

Intelligent Transportation Systems

Construction Engineering and Inspection Training, for Closed-Circuit Television Cameras

Lesson 3

Welcome to the Intelligent Transportation Systems Construction Engineering and Inspection Training, for Closed-Circuit Television Cameras, Lesson 3: Inspection.

During the review of equipment submittals, check the FDOT APL website under the Specification 682 - Video Equipment, for the approved CCTV Cameras. For Camera Lowering Devices, see Specification 641 - Prestressed Concrete Poles. And, for Surge Protective Devices, see Specification 620 - Grounding and Lightning Protection. A link to the FDOT APL website can be found on the Resources page.

During the material inspection, the CEI personnel should verify that the CCTV camera provided is the same CCTV camera that was approved in the submittal. If a Camera Lowering Device is required, make sure that the CCTV camera conductors and Camera Lowering Device connectors match. Also, ensure that the Camera Lowering Device is the same Camera Lowering Device that was approved in the submittal.

Verify that Surge Protective Devices are provided for all copper cables (both ends of the cables). The CEI personnel should also verify that the SPDs were approved in the submittal. The Camera Lowering Device cables are custom-made to fit for each installation, so be sure to verify the cable length.

Pole Identification Markings, per FDOT Standard Plans 641-020, should be verified during the material inspection. The pictures on the screen show different examples of pole markings. CEI personnel should verify shipping, handling, storage, and installation requirements for the poles per the FDOT Standard Specifications for Road and Bridge Construction, Section 450-16.

The CEI personnel shall verify that the Camera Lowering Device is on the Approved Product List and is the correct product for the project. The inspector shall ensure that all components, lightning protection, counterweights, safety clips and chains, and necessary tools for lowering are present. The lowering device pole fitter, disconnect unit fitter, divided channel arm and disconnect unit should be checked for defects, including cracks and defective welding. The specification section for the camera lowering devices can be found in the FDOT Standard Specifications for Road and Bridge Construction Section for Camera Lowering Device.

The CEI personnel shall verify that the CCTV Camera is on the Approved Product List and is the correct product for the project. The manufacturer's name, model, and serial number should be noted. This information will be entered into the Department's material tracking database.

The camera should be visually inspected for defects on the camera housing. The camera lens should be carefully inspected for blemishes and scratches. The power supply should be made specifically for the camera. Ensure that a power supply from another manufacturer is not used. For IP cameras, a power over ethernet injector may be required for the camera.

Some vendors may supply a special composite cable for power and communication. These cables are costly and made specific for each site. The fixed mounting brackets should also be supplied with the camera. Ensure that brackets from another manufacturer is not used. The specification section for

the camera lowering devices can be found in the FDOT Standard Specifications for Road and Bridge Construction Section 641 – Camera Lowering Device.

The CEI personnel shall verify that the SPD is on the Approved Product List and is the correct product for the project. The manufacturer's name, model, and manufacture date should be noted. This information will be entered into the Department's material tracking database.

For analog cameras, there are three types of SPDs that will need to be used. The three types are for the coax cable, twisted pair conductors, and the power supply. For IP cameras, an ethernet cable SPD should be used. Ensure that if the power over ethernet, or POE camera is being used, a POE SPD is used. The specification section for the surge protective devices can be found in the FDOT Standard Specifications for Road and Bridge Construction Section 620 - Grounding and Lightning Protection.

The FDOT Standard Plans for the Steel CCTV Pole and the Concrete CCTV Pole describe the foundation and pole installation requirements. Also, ensure that a concrete maintenance pad is located near the base of the cabinet, if required. The position of the cabinet shall be on the outside face of the pole. Confirm that the viewing angle of the camera is installed per the project Plans.

Information for the installation of grounding arrays and air terminals can be found in the FDOT Standard Plans for the Steel CCTV Pole and the Concrete CCTV Pole. The American Association of State Highway and Transportation Officials, or AASHTO, Roadside Design Guide is a reference that describes the requirements for roadside offsets and associated protection devices. If a protective barrier is installed, ensure that the pole is outside the deflection zone.

On freeways, most cameras are installed on poles. The mounting height may vary depending on the District, the roadway geometry, roadway constraints, and topology. This is typically designed by the Engineer of Record to provide 100% coverage. Sometimes certain locations, may require different heights for poles. In addition, the material of the pole may either be concrete or steel.

