

SECTION 672
MODEL 170 E
TRAFFIC CONTROLLER ASSEMBLIES

672-1 SCOPE

This section specifies the requirements for all Model 170 E microprocessor controller assemblies.

The controller shall be a microprocessor-based enhanced microcomputer and shall have four (4) ACIAs. The Model 170 E Controller Unit shall be battery-free with all random access memory (RAM) of the non-volatile type (NOVRAM) and a super capacitor shall be used to provide standby power to the system Down Time Accumulator (DTA) in place of standard batteries.

The Model 170 E controller shall be capable of being programmed to operate as a pre-timed, semi-actuated or full actuated controller through the use of a software package and shall have a keyboard in the front panel along with the capability to accept an external Field Transportable Unit (FTU) for the entry of all controller and timing parameters.

The controller shall be capable of being successfully integrated into the Tallahassee Advanced Transportation Management System which includes the capability of being operated in a dual pedestrian mode with remote selection of concurrent or exclusive pedestrian phasing.

Manufacturers/Vendors and Contractors bidding this specification shall make themselves thoroughly familiar with the Tallahassee Advanced Transportation Management System. The central site is located at 300 South Adams Street, Tallahassee, Florida 32301, and can be visited, after prior arrangements have been made, to obtain information on system characteristics and requirements.

672-2 MODEL 170 E CONTROLLER ASSEMBLY

672-2.1 General:

A controller assembly shall consist of a Model 170 E Controller Unit; Output File; Power Distribution Assembly; Solid State Load Switches; Flashers; a Conflict-Voltage Monitor; Input Files; DC and AC Isolators; Current Monitor; and other equipment (as specified in these specifications) that are wired into a controller cabinet to make a complete operational traffic controller assembly.

672-2.2 Assembly Components:

672-2.2.1 Actuated Controller Cabinet:

The Actuated Controller Cabinet shall conform to the requirements of Section 676. The cabinet shall contain all of the equipment specified in Section 672-8.3.

672-2.2.2 Model 170 E Controller Unit:

The Model 170 E Controller Unit shall conform to the requirements of Sections 672 and 673.

672-2.2.3 Solid State Signal Load Switch:

The Model 200 Switch Packs shall conform to the requirements of Sections 672, 676 and 678.

672-2.2.4 Solid State Flasher:

The Model 204 Flasher shall conform to the requirements of Sections 672, 676 and 678.

672-2.2.5 Power Supply Module:

The Model 206 Power Supply Module shall conform to the requirements of Sections 672, 676 and 678.

672-2.2.6 Conflict-Voltage Monitor:

The Model D210 Conflict-Voltage Monitor shall conform to the requirements of Sections 672, 676 and 678.

672-2.2.7 Two-Channel Loop Detector Sensor Unit:

The Model D222 Loop Detector shall conform to the requirements of Sections 660, 672 and 678.

672-2.2.8 Two-Channel DC Isolator:

The Model 242 DC Isolator shall conform to the requirements of Sections 672 and 678.

672-2.2.9 Two-Channel AC Isolator:

The Model 252 AC Isolator shall conform to the requirements of Sections 672 and 678.

672-2.2.10 Input Files:

The Input Files shall conform to the requirements of Sections 672, 676 and 678.

672-2.2.11 Output File:

The Output File shall conform to the requirements of Sections 672, 676 and 678.

672-2.2.12 Program Module:

The 412 Program Module shall conform to the requirements of Sections 672 and 673. When the Summary of Quantities for a project utilizing these specifications does not call for BI 681, the Maintaining Agency shall supply to the Contractor a set of computer memory chips containing the software utilized by the City of Tallahassee for each location specified in the plans. The Contractor shall notify the City of Tallahassee Three (3) weeks in advance as to the number of chip sets that is required on the job or jobs covered under the contract. The Contractor shall load the database to be supplied by the Maintaining Agency and shall fully integrate the cabinet, the controller, the controller accessories, the PROM module, including software and the database, into one fully operational controller assembly.

672-2.2.13 Transfer Relays:

The Model 430 Transfer Relays shall conform to the requirements of Sections 672, 676 and 678.

672-2.2.14 Power Distribution Assembly:

The PDA #2 shall conform to the requirements of Sections 672, 676 and 678.

672-2.2.15 Current Monitor:

The Current Monitor will no longer be required.

672-2.2.16 Controller Cabinet:

The Cabinet shall conform to the requirements of Sections 672 and 676.

672-3 ENVIRONMENTAL, ELECTRICAL AND TESTING REQUIREMENTS

672-3.1 General:

The general procedures and equipment used in the evaluation of the controller unit, cabinet, and auxiliary equipment are a minimum guide and should not limit the testing and inspection to insure compliance of the equipment with these specifications.

These test procedures shall be followed by the Manufacturer/Vendor, who shall certify that he/she has conducted inspection and testing in accordance with these specifications.

672-3.2 Inspection:

A visual and physical inspection shall include mechanical, dimensional and assembly conformance of all parts of these specifications, which can be checked visually or manually with simple measuring devices.

672-3.3 Environmental:

The intent of this standard is to define the ambient temperature and humidity inside the weatherproof cabinet of the controller assembly. The controller assembly shall maintain all of its programmed functions when the temperature and humidity ambiances are within the specified limits of this standard.

672-3.3.1 Ambient Temperature:

The ambient temperature range shall be from -37°C (-34.6°F) to 74°C (165.2°F).

672-3.3.2 Humidity:

The humidity range shall be from 5 to 95 percent.

The relative humidity and ambient temperature values provided in Figure 672-1 shall not be exceeded.

