STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT

CONSTRUCTION PROPOSAL

STATE PROJECT NO. 001-09-0084
TURN LANES at US 80 and DOWNING PINES ROAD
ROUTE US 80
OUACHITA PARISH

STATE OF LOUISIANA
WILLIAM D. DRAKE, JR.
REG. No. 19531
REGISTERED
PROFESSIONAL ENGINEER
IN
ENGINEERING

5/21/2009

STATE PROJECT NO. 001-09-0084
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NOTICE TO CONTRACTORS (11/08)

Electronic bids and electronic bid bonds for the following project will be downloaded by the Department of Transportation and Development (DOTD) on **Wednesday, June 24, 2009**. **Paper bids and paper bid bonds will not be accepted.** Electronic bids and electronic bid bonds must be submitted through www.bidx.com prior to the electronic bidding deadline. Beginning at 10:00 a.m., all bids will be downloaded and posted online at http://www.dotd.la.gov/cgi-bin/construction.asp. No bids are accepted after 10:00 a.m.

STATE PROJECT NO. 001-09-0084
DESCRIPTION: TURN LANES at US 80 and DOWNING PINES ROAD
ROUTE: US 80
PARISH: OUACHITA
LENGTH: 0.373 miles.
TYPE: TRAFFIC FLOW IMPROVEMENT
LIMITS: State Project No. 001-09-0084: LOCATED ON ROUTE US 80 FROM1200 FEET WEST OF DOWNING PINES ROAD to 900 FEET EAST OF DOWNING PINES ROAD
ESTIMATED COST RANGE: $1,000,000 to $2,500,000
PROJECT ENGINEER: JACKSON, JIM; 8010 DeSiard Rd., Monroe, LA 71203, 318-342-0200.
DOTD COORDINATOR: DRAKE, BILL; (225) 379-1507

Bids must be prepared and submitted in accordance with Section 102 of the 2006 Louisiana Standard Specifications for Roads and Bridges as amended by the project specifications, and must include all information required by the proposal.

Paper plans and/or proposals may be obtained in Room 101-A of the DOTD Headquarters Administration Building, 1201 Capitol Access Road in Baton Rouge, or by contacting the DOTD; Email: sharonknight@dotd.la.gov, Phone (225) 379-1111, FAX: (225) 379-1714, or by written requests sent to the Louisiana Department of Transportation and Development, Project Control Section, P. O. Box 94245, Baton Rouge, LA 70804-9245. Proposals will not be issued later than 24 hours prior to the time set for opening bids. All Addenda, Amendments, Letters of Clarification, and Withdrawal Notices will be posted online. **Paper notices will not be distributed.** Construction proposal information may be accessed via the Internet at www.dotd.la.gov. From the LA DOTD home page, select the following options: **Doing Business with DOTD**, then **Construction Letting Information**. Once the **Construction Letting Information** page appears, find the **Notice to Contractors** box. From the drop down menu, select the appropriate letting date and press the "Go To button to open the page, which provides a listing of all projects to be let and a **Construction Proposal Documents** link for each project. All project specific notices are found here. **It will be the responsibility of the bidder to check for updates.** If paper copies of the proposal are desired, the proposal cost is $25.00. If paper copies of the plans are desired, the cost of the plans is $14.50 for complete plans. The purchase price for paper plans and proposals is non-refundable. Additionally, plans and specifications may be seen at the Project Engineer's office or in Room 101-A of the DOTD's Headquarters Administration Building in Baton Rouge. Upon request, the Project Engineer will show the work.

All questions concerning the plans shall be submitted via the Electronic Plans Distribution Center known as **Falcon**. Questions submitted within 96 hours of the bid deadline may not be answered prior to bidding. Falcon may be accessed via the Internet at www.dotd.la.gov. From the home page, select ***Doing Business with DOTD*** from the left-hand menu, then select ***Construction Letting Information*** on the pop-up menu. On the Construction Letting Information page, select the link, ***DOTD's Plan Room***. Login to Falcon (or request an ID if a first-time user). Once logged in, you will have access to view Project Information, submit a question concerning the project, and view the plans. All submitted questions will be forwarded by email to the Project Manager and the Project Engineer for a response.

The U. S. Department of Transportation (DOT) operates a toll free "Hotline" Monday through Friday, 8:00 a.m. to 5:00 p.m., eastern time. Anyone with knowledge of possible bid rigging, bidder collusion, or other fraudulent activities should call 1-800-424-9071. All information will be treated confidentially and caller anonymity will be respected.

GENERAL BIDDING REQUIREMENTS (08/06): The specifications, contract and bonds governing the construction of the work are the 2006 Edition of the Louisiana Standard Specifications for Roads and Bridges, together with any supplementary specifications and special provisions attached to this proposal.

Bids shall be prepared and submitted in accordance with Section 102 of the Standard Specifications.

The plans herein referred to are the plans approved and marked with the project number, route and Parish, together with all standard or special designs that may be included in such plans. The bidder declares that the only parties interested in this proposal as principals are those named herein; that this proposal is made without collusion or combination of any kind with any other person, firm, association, or corporation, or any member or officer thereof; that careful examination has been made of the site of the proposed work, the plans, Standard Specifications, supplementary specifications and special provisions above mentioned, and the form of contract and payment, performance, and retainage bond; that the bidder agrees, if this proposal is accepted, to provide all necessary machinery, tools, apparatus and other means of construction and will do all work and furnish all material specified in the contract, in the manner and time therein prescribed and in accordance with the requirements therein set forth; and agrees to accept as full compensation therefore, the amount of the summation of the products of the quantities of work and material incorporated in the completed project, as determined by the engineer, multiplied by the respective unit prices herein bid.

It is understood by the bidder that the quantities given in this proposal are a fair approximation of the amount of work to be done and that the sum of the products of the approximate quantities multiplied by the respective unit prices bid shall constitute gross sum bid, which sum shall be used in comparison of bids and awarding of the contract.

The bidder further agrees to perform all extra and force account work that may be required on the basis provided in the specifications.

The bidder further agrees that within 15 calendar days after the contract has been transmitted to him, he will execute the contract and furnish the Department satisfactory surety bonds.

If this proposal is accepted and the bidder fails to execute the contract and furnish bonds as above provided, the proposal guaranty shall become the property of the Department; otherwise, said proposal guaranty will be returned to the bidder; all in accordance with Subsection 103.04.

MANDATORY ELECTRONIC BIDS AND ELECTRONIC BID BONDS SUBMISSION (10/08): This project requires mandatory electronic bidding. All Specifications, whether Standard, Supplemental or Special Provisions, are hereby amended to delete any references regarding paper bids and the ability to submit paper bid forms.

The contractor shall register online to be placed on the Louisiana Department of Transportation and Development (LA DOTD) prospective bidders list or for information only list.

Modifications to proposal documents will be posted on the Department's website at the following URL address: www.dotd.la.gov/cgi-bin/construction.asp.

LA DOTD shall not be responsible if the bidder cannot complete and submit a bid due to failure or incomplete delivery of the files submitted via the internet.

MAINTENANCE OF TRAFFIC (11/13/08): Subsection 104.03 of the 2006 Standard Specifications is amended to include the following requirements.

The contractor shall provide for and maintain local traffic at all times and shall also conduct his operations in such manner as to cause the least possible interference with traffic at junctions with roads, streets and driveways. The contractor will not be required to provide for or maintain through traffic.

When asphaltic concrete pavement is cold planed to a depth of 2 inches (50 mm) or less, the contractor will be permitted to cold plane in one lane for a full day; the adjacent lane may be cold planed the following workday. When the depth of cold planing is greater than 2 inches (50 mm), the contractor shall cold plane approximately 1/2 of each day's production in one lane and the remainder in the adjacent lane.

LATE LANE OPENING ASSESSMENT: All lanes shall remain open to traffic and no work shall be performed except during the times when lane closures are allowed.

Contractor may only close one lane of US Hwy 80 at a time. One lane closure on US 80 will be allowed for the duration of the project.

Contractor shall maintain thru and local traffic at all times for Norris Lane. Single lane daytime lane closures utilizing flagging operations and proper traffic control will be allowed.

Contractor shall maintain thru and local traffic for Downing Pines except Downing Pines may be closed at its intersection of US Hwy 80 for 30 continuous calendar days to perform base and grading operations.

A late lane opening penalty will be charged to the contractor for any lane closure on any roadway which extends beyond the allowable closure times. For this project, a lane is defined as a mainline through-lane on US Hwy 80, Norris Lane and/or Downing Pines. The number of lanes considered closed will be based on the number of lanes available prior to construction versus the number of lanes maintained during any particular hour.

The late lane opening penalty will be assessed at a rate of $1000 per lane per hour up to a maximum of four hours per lane per day. The penalty will be assessed at a rate of $4,000 per lane per day for any closure extending beyond four hours until the next opening period. This penalty will be computed in hour increments only. Fractions of an hour will be rounded up to the next whole hour. For purposes of computing the late lane opening penalty, the period will begin when the contractor closes a lane to traffic and will continue until traffic is restored. The computation of the late lane opening penalty will include moving operations. Any monies assessed for late lane opening penalties will be deducted from partial payments due the contractor, not as a penalty but as stipulated damages.

ENVIRONMENTAL PROTECTION (08/06): Subsection 107.14 of the 2006 Standard Specifications is amended to include the following paragraphs at the end of this subsection.

The project engineer will complete and submit the Small Construction Activity Completion Report to the LADEQ by January 28th of the year following the calendar year of project acceptance and stabilization.

The use of erosion control features or methods other than those in the contract shall be as directed.

The Storm Water Pollution Prevention Plan shall be comprised of Section 204 of the standard specifications along with applicable supplemental specifications and special provisions, and Standard Plan EC-01, "Temporary Erosion Control Details."

SUBLETTING OF CONTRACT (01/83): In accordance with Subsection 108.01 of the Standard Specifications, the following items are designated as "Specialty Items":

Item 731-02-00100, Reflectorized Raised Pavement Markers
Item 732-01-01040, Plastic Pavement Striping (8" Width) (Thermoplastic 90 mil)
Item 732-01-01080, Plastic Pavement Striping (24" width) (Thermoplastic 90 mil)
Item 732-01-02080, Plastic Pavement Striping (24" Width) (Thermoplastic 125 mil)
Item 732-02-02000, Plastic Pavement Striping (Solid Line) (4" Width) (Thermoplastic 90 mil)
Item 732-03-02000, Plastic Pavement Striping (Broken Line) (4" Width) (Thermoplastic 90 mil)
Item 732-04-01020, Plastic Pavement Legends & Symbols (Arrow - Straight)
Item 732-04-01080, Plastic Pavement Legends & Symbols (Arrow - Left Turn)
Item 732-04-01100, Plastic Pavement Legends & Symbols (Arrow - Right Turn)
Item 732-04-15020, Plastic Pavement Legends & Symbols (Only)
Item 732-05-00100, Removal of Existing Markings
Item 732-06-00100, Removal of Existing Raised Pavement Markers
Item 736-04-03080, Signal Support (30' Steel Strain Pole)
Item 736-05-02000, Signal Heads (3 Section, 12" LED Lens, R, Y, G)
Item 736-05-02020, Signal Heads (3 Section, 12" LED Lens, R, Lt. Y, Lt. G)
Item 736-05-04000, Signal Heads (5 Section, 12" LED Lens, R, Lt. Y, Y, Lt. G, G)
Item 736-05-04020, Signal Heads (5 Section, 12" LED Lens, R, Y, Rt. Y, G, Rt. G)
Item 736-08-02000, Signal Controller (TS-2, Type 2; Type 6 Cabinet)
Item 736-10-00200, Underground Junction Box (Type E)
Item 736-10-00500, Underground Junction Box (Type H)
Item 736-11-00300, Conduit (2" HPDE, Schedule 80)
Item 736-11-00400, Conduit (3" HPDE, Schedule 80)
Item 736-12-02000, Conductor (3C, 6 Guage/#6 AWG)
Item 736-12-04000, Conductor (6C, #14 AWG)
Item 736-12-06000, Conductor (10C, #14 AWG)
Item NS-736-00020, Video Detector (MVP) Device
Item NS-736-00400, Video Detection (MVP) System

PROSECUTION OF WORK (12/08): Subsection 108.04, Prosecution of Work of the Standard Specifications as amended by the supplemental specifications thereto, is further amended as follows.

108.04 PROSECUTION OF WORK.

Subpart (a), General is deleted and the following substituted.

(a) General: The contractor shall provide sufficient materials, equipment and labor to complete the project in accordance with the plans and specifications within the contract time. If the completed work is behind the approved progress schedule, the contractor shall take immediate steps to restore satisfactory progress and shall not transfer equipment or forces from uncompleted work without prior notice to, and approval of, the engineer. Each item of work shall be prosecuted to completion without delay. If prosecution of the work is discontinued for

an extended period of time, the contractor shall give the engineer written notice at least 24 hours before resuming operations. The contractor's progress will be determined monthly at the time of each partial estimate, and will be based on the total amount earned by the contractor as reflected by the partial estimate. If the contractor's progress is behind more than 20 percent behind the elapsed contract time, the contractor may be notified that he is not prosecuting the work in an acceptable manner. If requested by the Department the contractor must meet with and provide the project engineer with an acceptable written plan which details how the contractor will re-gain lost progress and prosecute remaining work. If the contractor's progress is more than 30 percent behind the elapsed contract time, the contractor and the surety will be notified that he is not prosecuting the work in an acceptable manner. The contractor must meet with and provide the project engineer with an acceptable written plan which details how the contractor will re-gain lost progress and prosecute remaining work.

Subpart (b), Disqualification is deleted and the following substituted.
(b) Disqualification: A contractor who is in default in accordance with Subsection 108.09(a)(1) of and progress is deficient by 10 percent or more shall be immediately disqualified. The contractor shall remain disqualified until the project has received a final inspection and has been recommended for final acceptance. Should the surety or the Department take over prosecution of the work, the contractor shall remain disqualified for a period of one year from the completion of the project, unless debarment proceedings are instituted.

During the period of disqualification, the contractor will not be permitted to bid on contracts nor be approved as a subcontractor on contracts. Any bid submitted by the contractor during the period of disqualification will not be considered and will be returned.

DETERMINATION AND EXTENSION OF CONTRACT TIME (12/08): Subsection 108.07, Determination and Extension of Contract Time, is amended to include the following.

The contractor shall document for each month of scheduled construction, the occurrence of adverse weather conditions having an impact on controlling items of work. An adverse weather day is a previously scheduled or normally scheduled work day on which rainfall, wet conditions or cold weather will prevent construction operations on the controlling work activity from proceeding for at least 5 continuous hours of the day or 65 percent of the normal work day, whichever is greater, with the normal working force engaged in performing the controlling item of work. If the contractor submits a written request for additional contract time due to adverse weather conditions, the contractor's request will be considered only after the Department agrees with the days and then only for adverse weather days in excess of the allowable number of days per month stated below. Adverse weather days will be documented by the Engineer and agreed upon monthly. Adverse weather days will be prorated for partial months when a work order or final inspection is issued other than the first or last of the month and agreed to by the Department. If the contractor is being considered for disqualification by the Department, an equitable adjustment in contract time may be made at the end of the original contract period, including all days added by approved change orders. Contract time will be adjusted by comparing the actual number of adverse weather days to the statistical number of adverse weather days over the specific time period per the table below. The resulting number of adverse weather days will be multiplied by 1.45 to convert to calendar days. Adjustments for adverse weather cannot result in a contract time reduction. Once adjusted, a new adverse weather day accounting will begin using the adverse weather conditions having an impact on the controlling

items of work, in excess of the allowable number of days per month stated below. A second and final contract time adjustment will then be done at the final acceptance of the project. An adjustment in the contract time due to adverse weather will not be cause for an adjustment in the contract amount. There will be no direct or indirect cost reimbursement for excess adverse weather days.

The following are anticipated adverse weather days that the contractor shall include in each month of his calendar day construction schedule.

January	10 days	May	5 days	September	4 days
February	9 days	June	6 days	October	3 days
March	8 days	July	6 days	November	7 days
April	7 days	August	5 days	December	7 days

PAYMENT ADJUSTMENT (05/06): Section 109, Measurement and Payment of the Standard Specifications is amended to add the following.

This project is not designated for payment adjustments for asphalt cements or fuels.

SUPERPAVE ASPHALTIC CONCRETE MIXTURES (11/08): Section 502, Superpave Asphaltic Concrete Mixtures of the 2006 Standard Specifications as amended by the supplemental specifications thereto, is further amended as follows.

Subsection 502.04, Job Mix Formula Validation.

Delete the first sentence of the sixth paragraph and substitute the following.

A JMF is considered validated if the following parameters are 71 percent within limits of the JMF and meet the specifications requirements.

Subsection 502.05, Plant Quality Control.

Delete the first paragraph and substitute the following.

For quality control purposes, the contractor shall obtain a minimum of two (2) samples of mixture from each sublot using a stratified random sampling approach. Test results for theoretical maximum specific gravity (G_{mm}) and measured bulk specific gravity (G_{mb}) at N_{max} and percent G_{mm} at $N_{initial}$, on samples of each sublot shall be reported. Control charts may be requested by the engineer if mixture problems develop. Quality control gyratory samples may be aged or unaged at the contractor's option, but the method chosen shall be used consistently throughout the project. If aged samples are used, report the measured G_{mb} at N_{max}. If unaged samples are used, report the estimated G_{mb} at N_{max}. One loose mix sample shall be taken from each sublot after placement of the mix in the truck. The mix shall be tested by the contractor at the plant for aggregate gradation, asphalt content and percent crushed aggregate. The mix shall be tested in accordance with DOTD TR 309, TR 323 and TR 306. The lot average and standard deviation shall be determined for aggregate gradation and asphalt content. The percent within limits (PWL) shall be determined on the Nos. 8 and 200 (2.36 mm and 75 μm) sieves and for G_{mm}. Corrective action shall be taken if these parameters fall below 71 PWL. For each lot, the contractor shall report all quality control data to the DOTD Certified Plant Technician. The full range of gradation mix tolerances will be allowed even if they fall outside the control points.

The District Laboratory Engineer may require re-validation of the mix when the average of the Quality Control data indicates non-compliance with the specified limits or tolerances.

Subsection 502.15, Measurement.
Subheading (c), Surface Tolerance Incentive Measurement.
Delete the first paragraph and substitute the following.

At the completion of construction of the project, an independent certified profiler such as that of a private company or the Materials and Testing Section, approved by the Department, shall be used to measure a continuous profile from the start station to the end station of the construction project for the purpose of determining qualification for incentive pay under Subsection 502.16(e). Bridges and 300 feet (90 m) on each end of the bridge will be excluded from measurements for surface tolerance incentive pay.

Delete Table 502-7A, Payment Adjustment Schedule for Plant Acceptance and substitute the following.

Table 502-7A
Payment Adjustment Schedule for Plant Acceptance

Air Voids PWL (90 AQL)	Percent Payment
71-100	100
61-70	90
51-60	80
≤50	50 or Remove[1]

[1]At the option of the Department after investigation.

Delete Table 502-7B, Payment Adjustment Schedule for Roadway Density and substitute the following.

Table 502-7B
Payment Adjustment Schedule for Roadway Density

Roadway Density PWL (90 AQL)	Percent Payment
99-100	102
81-98	100
71-80	95
51-70	80
≤50	50 or Remove[1]

[1]At the option of the Department after investigation.

Delete Table 502-8A, Payment Adjustment Schedules for Longitudinal Surface Tolerance, Maximum International Roughness Index, inches per mile (mm per km) and substitute the following.

Table 502-8A
Payment Adjustment Schedules for Longitudinal Surface Tolerance, Maximum International Roughness Index, inches per mile (mm per km)

Percent of Contract Unit Price (by Sublot)[1]	102%[2]	100%	90%	80%	50% or Remove[3]
Category A All Interstates, Multi-Lift New Construction and Overlays of More than two Lifts	<45 (<710)	<65 (<1030)	65-75 (1030-1180)	NA	>75 (>1180)
Category B One or Two Lift Overlays Over Cold Planed Surfaces, and Two-Lift Overlays Over Existing Surfaces[4]	<55 (<870)	<75 (<1180)	75-89 (1180-1400)	NA	>89 (>1400)
Category C Single-Lift Overlays Over Existing Surfaces[4]	N/A	<85 (<1340)	85-95 (1340-1500)	>95-110 (>1500-1740)	>110 (>1740)
Longitudinal Surface Tolerance Incentive Pay, Final Completion, Average of All Travel Lanes[5]	≤ 45 (≤ 710)				

[1]Or portion of sublot placed on the project.
[2]Maximum payment for sublots with exception areas, exclusions or grinding is 100 percent, unless the excluded area is a bridge end.
[3]At the option of the engineer.
[4] Existing surfaces include reconstructed bases without profile grade control.
[5]Only Category A projects are eligible for incentive. However, any grinding except within 300 feet (90 m) of a bridge end will cause the roadway to be ineligible for surface tolerance incentive pay. Measurements must be verified by an independent entity.

