City of Brentwood, TN

Specifications for Traffic Signal Cabinet Assemblies

Standard: NEMA TS2 Type 2

Date: August 2012

Revision 1

1. Introduction

This specification sets forth the minimum requirements for a TS2 Type 2 traffic control cabinet assembly. The cabinet assembly shall meet, as a minimum, all applicable sections of the NEMA Standard Publication No. TS2-2003 or most recent version. Deviation from these specifications shall be at the discretion of the City of Brentwood Public Works Department.

2. Cabinet Design and Construction

2.1. The cabinet shall be constructed from type 5052-H32 aluminum with a minimum thickness of 0.125 inches.

2.2. The cabinet shall be designed and manufactured with materials that will allow rigid mounting, whether intended for pole, base or pedestal mounting. The cabinet must not flex on its mount.

2.3. The cabinet shall be supplied with a natural aluminum finish, unless otherwise specified. Sufficient care shall be taken in handling to ensure that scratches are minimized. All surfaces shall be free from weld flash. Welds shall be smooth, neatly formed, free from cracks, blowholes and other irregularities. All sharp edges shall be ground smooth.

2.4. Painting of cabinets shall not be required unless specified in the plans or other bid documents.

2.5. All seams that are not welded shall be sealed with RTV sealant or equivalent material on the interior of the cabinet.

2.6. Cabinets shall have a minimum of 3 shelves manufactured from 5052-H32 aluminum. Shelves shall be a minimum of 10 inches deep.

2.7. Shelves shall not obstruct the ability of the rear panel to fold down to provide access to the wiring on the backside. The rear panel shall fold down approximately 90 degrees.

2.8. The front edge of the shelves shall have holes punched every 6 inches to accommodate tie-wrapping of cables and harnesses.

2.9. The main door and police door shall close against a weatherproof and dust-proof, closed-cell neoprene gasket seal. The gaskets shall be permanently bonded to the cabinet.

2.10. The lower section of the main cabinet door shall be equipped with a louvered air entrance. The air inlet shall be large enough to allow sufficient air flow per the rated fan capacity. Louvers must satisfy the NEMA rod entry test for 3R ventilated enclosures. A non-corrosive, vermin and insect proof, removable air filter shall be secured to the air entrance. The filter shall fit snugly against the cabinet door wall.

2.11. The roof of the cabinet shall incorporate an exhaust plenum with a vent screen. Perforations in the vent screen shall not exceed 0.125 inches in diameter.

2.12. The main door on a size 3 or larger cabinet shall be equipped with a three-point latching mechanism.

2.13. The handle on the main door of the cabinet shall be manufactured from cast aluminum or stainless steel. The handle shall include a hasp for the attachment of an optional padlock. The handle shall not extend beyond the perimeter of the main door at any time. The lock assembly shall be positioned so that the handle shall not cause any interference with the key when opening the cabinet door.

2.14. The main door hinge shall be a one-piece, continuous piano hinge with a stainless steel pin running the entire length of the door. The hinge shall be attached in such a manner that no rivets or bolts are exposed.

2.15. The main door shall include a mechanism capable of holding the door open at approximately 90, 145 and 165 degrees under windy conditions.

2.16. The main door shall be equipped with a Corbin tumbler lock number 1548-1 or exact equivalent. Minimum of two (2) keys shall be supplied per cabinet.

2.17. The police door shall be provided with a treasury type lock Corbin No. R357SGS or exact equivalent. Minimum of two (2) keys shall be supplied per cabinet.

2.18. All base mounted cabinets require anchor bolts to properly secure the cabinet to its base. The cabinet flange for securing the anchor bolts shall not protrude outward from the bottom of the cabinet. Size 6 and size 7 cabinets require four (4) anchor bolts for proper installation.

2.19. Each cabinet shall be of sufficient size to accommodate all equipment. Cabinet size shall be as follows:

- **Size 6 cabinets—52" H x 44" W x 24" D**

2.20. Main door shall incorporate a shroud to cover the filtered louvered openings as appropriate for the design. The assembly shall be secured on the interior of the door over the filtered louvers. The shroud shall be louvered downward and match the door louvers.

