of not less than 2.5 mm in thickness. The visors on the one piece heads shall be black, and be of the eggcrate type with a depth of 38 mm and a thickness of 0.8 mm. The pedestrian signal indications shall be in general conformance with the latest edition of the Equipment and Materials Standards of the Institute of Transportation Engineers - Pedestrian Traffic Control Signal Indications. Pedestrian lenses shall be rectangular, with a side dimension of 300 mm if two pieces, or with dimensions of 470 mm wide by 475 mm high if one piece. The message shall consist of a Don't Walk "HAND" symbol in Portland Orange, and a Walk "WALKING PERSON" symbol in Lunar White. The pedestrian symbols shall be a minimum of 230 mm high. The lenses shall be of a molded prismatic glass. The indication shall be formed on the lenses in the same manner as specified for arrows.

3.2.4.3. **PROGRAMMED VISIBILITY SIGNAL HEADS.**

3.2.4.3.1. HOUSING. The programmed visibility signal heads shall be constructed of die cast aluminum. They shall be yellow, with black doors. Each section shall be provided with a black sheet aluminum sun visor.

3.2.4.3.2. VISIBILITY. The visibility of the signal indication shall be adjustable within the signal head to fit the lane or lanes in which traffic is to be controlled. During daylight, the signal indications shall be visible only in those areas or lanes designated. During dusk or darkness, a faint glow visible to the side will be permissible. External illumination shall not cause a signal indication, nor shall a signal indication in one signal section cause a signal indication in another signal section. Each section of a signal face shall provide a nominal 300 mm diameter round indication or arrow indication meeting the Institute of Transportation Engineers' dimensions as required.

3.2.4.3.3. PROGRAMMING. The indication of each signal head, when not programmed, shall be visible from anywhere within 15 degrees of the optical axis. The signal head shall be able to be preset at angles between 10 degrees above and 10 degrees below the horizontal, and shall be preset at 4 degrees (side-of-pole) or 8 degrees (mast arm) below the horizontal.

3.2.4.3.4. CANDLEPOWER. The signal section with the yellow indication, prior to programming, when directed downward 5 degrees from the horizontal, shall provide a minimum candlepower of 2500 candela in the direction of the axis and a maximum candlepower of 100 candela at 15 degrees horizontally in each direction from the axis. Said signal head with yellow indication shall be programmed so that a minimum candlepower of 2500 candela can be directed along the optical axis and a candlepower of less than 100 candela directed at $\frac{1}{2}$ degree horizontal from the axis and no measurable light is directed from 1 to 15 degrees horizontal from the axis. Under the same conditions, the candlepower of the red indication shall be at least 19 percent of the yellow indication, and the candlepower of the green indication shall be at least 38 percent of the yellow indication.

3.2.4.3.5. DIMMING DEVICES. Dimming devices shall be provided to gradually reduce the candlepower as a function of the individual background illumination of each signal head for nighttime operation to approximately 15 percent of that for daytime operation.

3.2.4.4. **L.E.D. LENSES.** When specified in the Plans, the lenses in each signal head shall be a 300 mm L.E.D. lens meeting the requirements of the I.T.E. November 1995 Proposed Interim Purchase Specification for Light Emitting Diode (LED) Vehicle Traffic Signals.

3.2.5. **SIGNAL LAMPS.** All vehicle traffic signal lamps shall meet the requirements of the latest edition of the Equipment and Materials Standards of the Institute of Transportation Engineers - Traffic Signal Lamps. A nominal 150 watt, 120 volt, A21 clear traffic signal lamp shall be used in all 300 mm vehicle traffic signal indications. A nominal 116 watt, 120 volt, A21 clear traffic signal lamp shall be used in all 300 mm pedestrian signal indications.

3.2.5.1. As an alternative, nominal 135 watt, 120 volt, AT21 traffic signal lamps containing a minimum of 80 percent Krypton fill may be used in all 300 mm vehicle traffic signal indications, and nominal 105 watt, 120 volt, AT21 traffic signal lamps containing a minimum of 80 percent Krypton fill may be used in all 300 mm pedestrian signal indications.