672-3.4 Tests:

672-3.4.1 Low Temperature Test:

With the unit functioning at a line voltage of 90 VAC in its intended operation, the ambient temperature shall be lowered from 20°C (68°F) to -37°C (-34.6°F) at a rate of not more than 18°C (32.4°F) per hour. The Unit shall be cycled at -37°C (-34.6°F) for a minimum of five (5) hours and then returned to 20°C (68°F) at the same rate. The test shall be repeated with the line voltage at 135 VAC.

672-3.4.2 High Temperature Test:

With the unit functioning at a line voltage of 90 VAC in its intended operation, the ambient temperature shall be raised from 20°C (68°F) to 70°C (158°F) at a rate of not more than 18°C (32.4°F) per hour. The unit shall be cycled at 70°C (158°F) for five (5) hours and then returned to 20°C (68°F) at the same rate. The test shall be repeated with the line voltage at 135 VAC.

**FIGURE 672-1: WET-BULB, DRY-BULB RELATIVE HUMIDITY TABLE
AT 29.92 hg BAROMETRIC PRESSURE**

Ambient Temperature/Dry-Bulb		Relative Humidity (in Percent)	Ambient Temperature/Wet-Bulb	
C degrees	F degrees		C degrees	F degrees
-37 to 1.1	-34.6 to 33.98	10	17.2 to 47.7	1.04 to 108.86
1.1 to 46.0	33.98 to 114.8	95	42.7	108.86
48.8	119.84	70	42.7	108.86
54.4	129.92	50	42.7	108.86
60.0	140.00	38	42.7	108.86
65.4	149.72	28	42.7	108.86
71.2	160.16	21	42.7	108.86
74.0	165.2	18	42.7	108.86

672-3.4.3 Shock Test:

Per Military Specification: MIL-STD-810D Method 516.1.

672-3.4.4 Vibration:

Per Military Specification: MIL-STD-810D Method 514.1, equipment class G (Common Carrier).

672-3.4.5 Cabinet Rain Test:

Cabinets shall comply with the requirements of UL Bulletin of Research No. 23, "Rain Tests of Electrical Equipment".

672-3.5 Electrical:

672-3.5.1 Operating Limits:

Applied line voltage: 90 to 135 VAC

Frequency: 60 (± 3.0) Hertz

- (a) All circuits, unless otherwise noted, shall commence operation at or below 90 VAC as the applied voltage is raised from 50 VAC to 90 VAC at a rate of 2 (± 0.5) volts per second.

- (b) All equipment, when housed within its associated cabinet, shall be unaffected by transient voltages normally experienced on commercial power lines. Equipment procured separately from cabinet will be tested for compliance with the equipment housed within a State Accepted Model 660-AT cabinet and the cabinet connected to the commercial power lines.
- (c) The power line surge protection (including the cabinets and that internal to the equipment) shall enable the equipment being tested to withstand (nondestructive) and operate normally following the discharge of a 25 microfarad capacitor charged to plus and minus 2,000 volts, applied directly across the AC line (applied at Cabinet Service Terminal block) at a rate of once every ten (10) seconds for a maximum of fifty (50) occurrences per test. The unit under test will be operated at 20°C (68°F) (±5°) and at 120 (±12) VAC.
- (d) Equipment shall be unaffected by transient voltages normally experienced of commercial power lines. Equipment procured separately from the cabinet will be tested for compliance as follows:
 - 1) Power from commercial power lines applied at Cabinet Service Terminal Block.
 - 2) Equipment properly housed and connected within a State Accepted Cabinet.
 - 3) The Cabinet Power Surge Protectors deactivated or removed.
 - 4) The equipment shall withstand (nondestructive) and operate normally when one (1) discharge pulse of plus or minus 300 volts is synchronously added at the AC power at the Cabinet Service Terminal Block and moved uniformly over the full wave across 360 degrees or stay at any point of Line Cycle once every second. Peak noise power shall be 5 Kilowatts with a pulse rise time of 500 ns. The unit under test will be operated at 20°C (68°) (±5°) and at 120 (±12) VAC.
 - 5) Within the circuit of any device, module or PCB, electrical isolation shall be provided between DC logic ground, equipment ground and the AC ground conductor. The DC logic ground and equipment ground shall be electrically isolated from the AC grounded conductor and from each other by 500 megohms, minimum, when tested at the input terminals with 500 VDC.
- (e) All equipment shall be capable of normal operation following opening and closing of contacts in series with the applied voltage to the cabinet at a rate of thirty (30) openings and closing per minute for a period of two (2) minutes in duration.
- (f) All equipment shall resume normal operation following a period of at least five (5) hours at -37°C (-34.6°F) and less than ten (10) percent humidity, when 90 VAC is applied to the input terminals of the cabinet.

672-4 DESIGN REQUIREMENTS

672-4.1 General:

All equipment furnished under these specifications shall be of the Solid State design. Use of vacuum or gaseous tubes or electro-mechanical devices within the equipment is not acceptable unless otherwise indicated in these specifications.