2.21. All enclosures must be constructed, approved and marked in accordance with the requirements for Type 1 Industrial Control Panel Enclosures contained in UL 508A, the Standard for Industrial Control Panels. Enclosure must meet NEMA 3R rating requirements and be marked with UL approval sticker.

3. Main/Rear Panel Design and Construction

3.1. The main panel shall be constructed from 5052-H32 brushed aluminum of 0.125 inches minimum thickness and installed so as to minimize flexing when plug-in components are installed.

3.2. All main panels shall be provided with a mounting mechanism which allows easy access to all wiring on the rear of the panel. Lowering the main/rear panel can be accomplished without the use of hand tools. Complete removal can be accomplished by the use of simple hand tools.

3.3. The terminals and facilities, main/rear panel shall be configured as follows:

1. Sixteen (16) load switch sockets
   a. 8 vehicle load switch sockets (positions 1-8)
   b. 4 pedestrian load switch sockets (positions 9-12)
   c. 4 overlap load switch sockets (positions 13-16)
2. Six (6) flash transfer relays
3. One (1) flasher socket

3.4. All load switch and flash transfer relay socket reference designators shall be silk-screen labeled on the front and rear of the main panel to match drawing designations. Socket pins shall be marked for reference on the rear of the panel.

3.5. All load switches shall be supported by a bracket, extending at least half the length of the load switch.

3.6. All field input/output (I/O) terminals shall be identified by permanent alphanumerical labels. All labels shall use standard nomenclature per the NEMA TS2 specification.

3.7. It shall be possible to flash either the yellow or red indication on any vehicle movement and to change from one color indication to the other by use of a screwdriver. All cabinets shall have flash operation wired as follow:

a. YELLOW Flash: Phases 2 and 6
b. RED Flash: Phases 1-3-4-5-7-8-OLA-OLB-OLC-OLD

3.8. Field terminal blocks shall be wired to use four positions per vehicle or overlap phase (green, yellow, red, flash). It shall not be necessary to de-buss field terminal blocks for flash programming.

3.9. The main panel shall contain at least one (1) flasher socket (silk screen labeled) capable of operating a 15-amp, 2-pole, NEMA solid-state flasher. The flasher shall be supported by a bracket, extending at least half its length.

3.10. One RC network shall be wired in parallel with each group of three flash transfer relays and any other relay coils.

3.11. All logic level, NEMA-controller and malfunction management unit input and output terminations on the main panel shall be permanently labeled. Cabinet prints shall identify the function of each terminal position. Labeling shall be as per NEMA TS2, Mode B

3.12. All main/rear panel wiring shall conform to the following wire size and color:

- Green/Walk load switch output—brown wire—14 gauge
- Yellow load switch output—yellow wire—14 gauge
- Red/Don’t Walk load switch—red wire—14 gauge
- MMU (other than AC power)—violet wire—22 gauge
- Controller I/O—blue wire—22 gauge
- AC Line (power panel to main panel)—black—8 gauge
- AC Line (main panel)—black—10 gauge
- AC Neutral (power panel to main panel)—white—8 gauge
- AC Neutral (main panel)—white—10 gauge
- Earth ground (power panel)—green—8 gauge
- Logic ground—gray wire—22 gauge
- Flash programming—orange wire
- Flasher terminal—black wire red or yellow field terminal—14 gauge

3.13. All wiring, 14 AWG and smaller, shall conform to MIL-W-16878/1, type B/N, 600V, 19-strand tinned copper. The wire shall have a minimum of 0.010 inches thick PVC insulation with clear nylon jacket rated to 105 degrees Celsius. All 12 AWG and larger wire shall have UL listed THHN/THWN 90 degrees Celsius, 600V, 0.020 inches thick PVC insulation and clear nylon jacketed.

3.14. A metal oxide varistor shall be placed at the output for each signal circuit.

3.15. Connecting cables shall be sleeved in a braided nylon mesh or poly-jacketed. The use of exposed tie-wraps or interwoven cables will not be accepted.

3.16. All terminals and facilities configurations shall be provided with sufficient RS-485 Port 1 communication cables to allow for the intended operation of the cabinet. A minimum of 3 SDLC connecting cables shall be provided.