Delete Table 502-8B, Individual Wheelpath Deficient Area Limits, Maximum International Roughness Index, Inches per Mile (mm per km) and substitute the following.

Table 502-8B
Individual Wheelpath Deficient Area Limits
Maximum International Roughness Index, inches per mile (mm per km)

Any 0.05 Mile (0.08 km) Segment	Wearing Course	Binder Course
Category A	89 (1400)	130 (2050)
Category B	99 (1560)	150 (2370)
Category C	N/A	N/A

TEMPORARY TRAFFIC CONTROL (03/09): Section 713 of the 2006 Standard Specifications and the Supplemental Specifications is amended as follows:

Subsection 713.04, Temporary Signs and Barricades, is amended to include the following:

(d) Project Signs: The contractor shall furnish, install, maintain, and upon completion of the project remove "project signs" in accordance with the following requirements.

Project signs shall conform to the requirements of Section 713 and the project sign detail contained elsewhere herein. Shop drawings will be furnished to the successful bidder by contacting the Department's Traffic Services Sign Shop at (225) 935-0121 or (225) 935-0142.

Project signs shall be required at the beginning and end of the project and shall follow sign G-20-1, "Road Work Next 'X' Miles", or as directed by the engineer.

Payment for project signs shall be included in the contract unit price for Item 713-01 Temporary Signs and Barricades.

Payment for all project signs within this subsection shall include all labor, materials, tools, and equipment required to complete the work and shall be included in the contract unit price for Item 713-01 Temporary Signs and Barricades.

PLASTIC PAVEMENT MARKINGS (09/07): Section 732 of the 2006 Standard Specifications and the supplemental specifications thereto, is amended as follows.

Subsection 732.03, Construction Requirements for Plastic Pavement Marking Material.

Heading (a) is amended as follows.

The first paragraph is deleted and the following substituted.

(a) Equipment for Standard (Flat) Thermoplastic Marking Material: The application equipment shall consist of an extrusion die or a ribbon gun that simultaneously deposits and shapes lines at a thickness of 90 mils (2.3 mm) or greater on the pavement surface. When restriping onto existing thermoplastic markings, only a ribbon gun shall be used. Finished markings shall be continuous and uniform in shape, and have clear and sharp dimensions. Applicators shall be capable of producing various widths of traffic markings. Applicators shall produce sharply defined lines and provide means for cleanly cutting off stripe ends and applying broken lines. The ribbon extrusion die or shaping die shall not be more than 2 inches (50 mm) above the roadway surface during application. A spray application will only be allowed when applying 40 mil (1.0 mm) thermoplastic.

Heading (e) is deleted and the following substituted.

(e) Application of Surface Primer: A single component surface primer will be required prior to placement of preformed plastic markings over an existing painted stripe, over oxidized asphalt, or when striping over existing thermoplastic on portland cement concrete surfaces unless otherwise directed by the engineer. A two component epoxy primer sealer will be required prior to placement of thermoplastic materials on portland cement concrete surfaces unless otherwise directed by the engineer.

ASPHALT MATERIALS AND ADDITIVES (04/08): Section 1002 of the 2006 Standard Specifications and the supplemental specifications thereto is amended as follows.

Subsection 1002.02, Asphalt Material Additives is amended as follows.

Table 1002-1, Performance Graded Asphalt Cements is deleted and the following substituted.

Table 1002-1
Performance Graded Asphalt Cements

Property	AASHTO Test Method	PG82-22rm[6]	PG76-22m	PG70-22m	PG64-22	PG58-28
		Spec.	Spec.	Spec.	Spec.	Spec.
Tests on Original Binder:						
Rotational Viscosity @ 135°C, Pa·s [1]	T 316	3.0	3.0	3.0	3.0	3.0
Dynamic Shear, 10 rad/s, G*/Sin Delta, kPa	T 315	1.00+ @ 82°C	1.00+ @ 76°C	1.00+ @ 70°C	1.30+ @ 64°C	1.00+ @ 58°C
Flash Point, °C	T 48	232+	232+	232+	232+	232+
Solubility, % [2]	T 44	N/A	99.0+	99.0+	99.0+	99.0+
Separation of Polymer, 163°C, 48 hours, degree C difference in R & B from top to bottom [5] .	ASTM D 7173 AASHTO T 53	---	2-	2-	---	---
Force Ductility Ratio (f_2/f_1, 4°C, 5 cm/min., f_2 @ 30 cm elongation)[3]	T 300	---	0.30+	---	---	---
Force Ductility, (4°C, 5 cm/min, 30 cm elongation, kg)[3]	T 300	---	---	0.23+	---	---
Tests on Rolling Thin Film Oven Residue:	T 240					
Mass loss, %	T 240	1.00-	1.00-	1.00-	1.00-	1.00-
Dynamic Shear, 10 rad/s, G*/Sin Delta, kPa	T 315	2.20+ @ 82°C	2.20+ @76°C	2.20+ @ 70°C	2.20+ @ 64°C	2.20+ @ 58°C
Elastic Recovery, 25°C, 10 cm elongation, % [4]	T 301	60+	60+	40+	---	---
Ductility, 25°C, 5 cm/min, cm	T 51	---	---	---	100+	---
Tests on Pressure Aging Vessel Residue:	R 28					
Dynamic Shear, @ 25°C, 10 rad/s, G* Sin Delta, kPa	T 315	5000-	5000-	5000-	5000-	5000- @ 19°C
Bending Beam Creep Stiffness, S, MPa @ -12°C.	T 313	300-	300-	300-	300-	300- @ -18°C
Bending Beam Creep Slope, m value,@ -12°C	T 313	0.300+	0.300+	0.300+	0.300+	0.300+ @ -18°C

[1]The rotational viscosity will be measured to determine product uniformity. The rotational viscosity measured by the supplier shall be noted on the Certificate of Delivery. A binder having a rotational viscosity of 3.0 Pa·s or less will typically have adequate mixing and pumping capabilities. Binders with rotational viscosity values higher than 3.0 Pa·s should be used with caution and only after consulting with the supplier as to any special handling procedures and guarantees of mixing and pumping capabilities.

[2]Not all polymers are soluble in the specified solvents. If the polymer modified asphalt digested in the solvent will not pass the filter media, a sample of the base asphalt used in making the polymer modified asphalt should be tested for solubility. If the solubility of the base asphalt is at least 99.0%, the material will be considered as passing.

[3]AASHTO T 300 except the second peak (f2) is defined as the stress at 30 cm elongation.

[4]AASHTO T 301 except elongation shall be 10 cm.

[5]Prepare samples per ASTM D 7173. Determine softening point of top and bottom per AASHTO T 53.
[6]The quality assurance plan for this product will require the contractors who use this material to submit written documentation of tank cleaning annually. Contractors must have tank mixers. Written certificates of analysis from the asphalt binder supplier confirming rubber source and size distribution of rubber used shall be furnished to the Materials Laboratory.

Add the following Table 1002-12, Anionic Trackless Tack Coat Grade NTSS-1HM.

Table 1002-12
Anionic Trackless Tack Coat Grade NTSS-1HM

Property	AASHTO Test Method	Specification Deviation	
		100% Pay	50% Pay or Remove[1]
Viscosity, Saybolt Furol @ 25°C, s	T 59	15 - 100	---
Storage Stability, 24 Hour, %	T 59	1.0-	---
Settlement, 5 Days, %	T 59	5.0-	---
Residue by Distillation, %	T 59	50+	49-
Oil Distillate, %	T 59	1.0-	---
Sieve Test[2], (Retained on the 850 μm), %	T 59	0.3-	---
Tests on Residue			
Penetration @ 25°C, 100g, 5s, dmm	T 49	20-	---
Softening Point, Ring and Ball, °C	T 53	65+	64-
Solubility, %	T 44	97.5+	---
DSR @ 25°C; G*Sin δ, 10 rad / s, kPa	T 315	1.0+	---

[1] At the option of Engineer.
[2] Sieve tests may be waived if no application problems are present in the field.

BASE COURSE AGGREGATES (07/08): Subsection 1003.03 of the 2006 Standard Specifications is amended to include the following.

(e) Blended Calcium Sulfate: When blended calcium sulfate base course material is allowed on the plans, it shall consist of calcium sulfate from a source approved by the Materials and Testing Section and be blended with an approved aggregate or lime. The source shall have a quality control program approved by the Materials and Testing Section. The source shall have been given environmental clearance by the Department of Environmental Quality for the intended use, and written evidence of such environmental clearance shall be on file at the Materials and Testing Section. DOTD monitoring for compliance with environmental regulations will be limited to the pH testing stated herein below. The blended material shall be non-plastic and reasonably free from organic and foreign matter. The pH shall be a minimum of 5.0 when tested in accordance with DOTD TR 430. Re-evaluation will be required if the source of the aggregate or lime that is blended with the calcium sulfate changes.

Blended calcium sulfate material used as base course shall comply with the following gradation requirements when tested in accordance with DOTD TR 113, modified to include a maximum drying temperature of 140°F (60°C). Sampling shall be taken from an approved stockpile at the point of origin.

U.S. Sieve	Metric Sieve	Percent Passing

1-1/2 inch	37.5 mm	60 - 100
1 inch	25.0 mm	40 - 80
3/4 inch	19.0 mm	30 - 70
No. 4	4.75 mm	20 - 65
No. 200	75 μm	0 - 25

Blended calcium sulfate shall be sampled in accordance with the requirements for stone in Section 302 of the Materials Sampling Manual.

ITEMS NS-500-00220, NS-500-00240 AND NS-500-00260, SAWING AND SEALING LONGITUDINAL AND TRANSVERSE JOINTS IN ASPHALTIC CONCRETE OVERLAY, AND SAWCUTS IN ASPHALTIC CONCRETE LIFTS (07/01): These items consist of sawing and sealing longitudinal and transverse joints in asphaltic concrete overlay and sawcuts in asphaltic concrete lifts in accordance with plan details and the following requirements.

Sawcuts shall be made in the overlay at the locations of all transverse and longitudinal joints in the concrete pavement, the existing joint between concrete pavement and asphaltic concrete shoulder and the existing joint between the concrete pavement and concrete shoulder. Before the overlay operation is started, the contractor shall accurately mark the location of each transverse joint in the existing concrete pavement and shoulder to the satisfaction of the engineer by placing a hub with a tack even with the ground at each edge of shoulder or by other approved methods. Offsets shall be measured from these hubs and tacks to locate the longitudinal joints.

All asphaltic concrete lifts shall be saw cut a minimum of 1/8 inch (3 mm) wide by 1 inch (25 mm) deep over the existing longitudinal and transverse concrete pavement joints. These saw cuts shall be made after the overlay has thoroughly cooled and shall be completed within 3 calendar days after each lift is placed, before any reflective cracking has developed or other courses placed.

Both longitudinal and transverse joint reservoirs in the final wearing course shall be sawed to the dimensions shown on the plans. Sawing shall not begin until the overlay has thoroughly cooled. Joint faces shall be blown free of sawing slurry, dirt and water by compressed air just prior to resealing. The air compressor shall be equipped with an approved oil and water trap. The joint shall be dry before sealing. Joints which have become contaminated or dirty before sealing shall be recleaned as directed by the engineer.

An approved backer material conforming to Subsection 1005.02(a) and consisting of a closed-cell, crossed linked polyethylene or polyolefin 3/16-inch (5 mm) foam rod shall be placed as shown on the plans. The longitudinal and transverse joints shall be sealed with a sealant conforming to Subsection 1005.02(a) in accordance with plan details and the manufacturer's recommendations. The sealing operation shall be done as soon as possible after the sawing and cleaning and before traffic, including construction traffic, is allowed on the overlay. The sealed joints shall remain closed to traffic until, in the engineer's opinion, the sealant has satisfactorily cured to tack free.

The hot poured sealant shall be sampled in accordance with the Materials Sampling Manual.

Measurement of sawing and sealing longitudinal and transverse joints in asphaltic concrete pavement will be made by the linear foot (lin m) along the sealant reservoirs in the final

wearing course. Measurement of sawcuts in asphaltic concrete lifts will be made by the linear foot (lin m) along the sawcuts in each lift.

Payment for sawing and sealing longitudinal and transverse joints in asphaltic concrete overlay will be made at the contract unit price, which includes locating and marking the joints, sawing the sealant reservoirs in the final wearing course, cleaning the sawed sealant reservoirs, backer material in the transverse joints, joint sealant, and all labor, equipment and incidentals necessary to complete these items. Payment for sawcuts in the asphaltic concrete lifts will be made at the contract unit price which includes locating the joints in each lift of asphaltic concrete, sawcuts in each lift of asphaltic concrete and all labor, equipment and incidentals necessary to complete this item.

Payment will be made under:

Item NS-500-00220, Sawing and Sealing Longitudinal Joints in Asphaltic Concrete Overlay, per linear foot (lin m).

Item NS-500-00240, Sawing and Sealing Transverse Joints in Asphaltic Concrete Overlay, per linear foot (lin m).

Item NS-500-00260, Sawcuts in Asphaltic Concrete Lifts, per linear foot (lin m).

ITEM NS-500-00360, SAW CUTTING ASPHALTIC CONCRETE PAVEMENT OVER PORTLAND CEMENT CONCRETE COMPOSITE PAVEMENT (05/08): This item consists of furnishing all equipment, labor, materials and incidentals to perform saw cutting of existing asphaltic concrete pavement over portland cement concrete composite pavement as shown on the plans or directed by the Project Engineer.

The saw cutting will be measured and paid at the contract unit price per inch depth of portland cement concrete pavement cut times the linear foot of cut. Asphaltic concrete pavement over portland cement pavement shall be considered incidental to the composite section cut.

Payment will be made at the contract unit price under:

Item NS-500-00360, Saw Cutting Asphaltic Concrete Pavement Over Portland Cement Concrete Composite Pavement, per inch depth-linear foot.

ITEM NS-600-00220, SAW CUTTING PORTLAND CEMENT CONCRETE PAVEMENT (05/08): This item consists of furnishing all equipment, labor, materials and incidentals to perform saw cutting of existing portland cement concrete pavement as shown on the plans or as directed by the Project Engineer.

The saw cutting will be measured and paid at the contract unit price per inch (mm) depth of cut times the linear foot (lin. meter) of cut.

Payment will be made at the contract unit price under:

Item NS-600-00220, Saw Cutting Portland Cement Concrete Pavement, per inch (mm) depth-linear foot (lin. meter).

ITEM NS-MSC-00120, DRAINAGE STRUCTURE (01/09): Furnish and install, or construct in place miscellaneous drainage structures at the locations and in conformity with the lines, grades and dimensions shown in the plans or established by the Engineer. Typical structure types may include but is not limited to, manholes, junction boxes, catch basins, culvert end treatments and safety ends, cast-in-place box culverts, precast box culverts, precast concrete pipe, or precast concrete arch pipe; or any combination thereof. Include all gasket materials, sealants, varnishes, etc. to provide watertight connections to pipes and other structures as may be

required to complete the item, as shown on the plans or required by the Engineer. Comply with plan details and referenced Sections of the *Louisiana Standard Specifications for Roads and Bridges* as indicated in the general notes of the drainage structure special details included elsewhere herein.
MATERIALS: Comply with plan details and referenced Sections of the *Louisiana Standard Specifications for Roads and Bridges* as indicated in the general notes of the drainage structure special details included elsewhere herein.
CONSTRUCTION REQUIREMENTS: Comply with plan details and referenced Sections of the *Louisiana Standard Specifications for Roads and Bridges* as indicated in the general notes of the drainage structure special details included elsewhere herein.
MEASUREMENT: Excavation and backfill required for installation of these units will not be measured for payment. Measurement will be made by the unit, per each.
PAYMENT: Payment for drainage structures, including all materials, tools, equipment, labor and incidentals necessary to complete the work will be made at the contract unit price, per each.

Payment will be made under:

Item NS-MSC-00120, Drainage Structure, per each.

Item NS-736-00020 and Item NS-736-00040, Video Detector (MVP) Device and Video Detection (MVP) System (11/08)

DESCRIPTION. These items consist of furnishing all necessary equipment, labor and material to install Video Detector Device and Video Detection System as described in these specifications.
EQUIPMENT REQUIREMENTS.

1.1. System Hardware

The machine vision system hardware shall consist of three components: 1) a color, 22x zoom, MVP sensor 2) a modular cabinet interface unit 3) a communication interface panel. The real-time performance shall be observed by viewing the video output from the sensor with overlaid flashing detectors to indicate the current detection state (on/off). The MVP sensor shall be able to store cumulative traffic statistics internally in non-volatile memory for later retrieval and analysis.
The MVP shall communicate to the modular cabinet interface unit via the communications interface panel and the software applications using the industry standard TCP/IP network protocol. The MVP shall have a built-in, Ethernet-ready, Internet Protocol (IP) address and shall be addressable with no plug in devices or
converters required. The MVP shall provide standard MPEG-4 streaming digital video. Achievable frame rates shall vary from 5 to 30 frames/sec as a function of video quality and available bandwidth.
The modular cabinet interface unit shall communicate directly with up to eight (8) MVP sensors and shall comply with the form factor and electrical characteristics to plug directly into a NEMA type C or D detector rack providing up to thirty-two (32) inputs and sixty-four (64) outputs or a 170 input file rack providing up to sixteen (16) contact closure inputs and twenty-four (24) contact closure outputs to a traffic signal controller.
The communication interface panel shall provide four (4) sets of three (3) electrical terminations for three-wire power cables for up to eight (8) MVP sensors that may be mounted on a pole or mast arm with a traffic signal cabinet or junction box. The communication interface panel shall provide high-energy transient protection to electrically protect the modular cabinet interface unit

and connected MVP sensors. The communications interface panel shall provide single-point Ethernet connectivity via RJ45 connector for communication to and between the modular cabinet interface module and the MVP sensors.

1.2. System Software

The MVP sensor embedded software shall incorporate multiple applications that perform a variety of diagnostic, installation, fault tolerant operations, data communications, digital video streaming, and vehicle detection processing. The detection shall be reliable, consistent, and perform under all weather, lighting, and traffic congestion levels. An embedded web server shall permit standard internet browsers to connect and perform basic configuration, maintenance, and video streaming services.

There shall be a suite of client applications that reside on the host client / server PC. The applications shall execute under Microsoft Windows XP or Vista. Available client applications shall include:

- Master network browser: Learn a network of connected modular cabinet interface units and MVP sensors, display basic information, and launch applications software to perform operations within that system of sensors.
- Configuration setup: Create and modify detector configurations to be executed on the MVP sensor and the modular cabinet interface unit.
- Operation log: Retrieve, display, and save field hardware run-time operation logs of special events that have occurred.
- Software install: Reconfigure one or more MVP sensors with a newer release of embedded system software.
- Streaming video player: Play and record streaming video with flashing detector overlay.
- Data retrieval: Fetch once or poll for traffic data and alarms and store on PC storage media.
- Communications server: Provide fault-tolerant, real-time TCP/IP communications to / from all devices and client applications with full logging capability for systems integration.

2. Functional Capabilities

2.1. MVP Sensor

The MVP sensor shall be an integrated imaging color CCD array with zoom lens optics, high-speed, dual-core image processing hardware bundled into a sealed enclosure. The CCD array shall be directly controlled by the dual-core processor, thus providing high-quality video for detection that has virtually no noise to degrade detection performance. It shall be possible to zoom the lens as required for setup and operation. It shall provide JPEG video compression as well as standard MPEG-4 digital streaming video with flashing detector overlay. The MVP shall provide direct real-time iris and shutter speed control. The MVP image sensor shall be equipped with an integrated 22x zoom lens that can be changed using configuration computer software. The digital streaming video output and all data communications shall be transmitted over the three-wire power cable.

2.1.2. Power

The MVP sensor shall operate on 110/220 VAC, 50/60Hz at a maximum of 25 watts. The camera and processor electronics shall consume a maximum of 10 watts and the remaining 15 watts shall support an enclosure heater.

2.1.3. Detection Zone Programming

Placement of detection zones shall be by means of a PC with a Windows XP or Vista operating system, a keyboard, and a mouse. The PC monitor shall be able to show the detection zones superimposed on images of traffic scenes.

The detection zones shall be created by using a mouse to draw detection zones on the PC monitor. Using the mouse and keyboard it shall be possible to place, size, and orient detection zones to provide optimal road coverage for vehicle detection. It shall be possible to download detector configurations from the PC to the MVP sensor and cabinet interface module, to retrieve the detector configuration that is currently running in the MVP sensor, and to back up detector configurations by saving them to the PC fixed disks or other removable storage media.

The supervisor computer's mouse and keyboard shall be used to edit previously defined detector configurations to permit adjustment of the detection zone size and placement, to add detectors for additional traffic applications, or to reprogram the MVP sensor for different traffic applications or changes in installation site geometry or traffic rerouting.