3.2.6. **SIGNAL MOUNTING BRACKETS.**

3.2.6.1. **MAST-ARM BRACKET.** The mast arm signal mounting brackets shall be fabricated of high strength aluminum. They shall provide for rigid mounting of the traffic signal heads while allowing signal aiming adjustment in all planes. The brackets shall be designed to strap to the mast arm using heavy-duty stainless steel banding material or aircraft-type cable which shall be pinned to the bracket at one end and which shall provide a turnbuckle style tightening adjustment on the other. The brackets shall incorporate wiring channels so that after installation, all signal cables shall be protected from the effects of exposure to the weather.

3.2.6.2. **SIDE-OF-POLE BRACKETS.** Side-of-pole signal mounting brackets shall be molded of yellow polycarbonate and shall incorporate a mounting arm and pole plate into a single member which shall include guides to correctly position the banding material on the pole plate. The dimensions of the mounting brackets shall be as required to provide proper signal head alignment. Each bracket shall have molded serrations to assure a positive lock with the signal head and allow positioning of the traffic signal heads in increments of 5 degrees. The bracket shall be designed to provide a wiring raceway for signal cable exiting the support pole and entering the signal head.

3.2.7. **BACKPLATES.** Backplates shall be of sufficient size to provide a minimum of 125 mm of dark background for the signal indications. They shall be fabricated from a minimum of 3 mm black ultraviolet stabilized ABS plastic. They shall have a haircell finish on front and smooth finish on the back. They shall be one-piece construction capable of withstanding a 160 km/h wind. Backplates shall be furnished with all necessary hardware to attach to the signal heads.

3.2.8. **PEDESTRIAN PUSH-BUTTON.** The pedestrian push button assembly shall consist of a high density aluminum housing fitted with a suitable push button switch. It shall contain a silicon or neoprene cover to body gasket. Cover screws shall be stainless steel. The switch and actuator shall be protected from dust and moisture with a silicon or neoprene cover.

3.2.9. **PEDESTRIAN SIGN.** The pedestrian information signs shall bear the legend as detailed in the Plans. The sign blank shall be constructed of minimum 2 mm thick aluminum alloy. The sign face shall have a non-reflective black legend direct screened on white regular performance sign sheeting. The sign shall be visually accepted by the Engineer.

3.2.10. **STEEL TRAFFIC SIGNAL POLES.**

3.2.10.1. TAPERED TUBULAR SHAFTS. Steel traffic signal pole and mast arm shafts shall conform to Subsection 1606 of the Standard Specifications and the requirements in the Plans. All pole and mast arm shafts shall be constructed of one of the following methods:

___3.2.10.1.1. NO TRANSVERSE WELDS. Pole and mast arm shafts shall be tapered tubular members made only of one length of structural steel sheet of not less than No. 7 Manufacturing Standard Gauge (Exception: Signal arms designed for lengths of 12 m or greater may have arm extensions, of not less than No. 11 gauge steel, with bolted telescopic field joints so as to develop full strength of the adjacent shaft sections to resist bending action). Round (Type I) members shall meet the requirements of the latest edition of A.S.T.M. A595 Grade A or B. Multi-sided (Type II) members have a minimum of 12 sides and meet the requirements of the latest edition of A.S.T.M. A570 or A.S.T.M. A572 with a minimum yield strength of 379 MPa and a maximum silicone content of 0.06 percent. Only one longitudinal weld, and no transverse welds, shall be permitted in the fabrication of the tubular members made only of one length of structural steel.