3.17. All wiring shall be neat in appearance. All cabinet wiring shall be continuous from its point of origin to its termination point. Butt type connections or splices will not be accepted.

3.18. All connecting cables and wire runs shall be secured by mechanical clamps. Stick-on type clamps will not be accepted.

3.19. The grounding system in the cabinet shall be divided into three separate circuits (AC Neutral, Earth Ground and Logic Ground). These ground circuits shall be connected together at a single point as outlined in the NEMA TS2 Standard.

3.20. The main panel shall incorporate a relay, to be designed as K1, to remove +24 VDC from pin 9 of the load switches when the intersection is placed into mechanical flash. The relay shall have a momentary pushbutton located on the relay to apply power to the load switch pin 9 inputs for ease of troubleshooting.

3.21. All pedestrian push button inputs from the field to the controller shall be opto-isolated through the BIU and operate at 12 VAC.

3.22. All wire (size 16 AWG or smaller) at solder joints shall be hooked or looped around the eyelet or terminal block post prior to soldering to ensure circuit integrity. Lap joint soldering is not acceptable.

4. Power Panel Design and Construction

4.1. The power panel shall be located on the lower right side of the cabinet. The power panel shall be wired to provide the necessary filtered power to the load switches, flasher(s), and auxiliary equipment necessary. The power components shall be equipped with a removable plastic front cover for protection. The design will allow a technician to access the main and auxiliary breakers without removing the protective front cover.

4.2. The power panel shall include the following components:

a. Circuit Breaker: 40-amp main breaker to supply power to the controller, MMU, signals, cabinet power supply and auxiliary components. Breaker primary line voltage shall come directly from the AC service terminal. Power to cabinet exhaust fans shall be wired from this breaker.

b. Circuit Breaker: 15-amp flash breaker to provide power to the flasher circuits. Breaker primary line voltage shall come directly from the AC service terminal (jumpers are allowed).

c. Circuit Breaker: 15-amp to provide power to the controller, MMU, BIU's, Terminals and Facilities Panel, cabinet power supply and detector rack(s). It shall also provide power to two (2) standard 15-amp duplex receptacles. One receptacle shall be mounted to the top left wall of the cabinet and one mounted to the top right wall of the cabinet. Breaker primary line voltage shall come from the EDCO SHA-1250 line out terminal.

d. Circuit Breaker: 15-amp auxiliary breaker to provide power to the LED lighting system and a GFCI utility outlet. Breaker primary line voltage shall come directly from the AC service terminal (jumpers are allowed).

e. Circuit Breaker: 15-amp spare breaker to provide power to future components such as illuminated street name signs. Breaker primary voltage shall come directly from the AC service terminal (jumpers are allowed).

f. An EDCO model SHA-1250 surge arrester shall be provided. The alarm output shall be wired to alarm 2 at the Terminals and Facilities Panel. The unit shall send an alarm when failure has occurred.
g. A 50-amp, 125 VAC radio interference line filter.
h. A normally open, 60-amp, solid state contactor with L.E.D. indicator. Contactors containing mercury will not be accepted.
i. A minimum of one (1) 8-position neutral bus bar capable of connecting three #12 wires per position.
j. A minimum of one (1) 6-position ground bus bar capable of connecting three #12 wires per position.
k. A minimum of two (1) NEMA type 5-15R GFCI utility outlet.

5. Auxiliary Cabinet Equipment

5.1. The cabinet shall be provided with two (2) independently thermostatically controlled exhaust fans mounted in the top of the cabinet plenum. Thermostats shall be adjustable between 55-160 degrees Fahrenheit. The fan plate shall be removable with the use of simple hand tools for serviceability. The fans shall be a ball bearing type fan and shall be capable of drawing a minimum of 100 cubic feet of air per minute (CFM). The fan/thermostat assembly shall be connected to the power panel at the protected side of the 40-amp main breaker.

5.2. An LED cabinet lighting system shall be used to illuminate the internal structure of the cabinet assembly. The LED cabinet lighting system shall provide adequate light to the top shelf, the Terminals and Facilities Panel and the controller front face. The LED lighting system shall be wired to a normally closed door activated switch mounted near the top of the door.