On arterials, cameras may be mounted on traffic signal mast arms. Cameras mounted on the mast arms are generally used to monitor traffic conditions as well as verify the messages displayed on the Arterial Dynamic Message Signs, or ADMSs. Cameras are typically mounted at heights that allow access with a bucket truck. Site accessibility for personnel and/or vehicles should be considered when selecting the location of the CCTV camera.

The orientation of the pole, CCTV camera, and the cabinet should be checked against the project Plans and FDOT Standard Specifications for Road and Bridge Construction. The CCTV camera should not be positioned above a cabinet or the CCTV pole hand hole, where the camera lowering tool is mounted. We don't want workers in harm's way, in case a CCTV falls. The CCTV pole will always create a blind spot for the CCTV camera. As a result, the camera should always be mounted facing the roadway.

Prior to the delivery of any equipment or materials, the project site Maintenance Of Traffic, or MOT, must be set up. The CCTV Pole is delivered to the CCTV installation site using a flatbed truck or trailer. The pictures show the MOT at a ramp using a flagman and a shoulder closure on an interstate mainline. Usually, for a CCTV pole installation, an interstate shoulder closure MOT is applied. Rarely is an interstate single lane closure MOT required for CCTV pole installations.

The Closed-Circuit Television camera pole needs to be safely delivered to the site location. The CEI personnel should ensure proper permits are obtained, and that the work plan and the MOT plan are approved.

The pictures show a CCTV camera pole breaking a signal strain pole while transporting it from a project staging area to a site location. This incident took place within the ITS project limits. The project CEI personnel coordinated with all related authorities to resolve the issue. Safety monitoring during any construction activity should be the primary objective of the project CEI personnel.

Here is a CCTV pole that is picked from the flatbed truck using a crane to be placed on the ground, away from traffic within the construction zone. The CCTV pole will be positioned such that the technicians can attach items on the top portion of the pole. The air terminal mounted to the CCTV pole using bolts. Air terminals should be anchored to the pole with mounting brackets and/or bolts. The use of stainless steel straps is not allowed.

Here is a picture of CCTV camera lowering device attachments. The rings are part of the lowering device to facilitate easy lowering of the CCTV. This image shows a CCTV technician mounting the CLD apparatus to the top of the CCTV pole.

To verify the proper mounting of the Camera Lowering Device on the CCTV pole, ensure that approved stainless-steel strapping is used for side mounts. The connection between the lowering device and tenon must be weather resistant. For safety reasons, the Camera Lowering Device shall be installed so that the camera is not suspended above the operator when it is being lowered or raised. The camera shall be securely mounted to the lowering device with counter weights. Inspect the camera dome and camera housing for cracks and ensure that the guide pin, contact connector, and contact assembly are clean and free of harmful particles.

The lowering device shall align with the centerline of the pole. Safety precautions are very important because cameras have fallen due to improper installation, endangering personnel working in the camera location.

Ensure that the CLD lowering cable is housed within a 1.25-inch PVC conduit mounted on the inside wall of the pole. Refer to the FDOT Standard Plans for Camera Mounting Details. Ensure that the conduit and the lowering cable are securely fastened at both the top and bottom. Check all functionality of the lowering device to ensure that it moves the cable freely in both directions.

The picture shows a camera lowering device installed on a pole that has already been erected. The installation requires a very tall bucket truck. The other picture shows a crane with a man lift cage, which was used to access the camera lowering device.

The cage should have enough room to carry two personnel, their tools and the camera lowering device, and other apparatus. The screen shows technicians inside a man lift cage attaching the camera lowering device and air terminal to the Closed-Circuit Television pole. This operation may take several hours. Although this practice may still be common, it is not practical for the technicians to be working in a risky environment, attaching the devices to the CCTV pole. Therefore, it is recommended that components on the pole be mounted before erecting the pole.

The photo shows the installation of a fixed mounted camera. Typically, fixed mounts are used on shorter poles which can be easily reached by a bucket truck. In addition, the poles are erected before the camera is installed. Fixed mounts are also used on traffic signal mast poles.

For locations that require fixed mounts, static brackets are used to attach the CCTV camera housing to the CCTV pole. The proper brackets shall be used for each type of housing according to the manufacturer's recommendation. Do not mix and match brackets from various vendors. Also ensure that any external cabling has a proper drip loop.

