

## SECTION 682 VIDEO EQUIPMENT

### **682-1 CCTV Camera.**

**682-1.1 Description.** Furnish and install a closed-circuit television (CCTV) camera at the locations shown in the Plans. The installed equipment must provide unobstructed video images of the roadway, traffic, and other current conditions around a roadside CCTV field site; respond to camera control signals from the operator; and transmit video images to remote locations for observation.

### **682-1.2 Materials:**

**682-1.2.1 Camera:** Provide a CCTV camera that is compatible with the current version of the Department's SunGuide® software system and any other camera operating software indicated in the Contract Documents. Cameras are classified by camera type and video type. Camera types include dome pan-tilt-zoom (PTZ), external positioner-PTZ, and fixed. Video types include analog and internet protocol (IP). Provide the appropriate type for the locations shown in the Plans. Use only equipment and components that meet the requirements of this Section and are listed on the Department's Approved Product List (APL).

For analog cameras, ensure that the camera produces National Television System Committee (NTSC) composite video output of 1V peak-to-peak (Vp-p) at 75 ohms with a minimum resolution of 470 horizontal and 350 vertical TV lines. In addition, ensure analog and IP cameras provide the following features and capabilities:

1. Day (color)/night (monochrome) switchover and iris control, with user-selectable manual and automatic control capabilities.
2. Ability to produce clear, detailed, and usable video images of the areas, objects, and other subjects visible from a roadside CCTV field site. Ensure that video produced by the camera is true, accurate, distortion free, and free from transfer smear, oversaturation, and any other image defect that negatively impacts image quality under all lighting and weather conditions in both color and monochrome modes.
3. User-selectable automatic gain control (AGC) that is peak-average adjustable to 28 dB.
4. A minimum signal-to-noise ratio of 50 dB.
5. Automatic color balance that references the white areas of the scene through the lens.
6. An automatic electronic shutter that is user selectable from 1/60 to 1/10,000 of a second.
7. PTZ cameras must include a minimum 10x digital zoom.
8. PTZ cameras must include programmable azimuth and compass display with ability to display pan and tilt position with a 1 degree resolution.

CCTV cameras must provide titling and masking features including, but not limited to, programmable camera title, programmable preset titles for each preset position, and programmable privacy zones. Programmable titles must allow a minimum of 18 characters per line.

**682-1.2.2 Lens:** Standard definition PTZ cameras must include a minimum 22x motorized optical zoom lens with automatic iris. High definition CCTV cameras must include a minimum 18x motorized optical zoom lens with automatic iris. The lens must provide automatic and manual focus and iris control. Fixed cameras must have a 3-9mm varifocal lens with

automatic iris unless shown otherwise in the Plans. The lens must have a maximum aperture of at least f/1.6 and the depth of field must provide a clear image of roadside areas under all lighting conditions.

**682-1.2.3 Pan/Tilt Mechanism for Dome-Type Cameras:** Dome PTZ cameras must meet the following requirements:

1. Have an integrated pan/tilt mechanism that provides 360 degree continuous pan with a minimum 90 degree tilt range (i.e., 0 degrees to minus 90 degrees);
2. Provide for variable speed control;
3. Have a preset position return accuracy of plus or minus 0.36 degree, or less than 0.10% or better;
4. Support a minimum of 64 presets; support a minimum of one tour with a minimum of 32 presets; and support a minimum of eight programmable blackout zones.

The positioner within the dome-type CCTV camera must have a minimum automatic pan speed of 240 degrees per second to a preset camera position, a maximum manual pan speed of 80 degrees per second minimum, and a maximum manual tilt speed of 40 degrees per second minimum.

**682-1.2.4 Pan/Tilt Mechanism for External Positioner-Type Cameras:** External positioner-type CCTV cameras must include a pan/tilt mechanism that provides 360 degree continuous pan with a minimum 115 degree tilt range (i.e., minus 90 to plus 25 degrees), provide for variable speed control, have a preset position return accuracy of plus or minus 0.36 degree or less than 0.10% or better, and support a minimum of 32 presets.

**682-1.2.5 Communication:** All CCTV cameras must support the National Transportation Communications for ITS Protocol (NTCIP) 1205 v1.08. The camera must communicate with other devices using Telecommunications Industry Association/Electronic Industries Alliance (TIA/EIA)-232 or TIA-422 at a rate of 9600 bps, transmission control protocol (TCP)/IP, or user datagram protocol (UDP)/IP. All CCTV cameras must support the communication links shown in the Plans and provide for remote firmware upgrades via the communication interface.

