FHWA REGION NO.	STATE	PROJECT NUMBER	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
7	KANSAS	618-34	1998	91	100

(6) A Walk Disable function shall be provided which will modify operation of Red monitoring. If this function is enabled via a front panel accessible programming device, the unit shall trigger if it senses the absence of active green, yellow, and red inputs of a channel regardless of the state of the walk input.

(7) A Voltage Monitor Latch function shall be provided which will sense an improper voltage level at the Controller Voltage Monitor input or either of the +24V Monitor inputs and cause the unit to trigger. If this function is enabled via a front panel accessible programming device, restoration of the proper voltage levels will not reset the unit. Only a manual reset or external reset will reset the unit.

(8) When the AC+ line voltage is below the drop-out level of 92 Vrms for 475 msec (+/- 25 msec) the unit will suspend all fault monitoring functions, de-energize the output relay, and de-energize the Start relay. The POWER indicator on the front panel will blink at a rate of 2Hz to indicate the brown-out status.

When the AC+ line voltage returns above the restore level of 100Vrms for 100 msec (+/- 16 msec) the monitor will resume normal operation and the POWER indicator on the front panel will remain illuminated. After a 2.5 second (+/- 1 second) delay the Start relay will be energized. After a programmable delay determined by a front panel accessible programming device the Output relay will be energized. This delay shall be programmable from 4 seconds to 15 seconds in 1 second increments. A 0.5 second delay shall be provided for test purposes.

(9) An internal watchdog circuit shall be provided to assure continuous operation of the internal microprocessor device. Failure of this circuitry to detect a logic input transition from the microprocessor device for 100 msec or a DC supply voltage sufficient to assure proper operation shall cause the unit to trigger.

(10) If a reset command is received from either the front panel control or the External Reset input for a continuous duration of more than 120 seconds, the unit will ignore the reset command and begin normal monitoring functions.

(11) A real time clock shall be provided to mark the date and time when the unit is triggered by an error condition. Backup power to the real time clock shall allow it to maintain timing accuracy during interruptions of AC+ power to the unit. Automatic adjustments should be made to the time of day and date to accommodate leap years and Daylight Savings time.

(12) In addition to displaying the fault status and field output status for an error condition which may have the monitor unit currently triggered, the unit shall maintain a complete record of at least the last three faults which caused the unit to trigger. These events should be able to be reviewed at any time via activation of a front panel control. This fault record shall not be lost due to AC+ power interruptions.

(13) All critical timing functions shall be accomplished by digital methods and shall utilize either the power line frequency or a quartz crystal based timer. All monitoring functions except conflict monitoring shall have a dedicated timer unique to each channel being monitored.

THE MINIMUM DISPLAY INDICATORS REQUIRED ARE AS FOLLOWS:

(1) Triggering of the Conflict monitoring portion of the unit.
(2) Triggering of the Red monitoring portion of the unit.
(3) Triggering of the Sequence monitoring portion of the unit.
(4) Triggering of the Dual monitoring portion of the unit.
(5) Triggering of the Controller Voltage Monitoring or Controller Watchdog monitoring portion of the unit.
(6) Triggering of the +24V Monitor #1 portion of the unit.
(7) Triggering of the +24V Monitor #2 portion of the unit.
(8) Triggering of the Program Card monitoring portion of the unit.
(9) Triggering of the internal watchdog portion of the unit.
(10) Time of day and date display.
(11) Four indicators per channel which display an active red, yellow, green, or walk input for each channel monitored.
(12) AC+ power indicator which is flashing when AC+ power is below 92 Vrms and illuminated when AC+ line voltage returns above 100Vrms.

C. DETECTORS:

The two-channel loop detector shall be of solid state design and meet the following requirements:

(1) The detector unit shall tune over a large inductance range from 20-2500 microhenries.
(2) The unit shall provide a "Failsafe" continuous output in response to multiple shorts to ground, an open loop or an open lead-in wire.
(3) The unit shall be able to operate a loop with a single short to ground or point leakage.
(4) The unit shall have push button switches for the selection of pulse, sensitivity, presence, channel reset and off.
(5) Eight sensitivity settings in 2:1 steps shall be offered.
(6) Multiple channel scanning method shall be such that crosstalk within the unit is eliminated.
(7) Output circuits shall be of the optically isolated solid state type.
(8) Inductance change shall be measured by the Δ L method to maintain constant sensitivity without regard to percent of change.

D. CONTROLLER CABINET:

The controller and all associated equipment shall be furnished completely housed in a sturdy aluminum cabinet. A slide out tray for a laptop computer shall be provided immediately below the lowest controller or detector shelf. The cabinet shall be of clean cut design and appearance having no sharp edges, corners or projections. The size of the cabinet shall be such as to provide ample space for housing the controller and all associated electrical and auxiliary devices. A hinged door shall be provided permitting complete access to the interior of the cabinet. The cabinet is to be weather proof and dust tight. The door shall be provided with a strong lock and two sets of keys. The door hinges and pins shall be of a non-corroding material.

