

CFX ITS Inspection Reference & Training Manual

Chapter 7 Cabinets and Enclosures

7.0 OVERVIEW OF CABINETS (HUBs) AND ENCLOSURES

ITS Cabinets, interchangeably referred to as HUBs, come in a range of multiple sizes and types. These cabinets/HUBs are used to house ITS and fiber optic equipment and can be installed on poles or mounted to walls or pads as specified by the plans. Pad-mounted cabinets are open on the bottom to allow for conduits to enter the cabinet. Pole or wall-mounted cabinets will be closed on the bottom and a hole will need to be drilled into the bottom of the cabinet to allow the conduits to enter. All cabinets and enclosures must be submitted to and approved by the CEI Engineer. All approved ITS Cabinets must have a light that will illuminate when the doors are opened and ventilation fans that are temperature controlled via an adjustable thermostat. Additionally, all Type 336S and Type 334 cabinets/HUBs used for ITS purposes must have a Sunshield installed to add an extra level of cooling protection from direct sunlight. Most cabinets are purchased pre-wired for electric with the addition of several outlets specific for equipment and technician use. Additionally, APL approved Type 336S and 334 may come pre-wired for Generator plugs.

7.1 CABINET MOUNTING

There are a variety of ways to secure/mount ITS Cabinets and the two most common are Pole and Base mounted. Both styles have unique installation processes but are always to be installed per the Contract Documents.

7.1.1 Pole Mount: Type 336S and NEMA 3R/4X cabinets can be pole mounted using the banding method. This method consists of securing the cabinet to the pole from the top and bottom of the cabinet with $\frac{3}{7}$ stainless steel banding and clamps. In instances when the pole is painted, the banding must be painted to match the color of the pole.



Figure 7.1: 336S Cabinet mounted to the pole with banding

The minimum height between the bottom of the cabinet and the ground must not exceed 36", unless otherwise approved, by the CEI Engineer prior to installation. The cabinet must be mounted and orientated so that it is on the opposite direction of travel and the technician's back is never to traffic. The only two acceptable locations to mount any type of cabinet to a pole or existing structure is on the downstream side of the pole or toward the Right of Way, with the front of the cabinet orientated such that the technician is looking at oncoming traffic when working in the cabinet. The Figure below shows an incorrectly mounted NEMA cabinet, which was mounted on the upstream side of the pole.



Figure 7.2: Incorrectly Mounted NEMA Cabinet Facing Oncoming Traffic

For installations where the cabinet is being mounted to a CCTV Pole, the cabinet must not be mounted beneath the lowering device and must not interfere with the opening of the hand hole where the lowering winch will be installed to lower the camera.

7.1.2 Base (Ground) Mount - Type 334 Cabinets are Base mounted, meaning the bottom of the cabinet will be open and it will be secured to a flat concrete surface. Galvanized anchor bolts, nuts, and flat washers in accordance with ASTM A153 are used when securing the cabinet to the concrete base. The joint between the bottom of the cabinet and the concrete base must be sealed with approved silicone rubber sealant both inside and out. The concrete base for the cabinet must be in accordance with Section 347 of the FDOT Specs. The base must be level, free of honeycombs and polished with a concrete polishing stone to be smooth. Typical dimensions for Type 334 are 66"H x 24" W x 30" D. The picture below shows a cabinet which has been installed on a pad, which does not have the required 3" lip extending past the cabinet on all four sides.



Figure 7.3: 334 Base Mounted Cabinet – Non-Conforming Pad

7.2 TYPES OF CABINETS

There are three types of cabinets/enclosures used on the CFX ITS System and the type of cabinet used will depend on the equipment, location, and cost.

7.2.1- Type 334 – Dimensions are 66" H x 24" W x 30" D with a Sunshield. This cabinet is the most commonly used cabinet on the CFX ITS System due to several reasons. These cabinets are installed as base mount cabinets which reduces scratching and wear on the ITS device poles, eliminates the need for banding which causes galvanic corrosion and issues related to lightning protection versus electrical ground. Additionally, the cabinets can be placed in a more suitable location and eliminates the issue of having pole mounted cabinets on steep slopes.

Type 334 cabinets generally are required by CFX Specification to be equipped with UPS, Batteries, and when required by the plans, a Generator Plug. Both sides of the cabinet must have doors for access. 334 cabinets are always base mounted due to their height. The larger size allows for additional batteries to ensure the network equipment and ITS devices are available during commercial power failures. For DMS sites, the DMS controller is installed in the 334 Cabinets, instead of them being housed within the DMS.