IP cameras must also support the Open Network Video Interface Forum (ONVIF) Core, Streaming, and Media Service specifications.

The camera must implement all objects, operations, and commands required by SR-682-1.2.1-01, Supplemental CCTV Camera NTCIP and ONVIF Requirements, as published on the Department's State Traffic Engineering and Operations Office website at the following URL:

[http://www.fdot.gov/traffic/Traf\\_Sys/Product-Specifications.shtm](http://www.fdot.gov/traffic/Traf_Sys/Product-Specifications.shtm).

**682-1.2.6 Electrical Specifications:** Cameras must operate on a nominal voltage of 120 V<sub>AC</sub>. Provide an appropriate voltage converter for devices that require operating voltages of less than 120 V<sub>AC</sub>.

**682-1.2.7 Mechanical Specifications:** Provide camera housings and hardware that are light in color or as noted in the Plans.

Camera housings must include a sunshield to reduce the solar heating of the camera. The total weight of dome-type CCTV cameras (including the housing, sunshield, and all internal components) must be less than 17.0 pounds. The lower dome of the camera housing must be constructed of distortion free clear plastic.

Pressurized dome-type housings must be capable of pressurization at 5 psi using dry nitrogen, have a low-pressure alarm feature, and a NEMA 4X/IP-67 rating.

If a non-pressurized dome-type housing enclosure is used, the unit must be vented with a thermostat-controlled heater and blower. The non-pressurized enclosure must have a NEMA 4/IP-66 rating.

The total weight of external positioner-type CCTV cameras (including housing, sunshield, all internal components, and external pan and tilt mechanism) must be less than 35 pounds.

**682-1.2.8 Environmental Specifications:** CCTV cameras must perform all required functions during and after being subjected to the environmental testing procedures described in NEMA TS2, Sections 2.2.7, 2.2.8, and 2.2.9.

All CCTV cameras, mounting hardware, and any other camera-related material that is exposed to the environment must be designed for 150 mph wind speeds and meet the requirements of the Department's Structures Manual.

**682-1.2.9 Additional Requirements for IP Cameras:**

**682-1.2.9.1 Video Encoding:** The camera must utilize the Moving Picture Experts Group's MPEG4 part 10 (H.264) video compression technology in accordance with the ISO and IEC requirements detailed in the ISO/IEC 14496-10:2009 Standard.

Cameras must provide unicast and multicast operation and provide for a 99.999% error-free operation. The encoded video must transmit using programmable bit rates and the camera supports, at a minimum, a fixed bit rate mode.

**682-1.2.9.2 Encoded Video Interoperability:** The camera's encoded video must be able to be displayed using video display control systems listed on the APL.

**682-1.2.9.3 Encoded Video Specifications:** The camera's encoded video must support resolutions that include; but are not limited to, those defined in Table 1.1. The camera must deliver color and monochrome video at 30 frames per second (fps), regardless of resolution.

Format	Vertical Resolutions
H.264	240, 480

Note: The resolutions attained depend on the data transmission rate.

**682-1.2.9.4 Network Interface:** The camera's local area network (LAN) connection must support the requirements detailed in the IEEE 802.3 Standard for 10/100 Ethernet connections. The camera must have a minimum of one 10/100 Base-TX connection Ethernet port.

Unshielded twisted pair/shielded twisted pair network cables must be compliant with the TIA-568 Standard. The network communication must conform to TCP, UDP, Version 4 of the IP, real-time streaming protocol (RTSP), and Version 2 of the internet group multicast protocol (IGMP), at a minimum. The camera must be able to be controlled via NTCIP using either TCP/IP or UDP/IP.

**682-1.2.9.5 Configuration Management:** The camera must support local and remote configuration and management via serial login, telnet login, or a web-based interface. Configuration and management functions must include access to all user-programmable features

including, but not limited to, network configuration, video settings, device monitoring, and security functions. .

**682-1.3 Installation Requirements:** Install the CCTV camera on a pole in accordance with Standard Plans, Indexes 641-020, 649-020, and 659-020, and as shown in the Plans.

Furnish and install the power supplies, local control equipment, and any other camera-related field electronic equipment and transient voltage surge suppressors within a pole- or base-mounted lockable cabinet. The cabinet must protect the electrical and electronic devices from rain, dust, dirt, and other harmful elements of nature.