672-4.2 Inter-change-ability:

The following assemblies and their respective associated devices shall electrically and mechanically inter-mate and be compatible with each other:

ASSEMBLIES

Model 170 E Controller Unit

Input Files

Output File #1

Power Distribution
Assembly #2

Aux. Output File

ASSOCIATED DEVICES

Cabinet Model 660-ATX
Cabinet Model 660-AT
Cabinet Model 552-AT
Model 412, 412C and 414 Program
Modules
Current Monitor

Model 222 Loop Detector
Model 242 DC Isolator
Model 252 AC Isolator
Model 292 Current Monitor

Model 200 Solid State Signal
Load Switch
Model 210 Conflict-Voltage
Monitor
Model 430 Transfer Relay

Model 204 Solid State Flasher
Model 206 Power Supply Module

Model 200 Solid State Signal
Load Switch
Model 430 Transfer Relay

672-4.3 Displays:

672-4.3.1 Indicators and Character Displays:

- (a) All indicators and character displays shall have a minimum 45 degrees cone of visibility with its axis perpendicular to the front panel. All indicators and character displays shall be readily visible at a radius of up to 121.92 cm (4 feet) within the cone of visibility when the indicator is subject to 9,000 foot candles of white light with the light source at 45 (± 2) degrees to the front panel. If characters are not self-luminous, illumination shall be provided for viewing in low levels of ambient light. Indicators supplied on equipment requiring handles shall be mounted such that a horizontal clearance of 15 degrees minimum shall be provided for Model D210, as well as clearance of 30 degrees minimum for Models 200, 204 and 206.
- (b) All indicators and character displays shall have rated life of one hundred thousand (100,000) hours minimum.
- (c) Liquid Crystal Displays (LCD) shall operate at temperatures of -20°C (-4°F) to 70°C (158°F) without loss of visibility or bleeding.

672-4.4 Connectors:

672-4.4.1 General:

- (a) All connectors shall be keyed to prevent improper insertion of the wrong connector or Printed Circuit Board (PCB).
- (b) The Type 25 Connector shall be a 25 contact AMP HDP-20 Connector or approved equivalent, with gold on nickel-plated contacts. The female mating connector with socket contacts is designated TYPE 25S and the male mating connector with pin contact is designated TYPE 25P. The TYPE 25P Connector shall be provided with lock spring clips for latching to its mating connector.
- (c) The Type T Connector shall be a single row, 10 position, feed through terminal block. The terminal block shall be a barrier type with 6-32, x 1/4 inch, or larger, nickel plated brass binder head screws. Each terminal shall be permanently identified as to its function.
- (d) The mating connectors shall be designated as the connector number and male/female relationship such as CIP (plug or PCB edge connector) and CIS (socket).

672-4.4.2 Connectors C1, C2, C2A, C4, C5, C6 and C9:

- (a) Pin and socket contacts for Connectors C1, C2, C2A, C4, C5, C6 and C9 shall be beryllium copper construction sub-plated with 0.00127 mm (0.00005 inch) nickel and plated with 0.00003 inch gold. Pin diameter shall be 1.57 mm (0.062 inch). Connectors shall have the number of contacts as shown in Figure 672-2.

Figure 672-2: CONNECTOR TABLE

<u>CONNECTOR</u>	<u>CONTACTS</u>
C1	104
C2	14
C2A	14
C4	37
C5	24
C6	24
C9	9

- (b) All pin and socket connectors of C1, C2, C2A, C4, C5 and C6 shall use the AMP #601105-1 or #91002-1 contact insertion tool or approved equal, and the AMP #305183 contact extraction tool or approved equal.
- (c) Connector C1 and C2 blocks shall be constructed of phenolic or approved equivalent and shall have an insulation resistance of 5000 megohms. The contacts shall be secured in the blocks with stainless steel springs.
- (d) Connector C1 and C2 corner guides shall be stainless steel. The guide pins shall be 27.86 mm (1.097 inches) in length and the guide sockets 15.88 mm (0.625 inch) in length.
- (e) Connector C4, C5 and C6 shall be circular plastic type with quick connect/disconnect capability and thread assist, positive detent coupling. The connectors shall be UL listed Glass Filled Nylon, 94 V-I Rated, heat stabilized, fire resistant.
- (f) Connector C9 shall have a RS-232 type connector, AMP Model #9133 or approved equivalent.
- (g) The pin assignments and functions for each of the connectors shall be as provided in Figures 672-3, 672-4, 672-5, 672-6 and 672-7.

672-4.4.3 Printed Circuit Board (PCB) Connectors:

- (a) PCB edge connectors shall have bifurcated gold plated contacts.

(b) The PCB receptacle connector shall meet or exceed the following:

Operating Voltage:	600 VAC (RMS) at sea level
Current Rating:	5 Amperes
Insulation Resistance:	5,000 megohms
Contact Material:	Copper alloy plated with 1.27 Micrometers (0.00005 inch) of nickel and 0.38 Micrometers (0.000015) inch of gold
Contact Resistance:	0.006 ohm maximum

(c) The PCB 22/44 Connector shall have 22 independent contacts per side, dual sided with 3.96 mm (0.156 inch) contact centers.

(d) The PCB 28/56 Connector shall have 28 independent contacts per side, dual sided with 3.96 mm (0.156 inch) contact centers.

(e) The PCB 36/72 Connector shall have 36 independent contacts per side, dual sided with 2.54 mm (0.1 inch) contact centers.

672-4.5 Components:

672-4.5.1 General:

(a) All components shall be second sourced and shall be of such design, fabrication, nomenclature, or other identification as to be purchased from a wholesale electronics distributor, or from the component manufacturer, except as follows:

- 1) When a component is of such special design that it precludes the purchase of identical components from any wholesale electronics distributor or component manufacturer, one (1) spare duplicate component shall be furnished with each twenty (20), or fraction thereof, components used.
- 2) Circuit design shall be such that all components of the same generic type, regardless of manufacturer, shall function equally in accordance with the specifications.

(b) All SRAMS (RAMS), NOVRAMS, MPU, MIC, ACIA devices, hybrid and resistor/capacitor packages consisting of six (6) or more pins shall be mounted on the PCBs using the approved IC socket types listed below:

- 1) AUGAT, Inc., Series 200, beryllium copper tinned contacts.
- 2) AMP, Inc., Diplomat Low Profile Socket Series, beryllium copper tinned contacts.
- 3) Texas Instruments, Low Profile Series C-87, beryllium copper tinned contacts.