2.2. Detection Types

The MVP shall be able to be programmed with a variety of detector types that perform specific functions. Detector types shall include the following:

a) Count Detector--outputs traffic volume statistics;
b) Presence Detector--indicates presence of a vehicle, stopped vehicle, or vehicles traveling the wrong direction;
c) Speed Detector--provides vehicle speed, length, classification, volume, density and traffic flow statistics;
d) Detector Function--combines outputs of multiple detector types via Boolean logic functions and allows timing extensions and delays. Similar to the Contrast Detector below, it monitors video signal quality in multiple detection zones.
e) Station--accumulates traffic data over user specified time intervals, including cycle splits for intersection applications;
f) Input Label Detector--provides states of a user-provided input signal;
g) Speed Alarm--generates an alarm output based on user-defined speed and volume thresholds;
h) Contrast Detector--monitors video signal quality and provides an optical fail safe alarm feature. The Contrast Detector shall be able to monitor specific areas of a detection zone.
i) Incident Detector--operates an incident detection algorithm which monitors speed and occupancy data from individual traffic lanes to detect the shock wave effects which propagate upstream from a capacity-reducing incident that occurs outside the camera field of view. It shall be adjustable for regularly recurring congestion.
j) Scheduler--controls detector operation based upon a user-defined time schedule;
k) Label--displays system or user-defined static or dynamic information on the output video of the MVP, including titles and bitmap graphics.

l) Lane Detector-- generates an alarm for stopped vehicle (default setting), a slow vehicle, or a wrong-way vehicle along an entire outdoor traffic lane within the field of view.

m) Tunnel Detector--generates an alarm for stopped vehicle (default setting), a slow vehicle, or a wrong-way vehicle along an entire tunnel lane within the field of view.

2.2.1. The speed detector shall report vehicle speed and vehicle classification based on five user-defined length categories, satisfying the four generalized category requirement recommended by FHWA.

2.2.2. Multiple detector outputs shall be able to be combined together via OR, AND, NAND, and N of M logical functions. In addition, the MVP shall be able to condition the detector outputs based on the state of associated input signals. The following detector output types shall be available:

a) Type 0 -- send a call for every vehicle presence detected;
b) Type 1 -- extends a call on Green, delays a call on NOT Green;
c) Type 2 -- both Extends and Delays a call on Green, no change to call on NOT Green;
d) Type 3 -- provides Stop Bar detection;
e) Type 4 -- provides Stop Bar detection with a timer;
f) Type 5 -- provides Stop Bar detection with a reset timer;
g) Type 6 -- enables a call when the input phase is Red;
h) Type 8 -- provides Dilemma Zone detection, based on the speed of the vehicle;
i) Type 9 -- provides moving vehicle detection and time validation during Red;
j) Type 10 -- arbitrates between individual Contrast Loss detectors to determine video quality loss.

2.2.3. Each MVP shall be able to detect the absence of a valid video signal on each image sensor input. Upon detecting the absence of a valid video signal, the MVP shall place all the detector outputs associated with the failed image sensor input into a fail-safe ON state known as recall.

2.2.4. Each MVP shall be able to detect when the quality of the video input from the image sensor is not sufficient to enable vehicle detection (e.g., when environmental conditions obscure the sensor view). Use of this video loss detection capability shall be selectable by the user. If a video loss failure is detected, the MVP shall place the detector outputs associated with the failed sensor on minimum recall, maximum recall, or fixed time recall as selected by the user.

2.3. Interval Traffic Data

2.3.1. Each MVP shall count vehicles in real-time and compute the average of traffic parameters over user-defined time intervals (or time slices), as follows:

a) Volume -- number of vehicles detected during the time interval;
b) Occupancy -- detector occupancy measured in percent of time;
c) Vehicle Classification -- number of vehicles in each of five classes, as defined by vehicle length in feet or meters;
d) Flow Rate -- vehicles per hour per lane;
e) Headway -- average time interval between vehicles;
f) Speed -- time mean and space mean vehicle speed in mi/hr;

g) Level of Service -- determined by user-defined thresholds for average speed or capacity flow rates;
h) Space Occupancy -- sum of the vehicle lengths divided by average distance traveled during the time interval measured as percent;
i) Density -- flow rate divided by space mean speed expressed in vehicles/km or vehicles/mi.

2.3.2. The duration of the time intervals (or time slices) shall be user-customizable as per signal control cycle or 10, 20, or 30 seconds, or 1, 5, 10, 15, 30, or 60 minutes, or any other arbitrary time interval of choice.

2.3.3. It shall be possible to poll the MVP for traffic flow, vehicle presence, or event alarm data during normal operation when connected to a computer with serial communications.

Furthermore, an option to minimize data loss, called persistent polling, shall be provided to collect time interval data when the MVP is not connected to a computer. It shall operate as follows: When the communication link to the traffic management computer is cutoff temporarily, for whatever reason, the MVP shall write the persistent poll data to non-volatile EEPROM flash memory. At such time as the link is restored, the persistent poll data shall be transferred to the traffic management computer. Thus though delayed, there is no loss of data due to communications link failures. This shall also allow the use of dial-up modem applications to be scheduled, for example daily or weekly calls, to collect all data since last connection was made.

Finally, the option for persistent polling shall begin accumulating and storing defined poll data to flash memory if needed after system reboot, as may be caused by local mains power failures.

2.3.4. Using the persistent polling technique above, it shall be possible to save the time-interval data in non-volatile EEPROM flash memory within the MVP for later transfer to the supervisor computer for analysis.

2.3.5. Retrieval of real-time poll data or persistent poll data stored in the memory of the MVP shall be via a serial communications port or integrated Ethernet port using manufacturer provided software tools. Provision shall be made for transfer of data via a modem and dial-up telephone lines, via private cable, fiber optic network, wireless system, Ethernet or via direct connection to another computer by serial cable.

2.3.6. Each MVP shall provide an optional power line monitor to ensure the accuracy of its internal clock.

2.4. Optimal Detection

The video detection system shall optimally detect vehicle passage and presence when the MVP sensor is mounted 30 feet (10 m) or higher above the roadway, when the image sensor is adjacent to the desired coverage area, and when the distance to the farthest detection zone locations are not greater than ten (10) times the mounting height of the MVP. The recommended deployment geometry for optimal detection also requires that there be an unobstructed view of each traveled lane where detection is required. Although optimal detection may be obtained when the MVP is mounted directly above the traveled lanes, the MVP shall not be required to be directly over the roadway. The

MVP shall be able to view either approaching or receding traffic or both in the same field of view. The preferred MVP sensor orientation shall be to view approaching traffic since there are more high contrast features on vehicles as viewed from the front rather than the rear. The MVP sensor placed at a mounting height that minimizes vehicle image occlusion shall be able to simultaneously monitor a maximum of six (6) traffic lanes when mounted at the road-side or up to eight (8) traffic lanes when mounted in the center with four lanes on each side.

2.5. Modular Cabinet Interface Unit

The modular cabinet interface unit shall provide the hardware and software means for up to eight (8) MVP sensors to communicate real-time detection states and alarms to a local traffic signal controller. It shall comply with the electrical and protocol specifications of the detector rack standards. The card shall have 1500 Vrms isolation between rack logic ground and street wiring.

The modular cabinet interface unit shall be a simple interface card that plugs directly into a 170 input file rack or a NEMA type C or D detector rack. The modular cabinet interface unit shall occupy only 2 slots of the detector rack. The modular cabinet interface unit shall accept up to sixteen (16) phase inputs and shall provide up to twenty-four (24) detector outputs.

2.6. Communications Interface Panel

The communications interface panel shall support up to eight MVPs. The communications interface panel shall accept 110/220 VAC, 50/60 Hz power and provide predefined wire termination blocks for MVP power connections, a Broadband-over-Power-Line (BPL) transceiver to support up to 10MB/s interdevice communications, electrical surge protectors to isolate the modular cabinet interface unit and MVP sensors, and an interface connector to cable directly to the modular cabinet interface unit.

The interface panel shall provide power for up to eight (8) MVP sensors, taking local line voltage 110/220 VAC, 50/60 Hz and producing 110/220 VAC, 50/60 Hz, at about 30 watts to each MVP sensor. Two ½-amp SLO-BLO fuses shall protect the communications interface panel.

3. System Installation & Training

The supplier of the video detection system may supervise the installation and testing of the video detection system and computer equipment as required by the contracting agency.

Training shall be available to personnel of the contracting agency in the operation, set up, and maintenance of the video detection system. The MVP sensor and its support hardware / software shall be a sophisticated leading-edge technology system. Proper instruction from certified instructors shall be recommended to ensure that the end user has complete competency in system operation. The User's Guide is not an adequate substitute for practical classroom training and formal certification by an approved agency.

4. Warranty, Service, & Support

For a minimum of two (2) years, the supplier shall warrant the video detection system. Ongoing software support by the supplier shall include software updates of the MVP sensor, modular

cabinet interface unit, and supervisor computer applications. These updates shall be provided free of charge during the warranty period. The supplier shall maintain a program for technical support and software updates following expiration of the warranty period. This program shall be available to the contracting agency in the form of a separate agreement for continuing support.
CONSTRUCTION REQUIREMENTS.
The contractor shall be responsible to provide the necessary hardware for the camera assembly, installation, and operation to detect and or count vehicles as shown in the plans.

This specification sets forth the minimum requirements for a system that monitors vehicles on a roadway via processing of video images. The detection of vehicles passing through the field-of-view of an image sensor shall be made available to a large variety of end user applications as simple contact closure outputs that reflect the current real-time detector or alarm states (on/off) or as summary traffic statistics that are reported locally or remotely. The contact closure outputs shall be provided to a traffic signal controller and comply with the National Electrical Manufacturers Association (NEMA) type C or D detector rack or 170 input file rack standards.

The system architecture shall fully support Ethernet networking of system components through a variety of industry standard and commercially available infrastructures that are used in the traffic industry. The data communications shall support direct connect, [modem,] and multi-drop interconnects. Simple, standard Ethernet wiring shall be supported to minimize overall system cost and improve reliability, utilizing existing infrastructure and ease of system installation and maintenance. Both streaming video and data communications shall, if specified in the plans, be interconnected over long distances through fiber optic, microwave, or other commonly used digital communications transport configurations.
MEASUREMENT.

Video Detector (MVP) Device, per each shall include all required materials, tools, equipment, labor, and incidentals required to install each video detection device as described above, including the cable connection to the controller cabinet, and fully functioning, per each as indicated on the plans.

Video Detection (MVP) System (Intersection) per each shall include all required materials, tools, equipment, labor, incidentals as described above, and fully functioning for the proper operation of the system.
PAYMENT. Payment for Video Detector (MVP) Device and Video Detection (MVP) System will be made at the contract price and shall be full compensation for furnishing all materials, tools, equipment, labor, and incidentals required to perform all work as described above or as directed by the engineer.
Payment for the Video Detector (MVP) Device will be paid at the contract price under:

Item No.	Pay Item	Pay Unit
NS-736-00020	Video Detector (MVP) Device	Per Each
NS-736-00040	Video Detection (MVP) System	Per Each

ITEM NS-713-00001, DYNAMIC MESSAGE SIGN UNIT (12/04): This work consists of furnishing, operating and maintaining solar powered portable dynamic (changeable) message signs to be used at locations designated on the plans or as directed by the engineer.

The dynamic message sign shall be in good operational condition when delivered to the job site. The engineer will inspect the signs, and if they are found to be in good operational condition with all working parts functioning, the signs will be approved for use on the project.

The message sign shall consist of three separate lines. Each line shall consist of eight characters. Each character shall nominally be 18 inches (450 mm) in height. The width shall be adequate to meet the below legibility requirements. Each character shall be a 5 x 7 LED module or hybrid LED disk. Characters shall be separated at a distance such that the legibility requirements are maintained.

All internally illuminated portions of the sign shall be amber in color. All other illuminated surfaces meant for message display shall be fluorescent yellow. All other surfaces on the front panel shall be flat black in color.

The sign shall be clearly visible under all conditions and all lanes of travel from a distance of 1000 feet (300 m) perpendicular to the sign center. The sign shall maintain this legibility throughout the entire project. The contractor shall be responsible for maintaining this minimum legibility. Determination of legibility distance shall rest solely with the engineer.

The portable dynamic message sign shall be used in conjunction with other traffic signs and devices in accordance with the plans, project specifications and as directed by the engineer.

The signs shall be stored in an approved secure storage area when not in use. The contractor shall be required to perform all maintenance operations recommended by the manufacturer and keep adequate records of such operations.

The signs shall be kept clean and in good repair at all times. This includes keeping unit clean.

Measurement of the dynamic message sign unit will be per each.

Payment for the dynamic message signs will be made at the contract unit price per each which will be full compensation for furnishing, operating, relocating and maintaining the unit during the life of the contract and includes all equipment, tools, labor and incidentals necessary for this item of work.

Payment will be made under:

Item NS-713-00001, Dynamic Message Sign Unit, per each.

CONTRACT TIME (03/05): The entire contract shall be completed in all details and ready for final acceptance in accordance with Subsection 105.17(b) within **one hundred twenty (120) calendar days**. Prior to assessment of contract time, the contractor will be allowed 15 calendar days from the date stipulated in the Notice to Proceed to commence with portions of the contract work including but not limited to assembly periods, preparatory work for materials fabrications such as test piles, or other activities which hinder progress in the beginning stages of construction. Prior to issuance of the Notice to Proceed, the Department will consider extending the assembly period upon written request from the contractor justifying the need for additional time.

The contractor shall be responsible for maintenance of traffic from the beginning of the assembly period. During the assembly period, the contractor will be allowed to do patching and other maintenance work necessary to maintain the roadway with no time charges when approved by the engineer.

If the contractor begins regular construction operations prior to expiration of the assembly period, the assessment of contract time will commence at the time construction operations are begun.

(05/09)

LOUISIANA
DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
SUPPLEMENTAL SPECIFICATIONS
(FOR 2006 STANDARD SPECIFICATIONS)

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LOUISIANA
DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
SUPPLEMENTAL SPECIFICATIONS

The 2006 Louisiana Standard Specifications for Roads and Bridges and supplemental specifications thereto are amended as follows.

PART I – GENERAL PROVISIONS

SECTION 101 – GENERAL INFORMATION, DEFINITIONS, AND TERMS:
Subsection 101.03 – Definitions (07/07), Pages 3 – 13.

Delete the definition for "Proposal/Bid Guaranty" and substitute the following.

Proposal / Bid Guaranty. The required security furnished with a bid. The only form of security acceptable is a Bid Bond.

SECTION 102 – BIDDING REQUIREMENTS:
Subsection 102.09 – Proposal / Bid Guaranty (07/07), Page 19.

Delete the contents of this subsection and substitute the following.

PROPOSAL/BID GUARANTY. Each bid shall be accompanied by a proposal/bid guaranty in an amount not less than five percent of the total bid amount when the bidder's total bid amount as calculated by the Department in accordance with Subsection 103.01 is greater than $50,000. No proposal/bid guaranty is required for projects when the bidder's total bid amount as calculated by the Department is $50,000 or less. The official total bid amount for projects that include alternates is the total of the bidder's base bid and all alternates bid on and accepted by the Department. The proposal/bid guaranty submitted by the bidder shall be a bid bond made payable to the contracting agency as specified on the bid bond form provided in the construction proposal. No other form of security will be accepted.

The bid bond shall be on the "Bid Bond" form provided in the construction proposal, on a form that is materially the same in all respects to the "Bid Bond" form provided, or on an electronic form that has received Department approval prior to submission. The bid bond shall be filled in completely, shall be signed by an authorized officer, owner or partner of the bidding entity, or each entity representing a joint venture; shall be signed by the surety's agent or attorney-in-fact; and shall be accompanied by a notarized document granting general power of attorney to the surety's signer. The bid bond shall not contain any provisions that limit the face amount of the bond.

The bid bond will be written by a surety or insurance company that is in good standing and currently licensed to write surety bonds in the State of Louisiana by the Louisiana Department of Insurance and also conform to the requirements of LSA-R.S. 48:253.

All signatures required on the bid bond may be original, mechanical reproductions, facsimiles or electronic. Electronic bonds issued in conjunction with electronic bids must have written Departmental approval prior to use. The Department will make a listing of approved electronic sureties providers on the Bidx.com site.

SECTION 107 – LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC:
Subsection 107.05 – Federal Aid Participation (04/08), Pages 57 and 58.

Delete the second paragraph.

SECTION 108 – PROSECUTION AND PROGRESS:
Subsection 108.04 – Prosecution of Work (03/05) Pages 74 and 75.

Add the following sentence to the third paragraph of Heading (b).

Should the surety or the Department take over prosecution of the work, the contractor shall remain disqualified for a period of one year from the completion of the project, unless debarment proceedings are instituted.

When the Department of Transportation and Development is not the contracting agency on the project, the second paragraph under Heading (c) is deleted.

PART II – EARTHWORK

SECTION 202 – REMOVING OR RELOCATING STRUCTURES AND OBSTRUCTIONS:
Subsection 202.06 – Plugging or Relocating Existing Water Wells (03/04), Page 105.

Delete the first sentence and substitute the following.

All abandoned wells shall be plugged and sealed at the locations shown on the plans, or as directed by the engineer, in accordance with the "Water Well Rules, Regulations, and Standards, State of Louisiana." This document is available at the Department of Transportation and Development, Water Resources Section, P. O. Box 94245, Baton Rouge, Louisiana 70804-9245. The Water Resource Section's telephone number is (225) 274-4172.

PART III – BASE COURSES

SECTION 302 – CLASS II BASE COURSE:
Subsection 302.01 – Description (12/08), Page 150.

Add the following to the third paragraph:

(6) Blended Calcium Sulfate

Subsection 302.02 – Materials (12/08), Pages 150 and 151.

Add the following to the first paragraph:

Blended Calcium Sulfate	1003.01 & 1003.03 (e)

Subsection 302.04 – General Construction Requirements (12/08), Page 152.

Add the following:

Blended calcium sulfate will be allowed in areas of new alignment, fill areas, and cut areas less than one foot.

In cut areas greater than one foot (300 mm), an additional one foot (300 mm) of undercut will be required prior to placement of BCS. The additional undercut area shall be replaced with non-plastic sand embankment and encapsulated with a Class D geotextile fabric. The additional

non-plastic material, geotextile fabric, and undercut shall be at no additional cost to the Department.

Blended calcium sulfate will not be allowed in areas needed to facilitate traffic control or when a soil cement base course is specified in the plans. Blended calcium sulfate shall not be placed within 10 feet (3.0 m) of metal drainage structures. The contractor will be allowed to substitute any untreated Class II base course material listed in Subsection 302.01. Flowable fill under Section 710, or other approved backfill material in Section 701 shall be used to backfill the drainage structure.

Subsection 302.05 – Mixing (08/06) (12/08), Pages 152 and 153.

Delete the first sentence of Subheading (b)(1), In-Place Mixing, and substitute the following.

In-place mixing shall conform to Heading (a)(1) except that the percentage of Type I portland cement required will be 6 percent by volume.

Add Heading (d) as follows:

(d) Blended Calcium Sulfate: Calcium sulfate shall be blended with an approved aggregate or lime prior to placement. The blended calcium sulfate material shall be uniformly mixed and sampled from dedicated stockpiles. Gradation sampling in accordance with Subsection 1003.03 shall be taken from the dedicated stockpiles at the point of material origin.

Subsection 302.06 – Transporting and Placing on Subgrade (12/08), Page154.

Add the following:

Water shall be added or other suitable means taken to prevent dust during the transporting and placing of dry blended calcium sulfate.

Subsection 302.07 - Compacting and Finishing (12/08), Pages 154 and 155.

Add Heading (e) as follows:

(e) Blended Calcium Sulfate: Blended calcium sulfate shall be placed and spread on the subgrade and compacted to produce layers not exceeding 12 inches (300 mm) compacted thickness. During placement the material shall be thoroughly wetted by application of water to maintain 2 to 4 percent above optimum moisture. After application of water, allow the moisture to reach equilibrium in the base before applying rolling techniques. Rolling of BCS is required to the edge of the embankment or subgrade. Each layer shall be compacted to at least 95 percent of maximum dry density or compacted by an approved established rolling pattern determined by the project engineer before the next layer is placed. Optimum moisture and maximum density shall be determined in accordance with DOTD TR 418 Method G modified to include a maximum drying temperature of 140°F (60°C).

Add Heading (f) as follows:

(f) Proof Rolling: Proof rolling shall be done by a load of 25 tons (25 Mg) in a 12 to 14 cubic yard (9 to 10.5 cubic meters) tandem dump truck with ten wheels or approved loaded truck

determined by the project engineer. Proof rolling shall be a minimum of 5 passes in each direction at the same locations and at a maximum vehicle speed of 3 mph (4.8 km/h).

