle detection at selected intersections. The video system shall be expandable without removing or replacing existing units.

Acceptable systems include that of any manufacturer whose system has successfully passed a 60 day ACHD field test, provided such equipment meets qualifying specifications identified herein, and whose video module is compatible with ACHD's traffic signal central software, Naztec, atms.now.

The purpose of the Video Image Processor is to detect the presence of vehicles over optical detection zones, which are placed on a standard video image (CCIR or EIA). Using standard image sensor optics and in the absence of occlusion, the system shall be able to detect vehicle presence with 98% accuracy under normal conditions (days and nights), and 96% accuracy under adverse conditions (fog, rain, snow).

All items and materials furnished shall be new, unused, current production models installed and operational in a user environment and shall be items currently in distribution. The detection algorithms shall have a proven record of field use at other installations for at least three (3) years of service i.e., not including prototype field trials prior to installation. Video cameras shall be available commercially; no sole source cameras will be allowed.

These technical specifications describe the minimum physical and functional properties of a video detection system. The system shall be capable of monitoring all licensed vehicles on the roadway, providing video detection for areas outlined in the construction drawings.

B. Materials

The entire video vehicle detection system shall consist of the following:

- Video image processing unit(s) – rack mountable
- ViewCom – Remote Monitoring, Video Image Storage and Communication card
- Video Camera(s) with IR Filter, Lens, Enclosure, and Sunshield
- Luminaire Arm or Signal Mast Arm Sensor Bracket(s)
- Surge Suppressor
- Programming Devices and/or Software. Coax/Power Cable
- All Other Necessary Equipment for Operation
- Training for Installation, Operation, and Maintenance

The following equipment package has been pre-approved for use by ACHD:

- Traficon VIP3.1/D and/or VIP3.2/D. and/or VIP3.1/Ds and/or VIP3.2/Ds
- Traficon 2 CH. I/Os – 4 Ch. I/Os Traficon ViewCom/E-MAX Naxtec by Traficon – VU Com
- Aigis Outdoor Camera Housing – HS9384
- Aigis Camera Housing Sunshield – HS9384SS FLIR thermal camera (as required by ACHD)
- Rainbow Camera Model CL54ZD65K (standard video detection camera) Sony 1/3” Super HAD II Color CCD 6.5-65mm 10x zoom lens
- Rainbow LCD 8” Flat Screen Monitor-RL8
- Pelco Extended Mast Arm Camera Mount - AB-0172-L-L Kar-Gor, Inc., Universal Camera Mount – MA/SOP-16
- Hesco/RLS Coaxial Surge Suppressor – HE75CX
- Coaxial + 5 Conductor Wire - RG59/U + STR PE/PVC 600V KG-9915

1. Video Image Processor

The Video Image Processor (VIP) shall be modular by design and housed in either a self-contained stand-alone unit or fit directly into NEMA TS2 type racks as well as Type 2070 input files. The VIP shall be interchangeable between a shelf or rack mount installation without replacing or modifying existing VIP units.

The system shall control from 1 to 4 VIP boards allowing for 1 to 8 image sensors.

The system shall be designed to operate reliably in the adverse environment of roadside cabinets and shall meet or exceed all NEMA TS2, as well as Type 2070 environmental specifications.

Ambient operating temperature shall be from –34 to +74 degrees Centigrade at 0 to 95% relative humidity non-condensing.

The system shall be powered by 12-40 VDC and draw less than 2 amperes.

The system shall utilize cabinet 24 VDC for rack mount installations or external 24 VDC for stand-alone shelf installations.

Surge ratings shall be set forth in the NEMA TS2 specifications.

Serial communications shall be through an RS232 serial port. This port can be used for communications into a modem or laptop to upload/download detector configurations, count data and software upgrades. RS485 on the rear edge connector shall facilitate communications to other VIP boards.

Each VIP board shall have 4 opto-isolated open collector outputs. Twenty (20) additional outputs shall be available via the expansion port. The VIP/3D shall have 20 presence detection zones and 4 data detection zones per camera. Data zones shall collect and store vehicle counts, volume, speed, gap time, headway, occupancy, and classification. Data shall be time-stamped (6713 intervals) and stored onboard (non-volatile memory) in intervals from 1-60 minutes.

Data alarms are generated for the following: queue, inverse direction, speed drop, no video, and errors. The system must be able to provide single or double loop emulation.

Presence hold time must have parameters that range from 10 to 600 seconds.

Each VIP board shall allow for 20 digital inputs via the I/O Expansion port.

Each VIP board shall have error detection. Outputs will be turned “ON” if the video signal is bad or the VIP board is not functioning properly. A user defined quality level will automatically put selected outputs to recall in cases of severe degraded visibility (i.e., fog, blizzard, etc.). Normal detection resumes when visibility improves above the user defined quality level.

Operator selectable recall shall be available via the VIP front panel. Holding the recall switch on for 5 seconds shall activate this function.

A video select button on the VIP front panel will switch between camera images of the VIP3D.2.

The VIP3D.1 board shall have 1 video input; the VIP3D.2 board shall have 2 video inputs (RS-170 NTSC or CCIR composite video) and one video out.

The VIP board shall have a reset button on the front panel to reset video detectors to “learn” the roadway image. During “relearn”, selectable recall can be enabled or disabled for immediate operation. Learning time of video detectors shall be less than 6 minutes.

External surge suppression independent of the VIP board shall separate the VIP from the image sensor. The VIP board shall have separate light emitting diodes (LEDs) that indicate:

POWER	Red Led to verify power supply.
I/O COMM	Red Led to indicate communications to expansion boards.
VIDEO 1 & 2	Red Led to verify the presence of video input 75 Ohm.
TX & RX	Red Led to indicate communications to other VIP modules via the RS485.
OUT1- OUT4	Green LED if the corresponding detection group is active.

The VIP board shall also have 2 separate buttons for “video select” and “recall”:

RECALL	Manually places call on detectors.
RESET	Manually reset detectors to “learn” new background.
VIDEO OUT	The VIP board shall also have a video out female RCA style connector.
SERVICE	B9 female Service port and DB9 I/O Expansion port.

The VIP Expansion board shall also have separate LEDs that indicate:

POWER	Red LED to verify power supply.
COMM	Red LED to indicate communications to VIP board.
I/O1- I/O4	Green LED if the corresponding detection group is active.

The VIP Expansion board shall have 8 dip switches that define inputs and outputs used (range: 1-12 or 13-24).

a. Event Log Database

The VIP module shall have an onboard database capable of time stamping and storing 500 events. The Event Log Database can be viewed or downloaded to a selected spread sheet. Erasure of the Event Log Database shall not alter programmed configurations. As a minimum, the VIP shall log and timestamp the following events:

- Firmware upgrade;
- Loss of video signal;
- Resumption of video signal;
- Configuration change;
- Poor video quality;
- Loss of power to VIP module;
- Resumption of power to VIP module;
- Speed alarm;
- Inverse direction;
- Recall activation.

b. Functional Capabilities

Each VIP board shall be capable of processing the video signal of one or two cameras. The video signal shall be analyzed in real time (30 times per second for NTSC video format and 25 frames per second for pal video format).

The system shall be expandable up to 8 cameras that may be connected to different VIP units and programmed independently.

The system shall be capable of displaying detectors on the video image with associated outputs. Outputs/Inputs status will be indicated on the screen. Parameters will also include the ability to view raw video without any verbiage and/or detectors for surveillance purposes.

Each VIP board will detect within the view of the connected camera the presence of vehicles in user defined zones. Detectors available shall be presence, count, delay, extension, or pulse mode for either arrival or departure of vehicles. Delay and extension shall be defined between 0.1 – 99.9 seconds and pulse mode between 0 – 200ms in 33ms increments if NTSC is used. Each VIP board shall also detect and collect within the view of the connected camera traffic data of passing vehicles in user-defined zones.

Collected traffic data by direction shall include:

- Volume (absolute numbers) per length class and per lane;
- Average speed (mph) per length class and per lane;
- Average gap time (1/10 sec) per length class and per lane;
- Average headway (m or feet) per lane;
- Occupancy (%) per lane;
- Concentration (vehicles/mile) per lane;
- Average length (feet) per lane;

- Confidence level (0-10) per lane

The VIP board shall be programmed without the use of a supervisor computer. A standard CCTV monitor and keypad plugged into the VIP serial port will facilitate detector programming.

The VIP board shall store up to 4 detector configurations. It shall be possible to switch between detector configurations manually, automatically by time of day or remote input.

Via the serial port, detector configurations can be uploaded to a laptop and stored on disk.

Detectors may be linked to 24 outputs and 20 inputs using Boolean Logic features: AND, OR, NOT. It will be possible to generate conditional outputs based upon inputs from a controller.

It shall be possible to make a detector directional sensitive. Options will include an omnidirectional detector or a detector that only senses movement: from right to left, left to right, up to down or down to up as you look at the monitor.

All detectors and parameters can be changed without interrupting detection.

For example: when one detector is modified all existing detectors continue to operate, including the one that is being modified. When the new position is confirmed, the new detector will enter a learning phase. Once the new detector is in function it will take over the job of the old one. In this way, the detector is always fully operational with no interruption on any detector, even during modification. Learning phases for new detectors shall not exceed 6 minutes.

Four data detection zones per camera on a two camera VIP board may be used for collection of vehicle count, speed, classification, occupancy, density, headway, and gap time. Eight data detection zones may be used on a single camera VIP board. These detectors will detect and store traffic data at user-defined intervals of 1, 2, 3, 5, 6, 10, 15, 30 & 60 minutes. It shall be possible for each VIP board to store up to 6713 intervals of data in non-volatile memory.

Associated software may be used with a PC to download data and export to a spreadsheet. Software will also be used to upload and download detector configurations, traffic data, technical events, send software versions upgrades and do remote setup of detectors.

The VIP board shall have or be able to perform the following functions:

- An internal clock with daylight saving time system, which can be enabled or disabled;
- Provide overlaid tool tips for each individual menu- and submenu-items;
- Optional password implementation. Different user-levels shall be available each having different rights. A minimum of 10 users can be defined for each user-level;
- Delay or extend a detector zone output in combination with an input from the controller;
- Detect wrong-way drivers and provide an alarm/event via communication board and/or output;
- Provide an alarm and/or output when the user selected queue detection threshold of occupancy is exceeded for more than a user selected time threshold;
Distinguish five classes of detected vehicles based upon user selectable vehicle length

- thresholds;
- Emulate loop emulation with user selectable loop dimensions.

c. Video System Communication Module (Viewcom/E-MAX)

By establishing communication between the PC management software on the central computer and the Video Image Processor (VIP) detectors, the Viewcom/E-MAX board performs all primary functions for communication and transmission of traffic data and alarm events issued by the VIP detectors. The Viewcom/E-MAX also provides MPEG-4 compressed streaming video for remote monitoring.

Key features of the video system communication module shall include the following:

- Transmission of data, alarm events, images, generated by VIP detector boards;
- MPEG-4 streaming video;
- Remote monitoring of VIP boards;
- Up to 4 cameras from the VIP 3.1/D and 8 cameras from the VIP3.2/D modules;
- Password secured, remote configuration;
- TCP/IP based 10/100 Mbps Ethernet;
- A standard internet browser to connect to the Viewcom/E-MAX to monitor and set-up the video detection installation;
- Easy set-up and user friendly;
- Direct plug-in for Type 170, 2070 MEMA TS1 & TS2 detector racks;
- High mean time between failures (MTBF), field-proven performance.

Specifications:

Dimensions:

NEMA and 2070 compatible card rack unit.

Communication:

Ethernet communication for image-data and streaming video transfer (10/100 Mbps RJ-45 connector).

RS-232 serial communication port for local service access and set-up with keypad.

RS-485 communication within a rack for data acquisition via edge connector.

Inputs:

Composite video 75 Ohm at 1 Volt peak to peak, CCIR/EIA. Power supply.

Reset button on front panel.

Outputs:

Analog video output with overlay of system information.

Power LED indicator.

Connector:

Double row 22 pins EDGE (NEMA TS 2-2003).

Power Supply Consumption:

10.8 volts to 26.5 volts DC.
170 mA @ 24 volts DC.

Environmental:

-30 degrees F to +165 degrees F (-34C to +74 C).
0 to 95% relative humidity – non condensing.

d. Image Sensor – Camera

The unit shall be a high resolution, 1/3" color image format CCD camera, designed for professional video surveillance systems. Incorporating the latest in CCD technology, the video camera shall provide detailed video without lag, image retention, or geometric distortion.

Temperature range	-20 to + 50 degrees C
Humidity	5% to 95% relative, non-condensing
Dimensions	47mm X 47mm X 83mm
Weight	7.1 oz.
Camera mounting slots	1/4-20, top and bottom
Connectors	BNC for video out
Lens mount	CS
	Power-in / pressure screw
	Lens / 4-square connector
Finish	Off-white semi-gloss polyurethane
Construction	All metal housing
Rated input voltage	12VDC or 24VAC +/-10% @60Hz
Nominal power	4 Watts
Imager Interline transfer	CCD 1/3" format
Imager spectral response	100% @ 550nm: 30% @ 400nm and 800nm
Sync system	EIA RS-170
Active picture elements	768 H X 494 V
Horizontal resolution	
sensitivity (3200 K)	580 TVL

	Usable Picture	Full Video
Scene Illumination:	fc = 0.01 Lx = 0.12	fc = 0.048 fc = 0.48
Imager Illumination:	fc = 0.0024 Lx = 0.024	fc = 0.010 fc = 0.10

* F1.2 lens @ 89% highlight

Signal to noise ratio	48 dB minimum
AGC	21 dB, (max)
Electronic Shutter	1/60 to 1/600000 sec. (EIA)
Aperture Correction	Horizontal and vertical symmetrical
Video out	1.0 volts peak-to-peak +/- 0.1 volt @ 75 Ohms
Programmable Controls	Video level, shutter, AGC, BLC, Auto Black

e. Image Sensor - Lens

The camera lens shall be a motorized vari-focal 6.5-65mm with auto iris.

Image format	1/3 inch
Focal length	10X zoom (6.5-65mm)
Iris range	f 1.4 – Approx. 360 (With ND)
Back focus distance	9.85mm (in air)
Weight	285g
Size	104.3mm X 70mm X 60mm
Lens mount	CS
Iris control	DC 4-pin square
Focus control	Motorized
Zoom	Motorized

f. Image Sensor - Housing

The environmental housing shall be an aluminum enclosure designed for outdoor CCD camera installations.

Temperature range:	-40 F to +122 F
Dimensions:	18.4" x 4" x 4.4"
Weight:	5.6 lbs.
Housing mounting:	Three 1/4-20 tapped holes
Camera mounting:	Removable cradle assembly
Cable entry:	Three liquid-tight fittings that will accept cable diameters of: One fitting - 2 to 7 mm Two fittings - 3 to 10 mm
Finish:	Light gray semi-gloss polyurethane
Construction:	Extruded aluminum housing, aluminum rear-end cap, aluminum front cap with glass face plate, and aluminum cradle; a sunshield shall also be included
Window:	3 mm thick glass that includes a thermostatically-controlled window Heater/defogger strip
Rated input voltage:	115 VAC, 50/60 Hertz
Voltage range:	108 VAC to 132 VAC
Output voltage:	24 VAC, 50/60 Hertz

Nominal power: 30 Watts (Heater requires 10 watts)
Enclosure protection: Waterproof and dust-tight, IP68
Designed to meet NEMA-6P

g. Surge Protection

A video surge suppressor(s) shall be available for installation inside the traffic signal controller cabinet. The suppressor shall provide coaxial cable connection points to an Hesco Model KE75CXR or approved equal transient suppresser for each image sensor.

Peak Surge Current (8 x 20 us): 20 KA
Technology: Hybrid, Solid State
Attenuation: 0.1db @ 10Mhz
Response Time: <1 nanosecond
Protection: Line to Ground
Shield to Ground: (isolated shield modules)
Clamp Voltage: 6 volts
Connectors: BNC
Impedance: 75 Ohms
Temperature: -40 to +85 degrees C
Humidity: 0-95% non-condensing
Dimensions: 3" x 1" x 1"
UL Listed UL 497B

h. Image Sensor – Mounting Brackets

Mast arm installations shall be mounted at a sufficient height to prevent occlusion from cross traffic between the stop bar and the mast arm on which the camera is installed. A six- (6) ft. maximum length of internally reinforced tube shall be attached to the mast arm bracket for camera mounting above the mast arm. Camera shall be mounted to the top of the tube with the camera manufacturers recommended bracket. Camera bracket shall provide adjustments for both vertical and horizontal positioning for the camera. Camera attachments shall be designed to securely fasten the camera to prevent the extension tube from falling into the path of vehicles and/or becoming loose. Miscellaneous hardware shall be stainless steel or galvanized steel. The cameras and associated pole/arm attachment unit shall be designed to withstand a wind load of 90 MPH with a 30-second gust factor.

Luminaire arm installations shall be installed on the luminaire arm, with the camera/video manufacturers recommended brackets. Camera luminaire brackets shall provide adjustments for both vertical and horizontal positioning of the camera. Camera attachments shall be designed to securely fasten the camera to the luminaire arm. Miscellaneous hardware shall be stainless steel or galvanized steel. The cameras and associated pole/arm attachment unit shall be designed to withstand a wind load of 90 MPH with a 30-second gust factor.

i. Image Sensor – Cable (Coaxial and Power)

Power/video cable from the signal controller cabinet to the video camera shall be a continuous

Kar-Gor composite cable 75 ohm RG59/U with 18awg, 5 conductors, Part Number KG-9915P, or ACHD approved equivalent.

Power/video cable shall be continuous from the controller cabinet to the video camera. No splicing of power/video cable will be allowed

Coaxial & power cable (Siamese) shall be installed in conduits or overhead as indicated in the plans. Coaxial cable shall be suitable for exterior use and in direct sunlight. Power cable will have a minimum of 5 conductors.

Coaxial cable will be terminated in the surge suppressor before being connected directly to VIP boards. Power cable will be terminated into a fuse panel provided by the manufacturer and connected to 120 VAC in the controller cabinet.

Description of cable: Composite, 6 Conductors 2 elements: 18awg 5 conductors 7/26 bare copper, .016" polyethylene, 20awg 1 conductor, solid bare copper, .056" foam polyethylene jacket black, overall .030" PVC jacket black.

	ELEMENT 1	ELEMENT 2
CONDUCTORS/PAIR COUNT:	5 CONDUCTORS	1 CONDUCTOR
GAUGE & STRANDING:	18AWG 7/26 BC	20AWG SOLID BC
PRIMARY INSULATION TYPE:	POLYETHYLENE	FOAM PE
INSULATION THICKNESS:	.016"	.056"
COLOR CODE:	WHITE,RED,BLUE,BLACK,BROWN.	NATURAL
SHEILD:	N/A	N/A
TAPE:	N/A	N/A
DRAIN WIRE:	N/A	N/A
BRAID:	N/A	95% BC
CAPACITANCE:	N/A	N/A
PRINT LEGEND:	N/A	N/A
JACKET TYPE:	N/A	POLYETHYLENE
JACKET COLOR:	N/A	BLACK
JACKET THICKNESS:	N/A	.035"
NOMIMAL OD:	N/A	.242"
JACKET THICKNESS:	.030"	
JACKET COLOR:	BLACK	
JACKET MATERIAL:	PVC	
RIPCORD:	YES	
NOMINAL OD:	.512"	
VOLTAGE RATING:	600V	
TEMP. RATING:	75C	
UL TYPE OR STYLE:	N/A	
PRINT LEGEND:	TBD	

OVERALL ASSEMBLY OF WIRE

PACKAGING: TBA
COPPER WEIGHT: 39.87
LBS/MFT SHIPPING WEIGHT: 100
LBS/MFT

j. Video Monitor

The black and white video monitor will need to be sized to fit in the existing ACHD controller cabinets. The maximum size of the TFT LCD monitor shall be 8" and shall meet the following requirements:

Electrical:

System: 8" TFT LCD Monitor
Resolution: 800 x 600, 380 TV Lines
Contrast Ratio: 500:1
Lamp Lifetime: 20,000 hours
Viewing Angle: (L/R)(U/D) 70Deg
Display Mode: Video 1, Video 2, S-Video
OSD Menu: Language, Contrast, Brightness, Color, Sharpness, Tint, Reset
Inputs: 2 x BNC, 1x S-Video, 2x Audio
Outputs: 2x BNC, 1x Audio
Power Requirement: 100~240V AC, 50/60 Hz.
1.5A Power Consumption: 18w (12VDC on rear of unit)

Environmental:

Operating Temperature: 32° F to 104°F (0° C to 55°C)

General:

Dimensions: 7.5 × 6.8 × 1.0 in.
(w/h/d) Weight: Approx. 2.4lbs
*Auto power off when no signal detected

C. Installation and Training

The ACHD Signal Inspector shall supervise the installation of the video equipment. An ACHD Signal Technician will install, make fully operational, and test the system as indicated on the intersection drawings and this specification.

Two days training shall be provided to personnel of the contracting agency in the operation, setup, and maintenance of the video detection system. Instruction and materials shall be produced for a maximum of 10 persons and shall be conducted at a location selected by the contracting agency. The contracting agency shall be responsible for travel, room and board expenses for its own personnel.

D. Warranty

The video detection system shall be warranted against manufacturing defects in materials and workmanship for a period of two years from date of installation or thirty months from date of shipment, whichever comes first. The video detection supplier shall provide all documentation necessary to maintain and operate the system.

E. Addendums

The following functions are added to the VIP3.x and VIP3D.x Video Detection Modules when upgrading to version 3.38 firmware:

1. Camera Movement Suppression
2. Tree Shadow Suppression
3. Startup Recall Timeout
4. Detection Hold Time
5. Wrong Way Sensitivity
6. Wrong Way Suppression Delay

1131.04 – RADAR ADVANCE TRAFFIC SIGNAL DETECTION

(Revised 12/12/11)

A. General Information

This Item shall govern the purchase and installation of above ground Radar Advance Detection Devices (RADD) equivalent to the Wavetronix SmartSensor Advance™ Model 200. Test results and other documentation demonstrating RADD performance and capabilities shall be provided.

The Radar Advance Detection Device shall be non-intrusive and equivalent to the Wavetronix SmartSensor Advance™ Model 200. The RADD shall be easy to install; it shall be remotely accessible; it shall provide multiple connectivity options for easy integration into legacy systems; it shall be manufactured to the strictest industry standards; and it shall utilize automated assembly processes to ensure product quality and minimize the risk of failure due to error.

B. Auto-Calibration

The RADD shall have a method for automatically calibrating the detection device; this method will be executed in the RADD's internal processor. This auto-calibration method shall automatically determine detection thresholds.

C. Sensor Performance

The RADD shall accurately and continuously detect ETA (Estimated Time of Arrival), speed, and range data for vehicles, or clusters of vehicles simultaneously moving within 100 feet to 500 feet from the sensor in the selected direction of travel. The RADD shall be mounted in a forward-fire position, looking into either approaching or departing traffic for the selected direction of travel. The RADD shall filter the ETA data, speed data, and range data based upon minimum and maximum constraints to produce alerts customizable for safe and efficient dilemma zone protection, congestion management, and other operational goals.

The RADD shall maintain accurate performance in all weather conditions, including rain, freezing rain, snow, wind, dust, fog and changes in temperature and light. The device shall not rely on temperature compensation circuitry and shall be capable of continuous operation over an ambient temperature range from -40° C to 75° C, and a relative humidity range from five percent to 95 percent (non-condensing). RADD operation shall continue in rain or snow up to 10 cm per hour, and the device shall not experience degraded performance when encased in ½" of ice.

Speed data shall be accurate for individual vehicle measurements when there are no adjacent vehicles traveling in the same direction. Eighty-five percent of all measurements shall be within five mph of truth when vehicles are not changing speed. Speed accuracy shall be verified with radar gun, or by video speed trap using the frame rate as a time reference.

Range data shall be accurate for individual vehicle measurements when there are no adjacent vehicles traveling in the same direction. Eighty-five percent of all measurements shall be within ten feet of the distributed length of the vehicle when vehicles are not changing speed. Range accuracy shall be verified with: LIDAR gun, or by video using visual markers as a distance reference and frame rate as a time

reference.

ETA data shall be accurate for individual vehicle measurements when there are no adjacent vehicles traveling in the same direction. ETA is the estimated time of arrival as calculated by dividing the vehicles range from the stop bar by the speed of the vehicle. ETA is calculated for purposes of safely and efficiently protecting vehicles within the decision dilemma zone, which is nominally defined to exist for motorists with an ETA between 2.5 and 5.5 seconds from the stop bar who are driving faster than 35 mph when the light turns yellow. Eight-five percent of all measurements shall be within one second of truth for all vehicles not changing speed within the decision dilemma zone. ETA accuracy shall be verified with LIDAR gun or by video using visual markers as a distance reference and frame rate as a time reference.