3.2.10.1.2. TRANSVERSE WELDS. Pole and mast arm shafts shall be fabricated from the best, hot rolled basic open hearth steel conforming to A.S.T.M. A570 for thickness' of No. 11 and No. 7 Manufacturing Standard Gauge, A283 Grade D for No. 3 gauge and A36 modified for 0 gauge. The shaft shall be longitudinally cold rolled to flatten the weld and increase the physical characteristics so that the metal will have minimum yield strength of 331 MPa. Where transverse full penetration circumferential welds are used, the fabricator of the shaft shall furnish to the Engineer Certification: (1) that all such welds have been magnetic particle tested by an independent testing laboratory using a qualified Nondestructive Testing (NDT) Technician and (2) that the NDT equipment has been calibrated annually.

3.2.10.2. POLES. The poles shall include a suitable clamp for attaching the mast arm to the pole shaft: a reinforced hand hole with gasketed cover located near the bottom of the pole and oriented 180 degrees from the mast arm: a grounding lug in the handhole or inside the pole near the handhole: a J or C hook wire support inside the pole near the top of the pole: 4 nut covers: and a removable pole cap. The poles shall be pre-drilled for the mast arm attachments prior to galvanizing. Rubber grommets shall be furnished for all wire entrances into the pole.

3.2.10.3. COMBINATION POLES. When combination lighting and signal poles are specified in the Plans, the poles shall also have suitable clamps for attaching the luminaire arm to the pole shaft. The pole shaft shall be pre-drilled for the luminaire arm attachment prior to galvanizing, with the luminaire arm to be mounted in the same vertical plane as the signal arm. In addition, a reinforced nominal 75 mm by 125 mm hand hole shall be located 180 degrees from and just above the mast arm, and a J or C hook wire support shall be welded inside the pole just above the mast arm.

3.2.10.4. MAST ARMS. All signal mast arms shall have suitable clamp-on attachment devices for attaching to the pole shaft, and a removable end cap. Rubber grommets shall be furnished for all wire entrances into the mast arm.

3.2.10.5. LUMINAIRE ARMS. Luminaire arms shall be either single tube or truss-type arms as indicated in the plans. All luminaire arms shall have suitable clamp-on attachment devices for attachment to the pole shaft. Single tube arms shall be welded to one half of the luminaire arm clamp. Truss-type arms shall be furnished with two clamp-on simplex fittings as detailed in the plans.

3.2.10.6. GALVANIZING. The poles, mast arms, luminaire arms and all steel accessories shall be galvanized to the requirements of the latest edition of A.S.T.M. A123.

3.2.10.7. DESIGN LOAD. All traffic signal poles shall be designed to accommodate the standard signal head, signing, and luminaire arm loadings established by the Bureau of Traffic Engineering. The design shall conform to the latest edition of the A.A.S.H.T.O. Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals handbook with a wind load of 130 km/h and a 30 percent gust factor. The poles shall also accommodate wind loadings which may cause deflections of the mast arm in the vertical plane. These deflections shall never result in less than a 4.6 m clearance between the roadway and the lowest point of the signal assembly.

3.2.10.8. ANCHOR BOLTS. High strength anchor bolts, washers, and nuts, conforming to Section 1613, Type II of the Standard Specifications shall be included. The leveling nuts may be either Heavy Square or Heavy Hex nuts. Anchor bolt washers conforming to the requirements of the latest edition of A.S.T.M. F436 will also be acceptable.

3.2.10.9. BASIS OF ACCEPTANCE.

3.2.10.9.1. STANDARD SHOP DRAWINGS. All traffic signal poles shall be detailed by the manufacturer on shop drawings. The drawings shall include the pole, mast arm and luminaire arm (on combination poles) dimensions, arm attachment details, handhole details, and anchor bolt details, along with the signal weight, projected areas, and mounting arrangement they are designed to accommodate. Design calculations shall be submitted along with the shop drawings. Approved shop drawings will be included in the Pre-qualified Traffic Signal Materials List.

3.2.10.9.1.1. For traffic signal poles that are not covered by the approved manufacturer's standard shop drawings, the Contractor shall submit three copies of detailed shop drawings, along with the design calculations to the Engineer for approval by the Bureau of Traffic Engineering.

3.2.10.9.2. POLES AND MAST ARMS. See Subsection 1606 of the Standard Specifications for the basis of acceptance for material furnished under that subsection.