5.3. Two (2) 120VAC duplex receptacles shall be supplied. Mounted at the top of each side of the cabinet.

5.4. A minimum of two sets of complete and accurate cabinet drawings shall be supplied with each cabinet. Drawings shall be size 24” x 36”. An electronic version in Microsoft Visio format shall also be provided to the City.

5.5. Each cabinet shall contain one (1) set of manuals for the controller unit, MMU, Power Supply, Detector Rack and Vehicle Detectors (video or loop). Electronic versions provided to the city can be substituted.

5.6. Each cabinet shall be supplied with a sliding storage drawer mounted under the middle shelf. Drawer shall have approximate dimensions of 1.75” H x 16” W x 14” D and have telescoping drawer guides to allow for full extension for the rack cage. Drawer shall support a weight of 25lb when extended.

6. Vehicle Detection

6.1. One (1) 12 position TS 1/TS2 detector rack with one (1) BIU

a. Slots 1 and 2 shall be reserved for a rack power supply
b. Slot 3-6 shall be for 2 channel loop amplifiers
c. Slots 7 and 8 shall be for Econolite TAP video detection

d. Slots 9 and 10 shall be for the emergency vehicle preemption system electronics used by the city
e. Slots 11 and 12 shall be for BIU

6.2. Each cabinet shall be supplied with four (4) 2-channel rack mount loop detector cards.
a. Reno model C-1200-SS two channel back-lit LCD display detector card shall be supplied.

6.3. All connections to the back of the detector racks to the detector cards shall be soldered to a 44 terminal, double row, 3.962 mm (0.156 in.) contact spacing. Cinch Jones card edge connector 50-44A-30M, or equivalent centered vertically for each detector module. All designations shall correspond to the requirements of the TS2-2003 specification.

6.4. Card guides shall be provided on the top and bottom of the card rack for each connector position.

6.5. Inductive Loops:
a. Each cabinet shall contain one (1) 8-position detector interface panel for the purpose of connecting field loops and vehicle detector amplifiers. The panels shall be manufactured from .125" thick 5052-H32 aluminum and use barrier type terminal blocks. The interface panel shall be secured to the left wall of the cabinet.
b. Each interface panel shall allow for the connection of eight (8) independent field loops. A ground bus terminal shall be provided between each loop pair terminal to provide a termination for the loop lead-in ground wire.
c. Surge protection devices, EDCO SRA-916, or equivalent, shall be mounted to each loop lead-in position on the interface panel.
d. All termination points shall be identified by a unique number and silk screened on the panel.
e. If required, each cabinet shall contain one (1) 16-position detector interface panel for the purpose of connecting field loops, system loops and vehicle detector amplifiers. The panels shall be manufactured from .125" thick 5052-H32 aluminum and use barrier type terminal blocks. The interface panel shall be secured to the left wall of the cabinet.

7. Cabinet Test Switches and Police Panel

7.1. A test switch panel shall be mounted on the inside of the main door. The test switch panel shall provide, as a minimum, the following:
a. SIGNALS ON/OFF SWITCH – In the off position, field indications go dark, but allow the controller to continue to operate normally. When in the OFF position, the MMU shall not conflict or require reset.
b. AUTO/FLASH SWITCH – When in the flash position, power shall be maintained to the controller and the intersection shall be placed in flash. The controller shall not be stop timed when in flash. Wired according to NEMA-TS2-2003 the MMU forces the controller to initiate the start-up sequence when exiting flash.
c. STOP TIME SWITCH:
1. In the ON position, the controller shall be stop timed in the current interval and shall apply logic ground to the interval advance switch.
2. In the OFF position, the stop time input is disabled and not applied.

3. In the AUTO position, stop time is applied by the MMU and the interval advance switch is not active.

d. CONTROL EQUIPMENT POWER ON/OFF - This switch shall control the controller, MMU and cabinet power supply AC power.

e. INTERVAL ADVANCE SWITCH – When pressed, shall apply logic ground to the controller interval advance input. Switch only active when Stop Time Switch is in the ON position.

f. VEHICLE/PEDESTRIAN TEST SWITCHES:
   1. In the OFF position no call is placed into the controller. This is normal position.
   2. In the ON position logic ground is applied to the controller and provides a locked call to the vehicle/pedestrian phase.
   3. In the MOMENTARY position logic ground is applied to the controller and provides a call to the vehicle/pedestrian phase only one time.