CONNECTOR C 2 “SOCKET ASSIGNMENT”

<u>SOCKET CONTACTS</u>	<u>FUNCTION</u>	<u>SOCKET CONTACTS</u>	<u>FUNCTION</u>
A	AUDIO IN	J	REQUEST TO SEND (RTS)
B	AUDIO IN	K	DATA IN
C	AUDIO OUT	L	DATA OUT
D	+5 VDC	M	CLEAR TO SEND (CTS)
E	AUDIO OUT	N	DC GROUND
F	-5 VDC	P	N/A
H	CARRIER DETECT (CD)	R	N/A

CONNECTOR C 2 A “SOCKET ASSIGNMENT”

<u>SOCKET CONTACTS</u>	<u>FUNCTION</u>	<u>CONNECT TO</u>
A	AUDIO IN	N/A
B	AUDIO IN	N/A
C	AUDIO OUT	N/A
D	+5 VDC	C2-H
E	AUDIO OUT	N/A
F	-5 VDC	-5 VDC
H	CARRIER DETECT (CD)	C2-D
J	REQUEST TO SEND (RTS)	C2-M
K	DATA IN	C9-2
L	REQUEST TO SEND (RTS)	C2-J
N	DC GRND	C9-5
P	N/A	N/A
R	N/A	N/A

FIGURE 672-5: CONNECTOR SOCKET ASSIGNMENTS

CONNECTOR C 9 "SOCKET ASSIGNMENT"

<u>SOCKET CONTACTS</u>	<u>FUNCTION</u>	<u>CONNECT TO</u>
1	N/A	N/A
2	DATA IN	C2A-K
3	DATA OUT	C2A-L
4	N/A	N/A
5	DC GND	C2A-N
6	N/A	N/A
7	N/A	N/A
8	N/A	N/A
9	N/A	N/A

JUMPER 1,4,6,7,8

Figure 672-6: TERMINAL BLOCK T-1 ASSIGNMENTS

<u>TERMINAL #</u>	<u>FUNCTION</u>	<u>TERMINAL #</u>	<u>FUNCTION</u>
1	AUDIO IN	6	CLEAR TO SEND (CTS)
2	AUDIO IN	7	DATA OUT
3	CARRIER DETECT (CD)	8	AUDIO OUT
4	REQUEST TO SEND (RTS)	9	AUDIO OUT
5	DATA IN	10	DC GND

- (c) The term "integrated circuit" or "IC" shall be interpreted as covering monolithic multi-element, semiconductor circuits, existing on a common substrate and enclosed in a continuous package. The foregoing shall also include encapsulated bridge rectifiers, resistors, etc. Neither bilateral trigger diodes (or similar devices) nor hybrid devices shall be considered as integrated circuits. Upon the package of all integrated circuits shall be clearly and legibly printed the manufacturer's name and/or logo and IC part number.
- (d) IC sockets for PROMS, EPROMS and EEPROMS are required to be Low Insertion/Withdrawal - LIF Lock type connector/socket, beryllium copper tinned contacts, available from above listed manufacturers.
- (e) No component shall be operated above 80% of its maximum rated voltage, current or power ratings. Digital components shall not be operated above 3% of their nominal voltage, current or power ratings.

- (f) No component shall be provided where the manufactured date is two (2) years older than the contract award date. The design life of all components operating twenty-four (24) hours a day, operating in their circuit application, shall be ten (10) years or longer.
- (g) Encapsulation of two (2) or more discrete components into circuit modules is PROHIBITED, except for transient suppression circuits, resistor networks, diode arrays, solid state switches, optical isolators, and transistor arrays.
- (h) Except as specified in (e) above, all discrete components, such as resistors, capacitors, diodes, transistors, and integrated circuits shall be individually replaceable. Components shall be arranged so they are easily accessible for testing and maintenance.
- (i) The Manufacturer/Vendor shall submit detailed engineering technical data on all components at the request of the Maintaining Agency. A letter from the component manufacturer shall be submitted with the detailed engineering data when the proposed application of the component alters the technical data. The letter shall certify that the component application meets specification requirements.

672-4.5.2 Capacitors:

- (a) The DC and AC voltage ratings as well as the dissipation factor of a capacitor shall exceed the worst-case design parameters of the circuitry by 150%.
- (b) A Capacitor which may be damaged by shock or vibration shall be supported mechanically by a clamp or fastener.
- (c) Capacitor encasements shall be resistant to cracking, peeling and discoloration.
- (d) All capacitors shall be insulated and shall be marked with their capacitance value and working voltage.
- (e) Electrolytic capacitors shall not be used for capacitance values of less than 1.0 microfarad and shall be marked with polarity.

672-4.5.3 Potentiometer:

- (a) Potentiometer with ratings from 1 to 2 watts shall be equivalent to Military Type RV4.
- (b) No potentiometer less than 1 watt rating shall be used (except for trimmer type function).
- (c) The power rating of any potentiometer shall be at least 100% greater than the maximum power requirements of the circuit.

672-4.5.4 Resistors:

- (a) Fixed carbon film, deposited carbon, or composition insulated resistors shall conform to the performance requirements of Military Specifications: MIL-R-11F or MIL-R-22684.
 - 1) All resistors shall be insulated and shall be marked with their resistance value.
 - 2) Resistance values shall be indicated by the EIA color codes or stamped value (power resistor).
- (b) Resistors shall be 10% or less tolerance.
- (c) The value of the resistors shall not vary by more than 5% between -37°C (-34.6°F) and 74°C (165.2°F).
- (d) Resistors that have a rating exceeding 2 watts shall not be used unless special ventilation or heat sinking is provided. They shall be insulated from the PCB.