D. Mounting and Installation

To achieve the specified accuracy and reliability, the RADD shall be installed according to the following conditions:

1. Two RADD units shall not be mounted so that they are pointed directly at each other unless separated by more than 400 feet; and a RADD shall not be placed within 20' of another RADD unless each device is configured to operate on a different RF channel using the installation software.
2. **Mounting Assembly** – The RADD shall be mounted directly onto a mounting assembly fastened to a pole, overhead mast-arm or other solid structure. The mounting assembly shall provide the necessary degrees of rotation to ensure proper installation. It shall be constructed of weather resistant materials and shall be able to support a 20 lb. load.
3. **Cabling** – The RADD shall be supplied with a connector cable of the appropriate length for each installation site. The connector shall meet the MIL-C-26482 specification; the backshell shall be an environmentally sealed shell that offers excellent immersion capability, and designed to interface with the appropriate MIL-C-26482 connector; all conductors that interface with the connector shall be encased in a single jacket, and the outer diameter of this jacket shall be within the backshell's cable O.D. range to ensure proper sealing; the backshell shall have a clamp bar style strain relief with enough strength to support the cable slack under extreme weather conditions. Recommended connectors are Cannon's KPT series, and recommended backshells are Glenair Series 37 cable sealing backshells. The MIL- C-26482 connector shall provide contacts for all data and power connection.

If communication is conducted over the RS-485 bus, the communication cable shall be Belden 9331 or an equivalent cable with the following specifications:

- Shielded, twisted pairs with a drain wire
- Nominal Capacitance Conductor to Conductor @ 1Khz \leq 26pF/ ft
- Nominal Conductor DC Resistance @ 20 Deg C \leq 15 ohms/1000 ft
- Single continuous run with no splices allowed
- Terminated only on the two farthest ends of the cable
- The operational baud rate and cable length shall not exceed the following limits:

Baud Rate*	Cable Length
115.2Kbps	300 feet
57.6Kbps	600 feet
38.4Kbps	800 feet
19.2Kbps	1000 feet
9.6Kbps	2000 feet

**Note: These represent maximum data rates. The data rate used should be the minimum data rate required for operation.*

If communication is conducted over the RS-232 bus, the communication cable shall be Belden 9331 or an equivalent cable with the following specifications:

- Shielded, twisted pairs with a drain wire
- Nominal Capacitance Conductor to Conductor @ 1Khz <= 26pF/Ft
- Nominal Conductor DC Resistance @ 20 Deg C <= 15 ohms/1000Ft
- Single continuous run with no splices allowed
- The RS-232 Driver must be able to source and sink +/- 7mA or more
- The operational baud rate and cable length shall not exceed the following limits:

Baud Rate*	Cable Length
115.2Kbps	40 feet
57.6Kbps	60 feet
38.4Kbps	100 feet
19.2Kbps	140 feet
9.6Kbps	200 feet

**Note: These represent maximum data rates. The data rate used should be the minimum data rate required for operation.*

If 12VDC is being supplied for the RADD, the power cable shall be Belden 9331 or an equivalent cable with the following specifications:

- Two shielded, twisted pairs with two drain wires connected in parallel
- Nominal Capacitance Conductor to Conductor @ 1Khz <= 26pF/Ft
- Nominal Conductor DC Resistance @ 20 Deg C <= 15 ohms/1000Ft
- The cable length shall not exceed 100 feet

If 24VDC is being supplied for the RADD, the power cable shall be Belden 9331 or an equivalent cable with the following specifications:

- Two shielded, twisted pairs with two drain wires connected in parallel
- Nominal Capacitance Conductor to Conductor @ 1Khz <= 26pF/Ft
- Nominal Conductor DC Resistance @ 20 Deg C <= 15 ohms/1000Ft
- The cable length shall not exceed 600 feet

If a cable length of 600 feet to 2000 feet is required, the power cable shall be an ANIXTER 2A-1002 or equivalent cable that meets the following requirements:

- 10 AWG Conductor Size/Gauge
- Two Conductor count
- Stranded Cable Type
- Bare Copper material
- 600 Volt range
- 90° Centigrade Temperature rating
- PVC/Nylon Insulation material
- PVC – Polyvinyl chloride jacketing material
- 40 Amps per conductor

Both communication and power conductors may be bundled together in the same cable as long as the above-mentioned conditions are met.

4. **Lightning Surge Protection** – Lightning surge protection that meets or exceeds the EN 61000-4-5 Class 4 specifications shall be installed no farther than 40 feet along the RADD cable from the RADD unit. To ensure the continued operation of the RADD in the presence of electrical surges, all connections to the RADD shall be protected, including power, RS-232, RS-485 communication lines and ground. The lightning surge protection unit shall be the Wavetronix Click! 200™ or equivalent.
5. **Power Supply** – The AC to DC power converter supplying the DC voltage for the RADD shall be the Wavetronix Click! 201 or equivalent, providing the following:

Power Rated	>15 W @25°C / >10 W@74°C minimum per RADD unit
Operating Temperature Range	From –34°C to +74°C
Operating Humidity Range	From 5% to 95% @25°C non-condensing
Input Voltage	From 85 V (AC) to 264 V (AC) or 120 V (DC) to 370 V (DC)
Input Frequency	From 47 Hz to 63 Hz
Output Voltage	24 VDC ±4%
Hold Up Time	>20 ms at 120 V (AC)
Withstand Voltage	Input to Output: 2 kV, Input to Ground: 1.5 kV
Safety Standards	UL 60950, EN60950
EMC Standards	EN55022 Class B and EN61000-3-2, 3
Brown-Out Protection	In brown-out conditions (i.e. <85VAC input) the output voltage shall be less than 1 VDC

E. Communication

The RADD shall provide two or more communication ports that can be accessed simultaneously using any RADD-supported protocol. This will enable multiple operators to collect data from the RADD at the same time without interrupting or interfering with each other. The RADD shall provide RS-232 and RS-485 serial communication ports; each communication port shall support all of the following baud rates: 9600, 19200, 38400, 57600 and 115200. Additionally, the RS-232 port shall be full-duplex and shall support true RTS/CTS hardware handshaking for interfacing to various communication devices. A Wavetronix Click 301 (Serial to Ethernet) shall be used in all ACHD cabinets that are tied into the ACHD fiber communications network.

F. Power Requirements

The RADD shall consume less than 10 watts with a DC input between 12 VDC and 28 VDC. The equipment shall be designed such that the failures of the equipment shall not cause the failure of any other unit of equipment. Automatic recovery from power failure shall be within 15 seconds after resumption of power.

G. Windows® and PocketPC®-based Software

The RADD shall also include graphical user interface software that displays all configured zones and provides visual representation of all detected vehicle clusters. The detected range, speed, arrival time, and identification number shall be viewable on the visual representation of all detected vehicle clusters. The graphical interface shall operate on Windows 98, Windows 2000, Windows NT 4.0, Windows XP Pro and Windows PocketPCs equivalent to the Dell Axim X50v. The software shall automatically select the correct baud rate.

The graphical user interface shall also display all configured alerts and provide visual representation of their actuation. The operator shall have the ability to configure alerts using minimum and maximum constraints on the detected ETA, speed, and range of vehicles.

The operator shall have the ability to save the configuration information to a file, or reload the RADD configuration from a file, using the graphical user interface software. Using the installation software, the operator shall be able to easily change the baud rate on the sensor by selecting baud rates from a drop-down list, as well as add response delays for the communication ports. Additionally, the operator shall have the ability to switch between data pushing and data polling, and change the RADD's settings for Flow Control from none to RTS/CTS and vice versa.

The operator shall be able to upload new firmware into the RADD's non-volatile memory over any supported communication channel.

H. RF Design

All microwave circuitry within the RADD shall be designed utilizing active control that dynamically adjusts to compensate for temperature and age variations in component performance. This eliminates most opportunities for human error or age degradation in circuits that contribute to product performance. The circuitry shall be void of any manual tuning elements that could lead to human error and degraded performance over time.

All transmit modulated signals shall be generated by means of digital circuitry, such as a direct digital synthesizer, that is referenced to a frequency source that is at least 50 ppm stable over the specified temperature range, and ages less than six ppm per year. Any up-conversion of a digitally generated modulated signal shall preserve the phase stability and frequency stability inherent in the digitally generated signal. These specifications ensure that during operation the RADD strictly conforms to FCC requirements and that the radar signal quality is maintained for precise algorithmic quality.

The RADD antennae shall be designed on printed circuit boards, eliminating the need for RF connectors and cabling that result in decreased reliability. Printed circuit antennae are less prone to physical damage due to their extremely low mass.

The antennae parameters shall meet the following criterion to ensure quality performance:

- 1) 3 dB Elevation Beam Width: > 65 degrees
- 2) 3 dB Azimuth Beam Width: < 15 degrees
- 3) Side Lobes: < -20 dB

I. Enclosure

The RADD shall be enclosed in a Lexan polycarbonate, ultraviolet resistant material and shall be classified as watertight according to the NEMA 250 Standard. The enclosure shall be classified "f1" outdoor weatherability in accordance with UL 746C.

The RADD shall be able to withstand a drop of up to 5 feet without compromising its functional and structural integrity.

J. Input File Cards

The RADD manufacturer shall provide an optional input file card compatible with 170, 2070, NEMA TS1 and NEMA TS2 input file racks. The input file card shall translate per vehicle data packets or real-time true presence packets from the RADD into corresponding contact closure outputs. Operators shall be able to assign any contact closure output channel to any configured alert. These settings shall be saved in non-volatile memory on the input file card for complete recovery in case of power failure.

The input file card shall support Dual Loop (Speed Trap) emulation, as well as the following modes of operation:

- Actuation (true presence filtered by conditional alert constraints output in real time with 2.5 ms resolution)
- Pulse (a single 125 ms output pulse for each vehicle)
- Presence (an output pulse corresponding to the duration of each vehicle cluster in the detection zone with a resolution of 2.5 ms)
- Single Loop Speed (duration of the pulse corresponds directly to the speed of the vehicle, speed (mph) = 13.64/duration in seconds)

The input file card shall receive data packets over an RS-485 bus at any of the following baud rates: 9600, 19200, 38400, 57600 and 115200. Also, the input file card shall auto-baud and auto-detect a

RADD over wired and wireless communication channels that have a maximum latency of 500 ms.

The input file card shall comply with the NEMA TS2-1998 Traffic Controller Assemblies with NTCIP Requirements, Section 2.8 specification. Documentation and results of the NEMA TS2-1998 test shall be provided.

The input file card shall also provide failsafe operation, so that in the event of failure of communication from the sensor, a constant call shall be placed on all contact closure channels.

Additionally, the input file card shall comply with the EN 61000-4-5 Class 4 lightning surge protection test specification. Documentation and results of the EN 61000-4-5 Class 4 test shall be provided.

K. Manufacturing Requirements

The RADD shall be manufactured and assembled in the U.S.A. The internal electronics of the RADD shall utilize automation for surface mount and wave solder assembly, and shall comply with the requirements set forth in IPC-A-610C Class 3, Acceptability of Electronic Assemblies.

The RADD shall undergo a rigorous sequence of operational testing to ensure product functionality and reliability. Testing shall include:

- Functionality testing of all internal subassemblies
- Unit level burn-in testing of duration 48 hours or greater
- Final unit functionality testing prior to shipment

Test results and all associated data for the above testing shall be provided, for each purchased RADD by serial number, upon request. Additionally, manufacturing quality data shall be maintained for each purchased RADD by serial number and shall also be made available upon request.

Externally, the RADD shall be modular in design to facilitate easy replacement in the field. The total weight of the RADD shall not exceed five lbs.

All external parts shall be made of corrosion resistant material, and all materials shall be protected from fungus growth and moisture deterioration.

L. FCC

Each RADD shall be Federal Communications Commission (FCC) certified under CFR 47, Part 15, section 15.245 as a field disturbance sensor, or section 15.249 as an intentional radiator. This certification shall be displayed on an external label on each device according to the rules set out by the FCC.

The RADD shall transmit in the 10.50 – 10.55 GHz or 24.00 – 24.25 GHz frequency band and shall meet the power transmission requirements specified under sections 15.245 and 15.249 of CFR 47.

The manufacturer shall provide documentation proving compliance to all FCC specifications.

M. NEMA 4X Testing

The RADD enclosure shall conform to test criteria set forth in the NEMA 250 Standard for Type 4X enclosures. Third party enclosure test results shall be provided for each of the following Type 4X criteria:

- External Icing (NEMA 250 Clause 5.6)
- Hose-down (NEMA 250 Clause 5.7)
- 4X Corrosion Protection (NEMA 250 Clause 5.10)
- Gasket (NEMA 250 Clause 5.14)

N. NEMA TS2-1998 Testing

The RADD shall comply with the applicable standards stated in the NEMA TS2-1998 Standard. Third party test results shall be made available for each of the following tests:

- Shock pulses of 10g, 11 ms half sine wave
- Vibration of .5 Grms up to 30 Hz
- 300 V positive/negative pulses applied at 1 pulse per second at minimum and maximum DC supply voltage
- Cold temperature storage at -45° C for 24 hours
- High temperature storage at +85° C for 24 hours
- Low temp, low DC supply voltage at -34° C and 10.8 VDC
- Low temp, high DC supply voltage at -34° C and 26.5 VDC
- High temp, high DC supply voltage at 74° C and 26.5 VDC
- High temp, low DC supply voltage at 74° C and 10.8 VDC

O. Support

Installers and operators of the RADD shall be fully trained in the installation, auto-configuration and use of the device.

The manufacturer shall thoroughly train installers and operators to correctly perform the tasks required to ensure accurate RADD performance. The amount of training necessary for each project shall be determined by the manufacturer and shall be included, along with training costs, in the manufacturer's quote. In addition, technical support shall be available to provide ongoing operator assistance.

1. Training

Training shall consist of comprehensive classroom labs and on-hands, in-the-field installation and configuration training.

Classroom Lab training shall involve presentations outlining and defining the RADD, its functions and the procedures for proper operation. These presentations shall be followed by hands-on labs in which trainees shall practice using the equipment to calibrate and configure a virtual device. To facilitate the classroom presentation and hands-on labs, the vendor shall provide the following items for the duration of training:

- Knowledgeable trainer or trainers thoroughly familiar with the RADD and its processes.

- Presentation materials, including visual aids, printed manuals and other handout materials for each student.
- Computer files, including video and raw data, to facilitate the virtual calibration and configuration of the RADD.
- Laptop computers with the necessary software, and all necessary cables, connectors, etc.
- All other equipment necessary to facilitate the virtual calibration and configuration of the RADD.

Field Training shall provide each trainee with the hands-on opportunity to install and calibrate the RADD in the field. Training shall be such that each trainee will mount and align the RADD correctly.

2. Technical Assistance

A manufacturer's technical representative shall be available to assist with the physical installation, alignment and auto-calibration of each supplied RADD. Technical support shall be provided thereafter to assist with troubleshooting, maintenance, or replacement of devices should such services be required.

P. Documentation

The following documentation and specification test results shall be supplied by the manufacturer at the time of the bid submittal. Attached documents shall include the following:

- Auto-calibration documentation
- EN 61000-4-5 Class 4 Lightning Surge Protection test results
- FCC CFR 47 certification
- NEMA 250 Standard for Type 4X Enclosure third-party test data
- NEMA TS2-1998 Standard third-party test data

Q. Warranty

The RVSD shall be warranted to be free from material and workmanship defects for a period of two (2) years from date of shipment.

1131.04.01 – RADAR VEHICLE TRAFFIC COUNT & SPEED DETECTION SYSTEM

(Updated 8/12/12)

A. General Information

This item shall govern the purchase and installation of above ground Radar Vehicle Sensing Devices (RVSD) for freeway and arterial side fire traffic counting and speed detection. The radar detection units shall be equivalent to the Wavetronix SmartSensor in High Definition. (HD™) (sidefire units)

B. Product Description

The Radar Vehicle Sensing Device shall be a non-intrusive device equivalent to the Wavetronix SmartSensor HD. The RVSD shall also:

- Be easy to install.
- Automatically configure up to ten lanes of traffic by determining lane boundaries and detection thresholds.
- Utilize a digitally-generated, modulated signal to accurately detect vehicle volume, speed, and occupancy in all weather conditions without performance degradation.
- Operate accurately in side-fire installations.
- Be remote accessible.
- Provide multiple connectivity options for easy integration into legacy systems.
- Support a variety of data protocols.
- Be manufactured to the strictest industry standards.
- Utilize automated assembly processes to ensure product quality and minimize the risk of failure due to error.

The manufacturer shall thoroughly train installers and operators to ensure accurate RVSD performance.

C. Auto-Configuration

The RVSD shall have a method for automatically configuring the detection device. This auto-configuration method shall execute on a processor internal to the RVSD and shall not require an external PC or other processor. This auto-configuration method shall automatically define traffic lanes or detection zones by detecting the relative position of vehicles within the RVSD's field of view.

The RVSD shall include a transceiver capable of detecting multiple vehicles present within its field of view. The RVSD shall also include a processor or computer with executable instructions that estimates the position of each of the vehicles, records the position of the vehicles, generates a probability density function estimation from each position of the vehicles, and defines traffic lanes from that probability density function estimation. The vehicle probability density function represents the probability that a vehicle will be located at any range.

The auto-configuration method shall automatically, with no user intervention, assign lane or zone boundaries and detection thresholds using the statistical representation of the relative vehicle positions. The auto-configuration method shall not prohibit the ability of the user to manually adjust the RVSD configuration. Documentation demonstrating the auto-configuration process shall be

provided.

D. Sensor Performance

The RVSD shall provide accurate, real-time volume, average speed and occupancy data. A single RVSD shall detect up to ten lanes of traffic simultaneously. Detections shall be correctly categorized into four length-based classifications. True vehicle detections shall occur within a range of 9 ft. to 250 ft. from the RVSD.

The RVSD shall maintain accurate performance in all weather conditions, including: rain, freezing rain, snow, wind, dust, fog and changes in temperature and light. The device shall not rely on temperature compensation circuitry and shall be capable of continuous operation over an ambient temperature range of -40°C to 75°C, and a relative humidity range of 5 percent to 95 percent (non-condensing). RVSD operation shall continue in rain or snow up to ten centimeters per hour.

Test data demonstrating or proving performance shall be provided.

1. Volume Data

Volume data shall be accurate within five percent of truth for any direction of travel in nominal conditions. Individual lane accuracy shall be within ten percent of truth during nominal conditions. Nominal conditions exist when traffic is flowing at speeds greater than 10 miles per hour, with less than 10 percent truck traffic per lane and at least 30 percent of each vehicle visible above roadway barriers for true sensor detection.

The number of missed vehicles and false detections shall be recorded. Errors shall be calculated by dividing the difference between missed and false detections by the total number of vehicles. To ensure low variability in performance, missed and false detections shall not exceed 15 percent. Such performance analysis shall be provided for the following environments:

- Free flowing traffic (speeds greater than 45 mph)
- Congested traffic (speeds from 15 to 40 mph)
- Traffic with a lane roughly five ft. beyond a concrete barrier
- 20 foot and 240 foot lateral offset (simultaneous performance)

2. Speed

Speed shall be a measured quantity using a dual antenna radar speed trap; and shall not be derived from a presence measurement as this has been shown to produce biases during congestion. Average speed data shall be accurate within three mph for each lane, and 90 percent of individual vehicle speed estimates shall be within four miles per hour for any direction of traffic and for all conditions.

3. Occupancy Data

Occupancy data shall be accurate within 10 percent of truth for any direction of travel on a roadway. For example, if the true occupancy in a lane is 20 percent, then the measured occupancy shall be between 18 and 22 percent. Lane occupancy shall be accurate within 20 percent in similar conditions. Test data verifying this performance shall be provided.

4. Classification Data

Classification data shall be accurately determined for 80 percent of detected vehicles. Vehicles shall be separated into four user-definable classifications. Test data verifying this performance shall be provided.

E. Performance Maintenance

The RVSD shall not require cleaning or adjustment to maintain performance. It also shall not rely on battery backup to store configuration information.

Once the sensor is calibrated, it shall not need recalibration to maintain performance unless the roadway configuration changes. In that case, the RVSD's remote connectivity shall allow operators to reconfigure and recalibrate the sensor automatically.

F. Range Resolution

To achieve the specified accuracy in a variety of conditions, the resolution shall not be larger than ten ft. null to null and four ft. at the half-power level. This requires a functional bandwidth of 240 MHz. This reduces the problem of vehicle responses getting drowned out by brighter vehicles in adjacent lanes and improves performance for moving and stopped vehicles near barriers.

G. Mounting and Installation

To achieve the specified accuracy and reliability, the RVSD shall be installed according to the following conditions:

- Two RVSD units shall not be mounted so that they are pointed directly at each other.
- An RVSD shall not be placed within 20 ft. of another RVSD unless each device is configured to operate on a different RF channel using the installation software.

1. Mounting Assembly

The RVSD shall be mounted directly onto a mounting assembly fastened to a pole, overhead mast-arm, or other solid structure. The mounting assembly shall provide the necessary degrees of rotation to ensure proper installation. It shall be constructed of weather resistant materials and shall be able to support a 20-pound load.

2. Side-Fire Mounting

The RVSD shall be mounted according the following table, based on a recommended offset of 20 ft. or more from the first detection zone:

Offset from first detection lane (feet)	Recommended Mounting Height (feet)	Minimum Mounting Height (feet)	Maximum Mounting Height (feet)	
10	12	9	15	
11	12	9	16	
12	13	10	16	
13	13	11	17	
14	14	11	17	
15	15	12	18	
16	15	12	18	
17	16	13	18	
18	17	14	19	
19	17	14	19	
20	18	15	20	
21	18	15	21	
22	18	16	22	
23	19	16	23	
24	19	16	24	
Recommended Offset	25	20	17	25
	26	20	17	26
	27	21	18	27
	28	21	18	28
	29	21	18	29
	30	22	19	30
	31	22	19	31
	32	22	19	32
	33	23	19	33
	34	23	19	34
	35	23	20	35
36	23	20	36	
37	23	20	37	
38	24	21	38	
39	24	21	39	
40	25	22	40	
41	25	22	41	
42	26	22	42	
43	26	22	43	
44	27	23	44	
45	27	23	45	
46	28	23	46	
47	28	24	47	

48	29	24	48
49	29	24	49
50 ft. to 180 ft.	30	25	Height must be less than the offset (i.e. if offset = 80', the maximum height is also 80')

NOTE: Depending on the site and type of traffic, the sensor may tend to over count or under count. If the sensor is over counting, reduce the height of the sensor by 3 ft and reconfigure the sensor. If the sensor is under counting, increase the height of the sensor by 3 ft. Reducing the height of the sensor normally improves performance.

The RVSD shall be mounted with its cable connector pointing towards the ground and tilted so that the RVSD is aimed at the center of the lanes to be monitored. Typically, the RVSD is tilted off of vertical by 10-20 degrees. The RVSD shall be aligned so that the side-to-side (azimuth) angle is within approximately ± 2 degrees of perpendicular to the flow of traffic. Software shall be available to verify the accuracy of the azimuth pointing angle.

If multiple RVSD units are pointed in the same direction, each shall be configured to operate on a different RF channel.

A distance of 40 ft. (or more), along the direction of the roadway, shall separate the RVSD's if they are located on opposing sides of a roadway.

When possible, the RVSD pole placement shall be selected where there is no guardrail or other type of barrier between the pole and the first lane of traffic.

When possible, the RVSD pole placement shall be selected where there are no large planar surfaces (sound barrier, building, parked vehicles, etc.) that run parallel to the monitored roadway within 70 ft. of the pole location.

It is recommended that the manufacturer be consulted to verify final RVSD placement if the RVSD is to be mounted near large planar surfaces (sound barrier, building, parked vehicles, etc.) that run parallel to the monitored roadway.

3. Cabling

The RVSD shall be supplied with a connector cable of the appropriate length for each installation site.

The connector shall meet the MIL-C-26482 specification. The backshell shall be an environmentally sealed shell that offers excellent immersion capability, and is designed to interface with the appropriate MIL-C-26482 connector. All conductors that interface with the connector shall be encased in a single jacket; and the outer diameter of this

jacket shall be within the backshell's cable O.D. range to ensure proper sealing. The backshell shall have a clamp bar-style strain relief with enough strength to support the cable slack under extreme weather conditions. Recommended connectors are Cannon's KPT series; and recommended backshells are Glenair Series 37 cable sealing backshells. The MIL-C-26482 connector shall provide contacts for all data and power connections.

If communication is conducted over the RS-485 bus, then the communication cable shall be ATP Matrix Type 2 Home Run Cable 1pr #18, 2 triads #22 or an equivalent cable with the following specifications:

- Shielded, twisted pairs with a drain wire
- Nominal Capacitance Conductor to Conductor @ 1Khz <= 26pF/ ft
- Nominal Conductor DC Resistance @ 20 Deg C <= 15 ohms/1000 ft
- Single continuous run with no splices allowed
- Terminated only on the two farthest ends of the cable.
- The operational baud rate and cable length shall not exceed the following limits:

Baud Rate	*Cable Length
115.2Kbps	300Feet
57.6Kbps	600Feet
38.4Kbps	800Feet
19.2Kbps	1000Feet
9.6Kbps	2000Feet

NOTE: These represent maximum data rates. The data rate used should be the minimum data rate required for operation.

If communication is conducted over the RS-232 bus, the communication cable shall be ATP Matrix Type 2 Home Run Cable 1pr #18, 2 triads #22 or an equivalent cable with the following specifications:

- Shielded, twisted pairs with a drain wire
- Nominal Capacitance Conductor to Conductor @ 1Khz <= 26pF/Ft
- Nominal Conductor DC Resistance @ 20 Deg C <= 15 ohms/1000Ft
- Single continuous run with no splices allowed
- The RS-232 Driver must be able to source and sink +/- 7mA or more
- The operational baud rate and cable length shall not exceed the following limits:

Baud Rate	*Cable Length
115.2Kbps	40Feet
57.6Kbps	60Feet
38.4Kbps	100Feet
19.2Kbps	140Feet
9.6Kbps	200Feet

NOTE: These represent maximum data rates. The data rate used should be the minimum data

rate required for operation.