Figure 7.4: Type 334 Ground Mount Cabinet Layout Diagram

7.2.2- Type 336S - Dimensions for a Type 336S Cabinet are 46" H X 24" W X 22" D with a Sunshield. These cabinets are closed off on the bottom unlike the 334 and are usually installed on CCTV Poles, TMS Poles, DMS Uprights and Type II Concrete poles. To access the cabinet, holes between 1" to 2" in diameter are drilled in the bottom; side access is not permitted. Like the 334, the 336S comes equipped with two doors that open opposite of each other. The cabinet is installed 36" from the bottom of the cabinet to the ground and is always secured to the pole on the downstream side of traffic unless otherwise approved. When installing behind guardrail, the minimum distance from guardrail to cabinet must be 5' which allows the doors to freely open and extend.



Figure 7.5: Pole Mount Cabinet Layout Diagram

7.2.3- NEMA 3R and 4X enclosures - NEMA 3R/4X Enclosures come in many sizes and have ratings for both indoor and outdoor specifications. These specifications are regulated by the National Electrical Manufacturer Association (NEMA). The 3R and 4X enclosures are smaller in size than the 334 and 336S Cabinets and are typically used as intermediate cabinets; meaning they typically do not have a Layer 2 Switch installed. Instead, they will have a media converter and associated cabling surge protection devices that will convert the electrical signals of the equipment in the enclosure to a light signal and send it back to the local hub (LHUB) it is associated with via Fiber Optic Cable. Other typical uses for these enclosures would include instances where a weatherproof location is required to house certain equipment up high on poles or bridge decks, such as DCS sites.

Unlike the 334 and 336S, NEMA enclosures do not come equipped with a rack. Therefore, rack mounted items cannot be housed within the enclosure. Instead Din Rail must be installed with the cabinet and any equipment is mounted to the Din Rail. Also, due to this being a smaller enclosure, as compared to Type 334 and 336S cabinets, they cannot hold a UPS or batteries.



Figure 7.6: NEMA 4X Equipment Enclosure

7.3 Cabinet Components

Within the three cabinet types, there are several components that create a cabinet/Hub assembly. Not every component is used at every cabinet/Hub type, and some are site-specific and cabinet specific. Listed below are examples of the type of components that are commonly found in ITS Cabinets.

7.3.1 Rack - A 19-inch rack is a standardized frame or enclosure for mounting multiple pieces of equipment. CFX requires all 336S and 334 cabinets to be equipped with a 19-inch rack for mounting much of the ancillary equipment. On each side of the rack there are threaded holes to which you screw and secure your equipment using stainless steel screws. 1 Rack Unit (RU) which is a measurement used for racks consist of 3 threaded holes that are separated by .625" and from center bottom to center top of hole measures 1.25". A 19-inch rack is shown in Figure 7.7. The rack has the cabinet power panel, a sliding drawer and a stationary shelf attached to it in this picture.



Figure 7.7: 19-inch rack inside of a 336S cabinet

7.3.2 Din Rail - Din Rail is a metal rail in which surge protectors/arrestors, circuit breakers and sometimes equipment are secured and supported. It is approximately 35 MM tall and 7.5 MM deep. In the US, these rails are known as TS35 Rails. Equipment is typically "clipped" to the rail versus being screwed in, like in the 19" Rack. Both 336s and 334 come equipped with Din Rails as well as racks for multiple rack mounting configurations. NEMA enclosures typically rely on Din Rail mounting as their primary way of securing equipment to the cabinet.



Figure 7.8: Din Rail with TVSS and a maintenance port mounted to it

7.3.3 Fan - Both the 336S and 334 Cabinets are equipped with 2 fans on the top of the inside of the cabinets. The fans are controlled by a thermostat within the cabinet. When the temperature inside of the cabinet rises above the temperature set on the thermostat, both fans are turned on and exhaust heat in an effort to cool the cabinet. When testing the operability of the fans you should turn up the thermostat to the same temperature as outside, or higher, and both fans should turn on.



Figure 7.9: Cabinet Fans

7.3.4 Lights - Both the 336S and 334 are equipped with two lights, one above each door. Switches are installed at both door locations, such that once either of the doors have been opened both lights will turn on. Some cabinets will have monitoring devices installed in the cabinet to monitor whether the lights and fans are on.

7.3.5 Shelf - All three types of cabinets can come equipped with either a fold-down shelf or a pull-out drawer from the manufacturer. These shelves and drawers provide maintenance technicians with a spot to place their laptops while working at the site. The pull-out drawers also have the added benefit of being able to store product manuals, spare cabling, and other items at the site.