672-4.5.5 Semiconductor Devices:

- (a) All solid state devices, except LEDs, shall be of the silicon type.
- (b) All transistors, integrated circuits, and diodes shall be a standard type listed by EIA and clearly identifiable.
- (c) All metal oxide semiconductor components shall contain circuitry to protect their inputs and outputs against damage due to high static voltages or electrical fields.
- (d) The device pin "1" location shall be properly marked on the PCB adjacent to each pin.

672-4.5.6 Transformers and Inductor:

- (a) All power transformers and inductor shall have the manufacturer's name or logo and part number clearly and legibly printed on case or lamination.
- (b) All transformers and inductor shall have their windings insulated and shall be protected to exclude moisture.
- (c) All transformer and inductor leads shall be color coded with an approved ETA color code or identified in a manner to facilitate proper installation.

672-4.5.7 Circuit Breakers (10 Amperes or Greater):

- (a) Circuit breakers shall be listed by UL or ETL. The trip and frame sizes shall be plainly marked (marked on the breaker by the manufacturer), and the ampere rating shall be visible from the front of the breaker. All circuit breakers (30 amperes or greater) shall be quick-break on either automatic or manual operation. Contacts shall be silver alloy and enclosed in an arc quenching chamber. Overload tripping shall not be influenced by an ambient air temperature range of from -18°C (-0.4°F) to 50°C (122°F). Minimum interrupting capacity shall be 5,000 amperes, RMS.
- (b) Circuit breakers shall be the trip-free type.
- (c) Multi-pole breakers shall be the common-trip type.

672-4.5.8 Switches:

- (a) DIP
 - 1) Dual-in-package, quick snap switch(s) shall be rated for a minimum of forty-thousand (40,000) operations per position at 30 ma, 30 VDC.
 - 2) Switch contact resistance shall be 100 milliohms maximum at 2 ma, 30 VDC.
 - 3) Contacts shall be gold over brass (or silver), at 120 VAC or 28 VDC and shall be silver over brass (or equal).
- (b) LOGIC
 - 1) Switch contacts shall be rated for a minimum of one (1) ampere resistive load at 120 VAC and shall be silver over brass (or equal).
 - 2) The switch shall be rated for a minimum of forty-thousand (40,000) operations.
- (c) CONTROL
 - 1) Switch contacts shall be rated for a minimum of five (5) ampere resistive load at 120 VAC or 28 VDC and shall be gold over brass (or equal).
 - 2) The switch shall be rated for a minimum of forty-thousand (40,000) operations.
- (d) POWER
 - 1) Ratings shall be the same as CONTROL except the contact rating shall be a minimum of ten (10) amperes at 125 VAC.

672-4.6 Mechanical:

672-4.6.1 Assemblies and PCB Design:

- (a) All assemblies (including Controller Unit) shall be easily replaceable and incorporate plug-in capability for their associated devices or PCBs with the following exceptions:
 - 1) Cabinet power supply
 - 2) Motherboard assemblies
 - 3) Power supply for the Model 170 may be a plug-in assembly.
- (b) PCBs shall be mounted vertically. Horizontal mounting of PCBs shall not be accepted.
- (c) Assemblies shall be provided with two (2) guides for each plug-in PCB or associated device (except relays). The guides shall extend to within 19.05 mm (0.75 inch) from the face of either the socket or connector and front edge of the assembly. If Nylon guides are used, the guides shall be securely attached to the file or assembly chassis.
- (d) No components, traces, brackets, or obstructions shall be within 3.18 mm (0.125 inch) of the PCB edge (guide edges).
- (e) The manufacturer's name or logo, model number, serial number, and circuit issue or revision number shall appear and be readily visible on all items. Placement of this information for modules such as the Model 210 Conflict-Voltage Monitor Unit, the Model 412 Program Module, the Model 222 Loop Detector Amplifier Unit, the Model 252 AC Isolator Unit and the Model 242 DC Isolator Unit shall be on the PCB.
- (f) Workmanship shall be in accordance with the highest industry standards.
- (g) All PCB connectors mounted on a motherboard shall be mechanically secured to the chassis or frame of the unit.
- (h) All screw type fasteners shall utilize locking devices or locking compounds except for finger screws which shall be captive.
- (i) The assembly tolerances provided in Figure 672-8 shall apply, except as specifically shown on the plans or in these specifications.

<u>ITEM</u>	<u>TOLERANCE</u>
Printed Circuit Board	+0, .25 mm (-.010 inch)
Edge Guides	±0.38 mm (0.015 inch)
Sheet Metal	±0.0525 inch

Figure 672-8: ASSEMBLY TOLERANCES

672-4.6.2 Model Numbers:

- (a) The Manufacturer's model number, serial number and circuit issue or revision number shall appear on the rear panel of all equipment and modules supplied.
- (b) In addition to any assignment of model numbers by the manufacturer, a model number assigned in the table below shall be displayed on the front panel in bold type, at least 6.35 mm (0.25 inch) high.