All BCS base will be tested by proof rolling prior to placement of surfacing material, including asphalt binder. Any irregularities or soft spots shall be corrected prior to placement of the surfacing material. Any rain event on the project site between the proof rolling and placement of the surfacing will require an additional proof rolling as noted above.

Subsection 302.09 – Protection and Curing (12/08), Page 155.

Add Heading (c) as follows:

(c) Blended Calcium Sulfate: Protection and curing of blended calcium sulfate shall be in accordance with Subsection 302.09(b).

Subsection 302.12 – Acceptance Requirements (12/08), Pages 156 – 161.

Add the following to Heading (a):

The acceptance requirements for blended calcium sulfate base course shall be the same as stone base course with the following modifications. Upon completion of compaction operations, the density will be determined in accordance with DOTD TR 401 except that all moisture content determinations for density calculations shall be conducted by oven drying the material for 24 hours at 140°F (60°C). A forced draft type oven capable of maintaining the temperature shall be provided by the contractor for field moisture content determination for density control.

SECTION 305 – SUBGRADE LAYER:

Subsection 305.06 – Payment (01/08), Page 184.

Delete the contents of this subsection and substitute the following.

305.06 Payment. Payment for subgrade layer will be made at the contract unit price which includes lime, lime treatment, cement, cement treatment, water, stone, recycled portland cement concrete, crushed slag, blended calcium sulfate, asphaltic concrete, and asphalt curing membrane or prime coat, subject to the payment adjustment provisions of Section 1002 for specification deviations of asphalt materials and Subsection 303.11(a) for density deficiencies of cement treated materials. Adjustments in pay for increase or decrease in the percent cement ordered by the engineer will be in accordance with Subsection 303.13. Adjustments in pay for increase or decrease in the percent lime ordered by the engineer will be based on the price of lime shown on paid invoices (total of all charges). The Materials and Testing Section will provide the payment adjustment percentage for properties of asphalt materials.

Payment for geotextile fabric will be included in the contract unit price for subgrade layer.

Payment will be made under:

Item No.	Pay Item	Pay Unit
305-01	Subgrade Layer _____in (mm) Thick	Square Yard (Sq m)

SECTION 307 – PERMEABLE BASES:

Subsection 307.02 – Materials (09/07), Pages 187 and 188.

Delete the contents of Subheading (b), Asphalt, and substitute the following.

(b) Asphalt: The asphalt for asphalt treated permeable base shall be an approved polymer modified asphalt cement, PG 76-22m, or PG 82-22rm complying with Section 1002. The percentage of asphalt cement shall be 2.0 percent to 4.0 percent by weight (mass) of the total mixture. Asphalt cement content and mixing process shall be such that all aggregates are visibly coated. The mixture shall retain 90 percent coating when tested in accordance with DOTD TR 317.

A job mix formula shall be submitted and approved in accordance with Section 502.

SECTION 308 – IN-PLACE CEMENT TREATED BASE COURSE:

All Subsections within Section 308 – (07/07), Pages 191 – 198.

Whenever the reference to "DOTD TR-432, Method D" is used, it shall mean "DOTD TR-432".

PART V – ASPHALTIC PAVEMENTS

SECTION 502 – SUPERPAVE ASPHALTIC CONCRETE MIXTURES:

Subsection 502.02 – Materials (08/06) (11/07), Pages 210 – 213.

Delete Table 502-2, Superpave Asphalt Cement Usage under Subheading (a) and substitute the following.

Table 502-2
Superpave Asphalt Cement Usage

Current Traffic Load Level	Mixture Type	Grade of Asphalt Cement
Level 1	Wearing Course	PG 70-22m
	Binder Course	PG 70-22m
	Base Course	PG 64-22
Level 2	Wearing Course	PG 76-22m
	Binder Course	PG 76-22m
Level A	Incidental Paving	PG 70-22m

Note: A PG 82-22 rm, Waste Tire Rubber Modified Asphalt, may be substituted for any other grade of asphalt cement.

Delete Table 502-3, Aggregate Friction Rating under Subheading (c)(1) and substitute the following.

Table 502-3
Aggregate Friction Rating

Friction Rating	Allowable Usage
I	All mixtures
II	All mixtures
III	All mixtures, except travel lane wearing courses with plan ADT greater than 7000[1]
IV	All mixtures, except travel lane wearing courses[2]

[1] When plan current average daily traffic (ADT) is greater than 7000, blending of Friction Rating III aggregates and Friction Rating I and/or II aggregates will be allowed for travel lane wearing courses at the following percentages. At least 30 percent by weight (mass) of the total aggregates shall have a Friction Rating of I, or at least 50 percent by weight (mass) of the total aggregate shall have a Friction Rating of II. The frictional aggregates used to obtain the required percentages shall not have more than 10 percent passing the No. 8 (2.36 mm) sieve.

[2] When the average daily traffic (ADT) is less than 2500, blending of Friction Rating IV aggregates with Friction Rating I and/or II aggregates will be allowed for travel lane wearing courses at the following percentages. At least 50 percent by weight (mass) of the total aggregate in the mixture shall have a Friction Rating of I or II. The frictional aggregates used to obtain the required percentages shall not have more than 10 percent passing the No. 8 (2.36 mm) sieve.

Subsection 502.14 – Lot Sizes (11/07), Pages 232 and 233.

Delete the first sentence of the first paragraph and substitute the following.

A lot is a segment of continuous production of asphaltic concrete mixture from the same job mix formula produced for the Department at a specific plant, delivered to a specific DOTD project.

SECTION 508 – STONE MATRIX ASPHALT:

Subsection 508.01 – Description (09/07), Page 274.

Delete this subsection and substitute the following.

508.01 DESCRIPTION. This work consists of furnishing and constructing Stone Matrix Asphalt (SMA) which is a plant mixed asphalt concrete wearing course for high traffic applications. This mixture is a rut resistant hot mix design with stone on stone contact. The mixture shall be composed of a PG 76-22m, or PG 82-22rm asphalt cement and a gap graded coarse aggregate structure. Mineral filler and/or fibers shall be used to control draindown. This work shall be in accordance with these specifications, plan details, and as directed. All requirements of Section 502 apply to Stone Matrix Asphalt, except as modified herein. All plant and paving equipment and processes must meet the requirements of Section 503.

Mixture used for shoulder may be Stone Matrix Asphalt or any mixture type shown in Table 502-5.

Subsection 508.02 – Materials (09/07), Page 274.

Delete the contents of subheading (a), Asphalt Cement and substitute the following.

(a) Asphalt Cement: Asphalt cement shall be PG 76-22m, or PG 82-22rm as listed on QPL 41 and complying with Section 1002.

PART VI – RIGID PAVEMENT

SECTION 602 – PORTLAND CEMENT CONCRETE PAVEMENT REHABILITATION:

Subsection 602.17 – Payment (09/07), Pages 341 – 344.

Delete the last paragraph of Subheadings (d), Full Depth Corner Patching of Jointed Concrete Pavement, (e) Full Depth Patching of Jointed Concrete Pavement, and (g) Patching Continuously Reinforced Concrete Pavement, and substitute the following.

Payment for deteriorated base course removed as directed by the engineer and replaced with concrete will be made as follows: The value per inch (mm) thickness will be determined by dividing the contract unit price per square yard (sq m) by the plan thickness. Thickness of patches will be measured from the surface that exists at the time of patching. Payment for the additional thickness will be made at 50 percent of the value per inch (mm) thus determined.

PART VII – INCIDENTAL CONSTRUCTION

SECTION 701 – CULVERTS AND STORM DRAINS:

All Subsections within Section 701 (08/07), Pages 347 – 358.

Delete Section 701, Culverts and Storm Drains and substitute the following.

SECTION 701
CULVERTS AND STORM DRAINS

701.01 DESCRIPTION. This work consists of furnishing, installing, and cleaning pipe, pipe arch, storm drains and sewers, also referred to as culverts or conduit, in accordance with these specifications and in conformity with lines and grades shown on the plans or established.

701.02 MATERIALS. Materials shall comply with the following sections and subsections:

Usable Soil	203.06(a)
Selected Soil	203.06(b)
Plastic Soil Blanket	203.10
Mortar	702.02
Flowable Fill	710
Portland Cement Concrete	901
Reclaimed Asphaltic Pavement (RAP)	1003.01 & 1003.04(d)
Stone	1003.03(b)
Recycled Portland Cement Concrete	1003.03(c)
Granular Material	1003.07
Bedding Material	1003.08
Concrete Sewer Pipe	1006.02
Reinforced Concrete Pipe	1006.03
Reinforced Concrete Pipe Arch	1006.04
Gasket Materials	1006.06
Plastic Pipe	1006.07
Split Plastic Coupling Bands	1006.07(d)(4)
Plastic Yard Drain Pipe	1006.09
Bituminous Coated Corrugated Steel Pipe and Pipe Arch	1007.02
Structural Plate for Pipe, Pipe Arch and Arch	1007.04
Corrugated Aluminum Pipe and Pipe Arch	1007.05
Coupling Bands	1007.09
Reinforcing Steel	1009
Geotextile Fabric	1019

(a) Side Drain Pipe or Side Drain Pipe Arch: When the item for Side Drain Pipe or Side Drain Pipe Arch is included in the contract, the contractor has the option of furnishing reinforced concrete pipe or reinforced concrete pipe arch, corrugated metal pipe or corrugated metal pipe arch, or plastic pipe, as allowed by EDSM II.2.1.1 or unless otherwise specified.

(b) Cross Drain Pipe or Cross Drain Pipe Arch: When the item for Cross Drain Pipe or Cross Drain Pipe Arch is included in the contract, the contractor has the option of furnishing reinforced concrete pipe or reinforced concrete pipe arch, corrugated metal pipe or corrugated metal pipe arch, or plastic pipe, as allowed by EDSM II.2.1.1 or unless otherwise specified.

(c) Storm Drain Pipe or Storm Drain Pipe Arch: When the item for Storm Drain Pipe or Storm Drain Pipe Arch is included in the contract, the contractor has the option of furnishing reinforced concrete pipe or reinforced concrete pipe arch, or plastic pipe, as allowed by EDSM II.2.1.1 or unless otherwise specified.

(d) Yard Drain Pipe: When the item for Yard Drain Pipe is included in the contract, the contractor has the option of furnishing concrete sewer pipe, plastic yard drain pipe or plastic pipe in accordance with Section 1006 unless otherwise specified.

(e) Material Type Abbreviations:

(1) Reinforced Concrete Pipe:

RCP	Reinforced Concrete Pipe
RCPA	Reinforced Concrete Pipe Arch

(2) Corrugated Metal Pipe:

CAP	Corrugated Aluminum Pipe
CAPA	Corrugated Aluminum Pipe Arch
CMP	Corrugated Metal Pipe
CMPA	Corrugated Metal Pipe Arch
CSP	Corrugated Steel Pipe
CSPA	Corrugated Steel Pipe Arch
BCCSP	Bituminous Coated Corrugated Steel Pipe
BCCSPA	Bituminous Coated Corrugated Steel Pipe Arch

(3) Plastic Pipe:

PP	Plastic Pipe
PVCP	Polyvinyl Chloride Pipe
RPVCP	Ribbed Polyvinyl Chloride Pipe
CPEPDW	Corrugated Polyethylene Pipe Double Wall

(f) Joint Type Abbreviations:

T1	Type 1 Joint
T2	Type 2 Joint
T3	Type 3 Joint

(g) Quality Assurance for Pipe: Manufacturing plants will be periodically inspected for compliance with specified manufacturing methods, and material samples will be randomly obtained for laboratory testing for verification of manufacturing lots. Materials approved at the manufacturing plant will be subject to visual acceptance inspections at the jobsite or point of delivery.

701.03 EXCAVATION. For all pipe, when the sides of the trench are stable as evidenced by the sides of the trench being able to maintain a vertical cut face, the minimum trench width at the bottom of the excavation will be 18 inches (460mm) on either side of the outside diameter of the pipe. If the sides of the trench are unstable, the width of the trench at the bottom of the excavation, for plastic or metal pipe, shall be a minimum width of at least 18 inches (460mm) or one pipe diameter on each side of the outside diameter of the pipe, which ever is greater. Surplus material or excavated material that does not conform to the requirements of Subsection 203.06(a) shall be satisfactorily disposed of in accordance with Subsection 202.02. Moisture controls including backfill materials selection and dewatering using sumps, wells, well points or other approved processes may be necessary to control excess moisture during excavation, installation of bedding, over-excavated trench backfilling, pipe placement and pipe backfill.

(a) Over-excavation: When unsuitable soils as defined in Subsection 203.04 or a stable, non-yielding foundation cannot be obtained at the established pipe grade, or at the grade established for placement of the bedding, unstable or unsuitable soils below this grade shall be removed and replaced with granular material meeting the requirements of Subsection 1003.07,

bedding materials meeting the requirements of Subsection 1003.08 or Type A backfill. All granular, backfill materials placed below the established pipe or bedding grade shall be placed in lifts not exceeding 8 inches (200 mm) thick and sufficiently compacted by hand or a dynamic mechanical hand compaction device over the surface of each lift to form a stable, non-yielding foundation at the surface of the established bedding or pipe grade.

When rock is encountered, it shall be removed below grade and replaced with material complying with Subsection 1003.07, bedding materials meeting the requirements of Subsection 1003.08 or Type A backfill. The compacted earth cushion shall have a thickness under the pipe of at least 1/2 inch per foot (40 mm/m) of fill height over the top of the pipe with a minimum thickness of 8 inches (200 mm). All granular, backfill materials placed below the established pipe or bedding grade shall be placed in lifts not exceeding 8 inches (200 mm) thick and sufficiently compacted by hand or a dynamic mechanical hand operated compaction device over the surface of each lift to form a stable, non-yielding foundation at the surface of the established bedding or pipe grade.

Materials used to backfill in an over-excavated portion of a trench do not require encasement in a Geotextile Fabric.

Density of approved materials placed in over-excavated trenches will not be measured or determined.

701.04 FORMING PIPE BED. Bedding material, when specified, shall be constructed in accordance with Section 726. Materials allowed for bedding shall be as specified in Subsection 1003.08 or may be Type A backfill materials. When bedding materials are specified, additional excavation shall be performed below established pipe grade and the bedding material placed in lifts not exceeding 8 inches (200 mm) thick and lightly compacted by hand or a dynamic hand compaction device over the surface of each lift.

When the bottom of the pipe is not laid in a trench but is constructed above natural soils, a uniform bed shall be constructed as specified for the bottom of a trench.

Density of approved bedding materials will not be measured or determined.

701.05 LAYING PIPE. Pipe laying shall begin at the downstream end of the line. The pipe shall be in contact with the foundation throughout its length. Bell or groove ends of pipe and outside circumferential laps of riveted metal pipe shall be placed facing upstream. Riveted seam metal pipe shall be placed with longitudinal laps at sides. Pipes in each continuous line shall have the same wall thickness. Metal pipes provided with lifting lugs shall be handled only by these lugs.

After pipe has been laid and before backfill is placed, the engineer will inspect the pipe for alignment, grade, integrity of joints, and coating damage.

701.06 JOINING PIPE.

(a) Joint Usage:

(1) Type 1 (T1) joints shall be used for side drains under drives and similar installations.

(2) Type 2 (T2) joints shall be used for cross drains under roadways, including turnouts.

(3) Type 3 (T3) joints shall be used for closed storm drain systems, flumes and siphons.

(b) Concrete Pipe: Concrete pipe may be either bell and spigot, or tongue and groove. The method of joining pipe sections shall be such that ends are fully entered and inner surfaces are flush and even.

An approved mechanical pipe puller shall be used for joining pipes over 36 inches (900 mm) in diameter. For pipe 36 inches (900 mm) or less in diameter, any approved method for joining pipe may be used which does not damage the pipe.

Joints shall comply with Subsection 1006.05, and shall be sealed with gasket material installed in accordance with the manufacturer's recommendations.

(c) Metal Pipe: Metal pipe shall be firmly joined by coupling bands. Bands shall be centered over the joint.

For Type 1 joints, approved gasket material shall be placed in one corrugation recess on each side of the joint at the coupling band and on each band connection in such manner to prevent leakage.

When Type 2 or 3 joints are specified, joining of metal pipe sections shall conform to the following provisions:

(1) General: Band joints shall be sealed with gasket material. Gasket material shall be placed in accordance with the plan details.

(2) Circular Section: Connecting bands shall be of an approved design and shall be installed in accordance with plan details.

(3) Arch Section: Connecting bands shall be a minimum of 12 inches (300 mm) wide for pipe arch less than 36 inches (900 mm) round equivalent diameter, and a minimum of 21 inches (525 mm) wide for 36 inches (900 mm) round equivalent diameter pipe arch and greater. Bands shall be connected at the ends by approved angle or strap connections. Connecting bands used for 36 inches (900 mm) round equivalent diameter pipe arch and above shall be 2-piece bands.

(d) Plastic Pipe: Joints for plastic pipe shall be either bell and spigot or split coupling bands.

(1) Bell and Spigot Type Joint System: The method of joining pipe sections shall be such that ends are fully entered and inner surfaces are flush and even.

Any approved method for joining pipe may be used which does not damage the pipe.

Joints shall be approved and shall be sealed with a gasket system utilizing gasket material complying with Subsection 1006.06(a).

(2) Split Coupling Type Joint System: Split coupling bands shall comply with all dimensional and material requirements of Subsection 1006.07. The bands shall be centered over the joint. The split coupling band shall be secured to the pipe with a minimum of five stainless steel or other approved corrosion resistant bands.

Joints shall be approved and shall be sealed with gasket material. Gasket material shall be placed in the first two corrugation recesses on each side of the pipe connections. Gasket material shall also be placed on each band connection to prevent leakage. When flexible plastic gasket material is used it shall be a minimum of 1/2 inch (13 mm) in size. The bands shall be tightened to create overlap of the band and shall adequately compress the gasket material.

(e) Connections: Approved connections shall be used when joining new pipes to existing pipes. When concrete collars are required in order to extend the ends of existing pipes that have been damaged or to join different types or sizes of pipes, the concrete collars shall be constructed in accordance with plan details, the applicable requirements of Section 901, and as directed.

(f) Geotextile Fabric, Pipe Joints: For concrete, metal and plastic pipes, Types 2 and 3 joints shall be wrapped with geotextile fabric for a minimum of 12 inches (300 mm) on each side of joint for pipe 36 inches (900 mm) or less in diameter and a minimum of 18 inches (450 mm) on each side of the joint for pipe greater than 36 inches (900 mm) in diameter. Ends of the fabric shall be lapped at least 10 inches (250 mm). The edges and ends of fabric shall be suitably secured for the entire circumference of the pipe.

701.07 RELAYING PIPE. If specified or directed, existing pipes shall be removed and suitable sections relaid as specified for new pipes.

701.08 BACKFILLING.

(a) General: Prior to backfilling, pipes found to be damaged or out of alignment or grade shall be removed and reinstalled, or replaced.

Type A backfill material shall be stone, recycled portland cement concrete, flowable fill, or RAP.

Type B backfill materials are selected soils. Where Type B backfill materials are called for, Type A backfill materials may be substituted.

When corrugated metal pipe is used, the backfill material shall be tested and shall have a resistivity greater than 1500 ohm-cm and a pH greater than 5 when tested in accordance with DOTD TR 429 and DOTD TR 430 respectively.

When Type A backfill material is used, geotextile fabric surrounding this backfill shall be placed in accordance with Subsection 726.03 between the aggregate backfill material and all other natural or placed soils in the trench or embankment. Care shall be taken to prevent damage to geotextile fabric during placement of backfill material. For concrete pipe, the fabric shall enclose not only the initial backfill but shall be wrapped over the top of the pipe with at least 12 inches (300 mm) of overlap.

When a trench box or trench sheeting is used in unstable soils and/or for worker safety, and when moved during backfilling operations, filling and additional compaction of the disturbed zone of backfill must take place immediately and in a manner acceptable to the engineer.

Initial backfill is a structural backfill encasing the pipe from the bottom of the pipe to the springline for concrete pipe and to a point one foot (0.3 m) above the top of the pipe for both metal and plastic pipe. Final backfill is not a structural backfill and shall extend from the top of the initial backfill to the top of the natural ground or subgrade in cut areas or to the top of existing ground in fill areas. Any fill required above the final backfill is considered and treated as embankment.

(b) Backfill Applications: For projects using A+B+C bidding method where rigid and flexible pavement alternates are considered, backfill application (2) below, "Cross Drains Under Flexible Pavements", shall apply for either rigid or flexible pavements.

(1) Under Concrete Pavements: Type B backfill may be used as initial and final backfill for all pipes, culverts or drains under concrete pavements. Placement and compaction shall be as specified in Heading (d) below.

(2) Cross Drains Under Flexible Pavements: All reaches, exclusive of those portions of the pipe which are under shoulders, of cross drains and all other culverts, pipes or drains that cross the centerlines of the new roadway or centerlines of existing roadways, such as intersections and are under flexible pavements shall receive an initial backfill of Type A material. Type B backfill materials may be used as final backfill for all pipes. Placement and compaction shall be as specified in Heading (c) and (d) below. Where the subgrade is above existing ground, embankment material as specified for the remainder of the project shall be used from the top of the final backfill to the top of the established embankment grade.