NEMA 3R and 4X cabinets are typically provided with fold-down shelves while 334 and 336S cabinets are always required to include a pull-out drawer.

7.3.6 Heat Shield – Installed on all 4 sides as well as the top of the 336S and 334 cabinet exteriors is a Heat Shield; sometimes referred to as a Sunshield. They are constructed of 0.125" aluminum and are mounted on standoffs that provide at least a 1" air gap between the exterior of the cabinet and the shield. The purpose of the heat shields is to reduce the amount of direct sunlight on the cabinet and create a separation between the sunshield and the exterior cabinet surfaces to provide an air gap. The reduction in cabinet surface area exposed to sunlight and the air gap result in a lower temperature inside of the cabinet, versus not using a sunshield.



Figure 7.10: Heat shields on a 334 Cabinet

7.3.7 Panduit Cable Management System - CFX requires that all ITS cabinets and hubs, except NEMA 3R and 4X enclosures, be outfitted with Panduit brand Cable Management System Type G Wide Slot Wiring Duct model G1X1LG6-A or approved alternate. The Panduit is to be cut to fit and be installed in accordance with the project plans and ITS Design Standards. The Panduit harnesses communications and power cables within the cable management system and are required to be installed on both the right and left sides of the cabinet. The Panduit is to be sized such that it does not make contact with the cabinet door or their handles, locks and hinges.



Figure 7.11: Panduit Cable Management

7.3.8 CyberLock – Cyberlocks and associated Cyberkeys, as shown in Figure 7.12, are part of an electronic key access control system used by CFX for their ITS cabinets and enclosures. The Cyberkey is encoded with identification data to allow CFX personnel to not only know who accessed a cabinet, but also provides CFX personnel with the ability to allow access to a single cabinet or a series of cabinets as well as dictating the period of time that the person can access the cabinet(s). CFX requires that all cabinet doors be provided with an approved Cyberlock, Model # CL-TC1 or an approved equivalent. The Contractor shall provide Cyberlocks on all cabinet doors, to include generator access

doors, and shall provide one Cyberkey for every 10 locks installed on the project, rounded up to the nearest whole value.



Figure 7.12: CyberKey

7.3.9 Cabinet Power Panel – Type 336S and 334 cabinets have a Rack Mounted Power Panel installed in the bottom of the cabinet for incoming A/C power. The power panels takes up 4 RUs of space and come equipped with circuit breakers, Din Rail, Duplex Outlet, GFCI Outlet and an SPD for incoming voltage. NEMA 3R and 4X enclosures are equipped with the same equipment and a terminal block which are all mounted to a backplane. Both cabinets have Cabinet Ground Buss bars installed for landing the grounding conductors. The manufacturers ship the power panels already "wired up" so all that is needed for power in the cabinet is to land the incoming A/C from either the disconnect or the transformer (depending on the application).



Figure 7.13: Type 334/336SCabinet Power Panel vs. NEMA 3R/4X Cabinet Power Panel

7.4 Inspection of Cabinets

Verify with contract documents that the cabinet has been installed in accordance with Contract Specifications. It is imperative to inspect the cabinet upon delivery to the site and once mounted to the foundation, structure, pole, or wall.

7.4.1 Common Cabinet Deficiencies - While enclosures and cabinets are being installed, they may get damaged, scuffed, or scratched. Depending on the severity of the damage they may need to be replaced. If the cabinet is improperly wired to the incoming A/C or the SPD is not wired correctly this may cause damage to the cabinet. Other typical deficiencies include cabinets not being installed according to the plans, i.e. in the clear zone, too close to the guardrail, or installed next to objects that would not allow the doors to completely open. Inspection staff need to work with the contractor to catch these types of deficiencies as soon as possible to minimize time impacts for removal and reinstallation per the plans.