<u>MODEL NUMBER</u>	<u>TITLE</u>
170 E	170 E Controller Unit - Quad ACIA
200	Solid State Signal Load Switch
204	Solid State Flasher
206	Power Supply Module
210	Conflict-Voltage Monitor Unit
222	Two-Channel Loop Detector Unit
242	Two-Channel DC Isolator
252	Two-Channel AC Isolator
412	Program Module
420	Output File No. 2
430	Transfer Relay

672-4.7 Printed Circuit Boards:

672-4.7.1 Design, Fabrication, and Mounting:

- (a) PCB design shall be such that components may be removed and replaced without damage to boards, traces or tracks.
- (b) All contacts on PCBs shall be plated with a minimum thickness of 1.91 Micrometers (0.000075 inch) nickel.
- (c) Fabrication of PCBs shall be in compliance with Military Specifications: MIL-P-13949, except as follows:

- 1) Only NEMA FR-4 glass cloth base epoxy resin copper clad laminated 0.0626 inch minimum thickness shall be used. Inter component wiring shall be by laminated copper clad track having a minimum weight of two (2) ounces per square foot with adequate cross section for current to be carried. All copper track shall be plated or soldered to provide complete coverage of all exposed copper track. Jumper wires will not be permitted, except from plated-through padded holes to an external component or for designed function selection with the jumper insulated and as short as possible.
 - 2) Section 3.3.3 of Military Specifications: MIL-P-13949E shall read "Pits and Dents". Grade of Pits and Dents shall be of Grade B quality (3.3.3.2) or better.
 - 3) Section 3.3 of Military Specifications: MIL-P-13949 shall be omitted.
 - 4) Section 3.4 of Military Specifications: MIL-P-13949 shall read "Warp or Twist". Class of permissible warp or twist shall be Class A (Table II) or better.
 - 5) Sections 4.2 through 6.6 of Military Specifications: MIL-P-13949 (inclusive) shall be omitted except as referenced in previous sections of this specification.
- (d) The fabrication of PCBs and the mounting of parts and assemblies thereon shall conform to Military Specifications: MIL-STD-275E, except as follows:
- 1) All semiconductor devices required to dissipate more than 250 mw or any case temperature that is 10°C (50°F) above ambient shall be mounted with spacers or transipads to prevent direct contact with the PCB.
 - 2) When completed, all residual flux shall be removed from the PCB.
 - 3) The resistance between any two (2) isolated, independent conductor paths shall be at least 100 megohms when a 500 VDC potential is applied.
 - 4) All PCBs shall be coated with a moisture resistant coating.
 - 5) Where less than 6.35 mm (0.25 inch) lateral separation is provided between the PCB (or the components of a PCB) and any metal surface, a 0.40 mm (-0.0 to +0.0156 inch) thick Mylar (polyester) plastic cover shall be provided on the metal to protect the PCB.
- (e) Each PCB connector edge shall be chamfered at 30 degrees from board side planes. The key slots shall also be chamfered so that the connector keys are not extracted upon removal of board or jammed upon insertion. The key slots shall be 1.143 mm (.127 mm)[0.045 (±0.005) inch] for 2.54 mm (0.1 inch) spacing and 1.397 mm [0.055 (±0.005) inch] for 3.9624 mm (0.156 inch) spacing.

672-4.7.2 Soldering:

- (a) Hand soldering shall comply with Military Specifications: MIL-P-55110.
- (b) Automatic flow soldering shall conform to the following conditions:
 - 1) Constant speed conveyor system.
 - 2) Conveyor speed shall be the optimum to minimize solder peaks or points which form at component terminals.
 - 3) Temperature shall be controlled to within $\pm 8^{\circ}\text{C}$ ($\pm 14^{\circ}\text{F}$) of the optimum temperature.
 - 4) The soldering process shall result in the complete coverage of all copper runs, joints and terminals with solder except that which is covered by an electroplating process.
 - 5) Whenever clinching is not used, a method of holding the components in the proper position for the flow process shall be provided.
 - 6) If exposure to the temperature bath is of such a time temperature duration as to come within 80% of any component's maximum specified time-temperature exposure that component shall be hand-soldered to the PCB after the flow process has been completed.

672-4.7.3 Definitions:

Definitions for the purpose of this section on PCBs shall be taken from MIL-STD-429 and any current addendum.

672-4.8 Metals:

672-4.8.1 General:

- (a) All materials shall be of domestic origin.
- (b) All sharp edges and corners shall be rounded.
- (c) All exposed edges shall be broken, free of burrs, and bit marks.

672-4.8.2 Aluminum:

- (a) Sheet shall be type 5052-H32 ASTM Designation B209.
- (b) Rod, Bar and Extruded shall be Type 6061-T6 or approved equivalent.

672-4.8.3 Stainless Steel Sheet:

Stainless steel sheet shall be annealed or one-quarter hard complying with the ASTM Designation: A666 for Type 304, Grade A or B, stainless steel sheet.

672-4.8.4 Cold Rolled Steel:

(a) Sheet, Rod, Bar and Extruded shall be Type 1018/1020.

(b) Plating:

1) All cold roll steel shall be plated.

2) All plating shall be either cadmium plating meeting the requirements of Federal Specification QQ-P-416C, Type 2 Class 1 or zinc plating meeting the requirements of Federal Specification QQ-Z-325B, Type 2 Class 1.

672-5 ENGINEERING

672-5.1 Human Engineering:

672-5.1.1 General:

To the highest practicable degree, the unit shall be engineered for simplicity and ease of operation and assistance. This shall include the following:

(a) No more than two (2) potentiometers, controls or switches may be mounted concentricity. Knobs for such devices shall have diameters in a ratio of 2:1 outer to inner. The outer knob shall have a diameter of at least 1-inch.

(b) Knobs shall be of large enough diameter [at least 12.7 mm (0.5 inch) diameter] and of great enough separation [at least 12.7 mm (0.5 inch) edge to edge] to assure ease of adjustment without disturbance of adjacent knobs.