(3) Other Drains Under Flexible Pavements: All reaches of all culverts, pipes or drains under flexible pavements that do not cross the centerlines of new roadway or centerlines of existing roadways, and exclusive of those portions of the pipe which are totally under shoulders, shall receive an initial and final backfill of Type B material. Placement and compaction shall be as specified in Heading (d) below. Where the subgrade is above existing ground, embankment material as specified for the remainder of the project shall be used from the top of the final backfill to the top of the established embankment grade.

(4) Other Areas: All culverts, pipes or drains in nonpaved areas or paved areas that serve as driveways or shoulders shall receive an initial and final backfill of Type B material. Placement and compaction shall be as specified in Heading (d) below.

(5) Pipes Subject to Construction Traffic; The embankment or pipe backfill shall be constructed to a minimum of 24 inches (600 mm) over the pipe before heavy construction equipment is allowed to cross the installation. Where practical, installations with less than 24 inches (600 mm) of cover over the top of the pipe shall be constructed after heavy hauling is completed over the pipe location. After completion of hauling operations, the contractor shall remove excess cover material. Pipe damaged by hauling and backfilling operations shall be removed and reinstalled, or replaced, at no direct pay.

(c) Placement and Compaction; Type A Backfill: For all pipes, culverts and conduits under paved and nonpaved areas, where Type A backfill material is used, the Type A backfill shall be thoroughly hand compacted under the pipe haunches and then dynamically compacted in layers not exceeding 8 inches (200 mm) compacted thickness. Compaction under the haunches of the pipe shall initially be by hand tamping or other acceptable means, until a level is reached that the dynamic tamping can commence. Each lift shall be compacted by applying at least eight

passes of a hand operated, dynamic mechanical compaction device over the surface of each lift. With approval of the engineer, layer thickness may be increased to 12 inches (300 mm) with verification of satisfactory installation and performance. If flowable fill is used it shall be furnished, placed and consolidated in accordance with Section 710. The contractor shall control placement operations during initial backfill operations so as not to damage protective coatings on metal pipes. The contractor shall repair damaged coatings at no additional pay.

(d) Placement and Compaction; Type B Backfill: For all pipes, culverts and conduits, where Type B backfill is allowed, the Type B material shall be placed in layers not exceeding 8 inches (200 mm) compacted thickness. Compaction shall be with suitable mechanical equipment. With approval of the engineer, layer thickness may be increased to 12 inches (300 mm) with verification of satisfactory installation and performance.

(e) Placement and Compaction; Trenchless or Partial Trench Condition: All pipes, culverts, drains and conduits placed with any portion of the pipe above existing ground must also comply with Subsections (a),(b) (c) and (d) above for the portion of the pipe within a trench and that portion of the pipe not constructed in a trench. The width of initial and final backfill of that portion above existing ground and not within a trench will be constructed to such a width that the requirements for placement, compaction and density are met.

(f) Density Requirements: The in place density of Type A backfill materials and bedding materials, will not be measured or determined. Type A backfill, exclusive of RAP and flowable fill, shall be placed at or near optimum moisture content determined in accordance with DOTD TR 415 or 418. RAP materials shall be placed and compacted in a slightly moist condition.

The maximum dry density of initial or final Type B backfill under all paved areas which are to be under traffic will be determined in accordance with DOTD TR 415 or TR 418 and in-place density determined in accordance with DOTD TR 401. Initial and final Type B backfill under all paved areas, under traffic, shall be placed at or near optimum moisture content determined in accordance with DOTD TR 415 or TR 418. Each layer shall be compacted by approved methods prior to the placement of a subsequent layer. The engineer will approve the compaction method based upon validation that such method, including moisture control, will achieve at least 95 percent of maximum dry density as determined in accordance with DOTD TR 401. With approval of the engineer, density testing may be waived on subsequent layers with backfill installation in accordance with approved compaction methods and continued satisfactory performance.

Initial and final backfill in unpaved areas or paved areas such as shoulders or driveways, shall be placed evenly and compacted along the length of the culvert, pipe or drain from the top of the initial backfill to the top of the subgrade. Layered backfill shall be compacted at least to the density of the adjoining existing soils or the compaction required of the laterally adjoining layers of soil immediately outside the trench for embankment elevations. Initial and final backfill shall be placed and compacted at or near optimum moisture content determined in accordance with DOTD TR 415 or TR 418.

701.09 INSPECTION OF PIPES. After completion of embankment and prior to roadway surfacing, the engineer shall inspect pipes for proper alignment and integrity of joints. Any misaligned pipe or defective joints shall be corrected by the contractor at no direct pay.

(a) Plastic Pipe: Installed plastic pipe shall be tested to ensure that vertical deflections do not exceed 5.0 percent. Maximum allowable deflections shall be governed by the mandrel requirements stated herein.

Deflection tests shall be performed no sooner than 30 calendar days after installation and compaction of backfill. The pipe shall be cleaned and inspected for offsets and obstructions prior to testing.

For pipe 36 inches (900 mm) and less in diameter, a mandrel shall be pulled through the pipe by hand to ensure that maximum allowable deflections have not been exceeded. The mandrel shall be approved by the engineer prior to use. Use of an unapproved mandrel or a mandrel altered or modified after approval will invalidate the test. If the mandrel fails to pass, the pipe is overdeflected.

Unless otherwise permitted, overdeflected pipe shall be uncovered and, if not damaged, reinstalled. Damaged pipe shall not be reinstalled, but shall be removed and replaced with new pipe. Any pipe subjected to any method or process other than removal, which attempts, even successfully, to reduce or cure any overdeflection, shall be removed and replaced with new pipe.

The mandrel shall be a rigid, nonadjustable, odd-numbered legged (minimum 9 legs) mandrel having a length not less than its nominal diameter or 24 inches (600 mm), whichever is less. The minimum diameter at any point shall be 5.0 percent less than the base inside diameter of the pipe being tested. The mandrel shall be fabricated of steel, aluminum or other approved material fitted with pulling rings at each end. The nominal pipe size and outside diameter of the mandrel shall be stamped or engraved on some segment other than a runner. A suitable carrying case shall be furnished.

For pipe larger than 36 inches (900 mm) in diameter, deflection shall be determined by a method approved by the engineer. If a mandrel is selected, the minimum diameter, length, and other requirements shall conform to the above requirements.

Mandrel testing shall be conducted by the contractor in the presence of the engineer. Mandrel testing shall be at no direct pay.

(b) Metal Pipe: If the inside diameter of metal pipe or rise dimension of metal pipe arch deflects more than 5.0 percent from original dimensions, they shall be removed and reinstalled, unless they do not rebound or are damaged. Pipe or pipe arch which are damaged or do not rebound shall be removed and replaced at no direct pay. Measurement of deflection will be made by the engineer away from rerolled ends.

701.10 CLEANING PIPES.

(a) Existing Pipes: Pipes designated to be cleaned shall be cleaned of soil, debris and other materials to the invert of the pipe. Designated pipes shall be cleaned by approved methods that will not damage the pipes. Any damage caused by the contractor's operations shall be satisfactorily repaired at no direct pay.

Removed soil, debris and other materials shall be disposed of in accordance with Subsection 202.02 or as otherwise approved in writing.

(b) Contractor Installed Pipes: Prior to final acceptance, pipes shall be cleaned of all debris and soil to the invert of the pipe at no direct pay.

Removed soil, debris and other materials shall be disposed of in accordance with Subsection 202.02 or as otherwise approved in writing.

701.11 STUBBING AND PLUGGING PIPES. When it is required that pipes be plugged, such plugs shall be constructed of Class R concrete complying with Section 901. Thickness of plug and method of construction shall be as directed.

When new pipes are to be stubbed into new or existing pipes or other structures, the connection shall be made with approved mortar complying with Subsection 702.02.

701.12 MEASUREMENT. Pipe, both new and relaid, will be measured in linear feet (lin m) as follows unless stated otherwise.

(a) Pipe not confined by fixed structures will be measured by the number of joints at the nominal length of each joint.

(b) Pipe confined by fixed structures will be measured along the pipe between the termini of pipe in structure walls.

(c) Pipe confined by a fixed structure on one end and unconfined at the other end will be measured along the pipe from the terminus of pipe in the structure wall to the unconfined end of pipe.

(d) Fabricating of pipe tees, elbows and other fittings will be measured per each fitting. The length of pipe in such fittings will be included in the pay length measurement of pipes of which they form a part.

(e) Excavation required for installation of pipes will not be measured for payment, except as otherwise specified in Subsection 203.14.

(f) Furnishing and placing backfill material below existing ground level for pipes will not be measured for payment. Backfill material needed to complete backfill above natural ground and around pipes that extend above natural ground will be measured and payment will be made under applicable earthwork items. When specified, flowable fill will be measured and paid for in accordance with Section 710.

(g) Plugging and stubbing of pipes will not be measured for payment.

(h) Cleaning existing pipes will be measured by the length of pipe cleaned and accepted.

(i) Concrete collars will be measured per each.

701.13 PAYMENT.

(a) Payment for pipe will be made at the contract unit price per linear foot (lin m) of the types and sizes specified.

When plastic pipe is specified on the plans or elected to be used by the contractor, payment will be made at the contract unit price per linear foot (lin m) of the types and sizes specified in accordance with the payment schedule of Table 701-1.

Table 701-1
Payment Schedule for Plastic Pipe

Percent Payment	Stage of Completeness
75	After placement and backfill has been completed
25	After the pipe has met vertical deflection requirements in accordance with Subsection 701.09(a)

(b) Payment for fabricating pipe tees, elbows and other fittings will be made at the contract unit price per each fitting.

(c) When unstable conditions are encountered, the additional excavation will not be measured for payment; however, the additional materials furnished and placed for the pipe foundation will be measured and paid for as follows:

(1) Granular Materials: Payment will be made under the embankment item. The net section volume of the materials will be multiplied by 3 to determine the pay volume. When the contract does not include a pay item for embankment, payment will be made in accordance with Subsection 104.02.

(2) Bedding Material: Measurement and payment will be made in accordance with Section 726. When the contract does not include a pay item for bedding material, payment will be made in accordance with Subsection 104.02.

(d) Payment for cleaning existing pipes will be made at the contract unit price per linear foot (lin m).

(e) Payment for concrete collars will be made at the contract unit price per each.

Payment will be made under:

Item No.	Pay Item	Pay Unit
701-01	Cross Drain Pipe (Size & Type)	Linear Foot (Lin m)
701-02	Cross Drain Pipe Arch (Size & Type)	Linear Foot (Lin m)
701-03	Storm Drain Pipe (Size & Type)	Linear Foot (Lin m)
701-04	Storm Drain Pipe Arch (Size & Type)	Linear Foot (Lin m)
701-05	Side Drain Pipe (Size)	Linear Foot (Lin m)
701-06	Side Drain Pipe Arch (Size)	Linear Foot (Lin m)
701-07	Yard Drain Pipe (Size)	Linear Foot (Lin m)
701-08	Relaying Pipe	Linear Foot (Lin m)
701-09	Fabricating Pipe Fittings	Each
701-10	Reinforced Concrete Pipe (Extension)	Linear Foot (Lin m)
701-11	Reinforced Concrete Pipe Arch (Extension)	Linear Foot (Lin m)
701-12	Corrugated Metal Pipe (Extension)	Linear Foot (Lin m)
701-13	Corrugated Metal Pipe Arch (Extension)	Linear Foot (Lin m)

701-14	Cleaning Existing Pipes	Linear Foot (Lin m)
701-15	Concrete Collar	Each
701-16	Plastic Pipe (Extension)	Linear Foot (Lin m)

SECTION 704 – GUARD RAIL:

Subsection 704.03 – General Construction Requirements (01/05), Pages 368 and 369.

Add the following to Heading (d), Guard Rail End Treatments.

All end treatments shall bear a label indicating the manufacturer and exact product name of the end treatment along with its assigned NCHRP 350 test level. This label shall resist weathering and shall be permanently affixed to the railing in such a way as to be readily visible.

SECTION 706 – CONCRETE WALKS, DRIVES AND INCIDENTAL PAVING:

All Subsections within Section 706 (04/08), Pages 375 – 377.

Delete Section 706, Concrete Walks, Drives and Incidental Paving and substitute the following.

SECTION 706
CONCRETE WALKS, DRIVES AND INCIDENTAL PAVING

706.01 DESCRIPTION. This work consists of furnishing and constructing portland cement concrete walks, handicapped curb ramps, drives and incidental paving slabs in accordance with these specifications and in conformity with lines, grades and dimensions shown on the plans or established.

706.02 MATERIALS. Materials shall comply with the following Section or Subsections.

Portland Cement Concrete (Class M)	901
Joint Filler	1005.01(c)
Reinforcing Steel	1009.01
Curing Materials	1011.01

706.03 CONSTRUCTION REQUIREMENTS.

(a) Excavation: Excavation shall be made to required depth and width. The top of the subgrade shall be shaped and compacted to a firm, even surface conforming to the section shown on the plans. Unsuitable material shall be removed and disposed of in accordance with Subsection 202.02 and replaced with approved material at no direct pay.

(b) Forms: Forms shall be of wood or metal and shall extend the full depth of concrete. Forms shall be straight, clean and of sufficient strength to resist the pressure of concrete. Bracing of forms shall be such that forms remain in horizontal and vertical alignment until their removal.

Concrete may be placed by slip-form methods. Slip-formed concrete shall be placed with an approved machine designed to spread, vibrate, consolidate and finish concrete in one pass of the machine in such manner that minimum hand finishing is necessary. Sliding forms shall be

rigidly held together to prevent spreading of forms. After the passing of the side forms there shall be no noticeable slumping of concrete.

(c) Subgrade: The subgrade shall be thoroughly moistened immediately prior to placing concrete.

(d) Placing and Finishing: Concrete shall be placed on the subgrade, struck off to required thickness and tamped sufficiently to bring the mortar to the surface. The surface shall be finished with a wood float or steel trowel followed by brushing to a slightly rough finish. Joints and edges shall be rounded with an edging tool having a 1/4-inch (6 mm) radius.

(e) Joints:

(1) Expansion Joints: Expansion joints shall be filled with 1/2 inch (13 mm) thick preformed expansion joint filler. Expansion joints shall be installed at maximum 100-foot (30 m) intervals, and between intersecting paving and any fixed structure such as a building, bridge or curbing, and between intersecting paving and the handicapped curb ramps. Expansion joint material shall extend for the full width and depth of paving.

(2) Weakened Plane: Weakened planes shall be formed by a jointing tool or other acceptable means. Weakened planes shall extend into concrete for at least 1/4 of the depth and shall be approximately 1/8 inch (3 mm) wide.

a. Walks: Spacing of weakened planes for walks shall be equal to the width of walk.

b. Drives: A longitudinal weakened plane shall be formed along the centerline of drives more than 16 feet (5 m) wide, and transverse weakened planes shall be formed at not more than 16-foot (5 m) intervals.

c. Incidental Paving: Weakened planes for incidental paving shall be formed at intervals not exceeding 30 times the thickness of the concrete in length or width. Incidental paving poured adjacent to jointed concrete shall be jointed to match existing joints, with intermediate joints formed as necessary not to exceed the maximum joint spacing.

(3) Construction Joints: Construction joints shall be formed around manholes, utility poles, etc., extending into paving and 1/4 inch (6 mm) thick preformed expansion joint filler shall be installed in these joints.

(4) Tie-ins: Tie-ins of existing concrete shall be made by full depth sawing at no direct pay.

(f) Curing: Concrete shall be cured in accordance with Subsection 601.10.

(g) Detectable Warning Surface for Handicap Ramps and At-Grade Sidewalk Intersections: Sidewalks, when intersecting with roadways, shall be equipped with a detectable warning surface system consisting of raised truncated domes as a transition between the sidewalk and the street as required by the Americans with Disabilities Act, 28 CFR Part 36, ADA Standards for Accessible Design.

Detectable warnings (truncated domes) shall be installed on the ramp surface over the full width of the ramp throat for a distance of 24 inches (600 mm) in the direction of travel from the back of the curb. Detectable warnings (truncated domes) shall also be installed on at-grade sidewalks intersecting with roadways for a distance of 36 inches (900 mm) in the direction of travel from the end of the sidewalk. Truncated domes shall be laid out on a square grid in order to allow enough space for wheelchairs to roll between the domes.

Light reflectance of the truncated domes and the underlying surface must meet the 70 percent contrast requirement of ADAAG.

706.04 MEASUREMENT. Quantities of concrete walks, drives and incidental paving slabs for payment will be the design quantities as specified on the plans and adjustments thereto. Design quantities will be adjusted if the engineer makes changes to adjust to field conditions, if design errors are proven or if design changes are made. Design areas are based on the horizontal dimensions shown on the plans. Excavation, backfill, reinforcing steel and joint materials will not be measured for payment.

Handicapped curb ramps, including the detectable surface warning system, will be measured per each.

Detectable surface warning systems for at-grade sidewalk intersection will not be measured for payment.

706.05 PAYMENT. Payment for concrete walks, drives and incidental paving will be made on a lot basis at the contract unit price per square yard (sq m), adjusted in accordance with the following provisions. Payment for each lot will be made in accordance with Table 901-6. Size, sampling, and testing of each concrete lot shall be in accordance with the Materials Sampling Manual.

Payment for handicapped curb ramps, including the detectable surface warning system, will be made by each and shall include, but not limited to, curb transitions, detectable warning system, gutter, landing and base.

Payment will be made under:

Item No.	Pay Item	Pay Unit
706-01	Concrete Walk (inch (mm) Thick)	Square Yard (Sq m)
706-02	Concrete Drive (inch (mm) Thick)	Square Yard (Sq m)
706-03	Incidental Concrete Paving (inch (mm) Thick	Square Yard (Sq m)
706-04	Handicapped Curb Ramps	Each

SECTION 713 – TEMPORARY TRAFFIC CONTROL:

Subsection 713.06 – Pavement Markings (08/06), Pages 400 – 403.

Delete Table 713-1, Temporary Pavement Markings and substitute the following.

Table 713-1
Temporary Pavement Markings[1,2]

		Two-lane Highways	Undivided Multilane Highways	Divided Multilane Highways
SHORT TERM	ADT<1500; or ADT>1500 and time<3 days	Lane lines 4-foot (1.2 m) tape on 40-foot (12 m) centers; with "Do Not Pass" and "Pass With Care" signs as required		
	ADT>1500; Time>3 days and<2 weeks	Lane lines 4-foot (1.2-m) tape on 40-foot (12-m) centers with no passing zone markings		
	All ADT's with time <2 weeks		Lane lines 4-foot (1.2m) tape on 40-foot (12 m) centers; double yellow centerline	Lane lines 4-foot (1.2 m) tape on 40-foot (12 m) centers
LONG TERM	All ADT's with time >2 weeks	Standard lane lines, no-passing zone markings, legends and symbols and when pavement width is 22 feet (6.7 m) or greater, edge lines	Standard lane lines, centerlines, edge lines, and legends and symbols	Standard lane lines, centerlines, edge lines, and legends and symbols.

[1]No-passing zones shall be delineated as indicated whenever a project is open to traffic.
[2]On all Asphaltic Surface Treatments that are open to traffic and used as a final wearing course or as an interlayer, temporary pavement markings (tabs) on 20-foot (6 m) centers shall be used, in lieu of the 4-foot (1.2 m) tape, on 40-foot (12 m) centers.

SECTION 729 – TRAFFIC SIGNS AND DEVICES:

Subsection 729.02 – Materials (04/08), Pages 456 and 457.

Delete the contents of Heading (a), Sign and Marker Sheeting, and substitute the following.

(a) Sign and Marker Sheeting: Sheeting material for sign panels, delineators, barricades and other markers shall comply with Section 1015. All permanent signs shall meet the requirements of ASTM D 4956, Type X.

Subsection 729.04, Fabrication of Sign Panels and Markers (04/08), Pages 458 – 460.

Delete the third paragraph of Heading (c), Sheeting Application and substitute the following.

ASTM D 4956 Type X reflective sheeting shall be applied with an orientation determined by the engineer to obtain the optimum entrance angle performance. Fabricated vertical splices in ASTM D 4956 Type X reflective sheeting will be allowed only when the horizontal dimension of the sign face or attached shield is in excess of the maximum manufactured width of the sheeting. Fabricated vertical splices in ASTM D 4956 Type X reflective sheeting will also be allowed when the specified orientation will create excessive sheeting waste.

SECTION 804 – DRIVEN PILES:

Subsection 804.08 – Construction Requirements (04/07), Pages548 – 554.

Delete the first sentence of Heading (a), Preboring and substitute the following.

Preboring by augering, wet-rotary drilling, or other methods used to facilitate pile driving will not be permitted unless specified in the plans or allowed by the engineer.