Here are examples of Closed-Circuit Television hole drilling operations. After proper preparation of the area, an auger is used to drill the hole in the ground to install the CCTV pole.

Here is the construction crew verifying the integrity of the drilled hole. Here is an example of water being removed from the hole using a sump pump and a hose. This is the construction crew measuring the depth of hole using a metal tape measure.

Here are a few examples of placing the Closed-Circuit Television or CCTV, pole into the drilled hole. The CCTV pole is being lifted after the Camera Lowering Device and the air terminal were attached to the CCTV pole. A crane can be used for the placement of the CCTV pole into the drilled hole. The crane can also be used to stabilize the CCTV pole in place while minor adjustments are made to the CCTV pole's position. Coarse aggregate or concrete is used to set the CCTV pole in place. The CCTV pole installation crew can provide minor adjustments to ensure the pole is vertical.

Concrete is poured into the drilled hole to surround and secure the CCTV pole in place. The use of a steel casing for the concrete placement is used in this example. And here is the concrete being poured into the drilled hole. The ground conductors should be properly positioned a few feet above ground level. And the disturbed ground around the CCTV pole should be leveled after the concrete has cured. Landscaping should be performed to bring the disturbed area back to its original condition.

The Closed-Circuit Television cabinet can be mounted on a pole or a foundation. The CCTV cabinet may be co-located with other ITS devices and Traffic Signal cabinets. The CCTV cabinet can be delivered to the site using a small crane.

Here is a rigid metal conduit and an LB conduit body attached to the CCTV pole. A hole will be cut into the bottom of the CCTV cabinet where the conduit will penetrate and terminate. Ensure that proper bushings are used at the conduit entry point to prevent cables from chafing against the rigid edges.

The cabinet might need to be prepared before attaching it to the CCTV pole. The cabinet is verified as outfitted with the correct door locks, rack, CCTV camera power supply, din rail and fan. These components are installed in the cabinet at the project workshop before transporting the cabinet to the device site. Upon delivery to the job site, the inspector shall verify that these components have been properly installed.

After the inspection, the CCTV cabinet will be installed on the pole. Stainless-steel bands are used to attach the cabinet to the pole. FDOT Standard Specifications for Road and Bridge Construction Section 659 - Mast Arm, Span Wire, and Pole Mounting Assemblies references the use of SAE Type 316 or 304 stainless steel to mount cabinets onto poles.

Here the cabinet is being picked up using a crane to hover near the Closed-Circuit Television pole. This picture shows the cabinet being gently pushed towards the CCTV pole by a construction crew. The bottom of the cabinet will attach to the top of the rigid conduit. The cabinet is being set on top of the conduit while a crane is holding the cabinet in place, against the CCTV pole. The cabinet is being adjusted for plumb while the crane is holding the cabinet in place.

The Closed-Circuit Television cabinet is being secured to the pole using Stainless Steel straps. The cabinet plumb is adjusted and verified while securing the cabinet to the CCTV pole. Once the cabinet has been installed, the conduit lock nuts and bushings are installed to secure the conduit to the base of the cabinet.

Lightning protection, grounding, and surge protection are key to long-term, trouble-free performance of the ITS field devices. Small surges from a nearby lightning strike could be enough to cause damage to the Closed-Circuit Television, or CCTV, camera and its components.

Air terminals, if required, should be anchored with screws and not straps. The materials will be submitted to the Engineer of Record for approval. The CEI personnel shall have the Contractor take a photo of the installation to verify that the air terminal has been properly installed.

The CEI personnel shall be very familiar with FDOT Standard Specifications for Road and Bridge Construction Section 620 - Grounding and Lightning Protection. In addition, the Grounding and Lightning Protection details are included in the Standard Plans Concrete CCTV Pole, Index 641-020 and Steel CCTV Pole, Index 649-020 which shows valuable installation information. Manufacturer specifications, plan notes, and the project plans should also be referenced during installation.

The CEI personnel should also verify that the surge protection wiring is installed correctly. Some surge protective devices have a "protected" side and an "unprotected" side. If extreme care is not taken during installation, it could accidentally be installed backwards.