If 12 VDC is being supplied for the RVSD, the power cable shall be Belden 9331 or an equivalent cable with the following specifications:

- Two shielded, twisted pairs with two drain wires connected in parallel
- Nominal Capacitance Conductor to Conductor @ 1Khz \leq 26pF/ ft
- Nominal Conductor DC Resistance @ 20 Deg C \leq 15 ohms/1000 ft
- The cable length shall not exceed 100 ft.

If 24 VDC is being supplied for the RVSD, the power cable shall be Belden 9331 or an equivalent cable with the following specifications:

- Two shielded, twisted pairs with two drain wires connected in parallel
- Nominal Capacitance Conductor to Conductor @ 1Khz \leq 26pF/ ft
- Nominal Conductor DC Resistance @ 20 Deg C \leq 15 ohms/1000 ft
- The cable length shall not exceed 600 ft.

If a cable length of 600 ft. to 2000 ft. is required, the power cable shall be an ATP Matrix Type 2 Home Run Cable 1pr #18, 2 triads #22 or equivalent cable that meets the following requirements:

- 10 AWG Conductor Size/Gauge
- Two Conductor count
- Stranded Cable Type
- Bare Copper material
- 600 Volt range
- 90° Centigrade Temperature rating
- PVC/Nylon Insulation material
- PVC – Polyvinyl chloride jacketing material
- 40 Amps per conductor

Both communication and power conductors can be bundled together in the same cable as long as the above-mentioned conditions are met.

4. Lightning Surge Protection

Lightning surge protection that meets or exceeds the EN 61000-4-5 Class 4 specifications shall be installed no farther than 40 ft. along the RVSD cable from the RVSD unit. To ensure the continued operation of the RVSD in the presence of electrical surges, all connections to the RVSD shall be protected including power, RS-232 communication lines, RS-485 communication lines, and ground. The lightning surge protection unit shall be the Wavetronix Click! 200™ or equivalent.

5. Power Supply

The AC-to-DC power converter, supplying the DC voltage for the RVSD, shall provide the

following:

Power Rated	>15 W @25°C / 10> W@74°C minimum per RVSD unit
Operating Temperature Range	From -34°C to +74°C
Operating Humidity Range	From 5% to 95% @25°C non-condensing
Input Voltage	From 85 V (AC) to 264 V (AC) or 120 V (DC) to 370 V (DC)
Input Frequency	From 47 Hz to 63 Hz
Output Voltage	24 VDC ±4%
Hold Up Time	>20 ms at 120 V (AC)
Withstand Voltage	Input to Output: 2 kV, Input to Ground: 1.5 kV
Safety Standards	UL 60950, EN60950
EMC Standards	EN55022 Class B and EN61000-3-2, 3
Brown-Out Protection	In brown-out conditions (i.e. <85VAC input) the output voltage shall be less than 1 VDC

H. Communication

The RVSD shall provide two or more communication ports that can be accessed simultaneously using any RVSD-supported protocol. This will enable multiple operators to collect data from the RVSD at the same time without interrupting or interfering with each other.

The RVSD shall provide both RS-232 and RS-485 communication. Both communication ports shall support all of the following baud rates: 9600, 19200, 38400, 57600 and 115200. Additionally, the RS-232 port shall be full-duplex and shall support true RTS/CTS hardware handshaking for interfacing with various communication devices. **A Wavetronix Click 301 (Serial to Ethernet) shall be used in all ACHD cabinets that are tied into the ACHD fiber optic cable network.**

1. Data Protocols

The RVSD shall support three different data protocols for all lanes being monitored: Interval (bin) data, Event (per vehicle) data, and Real-time True Presence data. The data protocol document shall be provided free of charge.

The Interval (bin) data packet protocol shall support:

- One or more detection zones of data per packet
- Sensor ID
- 32-bit or larger time stamps in one second or smaller increments that indicate the end of time interval
- Total volumes of more than 65536 (necessary for time intervals greater than 10 minutes)
- Speed values in either “Miles Per Hour” or “Kilometers Per Hour”
- Occupancy in 0.1 percent increments
- Four types (or more) of vehicle classifications with volumes per class

The Event (per vehicle) data packet protocol shall support:

- Sensor ID
- 32-bit time stamps in 2.5 millisecond increments or less that indicate the time the vehicle left the detection zone
- Speed values in either “Miles Per Hour” or “Kilometers Per Hour”
- Resolution of vehicle duration in the detection zone in 2.5 ms increments or less
- Four types (or more) of vehicle classification

The Real-time True Presence data packet protocol shall support:

- Sensor ID
- True presence information for each lane being monitored

2. Data Buffering

The RVSD shall store 24,000 (or more) Interval (bin) data packets that record volume, average speed, eighty-fifth percentile speed, occupancy, and class for each detection zone with at least ten zones and no groups per packet in non-volatile memory.

I. Power Requirements

The RVSD shall consume less than 9 watts with a DC input between 12 VDC and 28 VDC.

The equipment shall be designed such that the failures of the equipment shall not cause the failure of any other unit of equipment. Automatic recovery from power failure shall be within 15 seconds after resumption of power.

J. Windows CE®-based Software

The RVSD shall also include graphical user interface software that displays all configured lanes and the current traffic pattern using a graphical traffic history representing at least the last 1.5 seconds of detected traffic. This graphical traffic history shall also allow the option of displaying the measured speed or length of a detected vehicle.

The graphical interface shall operate on Windows CE, Windows 98, Windows 2000, Windows NT 4.0 and Windows XP Pro in the .NET framework. The software shall:

- Automatically select the correct baud rate and serial communication port from up to 15 serial communication ports
- Operate over a TCP/IP connection
- Support a dial-up modem connection
- Give the operator complete control over the configuration process
- Give the operator the ability to save the configuration information to a file or reload the RVSD configuration from a file using the graphical user interface software

Using the installation software, the operator shall be able to easily change the baud rate on the sensor by selecting baud rates from a drop-down list, as well as add response delays for the communication ports. Additionally, the operator shall have the ability to switch between data pushing and data polling, and change the RVSD's settings for Flow Control from none to RTS/CTS and vice versa.

The operator shall be able to upload new firmware into the RVSD's non-volatile memory over any supported communication channel including TCP/IP networks.

K. RF Design

The circuitry shall be void of any manual tuning elements that could lead to human error and degraded performance over time.

All transmit modulated signals shall be generated by means of digital circuitry, such as a direct digital synthesizer, that is referenced to a frequency source that is at least 50 parts per million (ppm) stable over the specified temperature range, and ages less than 6 ppm per year. Any upconversion of a digitally-generated modulated signal shall preserve the phase stability and frequency stability inherent in the digitally-generated signal. These specifications ensure that, during operation, the RVSD strictly conforms to FCC requirements and that the radar signal quality is maintained for precise algorithmic quality.

The RVSD antennae shall be designed on printed circuit boards, eliminating the need for RF connectors and cabling that result in decreased reliability. Printed circuit antennae are less prone to physical damage due to their extremely low mass.

The antennae parameters shall meet the following two-way criteria to ensure quality performance:

- 6 dB Elevation Beam Width: > 65 degrees
- 3 dB Azimuth Beam Width: < 6 degrees
- Side Lobes: < -40 dB

L. Enclosure

The RVSD shall be enclosed in a Lexan polycarbonate, ultraviolet-resistant material and shall be classified as watertight according to the NEMA 250 Standard.

The enclosure shall be classified "f1" outdoor weatherability in accordance with UL 746C.

The RVSD shall be able to withstand a drop of up to five ft. without compromising its functional and structural integrity.

M. Input File Cards

The RVSD manufacturer shall provide an optional input file card compatible with 170, 2070, NEMA TS1, and NEMA TS2 input file racks. The input file card shall translate per vehicle data packets or real-time true presence packets from the RVSD into corresponding contact closure

outputs. Operators shall be able to assign any contact closure output channel to any lane or detection zone. These settings shall be saved in non-volatile memory on the input file card for complete recovery in case of power failure.

The input file card shall support Dual Loop (Speed Trap) emulation, as well as the following modes of operation:

- **Pulse** (a single 125 ms output pulse for each vehicle)
- **Presence** (an output pulse corresponding to the duration of each vehicle in the detection zone with a resolution of 2.5 ms)
- **Actuation** (true presence output in real time with 2.5 ms resolution)
- **Single Loop Speed** (duration of the pulse corresponds directly to the speed of the vehicle, speed (mph) = 13.64/duration in seconds)

The input file card shall receive data packets over an RS-485 bus at any of the following baud rates: 9600, 19200, 38400, 57600 and 115200. The input file card shall also auto-baud and auto-detect an RVSD over wired and wireless communication channels that have a maximum latency of 500 ms.

The Input file card shall comply with the NEMA TS2-1998 Traffic Controller Assemblies with NTCIP Requirements (Section 2.8 specification). Documentation and results of the NEMA TS2-1998 test shall be provided.

Additionally, the input file card shall comply with the EN 61000-4-5 Class 4 lightning surge protection test specification. Documentation and results of the EN 61000-4-5 Class 4 test shall be provided.

N. Manufacturing Requirements

The RVSD shall be manufactured and assembled in the U.S.A. The internal electronics of the RVSD shall utilize automation for surface mount and wave solder assembly, and shall comply with the requirements set forth in IPC-A-610C Class 3, Acceptability of Electronic Assemblies.

The RVSD shall undergo a rigorous sequence of operational testing to ensure product functionality and reliability. Testing shall include:

- Functionality testing of all internal sub-assemblies
- Unit level burn-in testing of duration 48 hours or greater
- Final unit functionality testing prior to shipment

Test results and all associated data for the above testing shall be provided, for each purchased RVSD by serial number, upon request. Additionally, manufacturing quality data shall be maintained for each purchased RVSD by serial number and shall be made available upon request.

Externally, the RVSD shall be modular in design to facilitate easy replacement in the field. The total weight of the RVSD shall not exceed five pounds.

All external parts shall be made of corrosion resistant material, and all materials shall be protected from fungus growth and moisture deterioration.

O. FCC

Each RVSD shall be Federal Communications Commission (FCC) certified under CFR 47, Part 15, section 15.249 as an intentional radiator. This certification shall be displayed on an external label on each device according to the rules set forth by the FCC.

The RVSD shall transmit in the 24.00 – 24.25 GHz or another approved frequency band with 250 MHz of bandwidth available and shall comply with the appropriate requirements.

The manufacturer shall provide documentation proving compliance to all FCC specifications.

P. NEMA 4X Testing

The RVSD enclosure shall conform to test criteria set forth in the NEMA 250 Standard for Type 4X enclosures. Third party enclosure test results shall be provided for each of the following Type 4X criteria:

- External Icing (NEMA 250 Clause 5.6)
- Hose-down (NEMA 250 Clause 5.7)
- 4X Corrosion Protection (NEMA 250 Clause 5.10)
- Gasket (NEMA 250 Clause 5.14)

Q. NEMA TS2-1998 Testing

The RVSD shall comply with the applicable standards stated in the NEMA TS2-1998 Standard. Third party test results shall be made available for each of the following tests:

- Shock pulses of 10g, 11 ms half sine wave
- Vibration of 0.5 Grms up to 30 Hz
- 300 V positive/negative pulses applied at one pulse per second at minimum and maximum DC supply voltage
- Cold temperature storage at -45° C for 24 hours
- High temperature storage at +85° C for 24 hours
- Low temp, low DC supply voltage at -34° C and 10.8 VDC
- Low temp, high DC supply voltage at -34° C and 26.5 VDC
- High temp, high DC supply voltage at 74° C and 26.5 VDC
- High temp, low DC supply voltage at 74° C and 10.8 VDC

R. Support

Installers and operators of the RVSD shall be fully trained in the installation, auto-configuration, and use of the device.

The manufacturer shall thoroughly train installers and operators to correctly perform the tasks required to ensure accurate RVSD performance. The amount of training necessary for each project shall be determined by the manufacturer and shall be included, along with training costs, in the manufacturer's quote. In addition, technical support shall be available to provide ongoing operator assistance.

1. Training

Training shall consist of comprehensive classroom labs and on-hand, in-the-field, installation and configuration training.

Classroom Lab training shall involve presentations outlining and defining the RVSD, its functions, and the procedures for proper operation. These presentations shall be followed by hands-on labs in which trainees shall practice using the equipment to calibrate and configure a virtual device. To facilitate the classroom presentation and hands-on labs, the vendor shall provide the following items for the duration of training:

- Knowledgeable trainer or trainers thoroughly familiar with the RVSD and its processes.
- Presentation materials, including visual aids, printed manuals and other handout materials for each student.
- Computer files, including video and raw data, to facilitate the virtual calibration and configuration of the RVSD.
- Laptop computers or Windows CE hand-held devices with the necessary software, and all necessary cables, connectors, etc.
- All other equipment necessary to facilitate the virtual calibration and configuration of the RVSD.

Field Training shall provide each trainee with the hands-on opportunity to install and configure the RVSD at roadside. Training shall be such that each trainee will mount and align the RVSD correctly.

2. Technical Assistance

A manufacturer's technical representative shall be available to assist with the physical installation, alignment, and auto-configuration of each supplied RVSD. Technical support shall be provided thereafter to assist with troubleshooting, maintenance, or replacement of devices should such services be required.

S. Documentation

The manufacturer shall supply the following documentation and specification test results at the time of the bid submittal. The following documents shall be attached:

- Auto-configuration documentation
- Volume accuracy data, including performance analyses for:
 - Free-flowing traffic

- Congested traffic
- Traffic with a lane roughly eight ft. beyond a concrete barrier
- 20 foot and 240 foot lateral offset (simultaneous)
- Speed accuracy test data for both per-vehicle and average speed
- Occupancy accuracy test data
- Vehicle classification test data
- EN 61000-4-5 Class 4 Lightning Surge Protection test results
- FCC CFR 47 certification
- NEMA 250 Standard for Type 4X Enclosure third-party test data
- NEMA TS2-1998 Standard third-party test data

T. Warranty

The RVSD shall be warranted free from material and workmanship defects for a period of two (2) years from date of shipment.

1131.05 — CONDUIT

(Revised 11/25/2014)

A. Materials

The Contractor shall provide and install all conduit, locate wires, pull strings and necessary fittings at the locations noted on the Plans and as detailed herein. Conduit size shall be as indicated on the signal wiring schedule in the project plans. ACHD is not responsible for damage to/or locating conduits during the construction of the project.

Schedule 40 rigid plastic conduit (RPC) shall be used unless otherwise specified. Schedule 80 RPC or galvanized steel conduit shall be used when specified on the Plans. High Density Polyethylene (HDPE) conduit shall be used when specified on the Plans or approved by the ACHD Traffic Engineer. The connection from HDPE conduit to RPC conduit shall be made using a **Cantex Expansion Coupling Part # 5144019** or an approved ACHD equal. Aluminum conduit shall not be used. All conduit shall comply with the requirements of the **National Electrical Code (NEC)**.

Conduits in junction boxes shall be sealed with a closed polyethylene plug that will prevent moisture and foreign material from entering the signal conduits. All conduit ends shall be sealed with this plug using care to encase (surround) conductors or cables to achieve a secure seal. Contractor shall modify the plug to allow the conductors to penetrate the center of the plug while still maintaining a tight seal. Contractor shall insure that all modified plugs remain in one piece. Broken plugs and plugs that do not achieve a tight seal shall be rejected. All plugs shall be "**Backer Rod**" or approved equal by ACHD. Plugs shall be charcoal grey in color and of an appropriate size to properly seal the conduit, as recommended by the manufacturer. Approximately ½ inch of the plug length shall remain exposed after installation.

B. Installation

Jacking or drilling conduit shall only be allowed when specifically indicated on the Plans or approved by ACHD.

All traffic signal, street lighting, power to service and interconnect conduit installed with a bore machine shall be accompanied by an activity bore log. The contractor shall supply the bore logs to ACHD prior to approval and acceptance of work.

Conduits entering through the cabinet foundation shall be arranged toward the front of the cabinet for maximum accessibility. The conduit stub out in the controller cabinet is not to exceed 2 inches. See ACHD Standard Detail TS-1111.

A green #12 copper locate wire shall be installed in all conduits which are to receive future conductors. Locate wires shall have a minimum of five (5) feet of slack in each junction box with continuity.

Shared trenching for conduit with other utilities (telephone, cable, etc.) may be employed with prior approval by ACHD. See Section 1131.06 for further details on shared trenching specifications.

1131.06 — TRENCH AND BACKFILL

(Revised 11/25/2014)

The Contractor shall perform trenching as necessary for complete and proper installation of the signal and illumination conduit. Shared trenching for signal or interconnect conduit with other utilities may be considered only with prior approval from the ACHD Resident Project Representative. Any signal appurtenances installed in a shared trench without ACHD approval shall not be accepted.

A. Trench Size, Depth and Location

Trenching for conduit runs shall be done in a neat manner. The trench bottom shall be graded to provide a uniform grade, with a width and depth as specified herein. All trenches for placement of conduit shall be straight and as narrow in width as practical to minimize pavement disturbance. Interconnect and/or lighting conduits shall be installed by trenching. Installing conduits in the linear overcut of the roadway sub-excavation is not allowed.

If shared trenching with other utilities is employed, the trench shall be a minimum 24" wide and comply with other utility requirements. Any utility installed in a shared trench shall maintain a minimum 12" clearance (horizontal or vertical) from ACHD facilities. The trench shall be inspected by the ACHD Traffic Signal Inspector prior to any conduit installation and backfill.

Unless otherwise specified in this section, trench width shall conform to the latest adopted version of the **Idaho Standards for Public Works Construction (ISPWC)**.

B. Asphalt Pavement Cutting for Trench

All asphalt cuts required for trenches shall be performed with a motorized saw, unless otherwise specified on the Plans or directed by the ACHD Resident Project Representative. The asphalt cuts shall be to the full thickness of the pavement, shall be parallel, and shall conform to the latest adopted version of the **Idaho Standards for Public Works Construction (ISPWC)**.

C. Concrete Pavement Cutting for Trench

All other concrete pavement cuts required for trenches shall be performed with a saw cutting machine, unless otherwise shown on the Plans or directed by the ACHD Resident Project Representative. Saw cuts shall be to the full thickness of the pavement, shall be parallel, and shall conform to the latest adopted version of the **Idaho Standards for Public Works Construction (ISPWC)**.

Trenching in sidewalk areas shall require removal and replacement of the concrete to the limits of the existing sidewalk joints.

D. Pavement Removal

Pavement shall be removed in a manner approved by ACHD. The Contractor shall take care in removing existing paving so as not to damage the pavement outside of the pavement cut lines.

E. Conduit Cover

Contractor shall use the following table to determine the minimum conduit cover that shall be provided. Conduits for power service conductors shall be installed with 30 inches of cover from finished grade in all locations except under railroad.

Conduit Location	Conduit Depth
Underneath Sidewalk Area	24 inches below the top of curb grade
Underneath Roadway Surface	30 inches below the finished roadway surface
Underneath Railroad	48 inches below the bottom of the railroad ties
Landscape Areas	30 inches below the finished grade
All Other Areas	30 inches below the finished grade

F. Conduit Bedding

Prior to placing conduit in the trench, a bed of fine soil or sand, a minimum of 2 inches thick, shall be placed in the trench. A minimum of 4 inches of the same material shall be placed over the conduit before additional backfill material is placed.

G. Trench Inspection

No work shall be covered and no trench shall be backfilled until the trench and conduit work has been approved by ACHD.

H. Hazard Tape

Underground hazard tape shall be placed 12 inches above the conduit and shall be placed in the trench flat with text facing up. Hazard tape shall have the following properties:

- Color: red with black text
- Width: 6 inches
- Material: plastic, or other ACHD approved non-biodegradable material
- Text: "CAUTION BURIED ELECTRIC LINE BELOW"

In locations where shared trenching with other utilities is employed, hazard tape shall have the following properties:

- Color: yellow tape with red text
- Width: 24 inches
- Material: plastic, or other ACHD approved non-biodegradable material
- Text: "DANGER, JOINT UTILITY TRENCH. STOP DIGGING, CALL DIGLINE 811"

I. Trenching Across Roadways or Other Paved Areas

All roadway trench crossings shall be conducted at night between 7:00 p.m. and 6:00 a.m., unless otherwise approved by the ACHD Traffic Engineer. The Contractor shall be responsible for providing all necessary traffic control measures, including but not limited to lighting and flaggers.

Lighting and flaggers shall be paid for as provided in the contract documents. If no provision is made for one or both of these items in the contract documents, then they shall be incidental to the signal installation.

Trenches in newly constructed roadways that will receive an asphalt pavement shall be backfilled in one foot maximum lifts and shall be compacted to 95% of the maximum dry density and shall conform to the latest adopted version of the **Idaho Standards for Public Works Construction (ISPWC)**.

For areas where it is necessary to cut the existing asphalt pavement or concrete pavement, and dig a trench for burial of conduit or cable, the trench shall be excavated and backfilled (per ACHD Standard Drawing TS-1105) with a Controlled Density Fill material.

Materials: Controlled Density Fill (CDF) shall be a mixture of Portland cement, fly ash, aggregates, water and admixture materials. The result shall be a hardened, dense, non-settling fill mixed in accordance with **ASTM C 94**.

1. Portland Cement	ASTM C 150 or AASHTO M 85
2. Fly Ash	Class F or Class C
3. Aggregates	ASTM C 33
4. Water	Potable
5. Admixtures	AASHTO M 194 or ASTM C 494 or ASTM C 260

The table below provides properties for an acceptable CDF mixture.

CDF MIX	Compactable	Flowable
Maximum compressive strength, pounds per square inch (lbs./sq. ft.)	300 (43,200)	300 (43,200)
Maximum gallons of mixing water per cubic yard	30-46	50
Pounds of cement per cubic yard, approximate	110	50
Pounds of fly ash per cubic yard, approximate	0	250
Pounds of dry aggregate per cubic yard, approximate (assumed specific gravity = 2.67)	3,200	3,200
Slump, Inches	0-5	6-8

Contractor shall submit the CDF mix design with the backup data to ACHD for approval. Contractor shall

not install CDF until after the CDF mix design has been approved by ACHD.

ACHD reserves the right to make additions or deletions to the trenching which prove necessary for the completion of the project.

All asphalt patches shall comply with the latest adopted version of the **Idaho Standards for Public Works Construction (ISPWC)**. If the trench is in an area with asphalt fabric, then the Contractor shall install asphalt fabric in the patch. Asphalt fabric installation shall comply with the latest adopted version of the **Idaho Standards for Public Works Construction (ISPWC)**.

J. Trenching in Landscaped Areas

Trench alignment shall have minimum impact on existing landscaping and irrigation systems. Any damage caused by the Contractor shall be repaired or replaced by the Contractor to the satisfaction of the ACHD Resident Project Representative; this work shall be done at the Contractor's expense.

Unless otherwise shown on the plans or directed by the ACHD Resident Project Representative or the ACHD Signal Inspector, the backfill can be comprised of acceptable materials from the excavation and shall be considered a necessary part of and incidental to the excavation in accordance with the latest adopted version of the **Idaho Standards for Public Works Construction (ISPWC)**. After the conduits are bedded in sand, the backfill around and over the conduit shall be free of rocks greater than 2 inches in diameter. Backfill shall comply with the latest adopted version of the **Idaho Standards for Public Works Construction (ISPWC)**.

K. Trenching Through Concrete Sidewalk Areas

Trenching in sidewalk areas shall require removal and replacement of the concrete to the limits of the existing sidewalk joints. New concrete shall be the same thickness as that of the removed concrete. All materials shall comply with the latest adopted version of the **Idaho Standards for Public Works Construction (ISPWC)**.

Concrete removal and installation shall be paid for as provided in the contract documents. After the conduits are bedded in sand, the backfill can be comprised of acceptable materials from the excavation and shall be considered a necessary part of and incidental to the excavation in accordance with the latest adopted version of the **Idaho Standards for Public works Construction (ISPWC)**. Backfill in trenches in the sidewalk area shall be compacted to 95% of the maximum dry density. Backfill shall comply with the latest adopted version of the **Idaho Standards for Public Works Construction (ISPWC)**.

1131.07 —SIGNAL / FIBER CABLES AND CONDUCTORS

(Revised 2/27/2014)

A. General Requirements

All cables and conductors shall be installed as shown on the Plans, unless otherwise directed by ACHD. Wire conductors shall be copper of the gage shown on the plans, unless otherwise specified by ACHD. Copper wire shall conform to the applicable portions of **ASTM B 3 and B 8**. All wire sizes shall be based on **American Wire Gage (AWG)**, unless otherwise specified herein or on the Plan. All cables shall be approved by ACHD prior to installation.

B. Signal Cables and Conductors

Multiple overhead and underground signal cable shall be 600 volt, #14 uncoated annealed stranded copper wire with polyethylene conductor insulation and polyvinyl chloride sheath. The number of conductors shall be as shown on the plans. The multiple conductor cable shall meet the requirements of **International Municipal Signal Association (IMSA) Specification No. 19-1** with the exception that Section 3.2 shall read uncoated annealed stranded copper wire, latest version.

The cable used for traffic signal heads shall be 12 conductor, 600 volt #14 stranded copper. The cable for pedestrian heads/push buttons shall be 12 conductor, 600 volt, #14 stranded copper. For a normal four leg intersection, a minimum of two 12 conductor cables shall be installed from the controller cabinet to each signal pole base unless otherwise directed by the ACHD Traffic Engineer; one shall be for the traffic signal heads and one for pedestrian signal heads/push buttons. The cables shall extend out the hand access hole in the pole a minimum of 16 inches and a maximum of 20 inches, measured from the outside edge of the access hole. Cables that terminate in the controller cabinet shall extend six feet above the top of the concrete foundation.