Delete the first sentence of Heading (b), Jetting and substitute the following.

Jetting will not be permitted unless allowed in the plans or allowed by the engineer.

SECTION 901 – PORTLAND CEMENT CONCRETE:

Subsection 901.06 – Quality Control of Concrete (08/06), Pages 726 – 731.

Add the following to the contents of Heading (b), Quality Control Tests.

The contractor shall be responsible for monitoring the components (cement, mineral and chemical admixtures, aggregates) in their mix to protect against any changes due to component variations. As component shipments arrive, the contractor shall verify slump, air content and set time by testing at ambient temperatures. The contractor shall make adjustments to the mix design to rectify any changes which would adversely affect constructability, concrete placement or the specifications. The contractor shall submit test results to the Department for review each day of paving. Testing to validate component consistency will be documented on the control logs. Conformance or variation in mix parameters (workability, set times, air content, etc.) shall be noted on the control logs. The contractor shall provide a copy of the proposed testing plan to the engineer for record. Acceptance of the plan does not relieve the contractor's responsibility for consistency.

Subsection 901.08 – Composition of Concrete (12/05), Pages 732 – 734.

Add the following to Heading (a).

The blended cement containing up to 50 percent of grade 100 or grade 120 ground granulated blast-furnace slag must be in compliance with Subsection 1001.04 for portland blast-furnace slag cement.

SECTION 1001 – HYDRAULIC CEMENT:

Subsection 1001.01 – Portland Cement (09/07). Page 749.

Delete the contents of this subsection and substitute the following.

1001.01 PORTLAND CEMENT. Portland cement shall be from an approved source listed in QPL 7 and shall comply with AASHTO M 85.

Alkali content calculated as sodium oxide equivalent shall not exceed 0.60 percent by weight for all types of cement.

SECTION 1003 – AGGREGATES:

Subsection 1003.02 – Aggregates for Portland Cement Concrete and Mortar (07/07), Pages 763 – 766.

Delete the contents of Heading (c), Aggregates for Types B and D Pavements, and substitute the following.

(c) Aggregates for Types B and D Pavements: For the combined aggregates for the proposed portland cement concrete pavement mix, the percent retained based on the dry weight (mass) of the total aggregates shall meet the requirements of Table 1003-1A for the type of pavement specified in the plans. Additionally, the sum of the percents retained on any two adjacent sieves so designated in the table shall be at least 12 percent of the total combined aggregates. The maximum amounts by weight (mass) of deleterious materials for the total aggregate shall be the same as shown in Subsection 1003.02(b).

Table 1003-1A
Aggregates for Types B and D Pavements

U.S. Sieve	Metric Sieve	Percent Retained of Total Combined Aggregates	
		Pavement Type	
		Type B	Type D
2 1/2 inch	63 mm	0	0
2 inch	50 mm	0	0-20
1 1/2 inch	37.5 mm	0-20	0-20
1 inch	25.0 mm	0-20	**5-20**
3/4 inch	19.0 mm	**5-20**	**5-20**
1/2 inch	12.5 mm	**5-20**	**5-20**
3/8 inch	9.5 mm	**5-20**	**5-20**
No. 4	4.75 mm	**5-20**	**5-20**
No. 8	2.36 mm	**5-20**	**5-20**
No. 16	1.18 mm	**5-20**	**5-20**
No. 30	600 µm	**5-20**	**5-20**
No. 50	300 µm	0-20	0-20
No. 100	150 µm	0-20	0-20
No. 200	75 µm	0-5	0-5
Note: For the sieves in the shaded areas, the sum of any two adjacent sieves shall be a minimum of 12 percent of the total combined aggregates.			

Each type of aggregate to be used in the proposed mixture shall be sampled and tested individually. The percent of total combined aggregates retained shall be determined mathematically based on the proportions of the combined aggregate blend. All gradation calculations shall be based on percent of dry weight (mass).

SECTION 1005 – JOINT MATERIALS FOR PAVEMENTS AND STRUCTURES:
Subsection 1005.04 – Combination Joint Former/Sealer (11/05), Pages 782 and 783.

Delete Heading (a) and substitute the following.

(a) Description: This joint former/sealer is intended for use in simultaneously forming and sealing a weakened plane in portland cement concrete pavements.

The material shall consist of an elastomeric strip permanently bonded either mechanically or chemically at the top of each of two rigid plastic side frames and covered with a removable plastic top cap. Side frames shall be of such configuration that when the sealer is inserted into plastic concrete and vibrated, a permanent bond forms between side frames and concrete.

Delete Heading (b)(1) and substitute the following.

(1) Elastomer: The elastomer strip portion of the material shall be manufactured from vulcanized elastomeric compound using polymerized chloroprene or thermoplastic vulcanizate as the base polymer, and shall comply with the following requirements:

Property	ASTM Test Method	Requirements	
		Polymerized Chloroprene	Thermoplastic Vulcanizate
Tensile Strength, kPa, Min.	D 412	12,400	7,400
Elongation at Break, % Min.	D 412	200	400
Hardness, Shore A	D 2240	65 ± 10	65 ± 10
Properties after Aging, 70 h @ 100°C	D 573		
Tensile Strength, % Loss, Max.		20	20
Elongation, % loss, Max.		25	25
Hardness, pts. increase, Max.		10	10
Ozone Resistance, 20% strain or bentloop, 300 pphm in air, 70 h @ 40°C	D 1149	no cracks	no cracks
Oil Swell, IRM 903, 70 h @ 100°C, wt change, % Max.	D 471	45	75

Delete Headings (b)(2) and (b)(3) and substitute the following:

(2) Bond of Elastomer to Plastic: The force required to shear the elastomer from the plastic shall be a minimum of 5.0 pounds per linear inch (90 g/mm) of sealer when tested in accordance with DOTD TR 636.

(3) Bond of Plastic to Cement Mortar: This bond will be evaluated and shall meet the following requirements:

The force required to separate the cement mortar from the plastic shall be a minimum of 5.0 pounds per linear inch (90 g/mm) of sealer when tested in accordance with DOTD TR 636.

SECTION 1006 – CONCRETE AND PLASTIC PIPE:

Subsection 1006.09 – Plastic Yard Drain Pipe (06/07), Page 789.

Delete the contents of Subheading (a)(3), Ribbed Polyvinyl Chloride Pipe (RPVCP) and substitute the following.

Ribbed Polyvinyl Chloride Pipe (RPVCP): Ribbed Polyvinyl Chloride Pipe shall comply with ASTM F 794, Series 46 or ASTM F 949 (46 psi).

SECTION 1013 – METALS:

Subsection 1013.09 – Steel Piles (08/06) Page 822.

Delete the title and references to "Steel Piles" in this subsection and substitute "Steel H Piles".

SECTION 1015 – SIGNS AND PAVEMENT MARKINGS:

Subsection 1015.04 – Sign Panels (05/07), Pages 832 and 833.

Delete the contents of Heading (a), Permanent Sign Panels and substitute the following.

(a) Permanent Sign Panels: Flat panels shall be aluminum sheets or plates complying with ASTM B 209, Alloy 6061-T6 or Alloy 5052-H38. Extruded aluminum panels shall comply with ASTM B 221 (ASTM B 221M), Alloy 6063-T6 and after fabrication, have a flatness equal to or less than 0.031 inch per foot of length and 0.004 inch per inch of width.

Subsection 1015.05 - Reflective Sheeting (04/08), Pages 833 – 838.

Delete the contents of this subsection and substitute the following.

1015.05 REFLECTIVE SHEETING.

(a) Permanent and Temporary Standard Sheeting: Reflective sheeting shall be one of the following standard types as specified on the plans and complying with ASTM D 4956 except as modified herein. Permanent warning, regulatory, guide and supplemental guide sign sheeting shall meet the requirements of ASTM D 4956 Type X. Reflective sheeting for temporary signs and devices shall meet the requirements of ASTM D 4956 Type III except as noted in Subsection 1015.05(f). Reflective sheeting shall be an approved product listed in QPL 13.

Type III - A high-intensity retroreflective sheeting that is typically encapsulated glass-bead retroreflective material.

Type VI - An elastomeric high-intensity retroreflective sheeting without adhesive. This sheeting is typically a vinyl microprismatic retroreflective material.

Type X - A super high-intensity retroreflective sheeting having highest retroreflectivity characteristics at medium distances. This sheeting is typically an unmetalized microprismatic retroreflective element material.

(b) Fluorescent Pink Retroreflective Sheeting: Signs for temporary control of traffic through incident management areas shall be Type VI fluorescent pink retroreflective sheeting and shall comply with the MUTCD. Temporary traffic control signs for incident management shall be placed to notify motorists of upcoming incidents on the roadway, and shall be removed from public view once the incident has been managed. Physical properties shall comply with ASTM D 4956. Photometric properties shall be as follows.

(1) Retroreflectivity: Minimum Coefficients of Retroreflection shall be as specified in Table 1015-1.

Table 1015-1
Coefficients of Retroreflection for Fluorescent Pink Sheeting[1]

Observation Angle, degrees	Entrance Angle, degrees	Fluorescent Pink
0.2	-4	100
0.2	+30	40
0.5	-4	40
0.5	+30	15

[1]Minimum Coefficient of Retroreflection (R_A) (cd $lx^{-1}m^{-2}$)

(2) Color and Daytime Luminance: Color Chromaticity Coordinates and Daytime Luminance Factors shall be as specified in Table 1015-2.

Table 1015-2
Fluorescent Pink Color Specifications Limits (Daytime)

Chromaticity Coordinates (corner points) [1]								Luminance Factor, min.
1		2		3		4		Y%
x	y	x	y	x	y	x	y	25
0.450	0.270	0.590	0.350	0.644	0.290	0.536	0.230	

[1]The four pairs of chromaticity coordinates measured with CIE 2° Standard Observer and 45/0 (0/45) geometry and CIE D65 Standard Illuminant.

(c) Adhesive Classes: The adhesive required for retroreflective sheeting shall be Class 1 (pressure sensitive) as specified in ASTM D 4956.

(d) Accelerated Weathering: Reflective sheeting, when processed, applied and cleaned in accordance with the manufacturer's recommendations shall perform in accordance with the accelerated weathering standards in Table 1015-3.

Table 1015-3
Accelerated Weathering Standards[1]

Type	Retroreflectivity[2]				Colorfastness[3]	
	Orange/ Fluorescent Orange		All colors, except orange/Fluorescent Orange		Orange/ Fluorescent Orange	All colors, except orange/Fluorescent Orange
III	1 year	80[4]	3 years	80[4]	1 year	3 years
III (for drums)	1 year	80[4]	1 year	80[4]	1 year	1 year
VI	1/2 year	50[5]	1/2 year	50[5]	1/2 year	1/2 year
X	1 year	80[6]	3 years	80[6]	1 year	3 years

[1]At an angle of 45° from the horizontal and facing south in accordance with ASTM G 7 at an approved test facility in Louisiana or South Florida.
[2]Percent retained retroreflectivity of referenced table after the outdoor test exposure time specified.
[3]Colors shall conform to the color specification limits of ASTM D 4956 after the outdoor test exposure time specified.
[4]ASTM D 4956, Table 8.
[5]ASTM D 4956, Table 13.
[6]ASTM D 4956, Table 4.

(e) Expected Sign Life Data and Performance: The sheeting manufacturer shall supply expected retroreflectivity service life curves for each of the following sign sheeting colors: white, green, blue, brown, red, and yellow. The service life curves shall be plots of the 95 percent expected life plotted on an x-y graph with life years on the x-axis and retroreflectivity on the y-axis. The expected life shall account for worst case installations, equivalent to an installation in South Louisiana with the sign facing to the South. The sheeting manufacturer shall also supply a table of expected life values taken from the service life curves for Revision Number 2 to the 2003 Edition of the MUTCD minimum reflectivity requirements published in the Federal Register on December 21, 2007. Reflective sheeting for signs, when processed, applied and cleaned in accordance with the manufacturer's recommendations shall perform outdoors in accordance with the performance standards in Table 1015-4.

Table 1015-4
Reflective Sheeting Performance Standards

Type	Retroreflectivity[1] -- Durability[2]				Colorfastness[3]
	Orange/ Fluorescent Orange		All colors, except orange/Fluorescent Orange		
III	3 years	80[4]	10 years	80[4]	3 years
X	3 years	80[5]	7years	80[5]	3 years

[1]Percent retained retroreflectivity of referenced table after installation and the field exposure time specified.
[2]All sheeting shall maintain its structural integrity, adhesion and functionality after installation and the field exposure time specified.
[3]All colors shall conform to the color specification limits of ASTM D 4956 after installation and the field exposure time specified.
[4]ASTM D4956, Table 8.
[5]ASTM D 4956, Table 4.

(f) Temporary Signs, Barricades, Channelizing Devices, Drums and Cones: Reflective sheeting for temporary signs, barricades and channelizing devices, shall meet the requirements of ASTM D 4956, Type III except that temporary warning construction signs used on the mainline of freeways and expressways shall be fluorescent orange and meet the requirements of ASTM D 4956, Type X.

Reflective sheeting for vertical panels shall meet the requirements of ASTM D 4956, Type III.

Reflective sheeting for drums shall be a minimum of 6 inches (150 mm) wide and shall meet the requirements of ASTM D 4956, Type III, and the Supplementary Requirement S2 for Reboundable Sheeting as specified in ASTM D 4956. Reflective sheeting for traffic cone collars shall meet the requirements of ASTM D 4956, Type III or Type VI.

(g) Sheeting Guaranty. The contractor shall provide the Department with a guaranty from the sheeting manufacturer stating that if the retroreflective sheeting fails to comply with the performance requirements of this subsection, the sheeting manufacturer shall do the following:

Table 1015-5
Manufacturer's Guaranty-Reflective Sheeting

Type	Manufacturer shall restore the sign face in its field location to its original effectiveness at no cost to the Department if failure occurs during the time period[1] as specified below		Manufacturer shall replace the sheeting required to restore the sign face to its original effectiveness at no cost to the Department if failure occurs during the time period[1] as specified below
	Orange/Fluorescent Orange	All colors, except orange/Fluorescent Orange	All colors, except orange/Fluorescent Orange
III	<3 years	<7 years	7-10 years
X	<3 years	<5 years	5-7 years

[1] From the date of sign installation.

Replacement sheeting for sign faces, material, and labor shall carry the unexpired guaranty of the sheeting for which it replaces.

The sign fabricator shall be responsible for dating all signs with the month and year of fabrication at the time of sign fabrication. This date shall constitute the start of the guaranty obligation period.

Subsection 1015.11 - Preformed Plastic Pavement Marking Tape (06/07), Pages 842 – 844.

Delete the contents of this subsection and substitute the following.

1015.11 PREFORMED PLASTIC PAVEMENT MARKING TAPE.

(a) General: Preformed plastic pavement marking tape shall be approved products listed on QPL 64 and shall comply with ASTM D4505 Retroreflectivity Level I or Level II, or DOTD Intersection Grade (as specified below), except as modified herein. The marking tape shall be Class 2 or 3. The type and color shall be in accordance with the plans and the MUTCD.

(b) Thickness: All preformed plastic pavement marking tape shall have a minimum overall thickness of 0.060 inches (1.5 mm) when tested without the adhesive.

(c) Friction Resistance: The surface of the Retroreflectivity Level II preformed plastic pavement marking tape shall provide a minimum frictional resistance value of 35 British Polish Number (BPN) when tested according to ASTM E303. The surface of the Retroreflectivity Level I and DOTD Intersection Grade preformed plastic pavement marking tape shall provide a minimum frictional resistance value of 45 BPN when tested according to ASTM E303. Values for the Retroreflectivity Level I material with a raised surface pattern as defined in ASTM D4505 are calculated by averaging values taken at downweb and at a 45 degrees angle from downweb.

(d) Retroreflective Requirements: The preformed plastic pavement marking tape shall have the minimum initial specific luminance values shown in Table 1015-7 when measured in accordance with ASTM D 4061.

Table 1015-7
Specific Luminance of Preformed Plastic Tape

Type	Observation Angle, degrees	Entrance Angle, degrees	Specific Luminance (mcd/sq m/lx)	
			White	Yellow
Retroreflectivity Level I	1.05	88.76	500	300
DOTD Intersection Grade	1.05	88.76	375	250
Retroreflectivity Level II	1.05	88.76	250	175

(e) Durability Requirements: The DOTD Intersection Grade preformed plastic pavement marking tape shall show no appreciable fading, lifting or shrinkage for a least 12 months after placement when placed in accordance with the manufacturer's recommended procedures on pavement surfaces having a daily traffic count not to exceed 15,000 ADT per lane.

The Retroreflectivity Level I preformed plastic pavement marking tape shall show no appreciable fading, lifting or shrinkage for a least 4 years after placement for longitudinal lines and at least 2 years after placement for symbols and legends.

The Retroreflectivity Level I preformed plastic pavement marking tape shall also retain the following reflectance values for the time period detailed in Table 1015-8.

Table 1015-8
Retained Specific Luminance for Retroreflectivity Level I
Preformed Plastic Pavement Marking Tape

Time	Observation Angle, degrees	Entrance Angle, degrees	Specific Luminance (mcd/sq m/lx)	
			White	Yellow
1 year	1.05	88.76	400	240
4 years (2 years for symbols and legend)	1.05	88.76	100	100

(f) Plastic Pavement Marking Tape Guaranty (DOTD Intersection Grade and Retroreflectivity Level I): If the plastic pavement marking tape fails to comply with the performance and durability requirements of this subsection within 12 months for DOTD Intersection Grade and 4 years for Retroreflectivity Level I, the manufacturer shall replace the plastic pavement marking material at no cost to the Department.

SECTION 1020 – TRAFFIC SIGNALS:

Subsection 1020.01 – Traffic Signal Heads (06/07), Pages 873 – 884.

Delete the contents of Heading (a), General Requirements and substitute the following.

(a) General Requirements: Traffic signal sections, beacon sections and pedestrian signal sections shall be of the adjustable type. Materials and construction of each section shall be the same.

Signals shall be constructed for either 8 or 12-inch (200 mm or 300 mm) lens in accordance with the plans. Signal sections shall have three to five sections per face and beacon sections have only one section per face. Signal sections and associated brackets shall be finished inside and out with two coats of high grade dark olive green enamel, color number 14056 according to Federal Standard No. 595b with each coat independently baked. Visors shall be coated green on the outside and black on the inside. Edges shall be deburred and smooth with no sharp edges.

Subsection 1020.04 – Poles for Traffic Signal Systems (06/07), Pages 890 – 894.

Delete the sixth paragraph of Heading (a), Pedestal Support Signal Poles, and substitute the following.

Pedestals shall be finished with at least one coat of rustproofing primer, applied to a clean surface and one coat of dark olive green enamel, color number 14056 according to Federal Standard No. 595.

Louisiana
Department of Transportation
and
Development

Traffic Control Standard
Number 18A

TRAFFIC SIGNAL CONTROL SYSTEM

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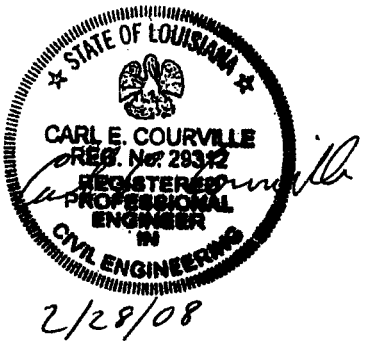

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1.0 INTRODUCTION.

This specification sets forth the minimum requirements for a shelf-mounted, digital, solid-state traffic control system including and to be furnished with time-based coordination, closed-loop system communication/coordination, multiple railroad/fire preemption sequences, and hardwired/telemetry interconnect capable of operating as both a master and secondary. All components needed to operate as both a master and secondary shall be provided for in each assembly. The system design shall be based on the requirements of NEMA Standards Publication No. TS-2, 1998. Controller sequencing referenced in this standard for diamond intersections emulates the design and standards from the Texas Department of Highways and the Texas Transportation Institute. The controller should have a database that conforms to Section 3.5 of the current NEMA NTCIP specifications.

All components and accessories shall comply with the NEMA testing requirements and a Certification of Compliance shall be presented with each bid for that equipment being offered. The operational requirements herein extend the requirement of NEMA controllers and supersede NEMA TS-2 where differences occur.

All equipment and operational characteristics specified herein shall be provided, except where noted.

2.0 CLOSED-LOOP COMPUTER OPERATING SYSTEM.

The closed-loop central operating system shall be a traffic management program for hard-disk supported IBM personal computers and compatible equipment which creates a system network using the principle system components. The software shall operate using Microsoft's Windows operating system. The software shall be programmed resident for the operating system.

2.1 SOFTWARE DESCRIPTION.

The software shall be loaded into the specified personal computer and operationally verified by the supplier. Back-up software shall be supplied on a compact disk.