The cabinet shall contain strong mounting tables, sliding ways or other suitable supports for the controller and associated equipment.

A solid-state two circuit jack mounted flasher with a rated load of 10 amps per circuit shall be supplied. Where additional load is required, more than one flasher will be provided. The flasher shall flash at the rate of 50 to 60 flashes per minute and be filtered. If required to prevent radio interference, the transfer from the controller to the flasher shall commence at the beginning of the major street green indication.

The cabinet shall contain a ventilating fan controlled by a thermostat and suitable dust filters for the capacity of the ventilating system. The filters shall be of the dry type and easily replaced.

In addition to the main door of the controller cabinet, there shall be an auxiliary door provided in the main door with a lock and standardized police key. The panel behind the auxiliary police door shall contain three (3) switches to accomplish the following functions:

(1) Change from normal operation to flashing, and vice versa.
(2) Interrupt power to the signal heads.
(3) Interrupt power to the controller.

A convenience outlet and trouble lamp receptacle shall be furnished with each cabinet.

The cabinet shall contain an internal test panel which shall have switches as follows:

(1) Twelve (12) detector test switches.
Three position type for normal - momentary, detect input - off.
(2) One (1) Stop Time - Run - Normal Test switch.

Detector Rack Assembly

All Detectors as specified elsewhere shall be rack mounted units and shall be installed in a rack meeting the following requirements.

Each rack shall be fabricated of aluminum and shall provide adequate support and protection for the detector units installed therein. The rack shall be equipped with card edge type socket connectors spaced on 1.2 inch centers to connect the detectors to the system. All wiring connections to the detectors shall be done through these card edge connectors. Each detector unit position within the rack shall be fitted with a card guide on both the top and bottom to guide the card into the socket to facilitate insertion. Card edge guides shall be of non conductive material and shall be held positively in place in the rack members.

Each rack shall accommodate a minimum of eight to twelve detectors units (sixteen to twenty-four detector channels). Where additional detection channels are required by the project plans, additional racks meeting these requirements shall be provided.

Each rack shall be powered by and wired to a separate shelf mount unregulated power supply capable of providing 24 volt DC power to a minimum of twelve, two channel detector units. Each power supply shall be rated at 3.5 amps (± 200 mA).

When supplied as part of a traffic signal controller the detector rack(s) shall be securely fastened to the upper shelf of the cabinet. Each rack shall be hinged on one front vertical edge to allow for convenient access to rear wiring. All wiring to the rack(s) shall be neat and shall be firmly bundled and trained to provide a workmanlike appearance. All connections to the rack shall be made to the rear of the rack assembly and shall be soldered directly to the card edge connectors described previously. Detector loop input wiring shall be arranged in a twisted pair configuration to reduce electrical interference caused by other wiring within the cabling of the controller cabinet.

Lightning Protection

The controller must be furnished with an externally installed lightning arrestor inside the controlled cabinet on the power supply side.

The lightning arrestor shall be of the hybrid type rated at 20,000 amps and capable of clamping such a surge to a peak of not greater than 340 volts without regard for the rise time of the surge. The arrestor shall be totally of solid state design, with no gas tube type devices of any kind and shall be a two stage unit providing separate protection for the controller and monitor unit. A minimum 200 microhenry inductor shall be incorporated between the "equipment line in" and "equipment line out" terminals. The arrestor shall be epoxy encapsulated with a flame retardant material.

2.0 TRAFFIC SIGNAL LAMPS: A nominal 135 watt, 120 volt, AT-21 clear krypton traffic signal lamp of a minimum 8,000 hour life rating guaranteed by the manufacturer, shall be used in all vehicular and pedestrian signal heads. The lamps shall meet the following requirements:

(1) Krypton fill gas content shall be a minimum of 80%, and this percentage shall carry verification from independent laboratory test results.
(2) The projection filament shall be V-shaped, and it shall be supported at a minimum of seven points.
(3) The projection filament shall be protected from iron residue contamination during manufacturing via the use of a copper coated mandrel.
(4) A reflector disk shall be built into each lamp.
(5) Each lamp shall have a non-corroding brass base.
(6) Each lamp shall have a built-in fuse wire to protect from electrical arc-out damage.
(7) All lamps shall meet beam candle power specifications in ITE 12.00 "Traffic Signal Lamp".

3.0 LED RED TRAFFIC SIGNAL LENS: The lens shall be a self-contained, sealed unit designed to fit in a regular 12 inch traffic signal housing. It shall incorporate 318 or more high reliability, high intensity LED indicators, each of which shall be individually sealed into its own cone shaped, optical cell. The lens shall provide a light beam spread of 30 degrees on all sides of its center axis. The center axis shall be designed to provide a 7 degree downward angle.

The lens shall be made of UV stabilized acrylic or impact resistant polycarbonate. The housing shall be ABS or other approved material sealed to the lens to create a vandal-resistant and weather-tight enclosure.

The design shall be such that light reduction will be less than two percent with the loss of one LED, and that not more than one-sixth of the LEDs shall be lost due to circuit failure from vandalism or burnout.