7.2. The police door switch panel shall contain the following:

a. AUTO/FLASH SWITCH – When in the flash position, power shall be maintained to the controller and the intersection shall be placed in flash. The controller shall be stop timed when in flash. Wired according to NEMA-TS2-2003 the MMU forces the controller to initiate the start-up sequence when exiting flash.

b. AUTO/MANUAL SWITCH – Cabinet wiring shall include provisions for an AUTO/MANUAL switch and a momentary hand cord. When in the MANUAL position, MCE shall be applied to the controller. While in the MANUAL position, the pushbutton can be used to advance through the green, red, walk and don't walk intervals. Yellow intervals shall not be manually advanced and shall be timed by the controller while in MCE. One coiled manual cord shall be provided with each cabinet.

7.3. All toggle switches shall be heavy duty and rated 15 amps minimum. Single or double poles switches may be provided, as required.

7.4. Any exposed terminals or switch solder points shall be covered with a non-flexible shield to prevent accidental contact.

7.5. All switch functions must be permanently and clearly labeled.

7.6. All wire routed to the police door-in-door and test switch push button panel shall be adequately protected against damage from repetitive opening and closing of the main door.

8. Auxiliary Devices

8.1. Load Switches

a. Load switches shall be solid state and shall conform to the requirements of Section 6.2 of the NEMA TS2 standard.

b. Signal load switches shall have a minimum rating of 10 amperes at 120 VAC for an incandescent lamp load.

c. The front of the load switch shall be provided with six (6) indicators to show the input and output signals from the controller.

d. Load switches shall be dedicated per phase. The use of load switches for other partial phases is not acceptable.

e. The full complement of load switches shall be supplied with each cabinet to allow for maximum phase utilization for which the cabinet is designed.

8.2. Flashers

a. The flasher shall be solid state and shall conform to the requirements of section 6.3 of the NEMA TS2 standard.
b. The flasher shall be rated at 15 amperes, double pole with a nominal flash rate or 60 FPM.

8.3. Flash Transfer Relays

a. All flash transfer relays shall meet the requirements of Section 6.4 of the NEMA TS2 standard.
b. The coil of the flash transfer relay must be de-energized for flash operation.
c. The full complement of relays shall be supplied with each cabinet to allow for maximum phase utilization for which the cabinet is designed.
d. Flash transfer relay shall provide LED for visual indication of coil voltage

8.4. Bus Interface Units (BIU2)

a. All BIUs shall meet the requirements of Section 8 of the NEMA TS2 standard.
b. Each Bus Interface Unit shall include power on, transmit and valid data indicators. All indicators shall be LEDs.
c. Each cabinet shall be supplied with one (1) Bus Interface Unit.

8.5. Cabinet Power Supply

a. The cabinet power supply shall meet the requirements of Section 5.3.5 of the NEMA TS2 Standard.
b. The cabinet power supply shall provide LED indicators for the line frequency, 12 VDC, 12 VAC and 24 VDC outputs.
c. The cabinet power supply shall provide (on the front panel) jack plugs for access to the +24 VDC for test purposes.
d. Each cabinet shall be supplied with one (1) cabinet power supply and shall be wired directly to the Power Bus Assembly via a 12-pin Molex Robotic type connector Model# 54332-1270 or exact equivalent.

8.6. Fiber Optic Cable Distribution

a. Each cabinet shall be equipped with a single panel fiber optic housing, Corning model SPH-01P, or equivalent.
b. Housings shall be populated with ST compatible adapters, simplex, UPC, 12 fiber, single mode CCH Panels.

9. Testing and Warranty

9.1. Testing

a. Each cabinet assembly shall be tested under signal load for a minimum of 48 hours.
b. Each cabinet assembly shall be delivered with a signed document detailing the cabinet final tests performed.

9.2. Warranty

a. The cabinet assembly and all other components shall be warranted for a period of one year from date of shipment. Where supplied, this includes the MMU and CU.
b. Any defects shall be corrected by the manufacturer or supplier at no cost to the owner.