The software shall be licensed to the agency for its use on a single computer or each computer specified in the system. Software improvements and enhancements to the supplied version shall be furnished to this agency at no additional cost. Software is supplied when indicated on the plans for a state job and will be specific to a highway district.

Programming displays, on the PC screen, shall aid the operator in entering data from the PC keyboard. These displays shall be arranged in using a tool bar format. The main tool bar shall allow the user to select a major function. A sub-tool bar shall be allowed for selection of a specific area within that function when it exists.

The central computer software shall provide rapid movement through menus, sub-menus and data base pages and limited only by the operating speed of the computer. Returning to the main menu or sub-menu shall be selected by pressing a single key.

Menus and sub-menus shall not contain mnemonics or codes for descriptions. Additional screens shall be provided where necessary to explain keyboard procedure. All icons that are defined within a tool bar shall be described in a help line as the cursor is placed over that icon.

Traffic engineering terminology shall be used throughout the programming displays. Display organization and data entry approach shall allow system operators to program the central computer without using reference cards or manuals.

2.2 SOFTWARE FEATURES.

Once the computer power-up routine is complete, the system shall be in monitor mode. It shall be possible for the operator to exit this mode and enter the user mode, and vice-versa.

In monitor mode, central computer shall continue to monitor events even if the printer is off-line. Upon restoration of the printer, it shall print a hard-copy of events occurring prior to and during printer off-line.

Central computer software shall provide:

a. Dynamic Displays
b. System Printouts
c. Data Base Management
d. Security
e. Directories
f. Data Back-up

2.3 DYNAMIC DISPLAYS.

Central computer shall display the following in real-time color graphics selected from the menus:

a. Intersection Display
b. System Map Display

All text data shall be displayed in traffic engineering terms. Mnemonics shall be acceptable; however, the need for reference guides and manuals shall not be acceptable. All information shall be simultaneously and continuously displayed until canceled by the operator. Displays shall not affect system on-street operation. The displays shall have a minimum one second resolution.

2.3.1 Intersection Display.

The central computer shall display the operation of any selected intersection controller within any selected system.

Each display shall be user-created to indicate the intersection configuration, including any "T" and standard diamonds, on a single screen display. The intersection display shall show as a minimum:

a. Intersection configuration layout for all possible phasing of intersection controllers including overlaps.
b. All vehicle signal indications, (R,Y,G) for each active phase.
c. All pedestrian signal indications: walk, flashing and solid don't walk, for all 16 active phases.
d. Vehicle and pedestrian detector actuation for each displayed phase.
e. Cycle, offset, split or plan in effect.
f. Arterial master and intersection controller identifier numbers, including intersection street names.
g. Central computer and local intersection controller TOD clocks.

The display shall include dynamic statuses of the arterial master and the intersection controller. Arterial master status shall consist of operational status, cycle, offset, split, plan in effect, cycle length, cycle countdown, and status of special functions. System control mode status shall include manual, external, time-of-day, or traffic responsive operation. This status shall indicate whether the system is operating under plan, time-base coordination, or time-base backup.

Intersection controller dynamic data shall consist of operational status; non-interconnected coordination, coordination offset value, or free/plan indicator; split values based on cycle and split in effect; preemption status; and diagnostic indications. Operational status shall include on-line, off-line, failed, or disabled. If the intersection controller is off-line or failed, the conditions causing that failure shall also be displayed. All diagnostic indications having alarm status shall be shown flashing. Alarms, preempt call numbers, and preemptor in effect shall also be shown. If preempt is in a flashing operation, it shall be displayed as flashing.

2.3.2 System Map Display.

System Map Display shall provide geometric layout of the system for a minimum of 32 intersections simultaneously and show real time display. The display shall also indicate the relative placements for a minimum of sixteen system detectors. Any intersection shall be selected to present a full screen display as stated in Section 2.3.1.

A map editor shall permit the user to lay-out the intersections in their relative physical relationship to each other, place the system detectors anywhere along the approaches, and number the intersections appropriately. Five-legged intersections, central business district layouts (CBD), and angled approaches shall be possible.

A text editor shall permit the user to create a minimum of 50, 20-character strings and place them on the display. This feature shall allow labeling streets, detector identification, or other points-of-interest. All text would preferably be placed at any angle on the screen. For instance, street names shall follow the angle of the drawn street (horizontal, vertical, or diagonally), if desired.

Display data shall include current system operating parameters, special function status, cycle countdown, zone control mode of operation, and consolidated intersection status.

Consolidated intersection status shall indicate if an intersection is on-line, free, has a coordination fault, is in preemption or flash, or has a communication failure.

2.4 SYSTEM PRINTOUTS.

System printouts present system readiness and operational status and are used for analyzing system performance. The printouts shall be divided into four categories: Computer Events, Event Reports, Status Reports, and Logs, as detailed in this specification.

2.4.1 Computer Events.

The central computer shall provide a monitor mode of operation to receive status change and operating failure event reports from any arterial master or isolated controllers.

Events shall be allowed for display on the central computer terminal or printed as a hard copy when they are received. Events shall consist of system identification, time and date of event occurrence, device identification (if device diagnostic event), and event description.

The central computer shall store events in a hard disk file to produce event reports, as needed. It shall be possible to transfer event files to a storage diskette for historical record keeping. Event files shall be removed from hard disk after file transfer to storage diskette to prevent overflowing the hard disk.

2.4.2 Event Reports.

Event report capability shall be provided for events occurring on one day, or group of days, from central computer files on the hard disk or storage diskette.

A directory search capability shall be provided that lists all event files for any system by date, on the selected disk drive. If one day is selected, the date shall be entered directly or by directory search. Directory search shall be used to select dates for event reports for a group of days.

It shall be possible to display and print events as received or sorted by event type. If event type selected is for a system device, it shall be possible to specify all devices or a single device.

Menus shall be provided to facilitate event type selection. Program operation shall allow interactive operation for preparing an event report for any combination of event type and system device.

2.4.3 Status Reports.

Status reports shall be generated by the arterial master controller in response to a manual command by the operator at the central computer. These reports shall present an immediate record of system operational status on the central computer display. Provision shall be made for hard copy printout.

2.4.4 Logs.

Detector data shall be processed by the central computer. Real-time logs shall be printed as received by the central computer while in the monitor mode. System detector logs shall be scheduled, formatted, and sent from the arterial master.

2.5 DATABASE MANAGEMENT.

2.5.1 Programming Displays.

A database management program shall exchange and update data with arterial master and intersection controller. Each arterial master and intersection controller shall have separate database programming pages. These pages shall contain all the programming options unique to each controller type.

Once database management is selected from the main menu, a sub-menu shall be presented listing the database pages available for programming. It shall be possible for the user to scroll through the data pages of a sub-menu or enter and exit a data page without waiting for data to fill the page. For example, page up and page down functions shall permit the operator to go from page 1 to 30, within 5 seconds.

All programming entries shall primarily consist of numerical values, YES/NO or ON/OFF entries. During program entry, the new data shall over-write the old data. If the data is in error, changes shall not be permitted and the user shall be alerted by either an error message on the display or a warning tone.

2.5.2 Upload/Download.

All devices shall use upload/download techniques for database programming. The arterial master shall employ an additional database programming method through direct data entry.

Upload/download shall transfer the entire programmable database from/to the arterial master or any intersection controller via the arterial master, with the exception of intersection controller preemptor and overlap configuration.

All upload/download data shall use block transfer techniques, and shall be verified by block check-sum and word parity. Non-verified data shall cause termination of the upload/download with no data transfer taking place. It shall not be possible to load erroneous interval and configuration information to the controller.

Upload techniques shall not cause the system or intersection controller to go off-line. Traffic control operation shall remain intact in all respects.

The program shall compare the database of any arterial master or intersection controller to the database on file following an upload. The compare function shall be executed by simple keyboard technique and shall identify any differences between loaded and file data. The system operator shall be able to correct, use, or substitute data values, and proceed with further comparison.

2.5.3 Backup Database.

Data from the backup files shall be read and verified for programming EEPROMs to be installed in intersection controllers and arterial masters.

2.5.4 Auto Print.

Selection to automatically print any or all arterial master or intersection controller databases that are stored in the central computer shall be provided.

Selection eliminating intersection controllers which are not in service when all intersection controllers are selected for printing shall be provided.

The system shall print only pages within a database that contain data. Pages with no user-entered data shall be skipped. If a database is selected for printing, but is not found on the central computer hard disk, it shall be noted on a separate sheet of the printout.

2.6 SECURITY.

System security at the central computer shall be ensured through three levels of access. The levels shall be as follows:

a. Supervisor
b. Data change
c. Viewer

The supervisor and data change levels shall have separate access codes that must be entered prior to making database changes.

The supervisor level shall permit access code number assignments and database changes. Data change level shall permit database changes. If an incorrect code is entered, database changes are denied. Viewer level shall not permit any database changes.

2.7 DIRECTORIES.

System and intersection directories shall include location of arterial masters and associated intersection controllers by name or number.

System directory text shall describe each of the systems. A system name may be entered and shall identify the system in menus, report titles, and arterial master database pages.

Intersection directory text shall list intersection names and telephone numbers for each associated arterial master. An intersection name may be entered and shall identify the intersection in menus, intersection displays, and intersection database pages.

The user shall assign names to the intersection controller alarm inputs. These names shall identify alarms in event reports. Each alarm name shall be twenty characters.

2.8 DATABASE BACKUP AND RESTORE.

The system shall include an option for making backup copies on diskettes of the database files contained in the central computer. All files required to restore the system to operation without the need to re-enter data shall be included on the backup diskette.

The central computer's files containing records of event and buffeted data shall be saved on hard disk when received from the arterial master. Provision for transferring computer files to storage diskettes shall be included. After transfer to storage diskette, monitor files shall be removed from the hard disk by a user selected command. Storage diskette files shall allow for data analysis by the same report programs used for files on hard disk.

2.9 SOFTWARE MAINTENANCE AGREEMENTS.

The software agreement for licensing to the Department shall be in force upon the acceptance by the vendor to supply equipment and software to the Department either by purchase order or construction project.

2.9.1 Performance.

The vendor shall warrant that the software will perform according to the specifications.

2.9.2 CPU Limitations.

The vendor shall agree that it will be the Department's option to use the software on upgraded equipment at any time and use the software on backup equipment for a limited time. The limits of use shall be as previously stated.

2.9.3 Backup Provisions.

The vendor shall agree that the Department will utilize off-site storage for the software and backup files. Copies of these files shall be made by the Department as needed within the operational guidelines previously stated.

2.9.4 Operational Restrictions.

The vendor shall agree that the Department will utilize the software to monitor any system within the Department's responsibility.

2.9.5 Maintenance Standards.

The vendor shall agree to supply the Department with updates to the software. If the updates require upgrading of the Department's equipment, the vendor will provide the source codes to the Department for the version of software provided to the Department.

2.9.6 Source Code.

The vendor shall deliver the source code and documentation to the Department to be used in the event of failure to provide support to the software. A viable holding arrangement will be considered as an alternate method for source code to be delivered to the Department at no cost to the Department. This option shall be stated on the order, plans, or other purchase agreements for the controllers, otherwise will not be required.

3.0 SYSTEM COMMUNICATIONS.

The controller unit shall communicate with a system master controller, central computer (for isolated intersections), or portable computer connected directly to the controller. Internal settings, including coordination, shall be accessible via an external Hayes compatible modem through the RS-232 interface. The controller unit shall receive system master commands and data transmissions. In addition, it shall transmit the controller unit status, database, and system detector information to the system master. All alarms provided shall be accessible through the RS-232 port by remote interrogation and by automatic dialing initiated by the controller unit.

3.1 SYSTEM COMMANDS.

The communication shall allow the controller unit to receive, as a minimum, the following commands:

a. The coordination pattern (selects the cycle, offset, and split)
b. Time of day and date
c. Special function commands (minimum of four)
d. Free and flash mode command patterns
e. Control of the local system on a specified master controller
f. Request for local status

3.2 STATUS DATA.

The status of each of the following functions shall be transmitted from each controller in response to a status request from any monitoring device:

a. Green and yellow status for all phases and overlaps
b. Walk and pedestrian clearance status for all phases
c. Vehicle and pedestrian detector status (8 pedestrian and 64 vehicle detectors)
d. Phase termination status
e. Local Cycle time
f. Coordination status
g. Conflict flash status
h. Local flash status
i. Preempt activity and calls
j. Volume and occupancy data from a minimum of 16 system detectors
k. Status of four user-defined alarms
l. Zone map display data

3.3 UPLOAD/DOWNLOAD.

The communication shall provide the capability to upload/download the entire intersection data base to/from a monitoring personal computer. When desired, only a single screen of data can be sent and received from the intersection.

3.4 OPERATION.

Communication shall operate from communication ports on the front of the controller. The controller unit shall communicate with a system master/secondary controller, central computer, portable computer and/or the conflict monitor with RS-232 serial ports accessible through DB-25S connectors. The reserve connector pin assignments shall be as follows:

Pin #	Designation
1	Frame Ground
2	Transmit Data
3	Receive Data
4	Request to Send
5	Clear to Send
6	Data Set Ready
7	Signal Ground
8	Data Carrier Detect
20	Data Terminal Ready
22	Ring Indicator

The baud rate of each port shall be keyboard selectable for any one of the following rates: 600, 1200, 2400, 4800, 9600, 14.4K, 19.2K, 28.8K, 33K, and 57.6K. The port shall be configured for an eight (8) bit word, one (1) start, one (1) stop bit and no parity.

The communication path shall use a twisted pair of wires. These may be leased lines (Type 3002, voice grade, unconditioned), radio modem, or dedicated cable.

Communication timers shall be programmable from 0 to 9.9 seconds.

The controller unit shall be programmable via keyboard with a user assigned, unique address identifying the master and intersection.

3.5 INTRA-SYSTEM COMMUNICATIONS.

Intra-system communication shall be achieved through one of the four RS-232 serial ports defined herein and an external modem. The modem shall not be provided with order unless specified elsewhere.

3.6 RADIO SYSTEM COMMUNICATION (Inter-system) - (WHEN SPECIFIED).

The data radio modem system is for microprocessor based control equipment. The modem is external to any other equipment in the controller cabinet and at the terminus and shall be provided for data transmission and indicated on the plans. The modem shall provide half or full duplex communications. The modem shall connect directly to the controller in accordance with these standards for the auto dial modem stated above.

The Department will provide the necessary management to obtain a study for interference on the above mentioned radio frequencies, coordinate the frequency to be used, and apply for licensing to use the frequency. The equipment shall operate at the assigned frequency and the supplier/contractor shall make the necessary adjustments for correct operation.

3.6.1 Radio Modem.

The modem shall meet the environmental requirements of NEMA TS-2 TYPE 2 and be a maximum dimension of 4 inches high x 12 inches wide x 12 inches deep. Indicators shall be provided on the front of the modem indicating carrier detect, transmit data, and receive data. The following shall be the operating characteristic of the modem:

TABLE 18A-2
RADIO MODEM CHARACTERISTICS

FUNCTION	CHARACTERISTIC
Frequency Range:	173 MHz or 940 MHz range (Capable of: 138-174 MHz, 406-430 MHz, 450-475 MHz, 928-960 MHz).
Temperature Range:	-30° to +60° C.
Operating Voltage:	120/240 VAC
Transmission Mode:	16F3, 16F9, 15F2
Modulation: (Receive and Transmit)	FSK, Frequencies, 2100 Hz - mark, 1300 Hz - space.
RF connector:	Type N Female
Data connector:	RS-232-C, 9-pin
Sensitivity:	-107 dbm (1.0μV) for BER_$1x10^{-3}$ over the voltage and temperature range.
Decoder type:	PLL FSK Demodulator
Carrier Attack Time:	_ 10mS
Turn Around Time:	10mS Maximum
Power Output:	2 watts extendable to 20 watts, 100% duty cycle.
Frequency Stability:	±5 ppm on all frequencies.
Harmonic Distortion:	5 % Maximum
Compliances:	FCC Part 15, EIA RS-316B, and RS-232-C, as applicable.

3.6.2 Antenna.

The antenna shall be connected to the modem by transmission cable meeting the Department standards. The antenna shall be a directional Yagi with a minimum of 9 Db gain and five elements. The mounting shall adapt to a 1-1/2 or 2 inch mount.

3.6.3 Antenna Tower.

The contractor (for projects) shall provide a tower for mounting the antenna at the site as shown on the plans. The height of the tower shall be determined from the frequency coordination study. The tower shall be erected in accordance with the AASHTO standards.

3.6.4 Central Office Radio Terminal.

Additional labor shall be provided by the project contractor to install the antenna on the Department's tower, the cable from the antenna to the modem, and the necessary hardware to complete the installation as designated on the plans and in accordance with good engineering practices. The radio modem and auto-dial modem shall be installed in a single 19 inch rack mounting system or on a wall mountable shelf. Mounting equipment and hardware shall be provided by the contractor. The Department will supply one RJ-11C jack for the dial modem and the necessary 120 VAC outlet for the equipment adjacent to the installation as designated by the Department.

The installation shall include lightning protection on the incoming RF cable in accordance with good engineering practices.

3.6.5 Telephone Terminal Boards (For information purposes only).

The following equipment will be installed into the existing PBX equipment for telephone lines needed to implement the system communication. All other equipment specified shall work with this equipment to complete the system's communications. This equipment will be installed in and manufactured by Rolm Telecommunication Company.

TABLE 18A-3
TELEPHONE TERMINAL EQUIPMENT

TYPE EQUIPMENT	MODEL
16-channel coder	#8551E
16-channel decoder	#8552A
8 channel line interface	#85540A

This equipment will be installed by the Department and made ready for the completion of the system.

4.0 SYSTEM MASTER CAPABILITIES

4.1 DESIGN REQUIREMENTS.

The system master shall be a microcomputer device that shall control and supervise a minimum system of twenty intersection controllers. It shall provide the communications link between the central computer and each of the intersection controllers within the system. The system master shall be assigned a unique identification number for communications on the same link with other system masters. An optional method for providing system master operation is to include the master operation as part of the software within the secondary controller. This option shall require the operation of the traffic signal control and system master without interference between them. Priority shall be given to the traffic signal control and operation as defined in this section.

Each master shall generate system commands to its associated intersection controllers, either in response to prevailing traffic conditions analyzed by system master using detectors information or by time-of-day scheduling, external command inputs, or manual inputs.

The central plans shall be constructed with the following minimum options:

a. 48 patterns with a unique cycle length per pattern
b. From one to four offsets per pattern
c. Selection of one split per pattern from a table of 24 programmable splits
d. Selection of one sequence per pattern from a table of 16 programmable sequences.
e. Pattern 254 (NTCIP) causes the intersection to operate in free.
f. Pattern 255 (NTCIP) causes the intersection to flash as programmed internally

The reference point for all cycles shall be programmable by the user. Normally it is initialized to midnight.

A minimum of 48 patterns will be provided. Each pattern can make all the selections as defined in Section 3.5 of the NTCIP NEMA protocol.

The system master shall monitor the operation of all the associated intersection controllers, communication paths, local detectors, and system detectors. User programmable reporting alarms shall initiate failure reports to the designated terminals from a list of user identification numbers. A minimum of four terminals shall be assignable.

System master shall provide:

a. Traffic Plan Selection
b. Crossing Arterial Synchronization
c. Diagnostics
d. Events
e. Logs
f. Reports
g. Data Entry

Alternative crossing arterial synchronization shall be accomplished by using the master synchronization reference point. The operating cycles having the same cycle length will be referenced to the same point. An additional interface method shall be used to operate both arteries on the same cycle length. Associated system control shall also be included for mutual coordination.

4.2 TRAFFIC PLAN SELECTION.

The traffic plan shall be selected on a priority basis. The priority order shall begin with the highest being:

a. Manual commands
b. Central System commands
c. Time-of-day/day-of-week/week-of-year scheduled commands
d. Traffic responsive commands.

4.2.1 Traffic Responsive Operation.

Traffic plans shall be automatically selected in response to real-time system detector input data. These commands shall be transmitted to, received and implemented by the intersection controllers within the master's system.

A minimum of 48 system detector inputs shall be provided and each, if selected, shall be processed into scaled values used for volume, density, and occupancy data. The volume and occupancy scale factors shall be user-specified and programmable through the keyboard into the master for each detector; otherwise a default value of zero shall be entered. Each detector shall be user-programmable as one of two directions or crossing direction.

Detector data shall be processed to provide a value representing traffic conditions for each function. The process shall include:

a. Data computations resulting in values accurately representing vehicle volume (vehicle/hour), occupancy (time detected), and density (vehicle/mile).
b. Comparison of computed values determining the relative volume and density for traffic conditions detected and assigned to directions as stated above.
c. Accumulation of detection values over a user programmable time interval, evenly divided into a minimum of ten sampling periods, shall provide smooth transitions into selected programs designed by the Department to progress traffic through the system. Functional requirement for this process is to select a cycle, offset, and split from user specified values of detector data.
d. User-specified adjustment factors for each function shall be used to make the detector data be within 50 to 100 percent of selected vehicle density characteristic.