(c) All fuses shall be easily accessible and shall be replaceable without the use of any tools.

(d) PCB's shall slide smoothly in their guides while being inserted into or removed from the frame and shall fit snugly into the plug-in PCB connection.

1) PCB's shall require a force no less than 2.27 kilograms (5 pounds) or greater than 22.68 kilograms (50 pounds) for insertion or removal.

672-5.2 Design Engineering:

672-5.2.1 General:

The following practices shall be employed in the design of solid state equipment circuitry:

- (a) The design shall be inherently temperature compensated to prevent abnormal operation. The circuit design shall include such compensation as is necessary to overcome adverse effects due to temperature in the specified environmental range.
- (b) For reasons of personal safety, personnel shall be protected from all dangerous voltages.

672-5.3 Generated Noise:

672-5.3.1 General:

No item, component or subassembly shall emit a noise level exceeding the peak of 55 dBa when measured at a distance of 1 meter (39.37 inches) away from its surface.

672-6 QUALITY CONTROL

672-6.1 General:

The following measures shall be taken by the manufacturer/vendor during the production and assembly process to insure a high standard of quality.

672-6.1.2 Components:

All components shall be lot sampled to assure a consistent high conformance standard to the design specifications of the unit.

672-6.1.3 Subassembly of Module:

- (a) Visual inspections shall be performed on all modules, printed circuits and subassemblies to determine any physical defects such as cracking, scaling, poor fastening, incorrect component values, etc.
- (b) Complete electrical testing shall be performed on each module, printed circuit or subassembly to determine its compliance with the manufacturer's design function.
- (c) Housing, chassis, and connection terminals shall be inspected for mechanical sturdiness, and harnessing to sockets shall be electrically tested for proper wiring sequence.

672-6.1.4 Unit:

- (a) The completely assembled unit shall be subjected to a full environmental cycling and timing test.
- (b) The unit shall be visually and physically inspected to assure proper placements, mounting and compatibility of subassemblies.

672-6.1.5 Pre-Delivery Repair:

The procedures listed below shall be followed in repair of equipment before shipment.

- (a) Any defects or deficiencies found by the inspection system involving mechanical structure or wiring shall be returned through the manufacturing process or special repair process for correction.
- (b) Defects in PCB's or electronic circuit components shall be specially treated as follows:
 - 1) A PCB may be flow soldered a second time if copper runs and joints are not satisfactorily coated on the first run.
 - 2) Under no circumstances shall a PCB be flow soldered more than twice.
 - 3) Hand soldering may be used for printed circuit repair.

672-7 INSTALLATION REQUIREMENTS

672-7.1 Scope:

The controller cabinets shall be installed in accordance with the -applicable requirements of these TSP's. The Controller Cabinets shall be installed with a matching adapter on new composite fiber (Quasite) controller foundation or with new or existing NEMA Type 5 concrete foundations. See Figures 672-9, 672-10, 672-11 and 672-12 for details on foundations as specified in the requirements for the TSP's.

672-7.2 Controller Cabinets Foundation: (Composite or Concrete bases)

672-7.2.1 Composite Controller Cabinet Foundation:

The Contractor shall install a composite Type V (P) base such as a Quazite Type V base or approved equivalent for a controller cabinet installation at sites shown in the plan set or as directed by the Engineer. The physical dimensions of the composite Type V (P) base can be found in Figure 672-9.

The Foundation shall be oriented in such a manner that the technician **SHALL NOT** have his/her back to traffic and **SHALL** be able to visually see the intersection and the Controller Equipment at the same time. The Engineer may adjust the foundation location as to meet ADA requirements.

- (a) The Contractor shall excavate material to the proper physical dimensions to enable him to install the foundation as shown in this document and as per the manufacturers recommendations.
- (b) All conduits shall stub up 5.08 cm (2-inches) and shall be 5.08 cm (2-inch) schedule 40 PVC minimum with the exception of the following:
 - 1) Electric Service - shall have 2.54 cm (1 -inch) schedule 40 PVC conduit.

- 2) Ground rod installation - shall have 2.54 (1-inch) schedule 40 PVC for ground wire to run to nearest pull box where ground rod shall be installed.
 - 3) Fiber Optic - shall have a 7.62 cm (3 - inch) schedule 40 PVC conduit.
- (c) When the controller cabinet is not placed within a sidewalk the contractor shall provide technician pads front and back.
- (d) When the controller cabinet is placed within the sidewalks and a grass swale area is located between the sidewalks and the roadway, the Contractor shall provide additional sidewalk.
- (e) Cabinets can be shimmed but only 6.35 mm (1/4 inch) max.

672-7.2.2 Technician Service Pads:

There shall be a minimum of two (2) Technician Service Pads (Work Platforms) installed at each cabinet location not on sidewalk or other concrete surfaces. These pads shall conform to the specifications outlined in Figure 672-9 of these TSP's.

672-7.2.3 Type V (P) Base Adapter:

The Contractor shall install a matching Type V (P) Adapter on top of the composite or concrete Type V (P) Controller cabinet base. These matching adapter(s) shall be painted in the same manner as the controller cabinet (See 676 of these TSP's). The standard base adapter is to be used in locations that have external (overhead) electrical power feeds. The standard power base adapter is to be used in locations that have an underground electrical power feed.

The cabinet shall be bolted to the base adapter with 7/16 inch x 2 inch long stainless steel bolts, washers and nuts. The base adapter shall be bolted to the composite base with either 7/16 inch x 2 inch or 3/8 inch x 2 inch stainless steel bolts, washers and nuts.