Individual cables are then run from the signal and pedestrian heads into the pole base and spliced with the 12 conductor cables. The individual cables that lead to standard three section "thru" signal heads are to be 5 conductor, #14 stranded copper cables. The individual cables that lead to standard "left turn" signal heads are to be 7 conductor, #14 stranded copper cables. The individual cables that lead to standard "pedestrian" signal heads are to be 3 conductor, #14 stranded copper cables. The individual cables that lead to standard pedestrian push buttons are to be 2 conductor, #16 stranded copper cables. The conductor cables shall then be spliced and completely covered with black electrical tape and placed in the pole base (see ACHD Standard Details TS-1103 & TS-1107).

All conduits containing field conductors shall also have a bare #6 stranded copper wire to serve as an equipment ground. This #6 equipment ground shall be terminated on the pole grounding device.

All wires terminated at a terminal block or strip shall have an open end, crimp style solderless terminal. All terminals shall be installed using a tool specifically designed for terminal installation. Crimping with pliers, wire cutters, etc., is not allowed. Terminals shall be color coded to the wire and sized to fit snugly on wire ends. No exposed conductor will be allowed; a minimum of 1/8 inch of insulation shall be under the crimp. All wiring inside the controller cabinet, and at intermediate points, shall be trimmed and cabled together to make a neat and clean-appearing installation. No splicing of any traffic signal conductor shall be permitted unless otherwise indicated on the Plans. The only exceptions shall be splices for detector loops at the nearest junction box to the loops, and splices in illumination circuits.

Unspliced conductors passing through junction boxes shall be labeled with the appropriate color coded tape (see ACHD Standard Detail TS-1103). Three (3) feet of slack, from the top, shall be provided at each junction box for each conductor.

ACHD field conductors (signal) and street lighting conductors shall be installed in separate conduit runs. Field conductors and street lighting conductors shall also terminate in separate junction boxes.

All cable and conductor installations shall comply with the **National Electrical Code (NEC)** and all applicable state and local regulations and these supplemental provisions.

1. Lighting Conductors

Conductors for intersection safety lighting shall be 600 volt, stranded copper wire with a weather proof covering, unless otherwise indicated on the plan or directed by the ACHD Traffic Engineer. Conductors for intersection safety lighting shall be #8 THWN, or larger. All conduits containing lighting conductors shall also have a bare #6 stranded copper wire to serve as an equipment ground. This #6 equipment ground shall be terminated on the pole grounding device (see Section 1131.13 of these Supplemental Provisions).

Lighting conductors shall be securely attached to the strain relief hook supplied inside the top of the pole.

A minimum of 3 feet of slack, from the top of the box, shall be provided at each junction box for each conductor.

2. Service and Power Conductors

Conductor sizes for service and power will vary depending on the load and the length of the conductors. All conductors shall comply with the latest edition of the National Electrical Code (NEC) and Section 1131.18 of these Supplemental Provisions.

Three (3) feet of slack shall be provided at the top of each junction box for each conductor.

C. Fiber Optic Cable

When indicated in the plans, the Contractor shall supply and install a single mode fiber optic communications cable containing 12 fibers, 36 fibers or 72 fibers. The number of fibers required for each conduit run should be shown on the project plans.

Contractor shall provide all-dielectric, dry-filled, loose-tube, dispersion- unshifted, single-mode fiber (SMF) with low water peak, gel free, and suitable for underground (i.e., in conduit) plant installation. All fiber optic cable shall be splice-compatible with ACHD's existing dispersion-unshifted SMF and require no electronic equipment for dispersion compensation between new and existing fiber. Ensure that all components that comprise a single length of cable are continuous and of the same material. Furnish only commercial off-the-shelf materials, equipment, and components.

Optical Fiber:

Ensure that the optical fibers used in the cable meet or exceed the Telecommunications Industry Association (TIA) and Electronic Industries Alliance (EIA) TIA/EIA-492-CAAB specification, the U.S. Department of Agriculture Rural Utilities Service (RUS) 7 CFR 1755.900, and International Telecommunication Union ITU-T G.652.D requirements. Use only optical fibers meeting the additional requirements as follows:

Single Mode Optical Fiber

Number of fibers:	12, 36 or 72
Cladding Diameter:	125µm, ±0.7 µm Core-
to-Cladding Concentricity:	≤0.5 µm Cladding
Noncircularity:	≤0.7%
Mode Field Diameter:	1,550 nm; 10.4 µm, ±0.5 µm
Coating Diameter:	245 µm, ±5 µm
Colored Fiber Nominal Diameter:	253 to 260 µm
Optical	
Cabled Fiber Attenuation:	1,310 nm, ≤0.4 dB/km; 1,550 nm, ≤0.3
dB/km	
Point Discontinuity:	1,310 nm, ≤0.05 dB/km; 1,550 nm,
≤0.05 dB/km	
Cable Cutoff Wavelength (ccf λ):	≤1,260 nm.
Total Dispersion:	,625 nm ≤23.0 ps/(nm•km) Macrobend
Attenuation:	– 100; Outer diameter (OD) of the
	mandrel – 60 mm, ±2 mm; ≤0.05 dB at
	1,550 nm
Cabled Polarization Mode Dispersion:	<0.5 ps km

Ensure that each optical fiber is glass and consists of a germania-doped silica core surrounded by concentric silica cladding. Ensure that all fiber in the buffer tube is usable fiber that complies with attenuation requirements. Ensure that fibers do not adhere to each other. Ensure that the fiber is free of surface imperfections and inclusions. Ensure that all fiber optic core glass is from the same manufacturer.

Buffer Tubes:

Ensure that the fiber optic cable includes loose buffer tubes that isolate internal optical fibers from outside forces and provide protection from physical damage as well as water ingress and migration. Ensure that buffer tubes provide freedom of movement for internal optical fibers. Ensure buffer tubes allow for expansion and contraction of the cable without damage to internal optical fiber. Ensure that fiber does not adhere to the inside of the tube. Ensure that buffer tubes permit intentional scoring and breakout without damage to the fiber. Ensure that each fiber optic cable buffer tube contains 12 fibers per tube unless otherwise noted in the plans.

Color Code:

Ensure that the marking and color-coding of the fibers and buffer tubes conforms to telecommunication industry requirements as detailed in the TIA/EIA-598-B standard. Ensure that colors are permanent and

stable during temperature cycling, and not subject to fading or smearing onto each other or into the water-blocking material. Ensure that fibers are colored with UV curable inks that remain clearly distinguishable as the intended color.

Strength Member:

Ensure that the fiber optic cable contains a dielectric central strength member and dielectric outside strength member to prevent buckling of the cable and provide tensile strength. Ensure that the fiber optic cable can withstand a pulling tension of 600 pounds during installation without increasing the fiber attenuation more than 0.8 decibel per mile, without changing other optical fiber characteristics after the tensile load is removed, and without damage to any components of the fiber optic cable.

Water Blocking Compound:

Ensure that the fiber optic cable contains a dry water-blocking material to prevent the ingress of water within the outer cable jacket. Ensure that the water-blocking tapes and yarns are non-nutritive, dielectric, and homogeneous, and free from dirt and foreign matter. Use dry water-blocking material for fiber optic cables used for either aerial or underground installations. Apply dry water-blocking compound longitudinally around the outside of the central buffer tubes. Construct all cables with water-blocking tape that complies with the requirements of the EIA/TIA-455-81B standard and is subjected to water penetration tests as defined in the EIA/TIA-455-82B standard.

Ripcord:

Ensure that the cable contains at least one ripcord under the sheath. Ensure that the ripcord permits the removal of the sheath by hand or with pliers.

Filler:

Fillers or rods may be included in the cable core to lend symmetry to the cable cross section if required.

Outer Jacket:

Ensure that the fiber optic cable is single jacketed with medium density polyethylene (MDPE) that is free of blisters, cracks, holes, and other deformities. Ensure that the nominal jacket thickness is a minimum of 0.03 inch. Apply the jacketing material directly over the tensile strength members and water-blocking material. Ensure that the MDPE contains carbon black to provide ultraviolet (UV) protection and does not promote the growth of fungus. Mark the jacket with the cable manufacturer's name, fiber type, fiber count, and the sequential cable lengths marked in feet. Ensure that the actual length of the cable is within 1% of the length indicated by the marking. Provide legible marking with contrasting color to that of the cable jacket.

The cable shall be wound on a reel in such a manner as to provide access to both ends of the fiber cable to enable testing to be performed while the cable is on the reel.

Fiber Cable Performance Requirements:

Operating Temperature:

Ensure that the shipping and the operating temperature range of fiber optic cable meets or exceeds - 30° to 165° F as defined in the environmental requirements section of the NEMA TS 2 standard. Ensure that the installation temperature range of fiber optic cable meets or exceeds -22° to 140° F.

Bend radius:

Ensure that the fiber optic cable is capable of withstanding a minimum unloaded bend radius of 10 times the cable diameter and a minimum loaded bend radius of 20 times the cable diameter when loaded to pulling tension of 600 pounds. Test the cable as required in the EIA-455-33A standard. Ensure that bending the fiber optic cable up to the minimum bend radius does not affect the optical characteristics of the fiber.

Cable Strength:

Ensure that the fiber optic cable is capable of withstanding a pulling tension of 600 pounds during installation without increasing the fiber attenuation more than 0.8 decibel per mile and without changing other optical fiber characteristics after the tensile load is removed. Ensure that optical fiber is proof-tested by the fiber manufacturer at a minimum of 100 kilo pounds per square inch. Ensure that the cable will withstand 25 impact cycles and the change in attenuation does not exceed 0.2 decibel at 1,550 nanometers when tested according to the requirements as detailed in the TIA/EIA-455-25B standard. Ensure that the fiber optic cable can withstand a minimum compression load of 125 pounds per square inch when applied uniformly over the length of the sample at the rate of 0.15 to 0.8 inch per minute and maintained for 10 minutes as defined in the TIA/EIA-455-41A standard. Ensure that the change in attenuation will not exceed 0.15 decibel during loading at 1,550 nanometers, and that no fiber displays a measurable change in attenuation after load removal.

Water Penetration:

Ensure that the fiber optic cable is capable of withstanding the tests for water penetration defined in the TIA/EIA-455-82 standard. Ensure that a one-meter length of cable is able to withstand a one-meter static head of water applied at one end for 24 hours without water leaking through the other open cable end.

Fiber Cable Requirements:

The fiber optic cable provided by the Contractor shall be manufactured by **Corning, Draka or OFS** . Cable shall be single mode, Gel free, loose tube and non-armoured.

12 fiber cable :

Corning Altos - 012RW4-14101A20
Draka ezprep F-EDH-1JKT-12-ES-12-E3
OFS - AT-3BE12YT-12

36 fiber cable :

Corning Altos - 036RW4-14101A20
Draka F-ezPrep - EDH-1JKT-12-ES-36-E3
OFS - AT-3BE12YT-36

72 fiber cable :

Corning Altos - 072RW4-14101A20

Draka exPrep - F-EDH-1JKT-12-ES-72-E3

OFS - AT-3BE12YT-72

All surplus fiber optic cable shall be returned to ACHD. Fiber optic cable shall be returned in the same condition it was received. ACHD may, at their option, test the excess fiber optic cable when it is returned.

All fiber optic cables supplied by manufacture were reel tested before delivery. The Contractor should test the fiber optic cable before accepting it from manufacturer.

D. Splice Enclosures and Connector Cables

Contain all optical fiber splices within a splice enclosure. Ensure that the enclosures provide storage for fiber splices, non-spliced fiber, and buffer tubes. Ensure that the splice enclosure restores the mechanical and environmental integrity of the fiber cable, encases the sheath opening in the cable, and organizes and stores optical fiber. Ensure that all hinges and latching devices are stainless steel. Ensure that the enclosure is airtight and prevents water intrusion. Ensure that the splice enclosure can accommodate pressurization and has the ability to be reentered without specialized tools or equipment. Ensure that the enclosure provides fiber and splice organizers including splice trays and strain relief.

For locations with more than 48 splices, the splice closures shall be **Tyco FOSC 450 (FOSC450-B6-6-24-1-BOV)** , **AFL Lightguard 250** or **Preformed Line Products Coyote Closures**. For locations with less than 48 splices, splice closures shall be **Tyco FOSC 450**, **AFL Lightguard 250** or **Preformed Line Products Coyote Closures** or **Preformed Line Products Coyote Pup Closures**.

A splice location and slack loop location worksheet shall be filled out for all fiber work as shown in the plans. Worksheets are attached at the end of this section.

1. Buffer Tube Fan-out Kits

Drop cables shall be factory manufactured using **Corning Altos, Draka or OSP** fiber optic cables. Drop cables shall be factory manufactured in a controlled factory environment. Drop cables shall be terminated with FC connectors. Ensure that the buffer tube fan out kit supports 12 fiber strands. Drop cable fan out kits shall be of a "Spider" design. Buffer tubes shall be protected by the cable sheath or fan out kit. Exposed buffer tubes are not acceptable. Individual fiber strands shall be protected by .114 inch Kevlar tubes. Minimum tubing length shall be 2 feet.

2. Pre-terminated Connector Assemblies (Pigtails)

Ensure that pre-terminated connector assemblies are used for fiber termination. Ensure that the pre-terminated cable assemblies consist of fiber optic cables with factory installed FC-type connectors on one end of the cable and un-terminated optical fiber on the other. Ensure that the pre-terminated connector assemblies are installed with fusion splices. Ensure that all buffer tubes and fibers are protected once the attachment of the pre-terminated connector assemblies is

complete. Pigtail fibers shall be spliced to fibers of the same color.

3. Patch Chords (Fiber Jumper Cable)

Patch chords are used within signal and ITS cabinets and HUB facility termination panels to jumper fiber inputs and outputs. ACHD uses the following types of patch chords; FC-FC single mode duplex fiber jumper, 1 meter; FC-FC single mode duplex jumper, 2 meter and FC-SC single mode duplex jumper, 1 meter. The type and length of patch chords required will be identified on the plans or in the special provisions for each project. The jumper cables shall meet the following requirements:

Buffering	250mm around each fiber, and 900mm around each fiber applied after the initial 250mm
Maximum Factory Measured Insertion Loss	0.5dB per EIA/TIA 455-171 less than 0.2 dB loss when subjected to EIA/TIA-455-1B, 300 cycles, 0.5kg (1.1 lbs)
Backreflection	>35 dB
Strength Member	Aramid yarn
Sheathing	Rugged PVC 3mm (0.12 inch)
Minimum Bending Radius	320 mm (12.5”) following installation, 640 mm (25”) during installation
Minimum Tensile Strength	444 N (100 lbf)
Connectors	Factory terminated with strain relief, connector type as required to connect to specified equipment, connector bodies shall be metallic and all ferrules shall be ceramic
Use	Comply with NEC requirements for indoor cable when used outdoors, and rated by manufacturer for outdoor field cabinets

Connectors:

- All connectors shall be FC connectors.
- All ferrules shall be ceramic.
- All connector bodies shall be metallic.
- FC connectors shall be used on test equipment.
- The maximum insertion loss for connectors shall be 0.30 dB.
- Connector back reflection shall be < .30 dB.
- Cleaning of all connectors with alcohol wipes and a compressed cleaning gas shall be required.
- Operating temperature of connector for installations outside of a controlled environment is -40°Fahrenheit (-40° Celsius) to +175° Fahrenheit (+80° Celsius).
- Operating temperature of connector for installations inside of a controlled environment is -40° Fahrenheit (-40 Celsius) to 140° Fahrenheit (+60 Celsius).

4. Termination Cabinets (Traffic Signal or CCTV cabinets)

The fiber optic cable termination cabinets shall be preloaded wall mounted interconnection centers (WIC) manufactured by **Corning, AFL or Commscope**. The exact model of the termination cabinets will be dependent on the number of fibers entering the signal or camera cabinet as outlined in the plans. The WIC shall be either be 12 or 24 port units. The WIC's shall have preloaded connector panels using FC connectors. The FC panels shall be included with each WIC. The preloaded panels shall be manufactured by **Corning, AFL or Commscope**.

Contractor shall coordinate with the ACHD Congestion Management Supervisor to determine the model and design features of the termination cabinet.

5. Closet Connector Housing (HUB Buildings & ITS Cabinets)

The closet connector housing (CCH) shall be a 72 position 19" rack mounted cabinet typically located in all HUB buildings and ITS cabinets. The CCH shall be preloaded with FC connectors and be manufactured by **Corning, AFL or Commscope** or approved equivalent. The CCH shall be a **Corning model # CCH-04U, Commscope RFE-FXD-BK/4U or AFL Lightlink CON072P** and the connector panels shall be made by the same manufacture as the CCH.

E. Fiber Construction Requirements, Splicing and Testing

1. Qualifications of Fiber Testing Staff and Installation Staff

All fiber optic technicians shall have completed a four day course on the installation, splicing and testing of fiber optic cable. The course shall be conducted by a supplier of fiber optic products or established education provider. In house and on the job training shall not be acceptable as a substitute for course completion.

All fiber optic technicians shall demonstrate two years (one year continuous) work experience with the splicing, termination, and testing of fiber optic cable.

Evidence of training and experience shall be maintained on file. The file for each technician shall include a resume listing relevant education and experience, and a certificate of completion for the fiber optic training course.

All fiber optic technicians shall have a certification certificate from an approved fiber optic cable manufacturer/supplier.

The technician performing the fusion splicing shall be certified by the manufacturer of the fusion splicer and the certification shall be current.

The Contractor shall keep accurate records of each splice and splice location. The Contractor shall complete the "Splice Location Worksheet", "Termination Location Worksheet" and the "Slack Loop Location Worksheet" for each splice location and slack loop vault and/or junction box. All worksheets shall be submitted to the ACHD Congestion Management Supervisor prior to final contract payment.

2. Pulling, Blowing and Splicing Requirements

a. Pulling

Install the fiber optic cable by hand or by using a mechanical pulling machine. If a mechanical pulling machine is used, equip the machine with a monitored or recording tension meter. Ensure that at no time the manufacturer's recommended maximum pulling tension is exceeded. Ensure that the central strength member and aramid yarn are attached directly to the pulling eye during cable pulling. Use pulling attachments, such as "basket grip" or "Chinese finger" type, to ensure that the optical and mechanical characteristics are not degraded during the fiber optic cable installation. Ensure that excess cable is coiled in a figure eight and fed manually when pulling through pull boxes and splice boxes by hand. If pulleys and sheaves will be used to mechanically pull through pull boxes and splice boxes, provide a drawing of the proposed layout showing that the cable will never be pulled through a radius less than the manufacturer's minimum bend radius. Use large diameter wheels, pulling sheaves, and cable guides to maintain the appropriate bend radius. Provide tension monitoring at all times during the pulling operation. Ensure that cable pulling lubricant used during installation is recommended by the optical fiber cable manufacturer.

A green #12 locate wire shall be installed in all conduits containing a fiber optic cable and shall be continuous continuity.

b. Blowing

Use either the high-air-speed blowing (HASB) method or the piston method. When using the HASB method, ensure that the volume of air passing through the conduit does not exceed 600 cubic feet per minute or the conduit manufacturer's recommended air volume, whichever is more restrictive. When using the piston method, ensure that the volume of air passing through the conduit does not exceed 300 cubic feet per minute or the conduit manufacturer's recommended air volume, whichever is more restrictive.

c. Splicing

All work shall be performed in a suitable environment. Acceptable environments for opening and work on splice closures include office type environments in buildings, splice trailers and splicing tents with floors. Any work area in which splicing is performed shall be free from excess dust and moisture.

Fiber splicing, testing and connectorization shall not be performed in freezing temperatures.

Open splice closures and fiber ends shall not be exposed to rain, snow or windblown dust.

All splices shall be fusion splices, unless otherwise approved by the ACHD Congestion Management Supervisor.

The maximum bi-directional average loss for all fusion splices shall not exceed 0.10 dB, except when a lower value is shown on the plans. Repair or replace splices that exceed allowable attenuation at no cost to ACHD.

The maximum loss for all mechanical splices shall not exceed 0.50 dB, except when a lower value is shown on the plans. Repair or replace connectors exceeding allowable attenuation at no cost to ACHD.

Perform all optical fiber splicing using the fusion splicing technique, and according to the latest version of the manufacturer's cable installation procedures; industry-accepted installation standards, codes, and practices; or as directed by the Engineer.

Ensure that all splices match fiber and buffer tube colors unless shown otherwise in the plans. Where a fiber cable is to be accessed for lateral or drop signal insertion, only open the buffer tube containing the fiber to be accessed and only cut the actual fiber to be accessed. If a fiber end is not intended for use, cut the fiber to a length equal to that of the fiber to be used and neatly lay it into the splice tray. Treat any fibers exposed during splicing with a protective coating and place in a protective sleeve or housing to protect the fiber from damage or contaminants.

Slack loops shall be left in all underground splice vaults. The **slack loops shall be a minimum of 50 feet long, per end**, to allow future work on the cable from an enclosed splice trailer. If a splice trailer is located further than 50 feet from the splice vault a longer slack loop shall be used.

3. OTDR Testing Requirements

A current calibration certificate for the OTDR being used shall be maintained on file. All OTDR traces shall be conducted using a pigtail or fiber box between the OTDR and the fiber under test.

The minimum length of the fiber in the fiber box shall be greater than the dead zone specified by the OTDR manufacturer.

The launch transition shall not exceed 6 dB.

All OTDR traces shall be conducted at both 1310nm and 1550nm. Bi-directional OTDR traces shall be supplied when a fiber is terminated with a connector at both ends. Unidirectional OTDR traces are acceptable when one end will remain unterminated. Test the fibers that are not terminated at the same time of installation using a bare fiber adapter. Bidirectional averaging may be used when apparent splice losses are being impacted by core offset or other factors. OTDR traces shall contain the following information:

- Horizontal Axis: distance in kilometers
- Vertical Axis: attenuation scale in dB
- Traces showing attenuation versus distance
- Cursors positioned at cable ends

The following shall be tabulated for each trace: method, fiber type, wavelength, pulse width, refraction index, range, search threshold, reflection threshold, end threshold, warning threshold, backscatter, jumper length, file date, file time, fiber ID, cable ID, OTDR location, far end location, operator initials.

An event table showing all events having more than 0.05 dB loss shall also be shown. The table

shall contain event type, position from OTDR end, loss and reflectance.

The Contractor shall test all fibers, identify unacceptable losses and make corrective actions at no additional cost. Failed splices may be remade and re-tested for compliance. The Contractor shall replace any cable that is not compliant with these specifications at no additional cost.

Fibers shall be identified by strand number, strand color, tube number and tube color when applicable. All results shall be submitted in printed form on 8.5 inch by 11 inch paper in a suitable binder organized by cable, tube number and strand number. All printing shall be clear and legible.

Each binder shall have a cover sheet indicating which cable(s) were tested, where each cable was tested, the OTDR users name, the reviewers name, the type of test performed and the date(s) of the test.

Cover sheets for final test results shall bear the reviewers signature, the date, and a statement indicating that the installation complies with the requirements of this section.

OTDR traces shall also be submitted on CD with a printed index. The CD shall be formatted on a personal computer running a Microsoft Windows operating environment.

4. Special Acceptance Criteria – Short Cables

The special acceptance criterion for cables less than 1km in length is maximum total attenuation of 1.0 dB for the entire cable length at both 1310nm and 1550nm. These criteria shall apply to the Factory Test, Receiving Test, Post Pulling/Blowing Test, Pre-Splice Test, Post Termination and Splicing Test, and End-to-End Optical Light Test.

a. Factory Test:

Fibers Tested:	Each and Every Strand
• Light Frequency:	1310nm and 1550nm
• Direction: Location	Uni-directional
• of test: When	Cable Factory
• performed: Tested	Prior to Shipment
• by: Acceptance	Factory Staff
• Criteria:	Cable meets factory attenuation specifications Cable attenuation ≤ 0.4 dB/km @ 1310nm Cable attenuation ≤ 0.3 dB/km @ 1550nm Strand lengths are consistent Launch Transition < 6 dB Trace available for each and every strand in cable

b. Receiving Test:

- Fibers Tested: Normally, one strand per buffer tube. Each and every strand must be tested when evidence of physical damage exists or when any damaged strand is found.
- Light Frequency: 1310nm and 1550nm
- Direction: Uni-directional
- Location of test: ACHD Traffic Operations Facility or in field prior to installation (may combine this test and Post Blowing Pulling test)
- When performed: After receiving material
- Tested by: Certified fiber optic Contractor/technician
- Acceptance Criteria: Cable attenuation shall be less than published attenuation criteria specified by the cable manufacturer. Published attenuation criteria for Corning Altos cable is: Cable attenuation \leq 0.4 dB/km @ 1310nm
Cable attenuation \leq 0.3 dB/km @ 1550nm
Strand lengths are consistent
Launch Transition < 6 dB
Trace available for one strand in each and every buffer tube in the cable

c. Post Blowing/Pulling - Pre Splicing Test:

- Fibers Tested: Normally, one strand per buffer tube. Each and every strand must be tested when evidence of physical damage or excessive pulling tension or kinks exists or when any damaged strand is found.
- Light Frequency: 1310nm and 1550nm
- Direction: Uni-directional
- Location of test: One field location for each cable installed
- When performed: After installing cable in duct but before splicing
- Tested by: Installation Contractor
- Witnessed/Approved: ACHD Electronic Tech shall witness and must approve before splicing
- Acceptance Criteria: Cable attenuation \leq 0.4 dB/km @ 1310nm Cable attenuation \leq 0.3 dB/km @ 1550nm Strand lengths are consistent
Launch Transition < 6 dB
Trace available for one strand in each and every buffer tube in the cable

If the fiber optic cable fails to meet any of the tests in this section it shall be re-spliced or replaced by the Contractor at the Contractor's expense.

d. Post Termination and Splicing Test:

- Fibers Tested: Each and Every Strand in each and every cable

- Light Frequency: 1310nm and 1550nm
- Direction: Unidirectional
- Location of test: Each and every field location required to obtain access to each cable segment
- When performed: After terminating and splicing at all points shown on the plans
- Cable Tested by: Installation Contractor
- Witnessed/Approved: ACHD Electronic Tech shall witness and must approve before final approval by the Engineer.
- Acceptance Criteria: Cable attenuation ≤ 0.4 dB/km @ 1310nm excluding splices shown on the plans.
Cable attenuation ≤ 0.3 dB/km @ 1550nm excluding splices shown on the plans.
Strand lengths are consistent
Launch Transition < 6 dB
Maximum mechanical splice attenuation 0.50 dB per splice unless otherwise shown on the plans.
Maximum fusion splice attenuation 0.10 dB per splice and typical loss shall be 0.07 dB unless otherwise shown on the plans.
Trace available for one strand in each and every strand in each and every cable segment

e. End-to-End Optical Light Test:

For field-spliced cables, the Contractor shall be furnished with "Fiber Optic Continuity Test Forms" identifying the specific set up location for the power meter and light source. The Contractor will be furnished with blank forms for recording end-to-end test results for fibers running continuously from building to building.