7.4.2 Cabinet Inspection Checklist - The Cabinet Inspection Checklist is included below for reference.

Date:	Contract Number:		Project Number:	Sta./Sheet Number:	
Passed	Fail	N/C	Inspection Required		
			Verify the cabinet was installed in accordance with the contract plans.		
			Verify the cabinet is at minimum 3' from the bottom of the cabinet to grade unless otherwise specified by the contract plans.		
			Verify the cabinet has been installed on the downstream side of the pole/Structure so that it is protected unless otherwise stated and approved by the department.		
			Verify a Tech Pad/Apron has been poured (all 334 cabinets shall have a Tech Pad).		
			Verify pole mounted cabinet has been installed per FDOT specifications or manufacturers recommendation and Stainless-Steel banding shall be used.		
			Verify Pole mounted cabinets are mounted with the hinges next to the pole.		
			Verify the cabinet is Plumb and Level.		
			Verify there are no scratches, dents or gouges on the cabinet or Sun Shield.		
			Verify the proper number of conduits were installed in accordance with the contract Plans and clearance was made for proper bends in the Cable/FOC.		
			Verify the Cabinet has been labeled per the contract Documents.		
			Verify the cabinet has been grounded to an array with exothermic welds.		
			Verify with a 3 Point Ground Megger attached to the cabinet ground that the earth resistance is less than 5 ohms		
			Verify the conduits inside the cabinet have all been installed with ground bushings.		
			Verify each ground bushing is grounded to the ground buss bar separately or to approved location (some agencies allow for the grounding bushings to be daisy chained to the ground buss bar). Verify Ground wire is free of kinks in the cabinet.		
			Verify all Din Rails are grounded to the grounding buss bar.		
			Verify the main ground from the Disconnect, Breaker Panel, Meter, or Transformer is #6 green conductor or per plan.		
			Verify the ground conductors are as short as possible.		

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			Verify the voltage from neutral to ground is 0 VAC		
			Verify all the breakers are the correct size per the contract plans.		
			Verify the proper incoming voltage, between 115 to 125 VAC.		
			Verify the AC SPD is installed, and the lights are green.		
			Verify proper voltage on the outlets and GFCI light is Green.		
			Verify both lights turn on when both doors are opened and closed when both doors are shut.		
			Verify both fans are working, and the thermostat is set to 75 degrees or per CFX Standards.		
			Verify the Document shelf/drawer has been installed and is secured with a minimum of 4 rack screws.		
			Verify all video cables, data cables, and power cables are connected to a SPD or per plans.		
			Verify all equipment in the cabinet are on the APL or approved per contract documents.		
			Verify the integrity of all cables and ensure connections are tight.		
			Verify all equipment has been labeled per contract plans and documents on both ends of the cable.		
			Verify all cables are labeled at each connection point, secured and minimum bend radius is maintained.		
			Verify the Patch Panel has been labeled.		
			Verify the fiber entering the Patch Panel has been labeled.		
			Verify the fiber jumpers have been labeled.		
			Verify all equipment has been programmed with the correct parameters i.e. IP Addresses		
			Shut off Breakers and verify the UPS is operational		
			Verify L2/L3 Switch is mounted per the contract plans, either Din Rail or 1U 19" Rack		
			Verify Cabinet Filters are installed.		
			Verify cabinet has been neatly dressed and the bottom of the cabinet is free from metal shavings.		
			Verify all conduits have been sealed with Duct Seal.		
*Complete and attach a Nonconformance Report for all Nonconforming items noted.					
Inspector Signature:			Date:	DOC Control No.	

7.5 PRE-ACTIVITY CONSIDERATIONS

1) Review CFX Specifications and Project Plan Requirements with the Contractor – Schedule a field meeting with the project Superintendent or Foreman and the crew who will be installing cabinets, prior to the work beginning. At this meeting review all relevant CFX Specifications and Project Plan requirements with the Contractor's staff. The Cabinet Inspection checklist can also be provided to the Contractor for their reference of the items that will be verified once the installation is completed.

2) Pre-Installation Inspection – Prior to the Contractor installing the cabinet, it should be inspected for damage, scuffs, scratches or dents. Depending on the severity of the damage, the cabinet may not be suitable for installation.

3) Inspection of Concrete Pad/Foundation – For ground mounted cabinets, verify the concrete pad is 6 inches above finished grade (or as noted in the plans), smooth and level without honeycombs, and all conduits are cut level. Verify that a Tech Pad has been poured for all cabinets, as required by the plans and specifications.

4) Review Cabinet Locations – Verify that the field location of the cabinet is per the contract documents to include outside of the clear zone, clear of the guardrail, and not installed next to objects that obstruct the doors from opening completely. When the cabinet is installed on a pole or structure, ensure that the cabinet is installed on the downstream side, unless otherwise approved.

5) Verify Cabinet Installations Immediately – Make it a point to verify that the Contractor is installing the cabinets correctly, as soon as they begin the installation. Any corrections that need to be made will be much simpler and less expensive if caught early.

6) **Powerup** – Before energizing the cabinet, review Chapter 8 Power Services and Chapter 9 Grounding to verify that service wires are sized correctly, that all connections within the cabinet are tight, and grounding is in place and correct. Once these items are addressed, the cabinet can be powered up and tested.