Furnish and install all power, video, and data cables necessary to provide connection points for camera video and PTZ control signals within the cabinet. Furnish and install any and all ancillary equipment required to provide a complete and fully operational CCTV camera. Verify that all wiring meets National Electric Code (NEC) requirements where applicable.

Route the data and video cables from the pole or support structure to the camera inside the mounting hardware and protect from exposure to the outside environment.

Coat the exterior of the dome-type enclosure's lower half with a clear, rain repellent product prior to final acceptance.

#### **682-1.4 Testing:**

**682-1.4.1 General:** Perform a field acceptance test (FAT) on equipment covered in this Section. Develop and submit a test plan to the Engineer for review and approval. The test plan must demonstrate all functional requirements specified for the device or system under test. The Engineer reserves the right to witness all tests.

**682-1.4.2 Field Test Requirements:** Perform local field operational tests at each local CCTV field sites to verify and confirm the following:

1. Physical construction has been completed as specified in the Plans and all existing and proposed lanes are clearly visible with no line of site obstructions.
2. The quality and tightness of ground and surge protector connections.
3. Proper voltages for all power supplies and related power circuits.
4. All connections, including correct installation of communication and power cables.
5. Video signal from the camera is present and of consistent quality at all connection points between the camera, the cabinet, and any video devices therein.
6. The communication link between the cabinet and the camera is functioning properly by performing PTZ and focus in all directions and executing a minimum of three other unique programming commands.

#### **682-2 Video Display Equipment.**

**682-2.1 Description.** Furnish and install video display equipment as shown in the Plans.

**682-2.2 Materials:** Use display devices of the types shown in the Plans. Video display equipment must have the capability to display analog, digital, and other images associated with the operation of the transportation management center (TMC). These types of images include, but are not limited to:

1. CCTV video images, including feeds from other TMCs.
2. Video vehicle detection (VVD) system images.
3. System infrastructure mapping images.
4. Graphical user interfaces from computers running typical TMC applications.

5. Weather mapping images.
6. Television broadcasts.
7. Digital video discs (DVDs), videocassette recordings, or other

video storage media.

Provide equipment, mounting hardware, cabling, and other video display components that are compatible with each other. All equipment and materials furnished and installed must be reviewed and approved by the Engineer.

**682-2.2.1 Video Display Control System:** Furnish a video display control system listed on the APL. The video display control system must allow the operator to control and manage the display of video and computer-generated graphics on the display equipment connected to the system as well as provide selection and switching of multiple sources for display, including video streams available on the TMC Ethernet network. The display control system must also allow for operator control of all displays from the same workstation that is used for the SunGuide<sup>®</sup> operator interface. The video display control system must decode and display all video streams produced by encoders listed on the APL.

Use a video display control system that simultaneously displays a minimum of 32 video windows, each containing streaming video at a minimum resolution of 720 pixels x 480 pixels and frame rate of 30 fps. The system must allow any display window to be sized from 1/32 of the total display area up to the total display area, and any size in between.

The video display control system hardware must be designed to be rack mounted and secured in an EIA 19 inch equipment rack. Any system incorporating personal computer (PC) hardware must use current microprocessor technology and commercial, off-the-shelf components, including random access memory (RAM), hard disk drives, and network interface cards sufficient to provide the functional requirements of the system.

**682-2.2.1.1 Display Control Software:** Provide display control software that allows multiple operators to control all features and functions of the video display control system. These features and functions include, but are not limited to, selection of video sources for display; adjusting the size, location, and layout of video and other graphic information the system displays; and system configuration and setup. The control software must be able to operate a video wall composed of multiple display components as though it were a single, high-resolution display.

Use display control software that is compatible with the Department's SunGuide<sup>®</sup> software system.

The display control software must include a non-proprietary software development kit (SDK) including, but not limited to, an application programming interface (API) that describes interfaces and protocols which can be used to integrate system features and functions with third-party applications.

**682-2.2.1.2 Inputs and Outputs:** Use a video display control system that supports and displays a variety of video and data inputs simultaneously, including composite and component National Television System Committee (NTSC) video, digital visual interface (DVI), video graphics array (VGA), super video graphics array (SVGA), and super extended graphics array (SXGA) computer graphics. All inputs and outputs must allow for operator control in order to display any or all of this information on any number of display devices within the system. Ensure all inputs and outputs can be sized with and without constrained proportions across multiple screens and moved at will around any display area and combination of displays.