The Contractor shall connect the light source to the connectorized fiber number at the location identified in the "Fiber Optic Continuity Test Forms" and to all strands that the Contractor installs in buildings. The Contractor shall connect a power meter to the other end of the fiber at the location identified.

The Contractor shall then turn on the light meter and record the power received at the power meter in the appropriate location on the "Fiber Optic Continuity Test Forms".

The Contractor shall turn the light or modulate the light source for three seconds. The individual observing the power meter shall observe the meter and record the response of the meter in the appropriate location on the "Fiber Optic Continuity Test Forms". The response shall be "OK" if the Contractor notes the meter responding to the modulated light source. No response to modulation is evidence of light being supplied by another laser and will require a "BAD" response. For each bad response, the Contractor shall submit a statement summarizing the response noted on the power meter.

Perform test on all fibers to ensure that no discontinuities greater than 0.2 decibel per 300 feet exist. Repair or replace cable sections exceeding allowable attenuation at no cost to ACHD.

5. Re-entry of Fiber Optic Splice Closures

All work shall be performed in a suitable environment. Acceptable environments for opening and work on splice closures include office type environments in buildings, splice trailers and splicing tents with floors. Any work area in which splicing is performed shall be free from excess dust and moisture.

Fiber splicing, testing and connectorization shall not be performed in freezing temperatures. Open splice closures and fiber ends shall not be exposed to rain, snow or windblown dust.

After completing the required work, the Contractor shall use an OTDR to test each and every fiber strand passing through any splice tray that was opened by the Contractor.

If the OTDR trace for any randomly selected strand shows evidence of damage, each and every strand passing through the splice enclosure shall be tested with an OTDR.

The Contractor shall repair any damaged fiber strands using fusion splicing methods and repeat all tests described above.

6. Termination of Fibers in Traffic Signal Cabinets/Camera Cabinets/ITS Cabinets

The termination of the 12, 36, 72 single mode fibers in the traffic signal, ITS and camera cabinets shall be done with FC connectors supplied by the Contractor. The termination cabinets inside the signal cabinets will typically be supplied and installed by ACHD. The termination cabinets will be preloaded wall mounted interconnection centers (WIC) manufactured by Corning or ACHD approved equivalent. **A termination location worksheet will need to be filled out for each location as required by the plans.** See termination worksheet on next page.

7. Numbering Convention

The Contractor shall use the following chart when numbering tubes in the fiber optic cable and when numbering the individual fibers. The tubes in the fiber optic cable and the individual fibers shall be numbered based on their color.

Color	No.	Color	No.
Blue	1	Red	7
Orange	2	Black	8
Green	3	Yellow	9
Brown	4	Violet	10
Slate	5	Rose	11
White	6	Aqua	12

Termination Location Worksheet

Location Information

Customer	ACHD		
Building/Street			
Address			
Room/X-Street			
Bay / Shelf			
Access Info.		Notes:	

Fiber Distribution Frame Information:

Manufacturer	
Model	
Capacity	
Layout	(diagram the front of the frame on the back of this paper or record the number of rows & columns, ex. 6 rows/12 columns = capacity of 72)

Installer Information:

Company	
Technician(s)	
Date	
ACHD Project #	

Cable Information:

Cable Part Number	Sequential at Frame	Sequential at Duct	From Direction

Splice / Termination Information:

From Cable (Direction)	From Fibers (fiber colors or number)	To Jack Number(s) in Frame	Connector Type (SC, ST, FC, etc.)

Note: if additional diagrams are needed, please draw them on the back of this page.

Comments / Observations:

Splice Location Worksheet

Location Information

Street						
Nearest Address						
Cross Street						
Plan Sheet #						
Placement	Underground	Above Ground	Other			
Type	S-50	Manhole	Splice Vault	J-Box	Cabinet	Other
Dimensions						
Notes						

Enclosure Information:

Manufacturer	Model/Part No.
Ports Available	(number of ports available after installation)
Splice Trays	(number of splice trays and capacity, ex 2 trays/24 capacity)
Other	

Installer Information:

Company	Date:
Technician(s)	
ACHD Project #	

Cable Information:

Cable Part Number	Sequential at Enclosure	Sequential at Duct	From Direction

Splice Information:

From Cable (Direction)	From Fibers (fiber colors or numbers)	To Cable (Direction)	To Fibers (fiber color or number)

Comments and Observations:

Slack Loop Location Worksheet

Location Information

Street							
Nearest Address							
Cross Street							
Plan Sheet #							
Placement	Underground			Above Ground		Other	
Type	S-50	S-45	Manhole	Splice Vault	J-Box	Cabinet	Other
Dimensions							
Notes							

Installer Information:

Company		Date:	
Technician(s)			
ACHD Project #			

Cable Information:

Cable Part Number	Sequential Entering Access	From Direction	Sequential Leaving Access	From Direction

Comments and Observations:

1131.08 — JUNCTION BOXES

(Revised 11/25/2014)

A. General Information

All necessary junction boxes shall be supplied by the Contractor, unless otherwise shown on the plan or directed by ACHD. Concrete junction boxes shall be bottomless and shall be constructed of vibrated concrete. The lid shall be steel diamond plate with a 3/8 inch minimum thickness, and a stainless steel bolt to hold the lid securely in place.

Junction boxes shall be manufactured by **Idaho Precast Concrete, Amcor Precast (Type S-40T/Ada, S-45T/Ada, 32"x32"x24")** or an equal. Fiber optic splice vaults shall be manufactured by **Utility Vault, Idaho Precast Concrete** or equal and be a **Type 25-TA** with two galvanized top hinged doors and a concrete bottom. The junction box located at the Idaho Power service shall be a composite box manufactured by **Carson Industries, Type H1324-18**, or manufactured by **Hubbell Power Systems, Model PG1324BA18 with lid, part number, PG1324HA00** or equal.

The service junction box shall have "POWER" inscribed on top of the junction box.

Any unused openings or gaps in the junction boxes shall be grouted. When a gap is greater than two inches (2") a solid backer shall be used.

B. Location

The location of the junction boxes as shown in the Plans is approximate. Their exact location shall be at the option of the Contractor, provided that the location satisfies the requirements of these Supplemental Provisions. Junction boxes shall not be located within the traveled way, within wheelchair ramps, or driveways. New junction boxes shall not interfere with any previous or relocated junction box installation. On roadway sections with curb, gutter and sidewalk, the Contractor shall install lighting junction boxes at the back of the sidewalk with at least 6" of concrete on the back side of the box. The signal interconnect junction boxes shall be installed in the middle of the sidewalk and signal loop junction boxes shall be located at the front of the sidewalk behind the curb with a 6" buffer from the back of the curb to the front of the junction box. The 6" buffers allow the concrete to be finished around the boxes. The location of junction boxes on each roadway leg shall be consistent. All junction box locations shall meet the requirements shown on the Plans and these Supplemental Provisions (see ACHD Standard Detail TS-1105).

Junction boxes installed within sidewalk areas shall have a minimum of 6 inches of $\frac{3}{4}$ inch minus crushed aggregate base to allow adequate drainage. The lid of the junction box shall be flush with its frame and with the surrounding area whether it is shoulder, sidewalk, or other surface. Each conduit entering the junction boxes shall be neatly upswept and shall terminate not less than 2 inches or more than 4 inches above the bottom of the junction box. The location of the conduit within the junction box shall be such that the side of the junction box through which the conduit enters indicates the direction the conduit came from.

S-40T/Ada junction boxes shall not receive more than six conduits. The S-45T/Ada shall not receive more than 14 conduits. The number of conduits received by an S40-T/Ada or S45-T/Ada junction box shall require approval from the ACHD Traffic Engineer when the maximum conduit size exceeds

2 inches in diameter. Fiber optic cable installations may require a 32"x32"x24" junction box as a minimum to allow for adequate bending radius for the fiber depending on the type of fiber used.

If applicable, junction boxes or splice vaults shall not be placed in or directly above shared trenches with other utilities.

C. Interconnect Spacing

When included in the contract plans, junction box spacing for signal interconnect or fiber cable shall be one at every intersection or a maximum of 500 feet apart, whichever is less. When conduit for future street lighting is included in the plans, a junction box shall be placed at every intersection or a maximum of 1000 feet apart, whichever is less. Conduits and junction boxes for communication cables shall be completely separate from other conduits.

D. Interconnect Conduit

Interconnect conduit may be shown in the same conduit run as other signal conduits. Interconnect junction boxes should only be installed on street corners and at approximately 500 foot intervals. Interconnect conduits shall be the only conduits that enter the interconnect junction boxes or splice vaults.

All interconnect conduits or spare installations without interconnect cable shall contain one #12 AWG stranded copper wire for line locates.

When interconnect conduit is installed in the roadway, access points or junction boxes shall be cast-in-place concrete manholes installed per ACHD Standard Detail TS-1105.

All conduit, conductor and junction box installations shall comply with the latest edition of the **National Electrical Code (NEC)** and all applicable state and local regulations and these special provisions.

1131.09 — STEEL SIGNAL AND LUMINAIRE POLES

(Revised 12/19/2012)

A. Materials

1. General

In order to be acceptable, a bid for poles and component parts furnished will be in accordance with the terms and requirements as set forth herein. All Materials shall conform to the Buy America requirements of the Surface Transportation Assistance Act of 1982 (S.T.A.A) See attached "Buy America" Procurement and Delivery Certificates and Paragraphs 21 and 22 of this Specification. At the manufactures option hot dip galvanization (Per ASTM A-123) may be used in place of the abrasive blasting and primer method of surface protection as outlined in items 2, 3, and 5. **ACHD has approved Valmont Industries, Ameron International, Union Metal and Northwest Signal pole manufactures.**

2. Surface Preparation for Exterior Protective Coating Systems

Exterior surfaces of shaft(s) and arm(s), and component parts, shall be abrasive blasted in accordance with coating manufacturer's recommendations. The lower interior portions of the shaft, from the base bottom to the top of the hand hole opening, will receive the same treatment. All rough and sharp edges shall be rounded off. All lineal welds shall be ground for a smooth finished appearance. All weld splatter, flux and slag around the base plate, hand hole, arm connections and other areas of welding shall be removed. All drilling of holes and welding of tenons or hubs shall be done prior to abrasive blasting.

3. Requirement of Interior Protective Primer System

Surface preparation for Interior Primer before primer is applied: the interior of the pole shafts and mast arms shall be thoroughly cleaned, dried, and free of mill scale, rust, oil, grease and dirt or other contaminates. Interior surfaces shall then be coated with a long oil alkyd liquid paint or acceptable primer application which conforms to Federal Specifications TTP-645. Such coating shall be a minimum thickness of 2.0 mils dry film.

4. Requirement of Exterior Coating System

All exterior surfaces are to be coated with a Urethane or Triglycidal Isocynurate (TGIC) Polyester Powder to a minimum dry thickness of 2.0 mils. The coating shall be applied electrostatically and subsequently cured by heating of the steel substrate to a temperature as recommended by the manufacturer or by the coating supplier. The pole and mast arm manufacturer shall guarantee exterior surface color coating adhesion for a minimum of 5 years. **Color of finish topcoat will be semi-gloss black.**

PROTECTIVE COATING SYSTEM SHALL BE RESISTANT TO CORROSION, ABRASION AND IMPACT. COATING SYSTEM SHALL BE APPLIED AT POINT OF MANUFACTURE.

5. Finish

All exterior material surfaces, except anchor bolts, nuts, and washers and mast arm attachment bolts shall be finished as specified in Item # 4. **Mast arm attachment bolts shall be galvanized.** All interior material surfaces shall be shop-coated with a rust-resistant paint as specified in **Item # 3.** All threaded holes shall be rethreaded after the finish coating is applied to remove any coating buildup. **The mast arm attachment fixture must be threaded to receive galvanized mast arm bolts. All galvanized hardware shall conform to ASTM A-153.**

6. Wrapping and Packaging

All components will be individually wrapped with heavy craft paper and/or boxes. The wrapping will overlap a minimum of 2-inches at all points of contact with the shipping dunnage. The shipping dunnage will consist of a cushioning form of sufficient width and length to adequately support each component and to eliminate shipping damage to the components or component coatings. All small components for poles, pole extensions, and mast arms (nuts, bolts, caps, hand hold covers, etc) shall be packaged (clear plastic bag) on an individual per pole, pole extension or arm basis and identified for the type of pole, arm, or extension they are intended to fit.

7. Handling and Shipment

Poles shall be handled in a manner that will preserve the overall appearance and prevent damage to the coating. The use of chains or cables for loading, unloading or shipping is prohibited. Only 3/4-inch diameter or larger non-abrasive nylon rope or equivalent nylon belting will be used. Adequate hold-downs and appropriate blocking shall be utilized for shipping to prevent load movement and damage to the outer coating in transit.

8. Delivery, Installation and Acceptance of Poles

Extra care shall be taken not to damage the coating. Upon arrival of the poles at the delivery point, neither chains nor cables will be used for unloading of poles.

9. Procedures for Field Touch-Up

The pole manufacturer will furnish extra paint, both primer and color coat, to satisfy the needs of field touch-up requirements, in the event of minor physical damage to the coating from handling or transit. Damaged area must be clean and dry before repair application. Field touch-up will be at the direction of the pole manufacturer or his authorized representative.

10. Construction

All signal pole and arm construction shall conform to AASHTO, Section 4 - Steel Designs.

11. Loading

Loading shall conform to AASHTO, Section 2 - Loads.

12. Shafts

Shafts will be manufactured from ASTM steel having the minimum yield strength before cold

forming of 33,000 PSI. Cold working will be held to a minimum to assure high ductility in the finished shaft. The manufacturing process will not reduce the wall thickness of the shaft during forming operations.

13. Pedestrian Poles

The pedestrian poles shall be supplied with anchor bolts, nuts, washers, base cover, and hand-hole cover. (See attached drawings) **Pedestrian poles shall be constructed from a minimum of 3-gauge wall thickness material to facilitate drilling and tapping of bolt holes.**

14. Luminaire Poles

The luminaire poles shall be supplied with anchor bolts, nuts, washers, base cover, and hand-hole cover. (See attached drawings) **Luminaire poles shall be constructed from a minimum of 7-gauge wall thickness material to facilitate drilling and tapping of bolt holes.**

15. Signal Poles

All signal poles are to be fitted with double mast arm mounts. (See attached drawings)

a. Base

The base shall be a one-piece cast steel anchor base of adequate strength, shape and size and secured to the lower end of the pipe shaft by two continuous electric arc welds. The base shall telescope the shaft and one weld shall be on the inside of the base at the end of the shaft, while the other weld shall be on the outside at the top of the base. The design shall be such that the welded connection and base shall develop the calculated yield strength of the adjacent shaft section to resist bending action and shall comply with AASHTO, Section 4. Base plates will be fabricated from steel plate meeting **ASTM-A-283, Grade D specifications.**

b. Hand Hole Cover

Furnished with each pole standard will be two (2) hand-hole covers, excluding pedestrian poles which will be supplied with one (1) hand-hole cover, complete with hardware to attach securely over the hand-holes at the base of the pole and adjacent to the mast arm mounting flanges. **All hand-hole covers shall have a nominal dimension of 4" X 10" and secured by 0.25" hex head stainless steel machine thread screws (20 TPI).** Hand-hole covers shall be finished as specified in 'SECTION III – SPECIFICATIONS' Item # 3 and 4.

c. Top Covers

All Signal poles and signal pole extension tubes shall be supplied with weather tight top covers constructed of cast or rolled steel and easily attached by means of cap screws.

d. Base Covers

Two piece steel base covers and hardware will be provided with each pole base section for the anchor bolts and base flange. The covers shall be constructed to clamp securely to the

pole. Base covers shall be finished as specified in **'SECTION III – SPECIFICATIONS' Item # 3 and 4.**

16. Signal Pole Anchor Bolts

Four high strength steel anchor bolts, eight nuts and eight washers shall be furnished with each pole. Each anchor bolt shall have an \angle "L" bend at the bottom end and shall be threaded at the top end for a minimum length of **12 inches**. The threaded ends of bolts, all nuts and all washers shall be galvanized. (See attached drawing) **All anchor bolts shall be color coded on the threaded end, 'Yellow' for 55 KSI yield and 'Red' for 105 KSI yield bolts. 10% spare anchor bolt assemblies (bolts, nuts, & washers) shall be furnished as part of the pole order. The signal pole anchor bolts may be delivered prior to the signal pole delivery. Each anchor bolt shall be shipped with two (2) nuts installed, threaded onto the bolt approximately 50% of the thread length. Anchor bolt washers shall be shipped in a separate container.**

17. Mast Arm Fittings

Cast or rolled steel mast arm fittings will be weather-tight and easily attached to the shaft by means of supplied cap screws. Fittings shall be finished as specified in **'SECTION III – SPECIFICATIONS' Item # 3 and 4.**

18. Pole Size Data

All pole data is described in the attached ACHD drawings. **All poles and arms shall be round in shape with a maximum break angle of 30° from tangent (12-sided minimum).**

- a. Pole Type X: 18' (extendable to 40') and a combination of 1-30' & 1-55' mast arm, or a combination of 1-40' & 1-50' mast arm, or dual 45' mast arms.
- b. Pole Type XI: 18' (extendable to 40') and a combination of 1-40' & 1-65' mast arm or a combination of 1-55' & 1-60' mast arm, or dual 55' mast arms.
- c. Pole extension A: 17' extension for poles X or XI, with luminaire mount.
- d. Pole extension B: 5' extension for extension A (specified above), with luminaire mount.
- e. Pole extension C: 7' extension for poles X or XI, with luminaire mount. f. Pedestrian pole: 12' tapered, minimum 3 gauge shaft thickness.
- g. Luminaire pole: 40' Luminaire mounting height using ACHD standard luminaire arms up to 20' in length.

19. Pole Extensions 'A', 'B', and 'C'

All extensions shall have a 'J' hook located at the arm mounting level for wire strain relief connections. All extensions having top access holes smaller than 5 inches in diameter shall have a handhold cover located adjacent to the arm mounting plate to facilitate access for wiring.

20. Mast Arms

All mast arm lengths shall be supplied as single piece units. **No mast arm shall require field assembly.**

21. Supplied Documentation

All Poles, Mast arms, Bolts, and associated hardware shall be supplied with detailed design drawings listing all size, angle, and strength information relevant to design, construction, and assembly. Loading analysis calculations shall be included with these drawings showing the structure meets and/or exceeds AASHTO requirements. This material shall be supplied in both paper form (2 copies) and electronic form (ACAD .dwg for drawing files and Word .doc or ASCII .txt for text files on CD ROM in windows based PC readable format). **The printed forms of all documentation shall be stamped, signed, and dated by a state of Idaho registered professional engineer.** All Supplied Documentation shall be completed and delivered to Ada County Highway District for review and approval. **In addition, a signed and notarized "Buy America" Procurement Certificate shall be submitted to ACHD with the Supplied Documentation.** Failure to provide Supplied Documentation and "Buy America" Procurement Certificate within the time frame stated may result in the termination of the Purchase.

22. Other Documentation Requirements

A signed and notarized "Buy America" Delivery Certificate shall be submitted to ACHD with each delivery of Signal Poles and Mast Arms under the Purchase Agreement. Failure to provide "Buy America" Delivery Certificate each delivery of Signal Poles and Mast Arms under the Purchase Agreement will result in the delay of payment under the Purchase Agreement until said Certificate has been received and accepted by ACHD.

B. Fabrication and Erection Requirements

1. Installation

After poles or mast arms are delivered to the job site and before they are installed, they shall be stored where they will be protected from damage and will not inconvenience the public. All poles and mast arms shall be installed in compliance with Idaho State Utility and Electrical Codes.

Poles shall be installed so that the mast arm is perpendicular to the centerline of the roadway, unless otherwise shown on the Plans or directed by the ACHD Traffic Engineer.

The poles shall be installed on leveling nuts and washers secured to the anchor bolts and with nuts and washers on the top of the base flange. The side of the pole opposite the load shall be plumbed by adjusting the leveling nuts or as directed by ACHD.

The space between the concrete base and the bottom of the pole flange shall be filled with dry pack mortar, per ACHD Standard Detail TS-1110. The dry pack mortar shall be neatly troweled to the contour of the pole flange. A plastic drain hose (1/2 inch diameter) shall be inserted through the mortar to provide drainage from the interior of the pole base. The plastic drain hose shall be trimmed flush with the exterior surface of the mortar.

Dry pack mortar shall consist of a 1:3 mixture of cement and fine sand with just enough water so that the mixture will stick together when molded into a ball by hand, and will not exude free moisture when so pressed.

All unused holes in the mast arm or signal pole shall be sealed with the appropriate size three piece knock-out seal or bolt and painted.

Traffic signal poles with a CCTV arm above the luminaire arm shall have a pull string from the end of the CCTV arm to the traffic signal controller cabinet. ACHD crews will then install the camera cable and CCTV camera.

2. Painting

If it becomes necessary to drill a hole in the pole prior to or during installation, the exposed metal shall be thoroughly wire brushed to remove loose and cracked coating. The cleaned area shall be painted with two coats of zinc rich primer and then painted with touch-up paint supplied by the pole manufacturer to match the existing color.

1131.10 — VEHICLE SIGNAL HEADS, LED INSERTS and MOUNTING HARDWARE

(Revised 10/08/2012)

A. General Information

ACHD normally solicits bids for a vehicle signal heads on an annual basis. All vehicle signal heads shall meet the requirements of the latest signal head bid specifications. The Contractor can obtain the latest bid specifications by contacting the ACHD Traffic Operations Supervisor.

All signal head displays shall have a minimum 30" wire leads equipped with 0.25" insulated female quick disconnect terminal connectors. A 4-position barrier type terminal block shall be mounted within each signal head group to accommodate up to 3 displays, for signal heads with more than 3 displays multiple 4-position barrier type terminal blocks shall be mounted each wired for maximum of 3 displays. 4-position barrier type terminal blocks shall be wired one side to the display module and the other side be left open for the field wires.

All vehicle signal heads shall be high performance LED modules manufactured by **McCain Traffic Supply (Part Number MTS TP304PA or MTS TP324PA)**, 3 section, one way, 12 signal head or an ACHD approved equal. The signal heads shall be constructed of corrosion resistant, polycarbonate alloy, contain a minimum of 10% glass filled LEXAN and reinforced strengthening "ribbing" on inside top and bottom of each signal section and shall be traffic signal green and shall be equipped with 12 inch polycarbonate tunnel-type visors and vacuum formed 5 inch polycarbonate backplates. Three section signal heads must accept backplates with a rectangular straight edged mounting flange. Three section heads shall have a minimum wind survivability rating for a single point mounting system of 80 mph at 150° F. Each head shall come complete with appropriate face arrangement and accessory hardware.

The accessory hardware shall consist of the following components. Face arrangement quantities will be identified in the bid document

- 12" tunnel visor, polycarbonate;
- 5" back plate, angular polycarbonate;
- Astro-Brac cable mounting assembly with 96 inch cables and stainless steel hardware;
- A tunnel visor for each face; the inside visor shall be finished in flat black;
- The signal head and tunnel visors shall be traffic signal green; this color shall be an integral part of the signal head, not a surface coating;
- A terminal block shall be furnished and installed in the center section of the signal head; all display wires will have terminal connectors and will be fastened to the terminal block;
- Signal back plates shall be furnished in flat black and shall fit the signal head properly; all back plates shall have minimum ½" reinforcing angles to stiffen the assembly;
- Each head shall be furnished with an Astro Brac cable mounting assembly, Pelco P/N: AB-3009 series with appropriate tube lengths for the supplied signal heads, stainless steel hardware and 96" mounting cables or equivalent; the mounting bracket shall be furnished but not installed on the signal head;

All LED traffic signal modules shall also be warranted for 5 years against manufacturing defects.