The self-contained, regulated power supply shall allow the unit to operate over an input voltage range between 85 and 135 volts AC. The lens shall be driven at between 20 and 23 milliamps, and consume not more than 20 watts of power +/- 2 watts at 120 volts AC. The light output shall meet ITE specifications for a 12 inch lens illuminated by a 150 watt incandescent A21 clear traffic signal lamp. The operating temperature range shall be between -30 degrees Celsius and +85 degrees Celsius. The red wave length shall be between 637 nm and 644 nm.

The unit shall be warranted against defects in workmanship and materials for a period of 5 years from date of receipt by Sedgwick County or installation by the Contractor.

4.0 BACK PLATES: Where shown on the plans, 5" back plates shall be furnished and attached to the signal faces to provide a dark background for signal indications. Back plates shall be constructed of aluminum alloy sheet or durable plastic capable of withstanding a 100 M.P.H. wind.

Where a back plate consists of two or more sections, the sections shall be fastened with rivets or stainless steel or aluminum bolts, peened after assembly to prevent loosening.

5.0 ALUMINUM TRAFFIC SIGNAL PEDESTALS: Unless otherwise specified on the plans, the following specifications shall govern the design of aluminum traffic signal pedestals.

A. SHAFT:

The shaft shall be a one-piece tube of 6063-T6 aluminum alloy with a minimum wall thickness of 0.237". The shaft shall be of uniform diameter throughout its length. The shaft outside diameter at the top shall be approximately 4.5". Overall height of the shaft and base shall be as indicated on the plans. The shaft shall have a satin brush finish. The shaft shall be threaded with a nominal 4" pipe thread and be threaded into the base. The base and shaft are to be taped and fitted with a 3/8" set screw.

B. BASE:

The base shall be equipped with a handhole and door for access to the interior of the base. The handhole shall have a minimum dimension of 7-3/4" by 8". The door shall be fastened in place by a single bolt which shall have an allenhead to discourage unauthorized personnel from gaining access to the wiring compartment in the pedestal base. The pedestal base shall be mounted to a poured concrete pad by means of four anchor rods set in a bolt circle of 13 1/2" diameter. There shall be a provision in the base for the attachment of a ground rod.

C. HARDWARE:

Anchor bolts shall be 3/4" diameter by 27" long plated, and they shall be supplied with nuts, lock washers and flat washers. The shaft shall be secured to the base by a 3/8" bolt to prevent loosening of the shaft due to vibration, wind, etc.

D. GENERAL:

The pedestal and base shall be designed to support two one-way, three section 12" polycarbonate traffic signal heads and two sets of 12" polycarbonate pedestrian signal heads. The shaft shall be wrapped with protective paper for shipment. Large scratches or gouges in the aluminum material shall be cause for rejection.

6.0 AC SERVICE INPUT: Each service disconnect must be furnished with an installed lightning arrestor on the AC service input.

The lightning arrestor shall be of the hybrid type rated at 20,000 amps and capable of clamping such a surge to a peak of not greater than 340 volts without regard for the rise time of the surge. The arrestor shall be totally of solid state design, with no gas tube type devices of any kind and shall be a two stage unit providing separate protection for the controller and monitor unit. A minimum 200 microhenry inductor shall be incorporated between the "equipment line in" and "equipment line out" terminals. The arrestor shall be epoxy encapsulated with a flame retardant material.

7.0 ELECTRICAL WIRE AND CABLE: All wire and cable supplied under this specification shall be approved based upon catalog cuts submitted to the engineer. In addition, all wire and cable shall be visually inspected by the Engineer. Any apparent defect that may shorten the service life of the wire or cable shall be cause for rejection.

A. SHIELDED DETECTOR LEAD-IN ELECTRICAL CABLE, 2/C:
The conductor and drain wires shall be tinned copper wires. The conductors shall be shielded by a layer of aluminum bonded to polyester film. All wires shall have polyethylene insulation and a jacket of vinyl.

In addition, the cable shall meet the following requirements:

16	AWG (stranded) drain wire
14	(19 X 27) AWG (stranded)
025	Insulation thickness (.001 inch)
030	Jacket thickness (.001 inch)
274	NOM. O.D. (.001 inch)
Black & Clear	Conductor color code
100	Percent shield coverage
24	NOM * Cap (PF/FT)
47	NOM ** Cap (PF/FT)
600	Suggested working voltage

* Capacitance between conductors
** Capacitance between one conductor and the other conductor connected to shield.

TRAFFIC SIGNAL SPECIFICATIONS

PREPARED BY
SEDGWICK COUNTY BUREAU OF PUBLIC SERVICES
HIGHWAY DIVISION

DAVID C. SPEARS, P.E. — DIRECTOR/COUNTY ENGINEER

REVISED	SCALE	DESIGNED	TRACED	CHECKED	SHEET NO.
				WDH	
	DATE				
	PLANFILE		TOTAL SHEETS		

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Plotted by: mdf 7-25-97