The video display control system must be expandable and scalable to support any combination of inputs and outputs. Provide the video display control system with a minimum configuration of 4 composite video inputs, 4 component (red, green, and blue (RGB)) video inputs, and 4 DVI inputs as well as network connections, decoders, and associated hardware and software required to display 32 inputs simultaneously at a minimum resolution of 720 pixels x 480 pixels and a frame rate of 30 fps, or as shown in the Plans. Provide the video display control system with a minimum configuration of 4 composite video outputs, 2 component (RGB video outputs), and 4 DVI outputs, or as shown in the Plans. Ensure the video display control system can be expanded to accommodate at least 128 discreet inputs and outputs.

Ensure that a single input can be routed to multiple displays simultaneously and that multiple inputs can be routed to a single display simultaneously for viewing in separate windows. All inputs and outputs must be synchronized by the video display control system and switching between inputs or outputs does not cause displayed images to unlock, roll, or otherwise exhibit visible distortion.

**682-2.2.1.2.1 Analog Video:** The video display control system must be able to accept S-video, composite, and component video sources, and can digitize these signals for manipulation and display on any display device attached to the system. All analog video inputs must use BNC connectors.

Analog video sources must display within their own windows, and can be resized up to or beyond their native resolution to conform to the wall display size.

**682-2.2.1.2.2 Digital Video:** The video display control system must be able to accept digital video sources and can manipulate and display these signals on any display attached to the system. All digital video outputs must use DVI connectors.

Each MPEG video stream must display within its own window and be freely movable and sizable up to or beyond its native resolution to conform to the wall display size.

**682-2.2.1.2.3 RGB Video:** Include an analog input that enables the TMC operator to project an exact copy of his or her workstation desktop display on the video wall display. Analog RGB inputs must allow native images up to 1,280 pixels by 1,024 pixels at 60 Hz to be displayed on the video wall.

RGB inputs must be sizable up to or beyond their native resolution to conform to the wall display size.

**682-2.2.1.2.4 Streaming Media:** The video display control system must be able to display a minimum of 32 compressed video streams simultaneously in MPEG-2 over TCP/UDP/RTP over IP and supports multicasting as defined in Version 2 of the Internet Gateway Message Protocol (IGMP). Ensure that the video display control system can display MPEG-4 and H.264. Ensure that the MPEG video input interface is, at minimum, a 10/100 megabit per second network port per every 15 streams.

**682-2.2.1.2.5 Primary Display Output:** Use a video display control system that can process the various signal input types to be viewed, such as the RGB feeds from monitor outputs and streaming video feeds. The unit must provide direct digital streaming video through cable feeds using a digital video decoder. The video display control system must provide the layout definitions for each signal to be displayed and save the

predefined layouts and must also permit switching of the predefined layouts and accept external alarm triggers to change the layouts.

Include output capacity with sufficient memory and processing speed to provide fast rendering of video and image displays. Ensure that the output has, at a minimum, a dual DVI connector that allows a digital connection of 1,280 horizontal pixels by 1,024 vertical pixels or greater resolution. Ensure that the color depth is a minimum of 24 bits per pixel. If the projection device requires an analog signal, then breakout cables may be used to convert the DVI output connector to a HD15 analog RGB connector.

**682-2.2.2 Video Wall Display:** Furnish and install a video wall display consisting of display devices described below arranged in a wall, as shown in the Plans, together with a video display control system.

The video wall display must produce, at a minimum, a large-scale, high-resolution video image having accurate color rendition, sufficient image brightness, and a high contrast ratio, as described in 682-2.3. The display system must provide access to serviceable components for repair and replacement of electronics, lamps, and optical components without removing the device from service for a period longer than 30 minutes.

Integrate the individual display units in a single, seamless display that provides a continuous image across the entire active display area provided, under the complete control of the TMC operators from their individual shared workstations.

Source all major wall display components from a single provider or manufacturer to ensure that the various devices are compatible with each other and able to function together as an integrated display.

The individual video images must exhibit a uniformity of color quality across the multiple displays. Colors must be displayed evenly across the video wall and the video wall must maintain uniform brightness characteristics from one video display unit to the next in the tiled display, with no degradation in color or brightness uniformity over time. The video wall display must provide features that allow physical and electronic alignment of the separate high-resolution display units that comprise the wall.

**682-2.2.3 Video Wall Support Structure:** Furnish and install an aluminum or steel-frame structure that supports the video display units as mounted and stacked to form the matrix for the video wall display. The support structure must consist of stackable display units that maintain a consistent maximum horizontal and vertical spacing of 0.04 inches between adjacent display units in the video wall matrix.