All vehicle and pedestrian heads shall be securely and completely covered with an opaque material between installation and signal turn-on. Signal head covers shall be made of heavy, waterproof

material and shall be securable by braided nylon rope or other ACHD approved method.

B. Signal Head Mounting

Signal heads shall be mounted using **PELCO Astro Bracket AB-3009 cable clamp kit and AB-4001 arm kit** or an ACHD approved equal. Mounting hardware shall provide for a rigid connection between the signal head and mast arm or pole.

Vehicle signal heads shall have 12 inch lenses. The highest intensity of the red indication in the signal head shall be aimed at a point four times the posted speed limit from the stop bar (measured in linear feet), unless otherwise directed by the ACHD Traffic Engineer.

C. Signal Head Positioning

The position of the signal heads shall be as specified on the Plans and these Supplemental Provisions, unless otherwise directed by the ACHD Traffic Engineer. The Contractor shall have all signal head locations verified in the field by the ACHD Signal Inspector prior to drilling holes in the signal mast arm. The ACHD Signal Inspector will require a minimum of two business day notice to schedule verification of traffic signal head locations. Signal heads shall be mounted on the mast arm such that the bottom of the signal head housing shall not be less than 17 feet nor more than 19 feet above the pavement grade at the center of the roadway. All signal head locations shall comply with the **Manual on Uniform Traffic Control Devices (MUTCD)**.

D. LED Technical Performance

This technical performance specification is applicable to new signal and pedestrian heads supplied with LED displays and retrofit LED display kits for existing signal and pedestrian heads. The specification covers all LED red, green, yellow, hand, and man LED modules to be used in place of the incandescent lamp, reflector, socket, gasket, and lens assemblies for these heads.

Referenced vehicle type LED modules shall fit in all standard, incandescent vehicle traffic signal housings. Each module shall incorporate a printed circuit board inclusive of all of the LEDs and required circuit components, 39 inch 16 AWG wire leads with strain relief and spade terminals, a rigid housing for protection in shipping, handling and installation, and a one piece neoprene gasket. Screw-in type products are not allowed for vehicle signals.

Outer lenses for ball type modules shall be made of ultraviolet stabilized polycarbonate, and shall serve to enhance the optical efficiency of the LED traffic signal module. Red, green, and yellow ball type signals shall incorporate an inner fresnel lens that is sealed to the lamp housing, and serves to collimate the light emitted by the LED light engine. The outer lens shall serve to focus the collimated light and shall be tinted red, yellow and green, and meet ITE intensity and distribution standards. Additionally, red, green, and yellow ball lamps shall approximate to the motorist the appearance of an incandescent traffic signal. The surface of red, green, and yellow ball LED lamps shall appear to the motorist as nearly totally uniform in illumination, and have a wide viewing angle that makes it suitable for installation on wide boulevards or single-tethered span wire. It shall not be apparent that LEDs are used as the light source for red, green, and yellow traffic signal ball type lamps. The external lens surface for all vehicle signals shall be smooth, with no raised features minimizing the collection of dirt, diesel smoke, and

other particulate contaminates, and to facilitate periodic cleaning. External lens facets are not allowed. The lens shall be keyed to the housing of the LED signal module to insure the proper orientation and to avoid possible rotation during any handling. External lenses shall be hard-coated in compliance with Caltrans specifications.

The LEDs shall be mounted and soldered to a printed circuit board. The LED signal module shall be watertight when properly installed in traffic signal housing. The LED signal module shall utilize the same mounting hardware used to secure the incandescent lens and gasket assembly, and shall only require a screwdriver or standard installation tool to complete the mounting. The LED signal module assembly shall weigh less than 5 pounds. To minimize possible maintenance problems, the LED lamp module may not protrude into the signal visor area more than three-quarters of an inch in depth.

The housing of the LED signal module shall be marked 'TOP' to designate the proper orientation of the LED signal module in the traffic signal housing. **Manufacturers part number, date of manufacture, and electrical characteristics of the LED signal module shall be visible on the rear of the assembly.** A label shall be affixed to back of the red and green ball type modules that certifies their complete compliance with the January 2005 ITE VTCSH, Part II specification for LED traffic signal modules and any current DOE regulations. **All LED Modules must carry the Intertek ETL verified mark.**

The LED traffic signal lamp manufacturer shall be ISO 9001 certified and a registered U.S. EPA Energy Star partner. With the exception of yellow ball lamps, all LED lamps shall be Energy Star compliant.

1. Optical

The light intensity, chromaticity, and distribution for red, green, and yellow ball and red, green, and yellow arrow LED signal modules, and LED pedestrian signals, shall have been tested by Caltrans, and found to be in compliance with Caltrans specifications. Additionally, red and green ball LED lamps shall meet the January 2005 ITE VTCSH Part II, standards and measurement criteria for LED traffic signal modules. Current test data verifying the compliance of red and green ball LED signals to the January 2005 ITE VTCSH, Part II specification shall be supplied from a certified independent testing lab. Current test data verifying compliance with Caltrans specifications shall also be supplied.

The control circuitry shall prevent the current flow through the LEDs in the off state to avoid any false indication as may be perceived by the human eye, during daylight and *evening* hours. The LED traffic signal module shall be operationally compatible with NEMA TS - 1 and NEMA TS - 2 conflict monitoring parameters. The intensity of the LED signal module shall not vary by more than 10% over the allowable voltage range as specified in the electrical section below.

2. Electrical

Power factor shall be 0.90 or greater, at nominal rated voltage and 25°C, after 60 minutes of operation. Total harmonic distortion (THD) shall be less than 20% at rated voltage, at 25°C.

All LED traffic signal modules shall be in compliance with FCC noise regulations and must meet the FCC Title 47, Subpart B Section 15 regulation.

The red, yellow, and Portland Orange LEDs shall utilize exclusively AlInGaP technology, either AS

(Absorbing Substrate) or TS (Transparent Substrate), and shall not exhibit degradation of more than 30% of their initial light intensity following accelerated life testing (operating at 85° C and 85% humidity, for 1000 hours). AlGaAs technology is not acceptable.

The green LEDs shall utilize Indium gallium nitride technology. Green LED traffic signal modules shall not be illuminated when the applied voltage is less than 35 VAC. They shall be illuminated (unregulated) when the applied voltage is 45 VAC to 80 VAC. Their illumination shall be in compliance with the January 2005 ITE VTCSH, Part II, when the applied voltage is between 80 VAC and 135 VAC.

The LED signal modules shall be connected directly to line voltage, 120 Volts AC nominal, and shall be able to operate over the voltage range of 80 VAC to 135 VAC.

The 12" red ball units shall consume no more than 10.5 watts at 120 VAC and 25° C. Maximum power consumption shall not exceed 17 watts at 120 VAC and 74° C.

Green ball LED traffic signal modules shall consume no more than 14.6 watts for 12" at 120 VAC and 25° C. Maximum power consumption shall not exceed 15 watts at 120 VAC and 74° C.

Yellow ball LED traffic signal modules shall consume no more than 22 watts for 12" lamps at 120 VAC and 25° C. Maximum power consumption shall not exceed 25 watts at 120 VAC and 74° C.

Red arrow type LED traffic signal modules shall be temperature-compensated so as to maintain intensity at elevated temperatures.

Combination hand-walking person LED Pedestrian signal modules shall incorporate a Lunar- white LED walking person symbol. The walking person symbol shall be filled-in. In order to insure accurate color transmittance, the module shall incorporate a replacement lens that is precisely matched to the dominant wavelength of the LEDs. The hand and walking person symbols shall be side by side. The hand symbol shall be filled-in. The hand and walking person symbols in the combination module, shall consume no more than a nominal 9 and 10 watts each, respectively. The module shall be compliant with NEMA water penetration prevention standards.

All LED modules must incorporate a sensing and control circuit, capable of detecting proper operation of the module. This sensing circuit will disable the module in the event of a failure of either the LED driver circuit or the LED's not operating within defined limits. When the sensing circuit disables the module, the module shall not illuminate and appear as a failed incandescent lamp to conflict monitors and malfunction management units.

Transient voltage suppression rated at 1500 watts for 1 millisecond and fusing with a maximum rating of 2 amps shall be provided to minimize the effect and repair cost of an extreme over voltage situation or other failure mode.

3. LED Inserts/Modules

The following LED modules have been tested by ACHD and are currently approved for use in

Ada County:

Red, Amber, and Full Green Balls:

	Dialight	GELcore	*EOI	Duralight
Red Ball	433-1210-003XL	DR6-RTFB-17A	TRV-R125G-D2T	JXL300-HFTR
Amber Ball	433-3230-001XL	DR6-YTFB-17A-YX1	TRV-YI25G-DIT	JXL300-HFTY
Green Ball	4300-2220-001XL	DG6-GTFB-17A	TRV-G125G-D2T	JXL300-HFTG

	Leotek
Red Ball	TSL-12R-LX-IL6-A1
Amber Ball	TSL-12Y-LX-IL6-A1
Green Ball	TSL-12G-LX-IL6-A1

*Excellence Opto, Inc.

Red, Amber and Green Arrows:

	Dialight	GELcore	*EOI	Duralight
Red Arrow	432-1314-001X-OD	DR6-RTAAN-17A	TRA-R12DG-IN	JXJ300-07TR03
Amber Arrow	431-3334-001X-OD	DR6-YTTAN-17A-YX	TRA-Y12DG-IN2	JXJ300-07TY03
Green Arrow	432-2374-001X-OD	DR6-GTAAN-17A	TRA-G12DG-IN	JXJ300-07TG03

	Leotek
Red Arrow	TSL-12RA-IL6-A1
Amber Arrow	TSL-12YA-IL6-A1
Green Arrow	TSL-12GA-IL6-A1

E. Warranty

All LED traffic signal modules supplied shall be warranted for 5 years against manufacturing defects and shall be tested and approved by ACHD Traffic Operations prior to bid award.

All red, green, and yellow ball LED traffic signal modules shall be performance warranted by the supplier to be in compliance with ITE minimum intensity standards for LED traffic signal modules, at 74° C, for a period of five (5) years. All red, green, and yellow arrow traffic signal modules, and 16" LED pedestrian modules shall be Caltrans approved. Additionally, red and green LED ball type traffic signals shall be warranted by the supplier to be in compliance with January 2005 ITE VTCSH, Part II specifications for five (5) years.

1131.11 — PEDESTRIAN SIGNAL HEADS and MOUNTING HARDWARE

(Typically Supplied by ACHD)

(Revised 9/12/2013)

A. General Information

ACHD normally solicits bids for a pedestrian signal heads on an annual basis. All pedestrian signal heads shall meet the requirements of the latest pedestrian head bid specifications and the most recently adopted version of the **Manual on Uniform Traffic Control Devices (MUTCD)**. The Contractor can obtain the latest bid specifications by contacting the ACHD Traffic Operations Supervisor.

The pedestrian signal heads shall be high performance LED countdown modules manufactured by McCain Traffic Supply, (Series 1000) or an ACHD approved equal.

Combination hand-walking person LED Pedestrian signal modules shall incorporate a Lunar- white LED walking person symbol. The walking person symbol shall be filled-in. In order to insure accurate color transmittance, the module shall incorporate a replacement lens that is precisely matched to the dominant wavelength of the LEDs. The hand symbol shall be filled-in. The hand and walking person symbols in the combination module, shall consume no more than a nominal 9 and 10 watts each, respectively. The module shall be compliant with NEMA water penetration prevention standards.

All LED pedestrian signal modules shall also be warranted for 5 years against manufacturing defects. The LED module shall be manufactured by one of the following vendors:

LeoTek	Dialight	GELcore	*EOI
TSL-PED-I6-CIL-9-P1	430-6479-001X	PS7-CFF1-26A-J1	TRP-C45D3154C20

*Excellence Opto, Inc.

The maximum overall dimension of the signal shall be 19 inches wide, 18 3/4 inches high, and 9 inches deep, including "Z" crate visor and hinges. The "Z" crate assembly shall be 1 inch to 1 1/2 inches deep. In order to facilitate installation and maintenance, the signal shall be designed so that all components are readily accessible from the front by opening the signal door.

B. Signal Head Mounting

Messages shall be International Symbols depicting a lunar white "walking person" and Portland orange "hand". The "hand" and "walking person" symbols shall be a minimum of 12 inches in height and 7 inches in width.

The case shall be a one-piece corrosion resistant aluminum alloy die casting. A one-piece neoprene gasket shall form a weather and moisture resistant seal. Integrally cast hinge lug pairs, two at the top and two at the bottom of each case, shall be provided for operation of a swing down door.

All vehicle and pedestrian heads shall be securely and completely covered with an opaque material between installation and signal turn-on. Signal head covers shall be made of heavy, waterproof material and shall be securable by braided nylon rope or other ACHD approved method.

1131.12 — PEDESTRIAN PUSH BUTTON ASSEMBLY

(Typically Supplied by ACHD)

(Revised 11/11/08)

A. General Information

The pedestrian push button assembly (including sign) shall be as shown in ACHD Standard Detail TS-1108.

The Pedestrian push button assembly shall be manufactured by **Dick Campbell Company** or an ACHD approved equal.

The Contractor shall install the pedestrian push buttons and signs on the signal poles or pedestrian push button poles, as shown on the Plans or as determined by the ACHD Traffic Design Engineer.

B. Push Button Mounting

The push buttons will be mounted to the poles by means of bolts, as shown on the ACHD Standard Details. All mountings shall be securely fastened and approved by ACHD. The center of the pedestrian push buttons shall be 42 inches above grade (see ACHD Standard Details TS-1106 & TS-1108).

Each pedestrian push button should be located so that it points at the crosswalk for which it is intended to serve; however, final positioning for the optimum effectiveness shall be approved by the ACHD Signal Inspector prior to installation. The position of all pedestrian push buttons shall comply with the requirements of the **Americans with Disabilities Act (ADA)**.

1131.12.01 – ACCESSIBLE PEDESTRIAN SIGNAL UNITS (FOUR-WIRE SYSTEM)

(Typically Supplied by ACHD)

(Revised 11/25/2014)

A. General Information

Where installed, accessible pedestrian signals (APS) shall comply with the guidelines outlined in these technical provisions with regard to pedestrian signals, pedestrian push buttons and directional information/signs. APS installation shall also conform to the most recently adopted version of the Manual on Uniform Traffic Control Devices (MUTCD) and the US Access Board's "Draft Guidelines for Accessible Public Rights of Way (PROWAG), Section R306.

The system shall also meet the following technical requirements, as substantiated by an outside testing services laboratory:

- NEMA TS2, Section 2.1 – Temperature and Humidity (salt/fog)
- NEMA TS2, Section 2.1 – Transient Voltage Protection
- NEMA TS2, Section 2.1 – Mechanical Shock and Vibration
- IEC 61000-4-4, IEC 61000-4-5 – Transient Suppression
- FCC, Title 47, Part 15, Class A – Electronic Noise
- NEMA 250-4X (push button station only) – Enclosure
- NEMA TS4 – Electrical Reliability (applicable portions of Section 8)

B. Pedestrian Signals

If APS is installed at an intersection, each crosswalk with a pedestrian signal indication shall have an accessible pedestrian signal which includes audible and vibrotactile indications of the WALK interval. Where a pedestrian pushbutton is provided, it shall be integrated into the accessible pedestrian signal. Signals should generally sound and vibrate throughout the WALK interval. Where signals rest in WALK, audible operation may be limited to a repetition at short intervals rather than continuous sounding for several minutes.

1. Location

Accessible pedestrian signals shall be located so that the vibrotactile feature can be contacted from the level landing serving a curb ramp, if provided, or from a clear floor or ground space that is in line with the crosswalk line adjacent to the vehicle stop line.

a. Crossings

Accessible pedestrian signal devices should be ten (10) ft. minimum from other accessible pedestrian signals at a crossing. The control face of the accessible pedestrian signal shall be installed to face the intersection and be parallel to the direction of the crosswalk it serves.

b. Medians and Islands

Accessible pedestrian signals located in medians and islands should be five (5) ft. minimum from other accessible pedestrian signals.

2. Reach and Clear Floor or Ground Space

Accessible pedestrian pushbuttons shall be located within a reach range complying with the criteria provided below. A clear floor or ground space complying with the criteria provided below shall also be provided at the pushbutton and shall connect to or overlap the pedestrian access route.

a. Forward Reach

Unobstructed

Where a forward reach is unobstructed, the high forward reach shall be 48 in. maximum and the low forward reach shall be 15 in. minimum above the finish surface.

Obstructed High Reach

Where a high forward reach is over an obstruction, the clear space shall extend beneath the element for a distance not less than the required reach depth over the obstruction. The high forward reach shall be 48 in. maximum where the reach depth is 20 in. maximum. Where the reach depth exceeds 20 in., the high forward reach shall be 44 in. maximum and the reach depth shall be 25 in. maximum.

b. Side Reach

Unobstructed

Where a clear space allows a parallel approach to an element and the side reach is unobstructed, the high side reach shall be 48 in. maximum and the low side reach shall be 15 in. minimum above the finish surface. An obstruction shall be permitted between the clear space and the element where the depth of the obstruction is ten (10) in. maximum.

Obstructed High Reach

Where a clear space allows a parallel approach to an element and the high side reach is over an obstruction, the height of the obstruction shall be 34 in. maximum and the depth of the obstruction shall be 24 in. maximum. The high side reach shall be 48 in. maximum for a reach depth of ten (10) in. maximum. Where the reach depth exceeds ten (10) in., the high side reach shall be 46 in. maximum for a reach depth of 24 in. maximum.

c. Clear Space

Clear space at accessible pedestrian signals, street furniture, and operable parts shall comply with the information provided in this section.

Surface Characteristics

Surfaces of clear spaces shall have a slope and cross slope of 2 percent maximum and comply with the provisions provided below.

Size

The clear space shall be 30" x 48" minimum.

Position

Unless otherwise specified, clear space shall be positioned for either forward or parallel approach to an element.

Approach

One full unobstructed side of the clear space shall adjoin a pedestrian access route or adjoin another clear space.

Maneuvering Space

Where a clear space is located in an alcove or otherwise confined on all or part of three sides, additional maneuvering space shall be provided as follows:

Forward Approach: Alcoves shall be 36 in. wide minimum where the depth exceeds 24 in.

Parallel Approach: Alcoves shall be 60 in. wide minimum where the depth exceeds 15 in.

3. Audible Walk Indication

The audible indication of the WALK interval shall be by tone or speech message.

a. Tones

Tones shall consist of multiple frequencies with a dominant component at 880Hz +/-20%. The duration of the tone shall be 0.15 seconds and shall repeat at intervals of 0.15 seconds. Many APS installations in the U.S. employ speech messages, which are perceived as being more user-friendly than tones. However, such messages may not be intelligible under high ambient noise conditions or to non-English speakers. Electronic tones are more universal and unambiguous. Section 4E.06 of the MUTCD specifies content of speech messages.

While electronic tones are the preferred method of conveying a walk indication, there may be instances where a speech message will be employed with APS installation. This includes locations where a 10' separation between push buttons on a corner is not feasible. At such intersections, a speech message shall be used at all corners of an intersection to avoid mixing different WALK interval messages.

b. Volume

Tone or voice volume measured at three (3) ft. from the pedestrian signal device shall be 2 dB minimum and 5 dB maximum above ambient noise level in standard operation and shall be responsive to ambient noise level changes. Where additional volume or beaconing features are available on pedestrian activation, they will momentarily exceed volume limits. Automatic volume adjustment in response to ambient traffic sound level shall be provided up to a maximum volume of 100 dB.

C. Pedestrian Pushbuttons

All pedestrian pushbuttons shall comply with the provisions specified below.

1. Operation

Operable parts shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist. The force required to activate operable parts shall be 22 N (5 lbs) maximum. An actuation indicator light and tone shall also be provided within the device. The device shall also be capable of extended press functionality.

2. Pushbutton Locator Tone

Pedestrian pushbuttons shall incorporate a locator tone at the pushbutton. Pushbutton locator tone volume measured at three (3) ft. from the pushbutton shall be 2 dB minimum and 5 dB maximum above ambient noise level and shall be responsive to ambient noise level changes up to 100 dB. The duration of the locator tone shall be 0.15 s maximum and shall repeat at intervals of one second. The locator tone shall operate during the DON'T WALK and flashing DON'T WALK intervals only and shall be deactivated when the pedestrian signal is not operative.

3. Size and Contrast

Pedestrian pushbuttons shall be a minimum of two (2) in. across in one dimension and shall contrast visually with their housing or mounting.

4. Optional Features

An extended button press may be installed to activate additional features. If included, buttons that provide additional features shall be marked with three Braille dots forming an equilateral triangle in the center of the pushbutton.

D. Directional Information and Signs

Pedestrian signal devices shall provide tactile and visual signs complying with the information included in this section on the face of the device or its housing or mounting to indicate crosswalk direction and the name of the street containing the crosswalk served by the pedestrian signal.

1. Arrow

Signs shall include a vibrating tactile arrow with high visual contrast aligned parallel to the crosswalk direction. The arrow shall be raised 0.03 in. minimum and shall be 1.5 in. minimum in length. The arrow shall contrast with the background.

2. Street Name

When provided, accessible pedestrian signals shall include street name information aligned parallel to the crosswalk direction and shall comply with the specifications outlined in this section or shall provide street name information in audible format.

a. Braille

All Braille installation shall be contracted (Grade 2).

Dimensions and Capitalization

Braille dots shall have a domed or rounded shape and shall comply with Table 1. The indication of an uppercase letter or letters shall only be used before the first word of sentences, proper nouns and names, individual letters of the alphabet, initials, and acronyms.

Table 1 – Braille Dimensions

Measurement Range	Minimum in inches Maximum in inches
Dot base diameter	0.059 in. to 0.063 in.
Distance between two dots in the same cell*	0.090 in. to 0.100 in.
Distance between corresponding dots in adjacent cells*	0.241 in. to 0.300 in.
Dot height	0.025 in. to 0.037 in.
Distance between corresponding dots from one cell directly below*	0.395 in. to 0.400 in.

* Measured center to center

Position

Braille shall be positioned below the corresponding text. If text is multi-lined, Braille shall be placed below the entire text. Braille shall be separated 0.375 in. minimum from any other tactile characters and 0.375 in. minimum from raised borders and decorative elements.

b. Crosswalk Configuration

When provided, graphic indication of crosswalk configuration shall be tactile.

3. Pedestrian Sign

A sign applicable to pedestrian actuation shall be provided for each pushbutton assembly. ACHD's standard pedestrian sign is a 9" x 12" R10-3 with type III or type IV high intensity prismatic retroreflective sheeting on the copy side, conforming to the most recently adopted version of **ASTM D4956** ("Push Button for Walk Indication", MUTCD). This sign shall either be mounted immediately above the pushbutton assembly or incorporated into the pushbutton detector units.

E. Signal Power Interface (SPI)

Unless otherwise specified on the Plans, a signal power interface (SPI) shall be supplied in the pedestrian display housing. The APS shall operate independent of a central control with a pedestrian display to pedestrian station ratio of 1:1. The SPI shall have the following capabilities:

- Interface with the pedestrian displays via WALK, DON'T WALK and neutral inputs.
- Interface with pedestrian stations via a four (4) wire conductor.
- A four (4) position, #8 barrier terminal connector for the four (4) conductor cable to be pulled to the pedestrian station.
- Mountable inside all types of pedestrian signal displays, with the exception of older, neon/transformer type pedestrian signals.

The SPI shall be fully functional at temperatures ranging from -30°F to +150°F and operate properly over power sources ranging from 12 VDC to 220 VAC.

A hand-held device for programming the individual Pedestrian Push Button Stations shall be available. A laptop or other portable electronic device capable of running the requisite manufacturer's programming software may be sufficient in meeting this requirement.

F. Environmental Requirements

The APS push button station shall be rated for the following temperature range: -30°F to +150°F. The station shall also be provided with a weatherproof enclosure.

G. Warranty

All components of the APS push button station and CCU shall have a minimum three (3) year warranty.

1131.13 — LUMINAIRES AND LAMPS FOR INTERSECTION SAFETY LIGHTING

(Typically Supplied by ACHD)

(Revised 12/9/2014)

A. General Information

The luminaires to be installed by the Contractor shall be for 240 volt service, unless otherwise shown on the Plans or as directed by the ACHD Traffic Engineer.

The light source shall be horizontally mounted with respect to ground surface. The luminaire shall produce a uniform pattern of light on the roadway. Adjustable drive is currently preferred.

The LED luminaire Fixtures shall be LEOTEK Part Number – EC7 18M MV NW 700 3 GY, Autobahn Number – ATB2 40BLED MVOLT R3 AO, Cooper Navion Part Number - NVN-AE-03-E-U-T3-10K-4-BK or an ACHD approved equal.

B. Additional Details

The luminaires shall be incorporated into a circuit independent of any existing illumination circuits. The luminaires shall be controlled by an integral photoelectric control located in the service cabinet.

All luminaires require a fused connector at each pole base for each energized conductor. Contractor shall supply and use a **Busman Mfg. Tron in-line fuse holder, catalog number HEB-JW-RLC-J**, or equal, with an 8 amp fuse.

All lighting conductor splices in junction boxes shall be made with the appropriate size sealed connector block suitable for wet locations. Contractor shall supply and use a **Blackburn or Elastimold USL-11, USL-30, or SEC Splice Box model SEC 0791**.