672-7.2.4 Concrete Foundation:

The Contractor shall construct a NEMA Type 5 concrete foundation for controller cabinet installation at sites shown in the plan set or as directed by the Engineer.

The Foundation shall be oriented in such a manner that the technician **SHALL NOT** have his/her back to traffic and **SHALL** be able to visually see the intersection and the Controller Equipment at the same time. The Engineer may adjust the foundation location as to meet ADA requirements.

- (a) The Contractor shall excavate material to the proper physical dimensions to enable him to form the foundation as shown in this document.
- (b) The location of the Foundation once excavated and formed shall have all conduits and reinforcing rods installed and inspected.

- (c) Class II concrete 3000 psi minimum strength in twenty-eight (28) days shall be used.
- (d) All conduits shall stub up 5.08 cm (2-inches) and shall be 5.08 cm (2-inch) schedule 40 PVC minimum with the exception of the following:
 - 1) Electric Service - shall have 2.54 cm (1 -inch) conduit run to the nearest pull box..
 - 2) Ground rod installation - shall have 2.54 cm (1 -inch) schedule 40 PVC for ground wire to run to nearest pull box where ground rod shall be installed.
 - 3) Fiber Optic - shall have a 7.62 cm (3 - inch) schedule 40 PVC conduit.
- (e) When the controller cabinet is not placed within a sidewalk the contractor shall provide technician pads front and back.
- (f) When the controller cabinet is placed within the sidewalks and a grass swale area is located between the sidewalks and the roadway, the Contractor shall provide additional sidewalk.
- (g) Cabinets can be shimmed but only 6.35 mm (1/4 inch) max.

672-7.2.5 Cabinet Installation:

- (a) The Contractor shall secure and level the cabinet to the foundation with four (4) anchor bolts, washers and aluminum shims per manufacture recommendations.
- (b) A mastic sealant shall be placed between the cabinet and the adapter base and between the adapter and the concrete foundation to prevent dust and moisture from entering the cabinet.

672-7.3 Field Wiring:

- (a) Signal cable, interconnect cable and loop lead-in wires shall be terminated on the appropriate terminal strips in the controller cabinet with insulated terminal lugs. A calibrated ratchet type crimping tools shall be used to install the insulated terminal lugs onto the field wires.
- (b) Spare circuits of the signal and interconnect cables shall be labeled and grounded to the cabinet ground buss bar.
- (c) All field wiring cable in the controller cabinet shall be neatly bundled and identified.

672-7.4 Grounding:

All controller cabinets shall be grounded in accordance with the requirements of Section 620. The ground wire from the controller cabinet ground bussbar to the ground rod assembly or array shall be kept as short as possible.

672-7.5 Equipment Placement:

All equipment shall be installed in the cabinet in accordance with manufacturer's recommendations.

- (a) Contractor shall remove from existing cabinets and re-install all Fiber Optic Transceivers into replacement controller cabinets. All used equipment shall be returned to the City of Tallahassee.
- (b) At new signalized intersections, the Contractor shall install new Fiber Optic Transceivers into the controller cabinet.

672-7.6 Coordination Between Contractor, Maintaining Agency and Utilities:

The contractor shall coordinate with Tallahassee Traffic Engineering Division-Traffic Control Center at 904-891-2080 a minimum of forty-eight (48) hours in advance of work at each location, to provide for adjustments to traffic signal data base and Computer/Fiber Optic/Telephone interruption shall not exceed eight (8) hours at any location.

672-7.7 Site Drawing:

The contractor shall provide a site drawing showing both Tallahassee Electric Utility (TEU) and/or Talquin Electric Cooperative Inc. (TEC) service points for emergency repairs and future reference of each signalized location listed as part of these contract documents.

672-8 METHOD OF MEASUREMENT

672-8.1 General:

Measurement for payment shall be in accordance with the following work tasks.

672-8.2 Furnish and Install:

The unit price per assembly for traffic controller assemblies, furnished and installed, shall include all equipment specified in this document in Sections 673, 676 and 678, including all labor, equipment and miscellaneous materials as specified in Section 672 necessary for a complete and accepted installation.

672-8.3 Assembly:

The Model 170 E traffic controller assembly shall consist of the following components:

- (a) 1 - Controller Cabinet
- (b) 1 - Controller (Model 170 E)
- (c) 2 - Input Files
- (d) 18 - Two-Channel Loop Detector Units (Model D222).
- (e) 4 - Two-Channel DC Isolator (Model 242)
- (f) 1 - Two-Channel AC Isolator (Model 252)
- (g) 1 - Output File (OF #1)

- (h) 1 - Power Distribution Assembly (PDA #2)
- (i) 16 - Solid State Load Switches (Model 200)
- (j) 1 - Flasher (Model 204)
- (k) 1 - Power Supply Module (Model 206)
- (l) 1 - Conflict-Voltage Monitor (Model D210)
- (m) 1 - Program Module (Model D412) (including S/W)
See Section 681
- (n) 6 - Transfer Relays (Model 430)
- (o) 1 - Fiber Optic Transceiver with fiber optic jumpers (4) 182.88 cm (6 feet long)
- (p) 1 - Emergency Preempt Receiver
- (q) 1 - ~~Current Sensing Monitor~~ Deleted
- (r) 1 -- Adapter Base (Standard or Power Adapter)
- (s) 1 - Field Service Panel
- (t) 1 - Auxiliary Field Service Panel
- (u) 1 - Aux Output File No. 2 Model 420
- (v) 1 – Controller Interface Panel

672-9 BASIS OF PAYMENT:

The contract unit price per assembly for traffic controller assemblies shall be full compensation for all work specified in this Document.