Fabricate the support structure specifically to ensure that a continuous, accurate image is provided on the screens without any distortion or unused screen space and that no observable distortions are present in the installed video wall display due to normal building vibration. Each completed structure must be enclosed such that there is no ambient light effect on the screen from behind the display.

Ensure that the components of the individual video displays can be serviced without disturbing the integrity of the entire video wall display.

**682-2.2.4 Rear Projection Video Display:** Use rear projection video displays that are suitable for digital video wall applications in mission-critical TMCs where video wall image quality, operational reliability, and serviceability objectives as stated in this Specification can be achieved.

Use rear projection video displays that display a minimum of a single or quad-split, four-paned CCTV camera video image. Each video display must be able to be

independently controlled from any of the central operator or shift supervisor workstations, and that each video display can be integrated with additional video units to form a single video display, or a virtual desktop where video windows can be positioned and resized by the operator.

Ensure that the rear projection video display facilitates lamp replacement without the need to readjust the image being projected on the screen.

The rear projection video display intensity must be sufficient for effective and comfortable viewing by TMC operations personnel under normal lighting conditions, subject to approval by the Department. The unit's display engine must produce a minimum light output of 550 ANSI lumens.

The rear projection video units must have the following minimum features and characteristics:

1. Screen brightness achieved by a combination of projection techniques and screen materials, so that the video display has a minimum brightness measurement of 130 candelas per square meter (cd/m<sup>2</sup>) across the outside viewing surface of the projection screen.

2. Brightness uniformity that meets or exceeds 80 percent across the display unit, as measured using a photometer.

3. A multi-lamp optical engine must be provided for rear projection video units that do not use light-emitting diodes (LEDs) for illumination. Multi-lamp optical engines must provide a failover feature whereby a second lamp can be automatically activated when the first lamp fails. Ensure displays with multi-lamp optical engines provide indication of lamp status.

4. Multi-lamp optical engines must include both a "hot standby" mode in which failover to the second lamp takes no more than two seconds and a "cold standby" mode in which failover and the time for the display to return to full light output does not exceed 30 seconds.

5. A display module that uses modular component architecture to permit service or replacement of serviceable parts without removing the projection engine.

6. Each unit must be completely enclosed and light tight, with fixed panels for access to the lamp, power supply, and projection engine.

**682-2.2.5 Flat Panel Display:** Furnish and install a flat panel display unit to reproduce video and computer graphics information. The device must display, at a minimum, a high-resolution, distortion-free image and maintain a consistent level of illumination across the entire screen area. Ensure that it has the following minimum features and characteristics:

1. Dimensions of 24 inches high by 41 inches wide by 4 inches deep, or as shown in the Plans.

2. Ability to be installed on the face of a standard wall or flush mounted within the wall system.

**682-2.2.6 Cabling:** Furnish each video display component with all required appurtenances, including all the necessary cables, with proper length and connectors for power and communication, as defined by the manufacturer. Ensure that cabling conforms to applicable EIA/TIA standards. Size the power cables to meet NEC requirements. Provide communication cables from each video display component to the network communication devices that are appropriate for and compatible with the technology employed (e.g., fiber optic, twisted pair, or coaxial), and meet the minimum size and bandwidth specifications the manufacturer requires.



Provide all cabling of adequate length, along with the compatible connectors and any ancillary equipment necessary to fully interconnect the video components and display control systems needed to achieve the functions required. Label all cables at both ends, as approved by the Engineer.

**682-2.2.7 Electrical Specifications:** Provide equipment that operates on 120 V<sub>AC</sub> at a frequency of 60 Hz. Furnish a transformer or other necessary means of power conversion for any device that requires another voltage or frequency.

Conduct TMC field reviews to examine the electrical distribution panels allocated for various equipment items and the electrical schedules for each. Make any changes, additions, or corrections to the electrical panels, wiring, outlets, and connectors that may be deemed necessary to adequately power all of the equipment proposed for a video display project at the intended location, subject to the approval of the Engineer. Make any changes to the building's electrical wiring in accordance with applicable codes and permits, and with the NEC. Modifications to an existing building's wiring or the video wall electrical wiring plans must be signed and sealed by a Specialty Engineer, and submitted for approval.