1131.14 — CONCRETE FOUNDATIONS

(Revised 12/19/2011)

A. General Requirements

The Contractor shall provide all material and labor for the construction of the foundations for traffic signal poles, luminaire poles for intersection safety lighting, pedestrian push button poles, traffic signal controllers and service cabinets. All foundations shall be built to the dimensions specified in the contract Plans and these Supplemental Provisions. The anchor bolt pattern shall match that of the item to be installed thereon, and shall be arranged such that the item installed thereon will point in the proper direction.

Foundation bolts are typically supplied by ACHD. For the purpose of use tax, the cost of the foundation bolts shall be included in the cost of the signal poles, luminaire poles, controller cabinets, and service cabinets, unless otherwise specified in the contract documents.

All excess materials shall be removed from the construction site and shall be disposed of at the Contractor's expense.

Except in areas with high ground water tables, concrete for signal pole bases shall be placed in an appropriate size sono tube. In areas with a high ground water table, concrete for signal pole bases shall be placed in an appropriate size corrugated metal pipe. Excess water shall be removed before placing concrete.

Backfill around pole foundations shall be Controlled Density Fill (CDF) placed from the bottom of excavation to four feet below the finished grade. Augured (drilled) holes not in the water may be poured against native soil with only the four feet below the finished grade formed with a sono tube.

Contractor shall securely install the anchor bolts required for the item to be mounted on the foundation. Contractor shall install all conduit required. Concrete foundations shall be troweled, brushed, edged and finished to the satisfaction of the ACHD Resident Project Representative or ACHD Signal Inspector. Concrete shall be promptly cleaned from the exposed portion of the anchor bolts and conduit after placement. Foundations for all standards shall be Class "30 MPa (4000 psi)" concrete as specified in the latest adopted version of the **Idaho Standards for Public Works Construction (ISPWC)**. Concrete and reinforcing steel shall be furnished and placed as shown in the contract plans.

Contractor shall seal the controller and service cabinets to the concrete foundation using an industrial grade RTV Silicone Sealant applied to the joint between the two after the cabinets are secured in place.

Concrete foundations shall be allowed to cure for a minimum of ten days, unless otherwise directed by the ACHD Resident Project Representative. The Contractor may install the traffic signal poles, controller cabinets, and service cabinets on the new foundations after the foundations have cured.

Concrete sidewalk removal required as part of the foundation installation shall be removed and replaced to the limits of existing joints.

All concrete foundation locations shall be approved by the ACHD Signal Inspector in the field prior to installation.

B. Pole Foundations

All pole foundations shall comply with ACHD Standard Detail TS-1110. The top of the signal pole base foundation elevation shall be provided by the Engineer on the design drawings.

1. When a pole foundation is placed adjacent to the back edge of the sidewalk, the top of the foundation shall be poured flush with the finished sidewalk grade. Where necessary, the sidewalk shall be notched around the foundation and a $\frac{3}{4}$ inch expansion joint shall be provided at all points where the foundation and sidewalk are in contact, such that the foundation can be removed without damage to the surrounding sidewalk.
2. When a pole foundation is placed in the sidewalk, the top of the foundation shall be 5 inches below the top of the sidewalk. The new sidewalk shall be installed on top of the new pole foundation (See ACHD Standard Detail TS-1110.)
3. If no sidewalk exists, the top of the foundation shall be to the elevation provided by the Engineer on the design drawings or as directed by ACHD.

C. Controller Cabinet

The controller foundation shall conform to the ACHD Standard Detail TS-1111 included in these Supplemental Provisions. The exact location and orientation of the controller cabinet shall be approved in the field by the ACHD Signal Inspector prior to foundation installation. The ACHD Signal Inspector will require a minimum of two business days notice to schedule inspection of the controller cabinet location.

D. Service Cabinet

The concrete foundation for the service cabinet shall be poured as one piece with the controller cabinet foundation as shown in the ACHD Standard Detail TS-1111. All foundation locations shall be approved in the field by the ACHD Signal Inspector prior to installation.

E. Potholing for Signal Pole Locations

As directed by ACHD, the Contractor shall dig to expose any utility conflict at the proposed signal pole location. The Contractor shall call Digline two business days prior to potholing. The potholes shall be:

1. Dug in such a manner to avoid any damage to existing utilities. Any damage done during potholing shall be the Contractor's responsibility;
2. Deep enough to accommodate proposed concrete bases;
3. Located as ACHD directs;
4. If utility conflicts exist then the Contractor shall immediately notify the ACHD Signal Inspector for direction. The Contractor shall also appropriately document the conflicts, backfill the holes and compact to 95% of the maximum dry density in 12 inch layers (or backfill with flowable CDF).

If no conflicts exist, the Contractor shall install the concrete foundations per plans.

1131.15 — REMOVED

1131.16 — EMERGENCY VEHICLE PREEMPTION SYSTEM

(Revised 11/1/11)

A. System Operation

A preempt signal shall be initiated by the closure of dry contacts and shall cause the intersection controller to hold or to advance by skipping phases to the green preempt phases shown in the Plans. The intersection controller shall provide for a yellow phase clearance interval to precede the red phase on all approaches to be stopped and shall also provide for an adjustable green hold interval. If calls are received from two opposing phases, the device shall respond to the first call first. A flashing "Don't Walk," other clearance, or minimum interval shall not be preempted or skipped.

The Contractor shall provide and install all of the equipment necessary to accomplish the preemption phases shown in the Plans.

Emergency Preemption System (EPS) equipment shall be manufactured by **Global Traffic Technology (GTT) Company** which shall include emitters, detectors, phase selectors and discriminators.

The EPS shall be capable of detecting and responding to an optical signal that has been received, and maintained for a period of 1.7 seconds from a vehicle-mounted optical emitter.

All EPS equipment shall operate over a temperature range of -40 degrees Fahrenheit to +175 degrees Fahrenheit and shall be electronically compatible with the intersection controllers typically supplied by ACHD.

B. Component Requirements

EPS equipment shall meet the following requirements:

1. Detector

(Typically Supplied by Fire Dept.)

The Contractor shall install **GTT Company 700 Series** preemption detectors at locations as shown in the Plans. Each emergency preemption detector shall be solid state device consisting of photoelectric cells and an amplifier mounted in a weather resistant housing. The detectors shall be capable of detecting an optical signal generated by an Opticom brand emitter assembly (**GTT Company**). The detectors shall detect the optical signals from the emitter, amplify the signals and transmit them to the phase selector.

2. Phase Discriminators

(Typically Supplied by Fire Dept.)

ACHD will install phase discriminator units as required to obtain the necessary phase discriminator channels for each leg of the intersection. The phase discriminator shall be a solid state, rack

mounted device which shall provide power to the detectors. The phase discriminator shall receive the amplified signal from the detector, verify it as valid, and send an input to the controller. This input shall be for the duration of the detected signal plus 8 to 10 seconds additional time after the signal is lost. Four channels shall be provided.

The phase discriminator shall also include the following features:

1. High and low priority discrimination;
2. Settable signal intensity threshold for up to at least 2,500 feet;
3. Computer based user interface;
4. Front panel switches and indicators for testing;
5. 20,000 priority/vehicle class/vehicle code ID combinations.

3. Detector Lead-in Cable

(Typically Supplied by ACHD)

The detector lead-in cable shall be a three conductor, shielded cable consisting of three #20 AWG stranded copper conductors, rated for 600 volts, and one #20 AWG drain wire. The detector lead-in cable shall be **GTT Company Opticom Model 138** shielded detector cable or an ACHD approved equal. No splicing will be allowed between the detector and the controller cabinet. Lead-in cable shall be installed from the controller cabinet to the end of the mast arm on all projects, whether Opticom is installed or not.

1131.17 — CONTROLLER CABINET, CONTROLLER AND APPURTENANCES (TS-2, TYPE 1 CABINET ASSEMBLY)

(Revised 4/21/14)

A. General Specifications

This specification describes the minimum acceptable requirements for a NEMA Type 5s and Type 6s cabinet assembly to house a solid state fully actuated controller unit, configured for TS2, type-1 operation. The manufacturer of the cabinet assembly shall have a minimum of five (5) years of cabinet manufacturing experience with NEMA TS2 cabinets and shall manufacture all SDLC equipment (**except MMU and controller**) supplied in this cabinet assembly. The cabinet assembly shall include the cabinet (1) Flasher, (3) Bus Interface Units (BIU) for a Type 5 cabinet and (4) Bus interface Unites for a Type 6 cabinet, (1) TS2 5 Amp Power Supply, (8) Load Switches for a Type 5 cabinet and (12) load Switches for a Type 6 cabinet, (4) Flash Transfer Relays with the Type 5 cabinet and (8) Flash Transfer Relays for a Type 6 Cabinet, and (2) Anchor Bolts for a Type 5 cabinet and (4) Anchor Bolts for a Type 6 cabinet. Each cabinet delivered to ACHD will also include a set of cabinet prints and to be located in the cabinet drawer. Each order of cabinets shall have included a complete electronic copy on CD of the cabinet drawings and schematics, schematics, BIU manual and schematics, power supply manual and schematics, and flasher and load switch manual and schematics. The electronic copy shall contain accurate information for the current version of the supplied devices. The supplied electronic copy shall be in MS Word Doc or Adobe pdf format for the manual text, Adobe pdf and AutoCAD dwg files for schematic files, and AutoCAD dwg files for cabinet drawing files. All drawing and schematic files shall contain sufficient resolution information to reproduce ANSI size 'D' drawings with smooth and legible detail.

A Type 5 cabinet shall have 8 load bays and a Type 6 cabinet shall have 16 load bays. See attached Load Bay Configuration Chart (fig 1.).

The cabinet assembly shall be tested and operated as a complete working unit prior to submittal to ACHD. This test shall consist of full 8-phase operation for a minimum of four (4) hours, and a 72-hour burn in certification test. Both tests shall be performed under a full signal load for the test period. This is required to reduce set up and miscellaneous time spent preparing a cabinet for testing and verification.

B. Cabinet Design Requirements

The cabinet shall be constructed using unpainted sheet aluminum with a minimum thickness of 0.125". No wood, wood fiber products or other flammable material shall be used in the cabinet. All welds shall be neat and of uniform consistency. No external rivets shall be present on the door or cabinet assembly.

The cabinet shall have a natural, unpainted aluminum finish on the outside.

The inside of the cabinet shall be white powder coated.

The size of the cabinet shall be:

Type 5s (Stretch) = 75" H x 18"D x 30"W (NEMA M-75)

Type 6s (Stretch) = 68" H x 26"D x 44"W (NEMA P-68)

Vertical shelf support channels shall be Unistrut 1-1/4" channel provided to permit adjustment of shelf location in the field. The channels shall have a single continuous slot to allow shelves to be placed at any height within the cabinet. Channels with fixed notches or holes are not acceptable. All panels attached to the slots shall have 0.25" channel nuts with springs.

Each cabinet shall be equipped with an extra set of unistrut channels or a keyhole panel on either side of the front section of the cabinet to permit the purchaser to mount additional equipment as necessary.

Shelves shall be at least 12" deep and be located in the cabinet to provide a 0.50" clearance between the back of the shelf and the back of the cabinet. A 1.50" document drawer shall be provided in the cabinet, mounted directly beneath the controller support shelf that shall have flat head bolts to attach the hardware. The drawer shall have a hinged top cover and shall be capable of storing documents and miscellaneous equipment. This drawer shall support to 50 lbs. in weight when fully extended. The drawer shall open and close smoothly. Drawer dimensions shall make maximum use of available depth offered by the controller shelf and be a minimum of 24" wide (Type 6s) and 20" wide (Type 5s).

Three shelves shall be provided in the cabinet. For the Type 6s cabinet the first shelf shall be located 15" below the ceiling of the cabinet, the second shelf shall be located 22" below the ceiling of the cabinet and the third shelf shall be located 35" below the ceiling of the cabinet. The top shelf shall be left empty to accommodate ACHD communications equipment. The second shelf is dedicated to the detection and opticom racks. The third shelf shall hold (left to right orientation) the power supply, controller and MMU.

For the Type 5s cabinet the first shelf shall be located 15" below the ceiling of the cabinet, the second shelf shall be located 28" below the ceiling of the cabinet and the third shelf shall be located 43.5" below the ceiling of the cabinet. The top shelf shall be left empty to accommodate ACHD communications equipment. The second shelf shall hold (left to right orientation) the power supply and the detection and opticom racks. The third shelf is dedicated to the TS 2 controller and MMU.

The card racks, and power supply shall be placed on the shelves in such a manner that sufficient ventilation is provided to all components. Labels showing the proper placement of each component shall be provided along the shelves to ensure proper placement.

The cabinet shall be vented and cooled by two (2) thermostatically controlled fans. The fans shall be a commercially available model and each fan shall move 200 CFM of free air and shall be rated for continuous duty and lifetime of three years. The thermostats shall be adjustable range of 20°C to 43°C. A press-to-test switch shall be provided to test the operation of the fans. The fans and thermostat shall be located on the ceiling with the thermostat being located on the right side of the cabinet door. One fan shall be installed on both sides of the front portion of the cabinet ceiling.

The cabinet shall have 2 removable lifting ears attached to the top of the cabinet. That shall have a single 1/2" bolt not to be in contact with the wiring in the top of the cabinet.

The cabinet anchor bolts shall be provided by the vendor. The galvanized anchor bolts shall be 3/4" x 18" x 4" and come with two nuts and two washers per bolt. There shall be (2) anchor bolts with a Type (5) cabinet and (4) anchor bolts with A type (6) cabinet.

1. Cabinet Door

The cabinet shall be provided with one door in front that will provide access to the cabinet. The door shall be provided with three hinges with non-removable stainless steel pins, or a full-length piano hinge with stainless steel pins spot welded at the top of the hinge. The hinges shall be mounted so that it is not possible to remove them from the door or cabinet without first opening the door. The bottom of the door opening shall extend at least to the bottom level of the back panel. The door and hinges shall be braced to withstand a 50 lbs/ft per vertical foot of door height load applied to the outer edge of the door standing open. There shall be no permanent deformation or impairment of any of the door or the cabinet body when the load is removed.

The cabinet door shall be fitted with a Number 2 Corbin lock and a stainless steel handle with a 0.65" (minimum) diameter shaft (or equivalent cross-sectional area for a square shaft) and a three point latch. The lock and latch design shall be such that the handle cannot be released until the lock is released. Two Corbin #2 keys shall be provided for each cabinet. A gasket shall be provided to act as a permanent dust and weather resistant seal at the controller cabinet door facing. The gasket material shall be of a nonabsorbent material and shall maintain its resiliency after long term exposure to the outdoor environment. The gasket shall have a minimum thickness of 0.24". The gasket shall be located in a channel provided on the cabinet or on the door(s). An "L" bracket is acceptable in lieu of this channel if the gasket is fitted snugly against the bracket to insure a uniform dust and weather resistant seal around the entire door facing. Any other method is subject to purchaser approval during inspection of an order.

A locking auxiliary police door shall be provided on the outside of the cabinet door to provide access to a panel that shall contain a signal 2 position shutdown switches (ON/OFF) and a 2 position signal flash switch (AUTO/FLASH). The police door shall be gasketed to prevent entry of moisture or dust and the lock shall be provided with one brass key.

A two position switch shall be provided on the inside face of the cabinet door that shall be labeled "Tech Flash" (Flash-Normal). When the switch is in the Normal position, call for flashing operation shall remove the power from the controller unit. When the switch is in the Flash position, the call for flashing operation shall permit the controller unit to continue to run so that its operation can be observed.

A three position switch shall be provided near the Flash-Normal switch to cause the controller unit, and any auxiliary equipment, to stop timing. It shall be labeled "Stop Timing" (On/Off/Auto).

A two position switch shall be provided near the Flash-Normal switch to cause the controller unit to be turned off. This switch shall be labeled "Controller" (ON/OFF).

The intake for the vent system shall be filtered with a permanent static air filter. The filter shall be disposable and securely mounted so that any air entering the cabinet must pass through the filter. The cabinet opening for intake of air shall be large enough to use the entire filter. The air intake and exhaust vent shall be screened to prevent entry of insects. The total free air opening of the exhaust vent shall be large enough to prevent excessive backpressure on the fan.

2. Cabinet Wiring

All wiring within the cabinet shall be neat and routed such that opening and closing the door or raising or lowering the back panel will not twist or crimp the wiring. All wiring harnesses shall be either braided, sheathed in nylon mesh sleeving, or made of PVC or polyethylene insulated jacketed cable. Wiring leading to the cabinet door shall be sheathed in nylon mesh sleeving or be PVC jacketed cable only. All TS2 cabinet serial (SDLC) cabling shall be Belden #7203A.

All conductors between the main power circuit breakers and the signal power bus shall be a minimum size 10 AWG stranded copper. All conductors carrying individual signal lamp current shall be a minimum size 16 AWG stranded copper. All AC service lines shall be of sufficient size to carry the maximum current of the circuit or circuits they are provided for. Minimum cabinet conductor wire size shall be 22 AWG stranded copper. All wiring and insulation shall be rated for 600V or greater.

Conductors for AC common shall be white. Conductors for equipment grounding shall be green. All other conductors shall be a color different than the foregoing.

P.C. board construction will NOT be allowed for the main back panel and main loop panel of the cabinet. All wiring must be routed from the BIUs to the Load Switches using standard 19-gauge wiring. The back panel shall have the ability to hinge down for access.

A barrier terminal block with a minimum of three compression fitting terminals designed to accept up to a #4 AWG stranded wire shall be provided for connection of the AC power lines. The block shall be rated at 50 Amperes.

All terminals shall be permanently identified in accordance with the cabinet wiring diagram using a silk screen or fixed plastic label on the aluminum panels. Where through panel solder lugs or other suitable connectors are used, both sides of the panel shall have the terminals properly identified. Identification shall be placed as close to the terminal strip as possible.

1. Each controller input and output function shall be distinctly identified with no obstructions, at each terminal point in the cabinet, with both a number and the function designation. The same identification must be used consistently on the cabinet wiring diagrams.
2. Each load switch socket shall be identified by phase number, overlap number, and pedestrian phase number as applicable. No cabinet equipment, including the load switches themselves, may obstruct these identifications.
3. Each flash transfer base and power relay base shall be properly identified with no possible obstructions.
4. Each harness within the cabinet shall be distinctly identified by function on the connector end.
5. The flasher socket shall be distinctly identified with no possible obstruction.
6. All other sockets needed within the cabinet to fulfill the minimum requirements of the Invitation to Bid, or attachments thereof, shall be distinctly identified.
7. All Field Wires terminations shall be marked from left to right in the order of (GREEN-YELLOW-RED) along with its associated load bays and the pedestrian field wires to be marked as walk and then don't walk.

The controller unit TS2 power harness (A plug) shall be long enough to reach any point 16" above the timer shelf. The malfunction management monitor (MMU) harness and any required auxiliary harness shall reach 24" from the MMU shelf.

Copper ground buses shall be provided for both the power supply neutral (common) and chassis ground. Each bus bar must provide a minimum of ten unused terminals with 8-32 X 5/16" or larger screws. The AC neutral and chassis ground buses shall NOT be bonded at any point in the cabinet or service. Four (4) neutral bars shall also be required at the bottom of the main back panel.

A 20 Ampere and a 50 Ampere thermal type circuit breaker shall be mounted and wired in the cabinet. The 20 ampere breaker shall protect the base light, trouble light, GFCI receptacle, modem duplex receptacle, and fans. The 50 ampere breaker shall protect the signal load circuits, controller circuits, malfunction management monitor (MMU), flasher, and card rack detector power supply. The breakers shall be Square "D" QUO 150 Series 3 only.

The circuit breakers shall be equipped with solderless connectors and installed on the right side wall (facing the cabinet) or lower right hand side of the back panel inside the cabinet. The breakers shall be easily accessible. The breakers shall be positioned so that the rating markings are visible.

A Ground Fault Circuit Interruption (GFCI) type duplex receptacle shall be mounted and wired in the lower right side wall of the cabinet. An additional non-GFI duplex receptacle (for use with communications equipment) shall be mounted and wired in the upper left side of the cabinet above the preempt/interconnect panel. These receptacles shall be wired on the load side of the 20 Amp circuit breaker.

The above breakers are in addition to any auxiliary fuses which may be furnished with the controller to protect component parts, such as transformers, etc.

The load side of the main circuit breaker shall be protected by a two stage lightning surge suppressor, EDCO APC340, or approved equal.

The suppressor ground connection shall be connected to the cabinet by means of a short, heavy copper ground strap. The strap shall be bonded to the cabinet.

The suppressor shall be connected to the line filter as recommended by the manufacturer. Number 10 AWG or larger wire shall be used for connections to the suppressor, line filter and load switch bus.

Install two (2) sets of Dialight, LeoTek, GE or approved equal LED lights, with switch shall be installed in the cabinet. One LED light will be installed on the ceiling on top front of the cabinet and a second LED light shall be installed under the slide out document drawer. This light shall be turned on when the cabinet door is opened, and turn off when the cabinet door is closed. An external power supply shall be installed for these LED lights and be mounted to the ceiling of the cabinet.

The cabinet shall come with one (1) radio frequency interference (RFI) suppressor. The RFI shall be installed on the load side of the signal circuit breaker and shall be protected by the surge protector, filtering both inbound and outbound currents. The filter shall be Hesco/RLS model #LF50.

Transient suppression devices shall be placed on the coil side of all relays in the cabinet. DC relay coils shall have, as a minimum, a reversed biased diode across the coil. AC relays shall have Metal Oxide Varistors (MOV's) or equivalent suppression across their coils. Resistive-Capacitive (RC) networks are acceptable. One suppression device shall be supplied for each relay.

Except where soldered, all wires shall be provided with lugs or other approved terminal fittings for attachment to binding posts. Insulation parts and wire insulation shall be insulated for a minimum of 600 volts.

The outgoing traffic control signal circuits shall be of the same polarity as the line side of the power source.

The cabinet shall be wired so that activation of the MMU will cause the controller unit, and any auxiliary equipment, to stop timing.

Conflict and manual flash shall be wired for all red.

The cabinet shall be designed and equipped six (6) transfer relays for ACHD to change any "Main Street" indications (phase movements 2, 6, and/or 1, 5) to amber for the conflict and/or manual flash operation on the face of the back panel or a side panel, using only simple tools.

Transfer relays shall be the plug-in type manufactured by Struthers-Dunn (Part No. 21ACPX - 2/21XBXD), Magnecraft (Part No. W21ACPX-2) or AEMCO (Part No. 136-4992) or equal. The relays shall have contacts a minimum of 3/8" diameter in size and shall be rated at a minimum of 30 Amps 102 / 240 VAC, 20 Amps 28 VDC.

The red enable and remote reset from the MMU shall be terminated on the face of the back panel.

A 75 Amp, solid state relay shall be wired between the RFI filter output and the load switch power bus. The relay shall be controlled by the signal shutdown switch and the flash switch. The relay shall be mounted to a heat sink designed to allow maximum current flow at 74 C without damaging the relay.

All exposed AC wiring points, including the RFI filter, surge suppresser, and solid state relay shall be covered with a clear non-conductive plastic cover to prevent accidental contact. Unless otherwise noted in this specification, wiring at terminal strips is exempt from this requirement.

An input point shall be provided on the back panel to allow external reset of the Malfunction Monitoring Unit.

The load switch outputs shall be brought out through posted 10-32 X 5/16" binder head screw terminals. Field wiring for the signal heads shall be connected at this terminal strip.

C. Detector Panel and Card Rack

1. General Information

The Type 6s cabinet shall have 32-channel detector assembly consisting of (2) 16-channel detector panels (mounted on the lower left side of the cabinet) and (2) 8-position, 16-channel detector racks located on the second shelf. The panel shall provide for all connections between detection zones on the street and the detector amplifiers as described in the following sections. The Type 5s shall have a single 16 channel detector panel.

2. Detector Card Rack

The Type 6s cabinet assembly shall have two (2) card racks and provide for 32-channels of detection. Each rack shall consist of one (1) BIU position and eight (8) detector positions (2-channel/single position). The first detector rack assembly, which operates detector channels 1-16, shall have an integrated dual-position EVP discriminator card slots. One EVP slot shall operate channels A, B, C, D and the other shall operate channels C and D. The second detector rack shall accommodate for an additional 16 channels, with an integrated slot for a BIU and eight (8) two-channel TS2 detector cards. Total detector rack provision shall be for a minimum of 32 channels of loop detection. The Type 5s cabinet shall only have a single card rack to provide 16 channels of detection.

The detector card rack shall have a rigid frame and shall be fabricated from aluminum and shall have slots set in a modular fashion such that the PCB edge connectors shall plug into the rear while sliding between top and bottom card guides for each module. Mounting flanges shall be provided and be turned outward for ease of access. The detector card rack shall be bolted to a cabinet shelf. It shall be possible to unbolt the rack using simple tools.

All wiring to the rack shall be labeled and neatly run to other parts of the cabinet and detector termination panel.

The slots shall be numbered 1 to 8 left to right when viewed from the front of the rack. A flange shall be provided on the top and the bottom of the rack to label each individual channel.

The Detector DC power supply shall be bussed to a common point and wired to the Intersection Detector Panel.

The Chassis Ground shall be bussed to a common point and wired to the Detector Panel.

The Logic Ground shall be bussed to a common point and wired to the Detector Panel.

The Data Address for the detector channels shall be according to TS-2.

3. Detector Panel

The Detector Panel shall provide all connections between the detector loops and the detector amplifiers. The panel shall be attached using 0.25" channel nuts with springs.

The panel shall be constructed of 0.125" aluminum.

The panel shall contain a 3.00" horizontal slot in each corner to accommodate 0.25" mounting bolts.