3.2.10.9.3. ANCHOR BOLTS. See Subsection 1613 of the Standard Specifications for the basis of acceptance of anchor bolts for traffic signal poles. If Type "B" certification is not provided according to Section 2600 of the Standard Specifications, the Engineer may require testing of an anchor bolt.

3.2.10.9.4. TRAFFIC SIGNAL MATERIALS LIST. Along with the Traffic Signal Materials List, the Contractor shall submit the necessary traffic signal pole ordering information. The Engineer will review the information for compliance with the plan dimensions for pole height, mast arm length and mounting height, and luminaire arm length and mounting height.

3.2.11. **TRAFFIC SIGNAL PEDESTALS.** Traffic signal pedestals shall consist of an aluminum shaft of the length specified in the Plans, a cast aluminum base, anchor bolts with nuts and washers, and be provided with a pole cap.

3.2.11.1. SHAFT. The shaft shall be of Type 6061-T6, 6063-T6 or 6063-T832 aluminum alloy, and shall be a single piece of drawn seamless tubing having a nominal 110 mm outside diameter and 6 mm wall thickness. The shaft shall be threaded at one end for attaching the shaft to the base. The shaft shall have a uniform polished finish.

3.2.11.2. BASE. The pedestal base shall be A.A.S.H.T.O. certified and be cast of Type 356.0-T6 aluminum alloy. It shall have a threaded collar with a set screw, and plastic hand hole cover.

3.2.11.3. ANCHOR BOLTS. Anchor bolts for traffic signal pedestals shall be of the dimensions detailed in the Plans and shall meet the requirements of the latest edition of A.S.T.M. A36. The threaded ends of the anchor bolts shall be galvanized, and galvanized nuts and washers shall be included with the anchor bolts. Anchor bolts for traffic signal pedestals will be visually accepted by the Engineer.

3.2.12. **TERMINAL BLOCK.** Terminal blocks in the poles shall be U.L. recognized barrier type or dead-front type terminal strips having terminals of sufficient size and number to connect the individual conductors run between the cabinet and the pole to the conductors run between the pole and the signal heads. They shall be rated for at least 30 amps current.

3.2.13. **JUNCTION BOXES (IN-GROUND).** The junction box shall be of sufficient size to facilitate the conduit and wiring as indicated in the plans. Junction boxes shall have the minimum nominal dimensions of 300 mm deep with a minimum physical opening of 81 000 mm ^{2}. In-ground junction boxes may be constructed of one of the following methods: pre-cast concrete with a cast iron cover: polymer concrete with a polymer concrete cover: fiberglass reinforced polymer body with a polymer concrete ring and cover: high density polyethylene body with polymer concrete ring and cover. The ring shall be securely attached to the body.

3.2.13.1. The box and cover shall support, without damage to the box or cover, a static load of 9070 kg distributed over a 250 mm by 250 mm area in the center of the cover when installed as detailed in the Plans.

3.2.13.2. The cover shall bear the logo "TRAFFIC SIGNAL" clearly and permanently molded or etched into the cover.

3.2.14. **JUNCTION BOXES (ABOVE-GROUND).** Above ground junction boxes shall have the nominal dimensions of 300 mm by 300 mm by 150 mm. The junction box shall be made of minimum 2 mm thick sheet metal (steel) with welded seams, knockouts and weather proof screw cover. Boxes shall be hot dipped galvanized in accordance with A.S.T.M. A-123 after fabrication.

3.2.15. **SERVICE BOXES.** The service box shall have the minimum nominal internal dimensions of 600 mm diameter by 900 mm deep. Service boxes shall be provided with cable hooks as detailed in the Plans. The box may be constructed of one of the following methods: pre-cast concrete with a cast iron ring and cover: galvanized corrugated steel with a cast iron ring and cover: polymer concrete with a polymer concrete cover: fiberglass reinforced polymer body with a polymer concrete ring and cover. The ring shall be securely attached to the body.