**682-2.3 Performance Specifications:** Use only display devices meeting the following minimum requirements.

	Flat Panel Display			Rear Projection Video Display
Type	Direct View LCD			DLP or LCD
Size	(dependent on TMC design, as shown in the Plans)			
Aspect Ratio	(dependent on TMC design, as shown in the Plans)			
Resolution	1600 x 1200 / 1280 x 768 pixels; 16.7 million colors			1024 x 768 pixels
Viewing Angle	170 degrees horizontally and vertically	160 degrees horizontally and vertically		160 degrees horizontally and vertically
Half Gain Angle	—	—		±40 degrees horizontally and vertically
Contrast Ratio	500:1	600:1		600:1
Screen Brightness *	250 cd/m <sup>2</sup>	450 cd/m <sup>2</sup>		130 cd/m <sup>2</sup>
Lamp Life	—	—		8,000 hrs. (avg.)
Video Inputs	Analog/digital via 15-pin D-sub (HD-15) connector; DVI-D connector.	Composite video (NTSC) on RCA connector; analog/digital via 15-pin D-sub (HD-15) connector; DVI-I connector;		Composite video (NTSC) on BNC; RGB via 15-pin D-sub (HD-15) connector; DVI-D connector.

		HDMI.		
Operating Temperature and Humidity	32° to 95°F. 20 to 80%.	32° to 95°F. 20 to 80%.		32° to 95°F. 20 to 80%.
Power Requirements	120 V <sub>AC</sub> at 60 Hz	120 V <sub>AC</sub> at 60 Hz		120 V <sub>AC</sub> at 60 Hz
* Measured using a photometer.				

**682-2.4 Installation Requirements:** Do not proceed with any part of the procurement, construction, or installation of the video display equipment until the construction plans and materials are approved by the Engineer. Submit to the Engineer documentation, including the manufacturers' product specification sheets and a detailed description of each item's function as well as a compliance matrix that confirms all equipment meets or exceeds the requirements of these Specifications.

Configure each video display unit to provide individual, independent control from each operator workstation.

Create the video wall display by arranging individual video display units in a framework or apparatus that creates the video wall configuration as shown in the Plans. The finished video wall must provide a single, apparently seamless display area. The adjacent individual display units must be aligned physically and electronically so that image content stretched across multiple monitors align within plus or minus 2 lines of horizontal and vertical resolution.

All rear projection video unit controls must be accessible at all times when the devices are permanently installed. Ensure that installation and positioning does not conceal or limit access to any display unit controls at any time during active use.

Follow proper ventilation and cooling procedures for the equipment installed, as determined by the equipment manufacturers. Provide electrical requirements and power distribution units and power supplies for the video display components as-needed.

**682-2.5 Testing:** Submit a detailed system acceptance test plan to the Engineer for review and approval. Prepare a test plan that covers all areas of system function described in this Section, and that is developed according to the various equipment manufacturers' recommendations.

Check and test the satisfactory operation of all video display components upon completion of the equipment's installation. At minimum, include in the video display system test the testing of each color video monitor type, each secondary display output at workstations, each rear projection video display unit, and the video wall display's image alignment and control functions.

**682-2.6 Observation Period:** Subject the video wall display to a 90 day operational observation period. During this time, perform any and all maintenance, recalibration, system checking, and display modifications required by the Engineer. The Engineer has the option to require a restart of the observation period if a major system flaw or failure occurs.

### **682-3 Warranty.**

Ensure that CCTV cameras and video display equipment have a manufacturer's warranty covering defects for a minimum of three years from the date of final acceptance by the Engineer in accordance with 5-11 and Section 608. Ensure that the warranty requires the manufacturer to furnish replacements for any part or equipment found to be defective during the warranty period at no cost to the Department or the maintaining agency within 10 calendar days of notification.

Warranty repairs of the video display control system and related TMC display equipment must commence within 24 hours after notification by the Department.

**682-4 Method of Measurement.**

The Contract unit price for each CCTV camera or video display device or system, furnished and installed, will include furnishing, placement, and testing of all equipment and materials, and for all tools, labor, operational software packages and firmware, supplies, support, personnel training, shop drawings, documentation, and incidentals necessary to complete the work.

The video display equipment will be measured as each major system component is furnished, installed, made fully operational, and tested in accordance with this Specification or as directed by the Engineer.

**682-5 Basis of Payment.**

Price and payment will be full compensation for all work specified in this Section.

Payment will be made under:

- |                 |                               |
|-----------------|-------------------------------|
| Item No. 682-1- | CCTV Camera—each.             |
| Item No. 682-2- | Video Display Equipment—each. |