Grounding electrodes should be tested using the "fall-of-potential" method for earth/ground resistance, soil resistivity and current flow. The exothermic welds should be carefully inspected for proper bonding. Reference the Ground Resistance Testing and Inspection section in the FDOT Standard Specifications for Road and Bridge Construction.

The CEI personnel should also be very familiar with the National Electrical Safety Code, and the National Electrical Code, regarding these items. The CEI personnel is responsible for bringing any potential problems in the design or construction to the Department's attention.

This is a Closed-Circuit Television cabinet disconnect and a transformer. A CCTV cabinet is usually powered by a 120 volt service. Depending on the location of the CCTV cabinet, only a high voltage power distribution system may be available. In this example, the utility provider is supplying 600 volts, therefore a step down transformer is used to convert the 600 volts to 120 volts.

Here is a CCTV camera co-located with a Microwave Vehicle Detection System, or MVDS, device on the same pole. This particular CCTV camera is installed using a CLD mount. The Contractor shall ensure that the MVDS is positioned so it does not interfere with the camera lowering operation.

Here are some images that show the voltage measurement at the cabinet maintenance outlet and the evaluation of the power entering the cabinet. These tests are usually performed during the functional inspection.

The Closed-Circuit Television cabinet voltage is verified using a volt meter. The maximum allowable voltage drop from the utility company's power meter to the cabinet is 5 percent. For example, if the voltage at the utility provider's power meter is 120 volts, then the minimum voltage at the cabinet shall be 114 volts. The contractor shall measure the voltage at the circuit breaker, at the power meter, and the voltage at the cabinet terminal block to verify these minimum voltage requirements.

When measuring the voltage, ensure that the maximum amount of electricity is being used and all the cabinet components are running. For example, the cabinet fans should be running, the cabinet light is on, the camera is being panned and zoomed, and any equipment that is plugged into the cabinet maintenance outlet is turned on.

An oscilloscope is used to determine the quality of the incoming power into the CCTV cabinet. The is a typical reading of a CCTV cabinet. The sine wave should show a minimum of 114 volts peak to peak with a 60 hertz frequency. The waveform should be stable and not shift from side to side.

In addition to the video output and Pan/Tilt/Zoom control, the Construction Engineering Inspection personnel shall verify that the camera image has the correct text label showing the Camera ID, location, and direction of view information superimposed on the image. The text label should match those shown on the other existing cameras. This can be verified when the camera video stream is shown on the laptop during the field acceptance test or at the traffic management center during the system test.

The CEI personnel should verify that the camera dome is properly pressurized per the manufacturer's specifications. If the dome is not adequately pressurized, then a low pressure message will be superimposed on the camera video stream.

This picture shows a lowering device hand-crank winch, but an electric drill could be used instead of the hand crank. The lowering cable inside the pole is attached to the winch. The picture shows the camera in the lowered position.

Ensure that the lowering cable is installed in a 1.25-inch PVC conduit inside the pole in accordance with FDOT Standard Plans for Camera Mounting Details, 659-020. The conduit should be securely fastened at both the top and bottom. The Inspector should verify the presence of the counter weights and the safety chain, which may be shipped separately.

After the camera has been lowered, the inspector can witness the contractor performing the nitrogen pressure test. A manual pressure gauge should be used to measure the pressure. The test should verify that there is 5 pounds per square inch of dry nitrogen. Also, the Contractor should enable the low-pressure alarm feature using his laptop. This will automatically superimpose a low-pressure message on the video display when the pressure reaches a predetermined threshold.

The CEI personnel should also verify that there is adequate lubrication for the proper operation of the lowering system. Refer to the manufacturer's installation and operation manual for lubrication points.

There could be issues accessing the closed-circuit television camera if the camera lowering device does not work properly and is mounted at a height of 65 feet or higher. It would require a special crane or taller bucket truck for the field technician to reach the top of the pole to rectify the issue. Here you can see a taller bucket truck being used to reach the top of the pole. There is also an example of a crane with a personnel safety cage. These types of special equipment are hard to come by and mobilizing them can be difficult. Therefore, it is important to ensure that the lowering device is functioning properly prior to acceptance.

This concludes the Intelligent Transportation Systems Construction Engineering and Inspection Training, for Closed-Circuit Television Cameras, Lesson 3: Inspection.

Please continue to Lesson 4: Testing and Resources.