3.2.15.1. The box and cover shall support, without damage to the box or cover, a static load of 9070 kg distributed over a 250 mm by 250 mm area in the center of the cover when installed as detailed in the Plans.

3.2.15.2. The cover shall bear the logo "TRAFFIC SIGNAL" clearly and permanently molded or etched into the cover.

3.2.16. **LUMINAIRES.** Luminaires shall be High Pressure Sodium of 250 watts or 150 watts, as indicated in the Plans. The luminaire shall have a housing of a single piece aluminum alloy casting, with an integral slip-fitter for 50 mm bracket mounting, an aluminum reflector, an auto-regulator type ballast set at 120 volts, a medium semi-cutoff glass refractor with Type III light distribution, and a photocell receptacle.

3.2.17. **LUMINAIRE LAMPS.**

3.2.17.1. 150 WATT LAMP. The 150 watt lamp shall be High Pressure Sodium with a rated initial light output of 16,000 lumens, and a mean light output of 14,400 lumens.

3.2.17.2. 250 WATT LAMP. The 250 watt lamp shall be High Pressure Sodium with a rated initial light output of 30,000 lumens, and a mean light output of 27,000 lumens.

3.2.18. **PHOTOCELL.** The photocell shall be solid state type, 1000 watt/1800 volt-amps maximum, single pole, single throw, twist lock mounting, 120 volt operation. The operating levels shall be 16.1 lx ON and 3.6 lx OFF, with an allowable variation of 5.4 lx ON or OFF. The photocell shall have a minimum of a 30 second time delay OFF, and fail in the ON mode.

3.2.19. **UN-FUSED STREET LIGHT CONNECTOR KIT.** Un-fused connector kits shall be of the set-screw type sized to the conductors specified in the Plans. They shall be furnished with waterproof rubber boots.

3.2.20. **FUSED STREET LIGHT CONNECTOR KIT.** Fused connector kits shall be sized to the conductors specified in the Plans and shall be supplied with molded rubber boots for waterproofing. The connector shall be capable of withstanding multiple disconnects without damage to the watertight seals or terminals. Each connector shall include all parts and materials necessary to complete its installation, such as fuses, lubricating compound, and assembly devices.

3.2.20.1. **FUSE.** The fuse shall be a minimum of 5 amp cartridge type as recommended by the connector manufacturer.

3.2.21. **OVERHEAD STREET NAME SIGNS.** Overhead street name signs shall bear the message indicated in the Plans. The legend shall be centered on the sign face. The border shall be 19 mm wide.

3.2.21.1. BLANK. The sign blank shall be of 3 mm thick Type 5052-H38 aluminum alloy. All corners on the sign blank shall be rounded.

3.2.21.2. SHEETING. The sign faces shall be either direct-applied white enclosed lens high performance retroreflective legend and borders on a green enclosed lens high performance retroreflective sheeting background, or transparent green cuttable film over white enclosed lens high performance retroreflective sheeting. The use of the transparent film shall in no way limit the manufacturer's warranty on the retroreflective sheeting over which it is applied. The green sheeting or film shall conform to Federal Color Standard 595A, Color No. 14109.

NO.	DATE	REVISION	BY	APP'D
3				
2				
1	4/7/99	Revised 3.2.18	JFF	LGV

KANSAS DEPARTMENT OF TRANSPORTATION

TRAFFIC SIGNAL SPECIFICATIONS

TE120CSI 04/28/98

FHWA APPROVAL	04/12/02		APP'D	Linda G. Voss, P.E.	
DESIGNED	J.F.F.	DETAILED	J.F.F.	QUANTITIES	TRACED
DESIGN CK.	D.A.C.	DETAIL CK.	D.A.C.	QUAN. CK.	TRACE CK.

Plotted By : @@USERNAME@@ Thacher Bldg., 4th Floor
Plot File : @@@@@@@@@@@@DGNSPEC@@@@@@@@@@@@
Plot Date : @@@@@@STTIME@@@@@@