All inputs from the loops shall be brought through posted 10-32 X 5/16 inch binder screw terminals or 8-32 X 5/16 inch binder screw terminals.

Each detector will have a 3-position test switch such that when the switch is closed, a call is placed upon that detector input. The test switch will have three positions; no effect "NORMAL", permanently on "LOCK", and momentarily on "CALL". The detector test switches shall be located on a panel on the inside of the front cabinet door. The test switches shall be covered with a clear plastic cover to protect the switches.

The detector panel for cabinet configuration shall provide the following connection points as a minimum for sixteen (16) detectors:

<u>CONNECTION POINT</u>	<u>NO. OF CONNECTION POINTS</u>
EXTERNAL 24V POWER SUPPLY	1
LOOP INPUTS	32, 2 FOR EACH DETECTOR
LOGIC GROUND	1
SPARES	6
CHASSIS GROUND BUS	1 BUS

A chassis ground bus bar shall be provided on the panel and connected to the cabinet by an insulated braided copper ground strap. The strap shall be bonded to the cabinet.

D. Preempt / Communication Panel

A preempt / card slot to be installed in the detector card rack. A panel shall be provided that contains all interface circuits and wiring for preemption and communication functions. The panel shall be located on the left side of the cabinet interior for a Type (5) and (6) cabinet .

One input relay circuits, with 120 VAC coil and contacts rated for the application, shall be provided on the preempt panel. This circuit shall be used to isolate the incoming preempt commands from the controller unit logic circuitry. The circuit shall be programmable to operate with either a normally open or normally closed relay contact by jumpers on a terminal strip. A barrier strip protected from accidental contact by service personnel shall be supplied to connect the external input. It shall be possible to use either a neutral or hot 120 VAC input. Relay used shall be plug-in Potter Brumfield K10P series/Magnecraft W-78 series or interchangeable equivalent. The relay shall be mounted in relay sockets.

Adequate protection of the input relay circuits as well as the preemptor circuitry shall be provided to eliminate damage or false preemption commands caused by line transients or lightning surges. The devices shall have a minimum rating of 20 Joules.

Six momentary test switches (push-button style), one for each preempt circuit, shall be provided on a panel on the inside of the cabinet front door (PRE1-PRE6). The operator shall not be exposed to hazardous voltages during operation of the test switches.

All necessary interconnection cables and mounting hardware shall be provided. A 757 auxiliary opticom harness shall be included for advance pre-emption.

There shall be a switch on the inside of the cabinet front door, which shall release the local controller to operate in an isolated, full-actuated manner (FREE), when necessary for maintenance purposes. The "SYSTEM" position shall engage the controller to operate via system command and/or TOD operation. The switch positions shall be labeled "SYSTEM" and "FREE".

Terminal connections for 3 twisted pair communication lines and one telephone line shall also be provided. The protection will consist of series 25 ohm resistors, 15 volt transorbs, and other devices, which allow protection including primary overvoltage protection, resettable overcurrent protection, secondary clamping voltage protection, and fast transient filtering. The secondary overvoltage stage shall allow peak voltages of no more than 250 volts. The fast transient filtering stage shall provide no less than 40 dB/decade of attenuation to transients above the required pass band. The protection shall be provided in an integrated closure with eight (8) input/output terminations and ground connection.

E. Power Supply

The cabinet shall come with a shelf mounted power supply meeting at minimum TS 2-2003 standards. It shall be a heavy duty device that provides +12VDC at 5 Amps, +24VDC at 2 Amps, 12VAC at .25 Amps and line frequency reference at 50 mAmps. The power supply shall provide a separate front panel indicator LED for each of the four outputs. Front panel banana jack test points for 24 VDC and logic ground shall also be provided. The power supply shall provide 5 A of power and be able to cover the load of (4) complete detector racks.

One power supply cable per power supply shall be furnished and installed in each cabinet. The wires shall be terminated to bus bars, terminals on the front of the back panel, detector panels, or connector as appropriate. The connections shall be with forked spade lugs or otherwise as needed. Each individual wire shall be cut to the length required to reach the point at which it is to be connected.

F. Bus Interface Unit (BIU) Network Cards

The Type 6s cabinet shall be equipped with two (2) BIU cards for the load bays, plus two (2) BIU cards for the detector racks. The BIU shall meet, as a minimum, all applicable sections of the NEMA Standards Publication TS2-1998. The BIU shall be rack-mountable and solid-state. The BIU unit shall be constructed with discrete component circuitry in order to allow repair and maintenance of the unit by use of standard tools. For ease of repair, the BIU cards shall utilize machine tooled integrated circuit (IC) sockets for all optical-isolation circuits, and discrete IC's of 14 pins or greater. Use of surface-mounted components (SMT) for the construction of the BIU's will NOT be accepted.

G. Flasher

The solid state, two circuit flasher shall meet the electrical and physical characteristics described in Clause 6.3 of the NEMA Standards Publication TS 2-1992. The flasher shall be Type III (dual circuit rated at 15 Amps per circuit) unit and so constructed that each component may be readily replaced if needed. A handle shall be provided for ease of removal and installation.

The two circuit flasher shall be of solid state design and contain no electro-mechanical devices.

H. Load Switch

The solid state load switches shall meet the requirements set forth in Clause 6.2 of the NEMA Standards Publication TS 2-1992, and shall be "Single LED" indicating type. A handle shall be provided for ease of removal and installation.

I. Video Detection Surge Suppression Panel (Generally supplied by ACHD)

A 4-channel video surge suppressor panel shall be installed by ACHD staff inside the traffic signal cabinet on the left side. The suppressor shall provide coaxial cable connection points to the EDCO CX06-M or equal transient suppresser for each image sensor.

J. Signal Controller (Generally supplied by ACHD)

The Cabinet shall be equipped with an Ethernet enabled **Trafficware Model 980 ATC controller**. The controller shall come with the latest version of intersection software currently being used by ACHD.

The controller shall have a thumb screw on each side for easy access to the interior of the controller.

1131.17.01 – TYPE 334 ITS EQUIPMENT CABINET

(Revised: 1/22/2013)

A. General Description

This work consists of furnishing and installing a Ground Mounted ITS Equipment 334 Cabinet at locations indicated in the contract plans. The Ground Mounted Control Equipment 334 Cabinet shall contain all of the components as described in the material specifications herein. This cabinet shall be utilized to house other electronic components as defined in other contract pay items.

B. Material

A ground mounted cabinet shall be supplied which shall be mounted on a concrete base at locations indicated in the contract drawings. This cabinet shall be designed to house miscellaneous electronic items such as Ethernet switches, receiver/drivers, fiber termination panels, etc., as defined in other bid items. The cabinet shall be suitable for ground mounting and must be supplied with all required stainless steel mounting hardware. The cabinet shall be a NEMA 3R rated enclosure. The cabinet shall have single, full size front and rear doors with 3 point latching system.

The 334 cabinets shall have nominal outside dimensions of approximately 67" height x 24" wide x 30" depth. The cabinet shall be constructed of 0.125" thick 5052-H32 aluminum. The cabinet interior and exterior shall be bare, unpainted aluminum anodized finish.

Cabinets shall also be furnished with standard 19 inch EIA rack assembly. The rack assembly shall be installed 5 ½" behind the door locking mechanism. One adjustable height shelf and one pull out drawer/shelf shall be supplied for supporting electronic equipment. The cabinet shall be supplied with a Corbin #2 dead bolt lock or equal. The key shall be removable in the lock position only.

The power distribution assembly shall be comprised of three (3) circuits. Circuit #1 shall terminate in a GFI duplex receptacle. This circuit shall be protected by a 15 amp circuit breaker. Circuit #2 shall have a 15 amp circuit breaker and terminate in a single duplex grounded receptacle; a ten position power strip shall be connected to the output of the duplex receptacle and shall be utilized to power the electronic equipment in the cabinet. Circuit #3 shall have a 15 amp circuit breaker and shall be connected to the internal cabinet lighting, heater and ventilation fan.

The following components shall also be supplied and wired as part of the cabinet enclosure:

- **Surge Protector:** A surge protector shall protect each leg of the primary power feed. This surge protector shall be installed as a precautionary measure against possible damage resulting from voltage surges on all incoming power lines. The 120V AC single phase surge protector shall incorporate a series choke at a maximum clamp voltage of 340V at 20kA with a 5 ns response. In addition, the surge protector shall have the capability of removing high energy surges and shall block high speed transients. The surge protector shall comply with the following specifications:

Peak Current:	20,000 amps (8X20 us wave shape)
Occurrences:	20 times at peak current
Minimum Series Inductance:	200 microhenries

Continuous Series Current: 50A
Temperature Range: -40° C to +85° C

- Radio interference filter: A radio interference suppressor shall be installed in series with the line between the surge protector and the circuit breakers. The suppressor shall provide a minimum attenuation of 50 dB over a frequency range of 200 KHz to 75 MHz. The suppressor shall be hermetically sealed in a substantial metal case filled with a suitable insulation compound and shall be capable of passing 50 amperes of continuous current.
- Heater: The enclosure shall be equipped with a heater controlled by a thermostat. The heater shall engage when the temperature within the enclosure falls below 4° C. The heater should disengage when temperatures exceed 70° C. The heater shall be sufficient to maintain the inside temperature of the cabinet above 0° C as long as the outside temperature remains above -29° C and shall be minimum 150 Watts.
- Ventilation Fan: In order to maintain airflow in the cabinet when the assembly is operated during high temperature days, a thermostatically controlled ventilation fan sufficient to produce a minimum of 2.8 cubic meters (100 cubic ft.) of air per minute shall be provided. The fan shall engage when enclosure temperatures reach above 32° C and disengage when cabinet temperatures fall below 23° C. Cabinet shall have louvered air intake in door and premium pleated filter.
- LED light: The cabinet shall be equipped with LED light assemblies on the ceiling over the front and back doors. The LEDs shall be manufactured by Dialight, LeoTek or GE. An external power supply shall be installed for the LED lights and mounted to the ceiling of the cabinet. The lights shall have an override switch and should normally activate whenever the associated doors are open and turn off when the doors are closed.

C. Construction Details

The Contractor shall prepare a shop drawing submittal which details the complete "TYPE 334 ITS EQUIPMENT CABINET", all components to be supplied and mounting hardware. All cables shall be labeled utilizing marking tags. The shop drawing submittal shall be submitted by the Contractor and approved by the Engineer prior to any testing or installation of the completed cabinet in the field.

All material to be installed in the cabinet assembly which is included in other bid items in this contract shall be installed and fully wired prior to shipment of the assembly to the project site. The Engineer reserves the right to inspect and/or factory test any completed cabinet assemblies prior to delivery of the material to the project site. Any deviancies from these specifications that are identified during such testing shall be corrected prior to shipment of the assembly to the project site.

The new cabinet shall be anchored to the concrete base with stainless steel hardware as detailed in the plan set along with conduit fittings necessary to bring cables into the cabinet.

The AC service to be run to the cabinet shall be terminated. The cost of providing the AC service connection is included in other bid items as designated in the contract plans. In addition, the cabinet shall be connected to an adequate grounding. Power shall be activated and tests shall be performed to verify that proper line service is being obtained.

The Contractor shall terminate any inbound and outbound (if required) fiber optic cable in the

cabinet on the fiber termination panels using FC connectors.

D. Testing

The Contractor shall deliver the cabinet to ACHD for testing prior to installing in the field.

1131.18 — SERVICE CABINET

(Revised 2/25/2014)

A. General Specifications

The service cabinet supplied for each intersection shall be white in color and manufactured by **Meyers Electrical Products**, Catalog No. MEUG24-M100/M100-ADA, **Tesco Controls Inc., Milbank** or equal. A copy of the wiring diagram shall be provided in a plastic holder mounted conveniently inside the service cabinet. Nameplates shall be provided for each control component and shall be embossed phenolic with white letters on a black background. Nameplates shall be screw-fastened.

The service cabinet shall be mounted to a concrete base with anchor bolts fastening to the inside of the base of the cabinet. All sheet metal cuts will be cold galvanized at the fabricator. Finish shall be white baked enamel conforming to **ASTM F 1178**. White baked enamel finish shall be applied over a corrosion-resistant primer and shall match the controller cabinet.

B. Equipment

The service cabinet shall be equipped with a dual meter base at the top of the cabinet which is positioned to permit viewing the meter through a viewing port at the top of the cabinet door. The meter bases shall be provided with a suitable device for providing circuit continuity in lieu of a meter which may be added at a future time.

The service cabinet shall be equipped with a door-in-door dead front assembly which shall prevent the exposure of circuit breakers and wiring. Wiring shall be arranged so that any piece of apparatus may be removed without disconnecting any wiring except the lead to that piece of apparatus. All wiring shall be appropriately marked with a permanent, indelibly marked, clip sleeve wire marker. Control wire shall be seven-strand #14 AWG THHN. All wiring shall conform to **NEMA Class II C**.

The service cabinet shall, as a minimum, be provided as follows:

- 4 JAW, 100 Amp. meter base (2)
- 100 Amp. (200 amp entrance) 2P main breaker (2)
- 60 Amp. 1P signal branch
- 30 Amp. 2P mag lighting contactor (4)
- 15 Amp. 1P control branch
- Test switch to bypass remote photo control
- Photo cell socket and associated wiring

The anchor bolts shall be four (4) galvanized 5/8" x 18" x 4" anchor J-bolts, two (2) galvanized nuts and two (2) washers for each anchor J-bolt.

A **Fisher Pierce #6690B** or ACHD approved equal photocell shall be mounted inside the cabinet.

C. Conduit/Wiring Installation

If indicated on the plans or directed by ACHD, the contractor shall install a two inch conduit between the service cabinet and the power supply. The conduit shall be installed with 30 inches of cover and 13 inch

radius elbows shall be used. If indicated on the plans or directed by ACHD, the contractor shall also provide and install a junction box at the base of the power pole or pad mounted transformer with the closest edge of the junction box two feet from this supply pole. The junction box shall be an **Idaho Precast S40-T/Ada** or an ACHD approved equivalent.

If indicated on the plans or directed by ACHD, the contractor shall install a three-wire electrical service to be used at 120/240 volts, single phase, 60 hertz AC between the power supply and the service cabinet. The electrical service connector to the power supply shall be manufactured by **The Homac Companies, HOMAC-RAB 4C** or an ACHD approved equal. The size of the electrical service wires shall be of a sufficient gauge to satisfy the requirements of the latest edition of the **National Electrical Code (NEC)**. The unfused power shall enter the service cabinet through a separate conduit. The illumination components shall be connected to the 240 volt, 60 hertz power supply. The traffic signal components shall be connected to one of the 120 volt, 60 hertz elements.

D. Inspection

The Contractor shall have the service inspected by the State Electrical Inspector.

The Contractor shall coordinate with the ACHD Signal Inspector to arrange for power service. The ACHD Signal Inspector will require a minimum of 30 days advance notice to arrange for power service.

1131.19 — GROUNDING

(Revised 2/25/14)

A. General Requirements

All metallic appurtenances containing electrical conductors (luminaires, light standards, junction boxes, cabinets and conduit, etc.) shall be made mechanically and electrically secure to form a continuous system which will be effectively grounded. The steel pole standards shall be grounded using the connection point provided inside the pole; drilling of the outside surface of the pole for grounding purposes shall not be allowed. All conduit installations shall include an equipment grounding conductor (#6 Stranded) in addition to conductors called for in the Contract. The #6 equipment grounding conductor shall extend to and be mechanically and electrically secured at each pole, junction box, or cabinet.

Grounding of conduit and neutral at the service point shall be accomplished as required under the **National Electrical Code (NEC)** and all related state and local regulations. Grounding of the neutral shall be accomplished only at the service.

B. Materials

Two service grounds shall be installed at each electrical service location. A primary service ground shall be installed in the concrete service pedestal foundation. A secondary service ground shall be installed in a junction box adjacent to the concrete service pedestal foundation. The service ground installations shall be located a minimum of 6 feet apart. A single continuous grounding electrode conductor shall connect each of the two ground rods and the neutral service bus. All ground rods shall be solid copper clad steel. The ground rod for the primary service ground in the concrete service pedestal foundation shall be a minimum of 10 feet in length with a $\frac{3}{4}$ inch minimum diameter. The ground rod for the secondary service ground shall be a minimum of 8 feet in length with a $\frac{5}{8}$ inch minimum diameter.

The connection of the grounding electrode conductor to the grounding electrodes shall be made with two approved ground clamps. All other grounding of the equipment grounding conductors throughout the system shall be with approved bushings and clamps.

1131.20 — TRAFFIC SIGNS MOUNTED ON THE SIGNAL POLE OR MAST ARM

(Revised 11/30/2011)

A. General Requirements

The Contractor shall provide all labor and material required to install signal pole mounted and signal mast arm mounted traffic signs of the type, size, and at the locations shown on the plans.

The signs and all mounting hardware shall conform to the details on the plans and these Supplemental Provisions. (See ACHD Standard Detail TS-1109 for street name sign and block number sign details).

B. Materials

1. Sign Blanks

Blanks for Street Name Signs shall be .80 inch tempered aluminum alloy. Blanks for regulatory and warning signs with areas smaller than or equal to 9 square feet shall be .080 inch tempered aluminum alloy. Materials for signs larger than 9 square feet shall be determined by ACHD, unless otherwise shown in the contract documents.

2. Sign Blank Covering (type, coloring, and letter specifications)

Background color for public street name signs shall be green with High Intensity Prismatic diamond grade sheeting on the copy side. Sheeting shall be 3M or approved equal.

Background color for private street name signs shall be blue with Prismatic High Intensive diamond grade sheeting on the copy side. Sheeting shall be 3M or approved equal.

Colors for all school related warning signs shall be fluorescent yellow-green and shall comply with the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD). These signs shall have florescent sheeting on the copy side. Sheeting shall be manufactured by 3M Company or approved equal.

Colors for all other signs shall comply with the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD). These signs shall have High Intensity Prismatic retroreflective sheeting, unless otherwise directed by the ACHD Traffic Engineer.

3. Lettering (type, size, and other requirements)

All lettering for street name signs shall be made of white High Intensity Prismatic sheeting. Sheeting shall be 3M or an ACHD approved equal.

All lettering for block number signs shall be made of white High Intensity Prismatic sheeting. Sheeting shall be 3M or an ACHD approved equal.

Main legend lettering for street name signs shall be 12 inch "Clearview" series for the initial capital letters and 9 inch lower case for the remaining characters with appropriate spacing.

Letters larger than 12 inches may be used for short street names (6 letters or less) if approved by the ACHD Traffic Engineer.

Directional prefixes (e.g.: N, E, S, W) for street name signs shall be 6 inch "Clearview" series, period omitted, with proper spacing.

Street designation suffixes (e.g.: Rd, St, Way, etc.) for street name signs shall be 6 inch "Clearview" series, period omitted, with proper spacing.

Main legend lettering for block number signs (e.g.: 200, 1200, etc.) shall be 6 inch "Clearview" series with proper spacing.

Letters and symbols for all other signs shall comply with the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD).

4. Sign Sizes

Street name signs shall be 30 inches high by the length required to fit the text.

All other signs shall be "Standard" size as specified in the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD), unless otherwise specified on the Plan or by the ACHD Traffic Engineer.

5. Sign Mounting Brackets

Signs shall be mounted to the signal mast arm or pole with a Pelco Astro Sign Bracket AS-3009 (or an ACHD approved equivalent). Street name signs to be mounted on the mast arm shall require two sign brackets for signs over eight feet long and an attachment support shall be provided every two feet.

C. Construction Requirements

1. All signs to be installed shall be located in conformance with the guidelines set forth in the **Manual on Uniform Traffic Control Devices (MUTCD)**.
2. See ACHD Standard Detail TS-1109 for street name sign and block number sign details.
3. Signs shall be installed and covered prior to revisions or additions to roadway channelization. No signs shall be uncovered without the authorization of the ACHD. When new signs are uncovered, ACHD may require warning flags to highlight new signs.
4. Overhead signs shall be level and tilted downward approximately 5% toward oncoming traffic, or as directed by the ACHD Traffic Engineer, to maximize night time visibility.
5. All existing signs that conflict with the new signs being installed shall be removed at the appropriate time, as determined by ACHD, and delivered to the ACHD Traffic Operations Sign Shop. If the conflicting signs are not shown on the plan, then the Contractor shall verify the

removal with the ACHD Traffic Engineer. The ACHD Traffic Operations Sign Shop is located at:

3700 Adams St.

Garden City, ID 83714

All deliveries shall be coordinated with the Traffic Operations Supervisor at least two business days prior to delivery.

6. Any sign damaged or destroyed due to the Contractor's negligence shall be replaced by the Contractor at no cost to ACHD.

1131.21 — MEASUREMENT AND PAYMENT

(Revised 11/25/14)

Measurement and payment for work under Section 1131 of these Supplemental Provisions shall be made as described below.

A. Measurement

Measurement for work under Section 1131 shall be as follows:

1. Traffic Signal and Illumination System - Complete

All work included in the Plans or specified herein, shall be considered as part of the work for "Traffic Signal and Illumination System, Complete." No specific unit of measurement will apply, but measurement will be for the sum total of all items for a complete system to be furnished and installed.

2. Rapid Rectangular Flashing Beacon – Complete

All work included in the Plans or specified herein, shall be considered as part of the work for "Rapid Rectangular Flashing Beacon, Complete." No specific unit of measurement will apply, but measurement will be for the sum total of all items for a complete system to be furnished and installed.

3. Install Traffic Signal Interconnect Conduit

Traffic signal interconnect conduit shall be measured by the linear foot of conduit installed, trenched or bored. In both cases, this item includes a pull wire to be installed if the conduit does not receive the interconnect cable at the time of installation.

No extra payment shall be issued for shared trenches with other utilities. If employed, shared trenches shall be incidental to the conduit installation bid item.

4. Install Traffic Signal Interconnect Junction Box

Traffic signal interconnect junction boxes shall be measured by the unit from actual count.

5. Install Interconnect Splice Vault

Interconnect splice vaults shall be measured by the unit from actual count.

6. Install Traffic Signal Interconnect Cable

Traffic signal interconnect cable shall be measured by the linear foot of interconnect cable installed. The type of interconnect cable to be installed shall be shown on the plans.

7. Install Street Light

Street lights shall be measured by the unit from actual count. All labor, material and equipment

required for a complete street light installation (minus the cost of supplied materials, when applicable) shall be included in this item.

8. Install Street Lighting Conduit

Street lighting conduit shall be measured by the linear foot of conduit installed. This item includes a pull wire to be installed if the conduit does not receive the street light cable at the time of installation.

9. Install Street Lighting Junction Box

Junction boxes for street lighting shall be measured by the unit from actual count.

10. Terminate Fiber Optic Cable

Fiber optic cable terminations shall be measured by the unit from actual count.

11. Install Service Pedestal

Service pedestal installation shall be measured by the unit from actual count. All labor, material and equipment required for a complete service pedestal installation (minus the cost of supplied materials, when applicable) shall be included in this item.

12. Install Four-Section Signal Head (Flashing Yellow Arrow)

Four-section signal head installation (flashing yellow arrow) shall be measured by the unit from actual count. All labor, material and equipment required for a complete signal head installation (minus the cost of supplied materials, when applicable) shall be included in this item.

13. Install Three-Section Signal Head

Three-section signal head installation (red/yellow/green ball or red/yellow/green arrow) shall be measured by the unit from actual count. All labor, material and equipment required for a complete signal head installation (minus the cost of supplied materials, when applicable) shall be included in this item.

14. Remove Street Light

Street light removal shall be measured by the unit from actual count. This item applies to street light removal only; for measurement and payment related to relocating a street light, refer to bid item #1131.01.06 (Install Street Light).

15. Install Street Light Wire

Street lighting wire shall be measured by the linear foot of wire installed. This item includes a pull wire to be installed with the street light wire; no additional payment shall be made for installation of the pull wire.

B. Payment

The price for the bid items listed below shall be full compensation for all costs involved in furnishing all labor, material, tools and equipment necessary or incidental to the construction shown in the Plans and herein specified including but not limited to; saw cutting, excavation, back filling, concrete foundations, conduit, wiring, restoring facilities destroyed or damaged during construction, and for making all required tests. Any additional material and labor not shown in the Plans, or called for herein, and which are required to complete the specified systems, shall be incidental to the construction and included in the contract prices.

Payment shall be made for the following bid items:

Ref.	Bid Item	Unit
1131.01.01	Traffic Signal and Illumination System – Complete	lump sum (LS)
1131.01.01.A	Rectangular Rapid Flashing Beacon – Complete	lump sum(LS)
1131.01.02.A	Install Traffic Signal Interconnect Conduit (Trench)	linear foot (LF)
1131.01.02.B	Install Traffic Signal Interconnect Conduit (Bore)	linear foot (LF)
1131.01.03	Install Traffic Signal Interconnect Junction Box	each (EA)
1131.01.04	Install Interconnect Splice Vault	each (EA)
1131.01.05	Install Traffic Signal Interconnect Cable	linear foot (LF)
1131.01.06	Install Street Light	each (EA)
1131.01.07	Install Street Lighting Conduit	linear foot (LF)
1131.01.08	Install Street Lighting Junction Box	each (EA)
1131.01.09	Terminate Fiber Optic Cable	each (EA)
1131.01.10	Install Service Pedestal	each (EA)
1131.01.11	Install Four-Section Signal Head (FYA)	each (EA)
1131.01.12	Install Three-Section Signal Head	each (EA)
1131.01.13	Remove Street Light	each (EA)
1131.01.14	Install Street Light Wire	linear foot (LF)