Function values shall be compared to user-specified threshold values for traffic plan selection. Plan selections shall not oscillate between plans which have numerically close values. A method of hysteresis shall be used to prevent oscillation.

Ranges for six traffic volume and occupancy levels shall be programmable and used for comparing the master's computed volume and occupancy level from the overall detector data. Level one shall be associated with light traffic with no coordination and level six shall be associated with heavy traffic. Twelve programmable thresholds shall be provided for the master's comparison values to implement plan selection based upon its computed values.

Arterial directional preference shall be determined by computing directional detector data. The magnitude of the difference and directional preference shall be compared to user programmed threshold values to select and implement directional or average offsets.

Split selection shall be based on user assigned system or phase detector data. Programmable weighing of each detector data, as stated above, shall be used by the master for computing each detector adjusted data. The master shall implement the appropriate split by comparing the main street and cross street data. Programmable values shall be used for selecting four levels of increasing values and four levels of decreasing values. If an error condition is detected, the selection shall default to average or user specified value.

Based on the master's computed detector data levels, a user-specified traffic plan shall be selected as the traffic responsive plan. If computed level or computed offset cannot be determined because of detector failures, a default plan shall be implemented from TOD plan or from TBC.

Each traffic plan contains a programmed split command for that plan. Alternately, it shall be possible to select splits and special function commands for user-specified plans based on split demand function values. Four split/special function combinations shall be available.

4.2.2 Time-Of-Day/Day-Of-Week/Week-Of-Year Schedule.

Time-of-day scheduling shall be controlled by an internal clock, accurate to the power line frequency. In the event of a power failure, the clock shall be maintained for a minimum of 72 hours. Leap year shall be automatically compensated for and daylight savings time shall be programmable for date of occurrence. A minimum of 24 user-defined programs shall operate on a daily, weekly, and yearly basis.

TOD programming shall follow Section 3.5 of the NEMA NTCIP specifications.

Programmable entries shall include:

a. Day-program assignment
b. Start time
c. Traffic pattern (cycle, offset, split, special functions, free, plan command)
d. Traffic responsive plan enable
e. Traffic responsive plan override of TOD
f. Sample period interval
g. Sample period log interval
h. Detector log interval

The arterial master shall update time and date in all intersection controllers in a system a minimum of once every hour.

The arterial master shall include a time comparison feature. This feature shall indicate the need to update the master clock after being compared with the reference clock in the central

personal computer. It would be preferred to enable a clock reset from the central computer to update the master clock with the time from the central computer.

4.2.3 External Commands.

External commands shall be received from a remote source such as another arterial master. These control signals shall be used to initiate an external plan. Alternatively, the external command inputs shall be used for crossing arterial synchronization. External commands shall override TOD and traffic responsive operation.

4.2.4 Manual Entry.

Manual entry from the front panel keyboard or a remote source shall provide the highest priority of plan selection. It shall be the default program if traffic responsive operation fails and a TOD plan is not specified.

4.2.5 Pattern Mode Entry (Test Command).

Mode commands shall allow selection of any defined pattern. Intersection controllers may contain the same or different programs which shall allow sub-system coordination or independent operation under time-base control.

4.3 DIAGNOSTICS.

Diagnostic tests shall be continuous checks performed on system detector data, communications, and communication connected devices. Detected faults shall produce event failures at the arterial master and the central computer.

Failures shall be displayed on the arterial master. A fault isolation routine, selected from the front panel keyboard, shall identify the failed device. The operator shall have the ability to display all fault conditions on command.

4.3.1 Power Fail Restart.

Following a power interruption, the arterial master shall update the clock and bring itself on-line automatically and gain control of the system.

4.3.2 Device Event Reports.

If operating in a system, diagnostic failures shall be reported to the central computer as events. The following devices shall be monitored:

a. Communication
b. Local intersection controllers
c. System detectors
d. Local detectors

Report events shall verify system master and local intersection controller responses. Communication tests can be a specific test or results from normal evaluation during operation and shall be as follows:

a. System Master Test - A system master test failure shall occur when the master does not respond to central computer commands. If a response is received within three seconds following a failure, the failure condition shall automatically clear, restoring system master/computer service.

b. Local Intersection Controller Communication Test - A local intersection controller communication failure shall occur when valid data is not received by the master for five seconds. If data is received within five seconds following a local intersection controller communication failure, the failure condition shall automatically clear, restoring local intersection controller communications.

Local intersection controller events shall indicate CMU flash, local and commanded flash, cycle fail, coordination alarm, local and commanded free, coordination error, preempt, and user-designated events:

a. CMU flash - If intersection controller status indicates CMU flash for a period in excess of a user-programmable period of 0-30 seconds, the intersection controller shall fail and a CMU flash event shall be recorded.
b. Local Flash - If intersection controller status indicates CMU flash is OFF and flash is not commanded from the arterial master, the intersection controller shall be considered off-line and a local flash event shall be recorded.
c. Commanded Flash - If intersection controller status indicates flash, CMU flash is OFF, and flash is commanded from the arterial master, the intersection controller shall be considered off-line and a commanded flash event shall be recorded.
d. Cycle Fail - If intersection controller status remains in the same phase with opposing phase calls for two cycles during coordination or three minutes if the system is free, the intersection controller shall be failed and a cycle fail event shall be recorded.
e. Coordination Event - If intersection controller status indicates a coordination alarm condition, the intersection controller shall be failed and a coordination event condition shall be recorded.
f. Local Free - If intersection controller status indicates a free condition and free is not commanded from the arterial master, the intersection controller shall be considered off-line and a local free event shall be recorded.
g. Commanded Free - If intersection controller status indicates a free condition and free is commanded from the arterial master, the intersection controller shall be considered off-line and a commanded free event shall be recorded.

h. Coordination Error - If intersection controller status indicates a coordination error condition, the intersection controller shall be considered off-line and a coordination error event shall be recorded.

I. Preempt - If intersection controller status indicates a preempt condition, the intersection controller shall be considered off-line and a preempt event shall be recorded.

j. Event 1/Event 2 - If intersection controller status indicates an event 1 or event 2 condition, the intersection controller shall feed back user-designated alarm information and an event 1 or event 2 shall be recorded.

4.3.3 Detector Diagnostics.

System detector diagnostics shall check for maximum presence, minimum presence, excessive counts, and no activity. If a system detector is diagnosed as failed or in error, then data supplied by that device shall be automatically eliminated from system computations.

Local detectors shall be checked for maximum presence and no activity only.

Detector diagnostics shall be performed each minute. Diagnostic periods shall vary depending on the diagnostic test.

Maximum presence events shall be generated by a continuous detector call during a user-specified diagnostic period. The diagnostic period shall be user-selected from 0-30 minutes.

Excessive count events shall be generated if a detector volume count is greater than or equal to a user-specified excessive count threshold. The diagnostic period shall be user-selected from 0-30 minutes.

No activity events shall be generated if vehicle counts are not received during a user-specified diagnostic period. The diagnostic period shall be user-selected from 0-255 minutes.

Detectors shall be failed when its operation is not within the specified criteria. A detector that begins functioning within the specified limits shall be returned to a non-failed status and its input used by the controller.

4.4 MONITOR EVENTS.

Status changes and operating failure events at any intersection controller or arterial master shall be recorded by the arterial master at the time of failure or event occurrence. Events shall be reported to the central computer on a priority basis.

Reporting priority shall be selected by event or failure. It shall be programmable as: immediate, report with higher priority, or not at all.

Two telephone number entries shall be programmable from the central computer for reporting events to central computer and for reporting device failures to another maintenance

computer or terminal. Device failure reports shall be transmitted to the designated computer or terminal only when scheduled by a TOD entry.

If the central computer is busy or off-line, a reporting arterial master shall repeatedly attempt to call at a preset retry interval in the range of 3 - 15 minutes.

Reporting shall be selected for directing all events to a central computer and maintenance computer or terminal when this capability is selected. Printed events shall consist of the following categories:

a. Program and TOD changes
b. System events
c. Device diagnostics

4.4.1 Program and TOD Changes.

Program and mode changes shall occur automatically as a result of traffic responsive plan computations, TOD scheduling, external, and manual commands. Program and mode event changes shall include the following:

a. In-effect program change
b. Traffic responsive program change
c. Special function change
d. Time-of-day interval change
e. Controller command TOD change

4.4.2 System Events.

System events shall be arterial master self diagnostics. The diagnostic messages shall include:

a. Power-off (Comm-failure)
b. Power-on (Comm-failure)
c. Power interrupt
d. Clock error
e. Backup

Power-off event shall be stored in memory and reported when power is restored.

Power-on event shall report the time and date that power is restored. Time and date information shall be accurate if power is off less than 72 hours.

Power interrupt event shall report when power was off for less than one second.

Clock error event shall report when time and date information is different from the central computer reference. This event shall automatically occur whenever power was off

greater than 72 hours. A clock error event shall inhibit TOD operation and scheduled reports until the clock has been reset and is functioning correctly.

Backup event shall indicate a data change in the arterial master memory. All memory shall be automatically re-initialized with a backup data base to allow continued operation.

4.4.3 Device Diagnostics.

All device diagnostic failures shall be reported as events. Refer to Section 4.3 for diagnostic descriptions.

4.5 REAL-TIME DETECTOR LOGS.

Real-time logs shall provide the operator with a permanent record of system detector data. Real-time logs shall consist of the following categories:

a. System detector log
b. Sample period log

4.5.1 System Detector Log.

System detector logs shall show actual volume, and occupancy for user-specified system detectors. Volume shall be the number of vehicle counts accumulated, while occupancy shall be the actual percentage of time that vehicle presence was detected during a 15-minute log period.

Detector data intervals shall be user-specified by TOD scheduling. The user shall be capable of enabling and disabling the real-time log without affecting previous entries. At the end of the interval, the arterial master reports the log to the central computer for printing. The log shall not be stored on hard disk.

4.5.2 Sample Period Log.

Sample period logs shall show computed parameters used in determining the traffic responsive plan selection. The sample period log interval shall be user-specified as a multiple from 1-6 sample periods by TOD scheduling.

If the default log period is programmed to be zero, the sample period log shall be reported when there is a change in the computed traffic responsive program. The user shall be capable of enabling and disabling sample period logs without affecting previous entries. The sample period log is reported to the central computer for printing. The log shall not be stored on hard disk. The sample period log shall consist of the following:

a. Scaled volume and occupancy for enabled system detectors
b. Scaled volume and occupancy for detector groups with assigned detectors
c. Current value of each program selection function
d. Smoothed value of each program selection function

e. Computed program selection values
f. Selected traffic responsive plan program
g. In-effect program and cycle length

Additionally, the printout shall identify groups that have not been assigned and parameters containing errors.

4.6 STATUS REPORTS.

Manually commanded status reports shall be provided to allow the operator at the central computer an immediate record of system operations. Reports shall consist of the following categories:

a. System status
b. Controller failure summary
c. System detector failure summary
d. Current 15-minute system detector log

4.6.1 System Status.

System status report shall describe the system operating conditions. The report shall be a concise printout including the following:

a. Traffic responsive program (computed values)
b. Traffic responsive plan
c. Program-in-effect and source
d. Special function status
e. Communication status:
   1. System master communication failure
   2. Local intersection controller communication failure
f. Intersection controller status:
   1. On-line
   2. Off-line
   3. Failed
g. System detector status:
   1. On-line
   2. Failed
h. Local detector status:
   1. Failed

Local detectors shall be identified by intersection controller number and assigned phase. Intersection controller off-line shall indicate a disabled intersection controller or a non-coordinated intersection controller due to the following conditions: preemption, coordination error, local free, commanded flash, or local flash.

4.6.2 Intersection Controller Failure Summary.

Intersection controller failure summary shall identify failed intersection controller(s) and probable cause(s). Probable failure causes shall be as follows:

a. Communication
b. Cycle failure
c. CMU flash
d. Coordination alarm

4.6.3 System Detector Failure Summary.

System detector failure summary shall identify failed system detector(s) and probable cause(s). The possible failure causes shall be as follows:

a. Communication
b. No activity
c. Maximum presence
d. Excessive counts

4.6.4 Current Detector Log.

Current detector log shall show actual volume and occupancy recorded during the last log period. Volume shall be the number of vehicle counts accumulated while occupancy shall be the actual percentage of time a vehicle presence was detected. This data shall be indicated per detector.

4.6.5 Stored Events.

Stored events shall be a report of the last events stored in the arterial master (up to 255). These events shall be printed in the order recorded. If the event storage memory becomes full, the newest event over-writes the oldest event.

5.0 COORDINATION/SYSTEM OPERATION COMMANDS.

The controller unit shall provide coordination functions to control intersection cycle lengths, system offset relationships, and phase split timing. The coordinator shall perform these functions by internally manipulating the appropriate controller unit inputs. The controller unit shall be programmable for selecting these functions as output during all modes of coordination, controller unit designated as master, secondary or isolated.

Coordination functions shall be provided as a standard controller unit feature. These functions shall be included in the equipment and software provided. Hardwired inputs and outputs for coordination functions shall be through isolation relays, specified elsewhere, and shall be binaurally encoded on the respective cycle and split input lines. The voltage on the hardwired interconnect shall be 120VAC. The input lines shall have no active inputs for cycle

one and split one. Cycle four and split four shall be activated by both the cycle two and three or splits two and three inputs being active respectively. Offsets one through three shall be only activated one at a time by the synchronization pulse being superimposed upon active line. The offset line shall operate by using a continuous high (120VAC) interrupted by a low for three seconds at the coordination point. Only one offset line shall be operated at a time. The remainder of the required system operations is not required to operate within a hardwired system.

Alternate methods to the cycle-split concept of coordination shall be evaluated based upon providing programmable time distribution to control vehicle movements within system parameters for traffic progression. A minimum of sixteen "programs" of the alternate method shall be provided and controlled by the inputs specified and shall meet the requirements for coordination.

5.1 TRANSITION CYCLES.

The controller unit shall provide a smooth and orderly transition during operational changes in both free and coordinated operations. No skipping of through movement phases shall be allowed when changing a sequence from a lead-lag to a lag-lead.

5.1.1 Free to Coordinated Transition.

During the free to coordinated transition, the controller unit shall complete a pick-up cycle before entering the coordinated mode. The pick-up cycle shall begin upon receipt of a sync pulse and a valid coordination command. During the pick-up cycle, the coordinator shall service all non-coordinated phase calls in normal sequence until entering the coordinated phase(s).

5.1.2 Coordination Command Transfer.

The coordination command shall contain the system cycle, offset, and split. Command changes shall be implemented concurrent with a sync pulse. The cycle and split command shall take effect when the local zero point of the existing cycle is reached. Command transfers shall not stop the sequencing of the phases during the change except as noted elsewhere in this standard.

5.2 CYCLE.

The coordinator shall provide five cycles. Each cycle shall have a minimum programmable cycle length from 10-255 seconds, in 1-second increments.

5.2.1 Synchronization.

Coordination timing shall be synchronized to the leading edge of the system sync pulse (master zero). This point shall serve as the reference for all offset timing.

5.2.2 Sync Monitor.

The coordinator shall check for the proper occurrence of the system sync pulse, once each cycle. If a sync pulse does not occur, the coordinator shall self-sync and continue to operate with the last set of coordination commands.

Self-synchronization shall continue for a minimum of two cycles. If a sync pulse does not occur within the self sync period, the coordinator shall revert to the non-interconnected coordination mode.

5.2.3 Hardwired Interconnect.

The controller shall provide for external inputs to be used for coordination. These inputs shall be connected to the wiring for the special connector described elsewhere in this standard. The functions shall meet the requirements as defined in section 5.0.

5.3 OFFSET.

The coordinator shall provide a minimum of one offset per pattern. Each offset shall be programmable within the cycle in 1-second increments from 30 to 254 seconds.

The offset shall be defined as seconds from the beginning of the master cycle counter to the beginning of the local cycle counter. When entering splits according to the NTCIP format, it shall be possible to select that the coordinated phase begins with the local zero point or ends with the local zero point. Time of day will be used to sync the master cycle counter within the local controller. The master cycle count shall be seconds past the programmed reference, modulo of the current selected cycle length.

5.3.1 Offset Correction.

The coordinator shall provide offset correction through the following methods:

a. Shortway offset seeking
b. Dwell

5.3.2 Shortway Offset Seeking.

Shortway seeking shall establish an offset within the shortest number of cycles by either lengthening or shortening the cycle length. The method provided by the manufacturer shall continue sequencing the phases until the programmed offset is established and shall be limited to a maximum of four cycle lengths. Any method that causes the controller to lose coordination or force to dwell and require the coordination to begin a second re-sync routine will not be acceptable.

Offset changes shall be accomplished by lengthening only if the reduction of the current cycle length is shorter than the sum of the controller unit's minimum vehicle interval lengths. In addition, all offset corrections shall be programmable to be lengthened only.

5.3.3 Dwell.

The controller shall dwell in the coordinated phase if this method of offset seeking is selected. The sequence will begin in the first cycle after the offset is established and within the programmed permissive and force-off parameters for that cycle.

5.4 SPLIT.

The controller unit shall provide three splits for each cycle. Each split shall provide a split interval for each phase of the controller unit. Each split interval shall be programmable in seconds within the cycle length timing in 1 second increments.

5.4.1 Split Intervals.

Split interval settings shall determine the maximum time, including vehicle clearance (yellow and red) for a non-coordinated phase, or minimum time for a coordinated phase during the cycle. These times shall be controlled by establishing a force-off point for each phase within the cycle. Force-off points shall be determined from the phase timing values and split interval settings. Force-offs shall meet NEMA requirements and continue to be applied until the phase is terminated.

5.4.2 Coordinated Phase Split Extension.

During coordination, an option shall be programmable to operate the coordinated phase(s) as actuated or non-actuated. If the coordinated phase is actuated, vehicle detections shall permit the coordinator to extend a phase beyond the normal yield point. Extended coordinated phase green shall be selected in seconds or terminated by a force-off setting for that phase. Selection of the CNA I and/or II operation per cycle will meet the non-actuated operation with the selected phase remaining green until the programmed force-off for that phase is reached.

5.5 PERMISSIVE PERIODS.

Permissive periods shall be timed in seconds within the cycle length and provided for each cycle or program to control the time period when the coordinated phase is released to service calls on the non-coordinated phases.

5.5.1. Yield Point.

The yield point shall be defined as the point within the cycle when the hold input is released on the coordinated phase and the controller unit is allowed to service calls on non-coordinated phases. A force-off point shall be applied at the time the hold is released, unless a force-off has been programmed for this phase.

The yield point shall begin from the coordinated phase split interval and pedestrian clearance plus vehicle clearance time. The coordinated phase pedestrian clearance period shall always begin at the yield point regardless of calls on the non-coordinated phases.

5.5.2 Permissive Periods.

All permissive period timing shall begin at the yield point. A minimum of three programmable permissive periods shall be provided. The vehicle portion of each permissive period shall be a programmable timed interval within the cycle length. An automatic pedestrian permissive period shall be allowed for phases following the coordinated phase(s). Each permissive period shall be programmable for selecting phases that would operate during this period. This function shall operate as follows:

a. During the first permissive period, the controller unit shall answer only vehicle or pedestrian calls on the phase(s) following the coordinated phase in the programmed sequence. If the controller unit yields to a call during this period and the all remaining phases are allowed during this period, then other permissive periods shall be inhibited. All remaining calls shall be served in programmed sequence.
b. The second and third permissive periods shall be programmable for beginning and ending after the yield point. During each permissive period the controller unit shall answer calls on each period's programmed phase(s).
c. An alternate method for the permissive period operation described above will be considered. The principle guide lines for controlling phase time shall be followed.

5.5.3 Single Permissive Period.

Single permissive period shall become operational by eliminating the second and third permissive periods as described above. This single permissive period shall be similar to the first permissive period, except that the controller unit shall answer calls on any phase in order of the programmed sequence during the permissive period.

5.6 CYCLE PROGRAMMING.

In addition to cycle length, offsets and splits, the following functions shall be programmable on a per cycle basis. Alternate methods of function selection shall be controlled by cycle, split, and offset inputs.

5.6.1 Coordinated Phases.

Coordinated phases shall be selected for each cycle. If the coordinated phase assignments are changed when transferring between cycles, the coordinator may operate in the free mode until completing a pick-up cycle.

The coordinated phases shall normally operate in the non-actuated mode during coordination. However, it shall be possible to select the coordinated phases to remain in the actuated mode (see Section 5.4.2).

5.6.2 Phase Sequence.

The controller unit shall normally use a standard quad phase sequence. The controller shall be programmable to select the phase sequence by selecting cycle and split. The phase sequencing shall be selected from the sequences specified previously. The free mode phase sequence shall be programmable from the keyboard and not restricted to be one of the coordinated sequences.

5.6.3 Phase Omit.

Phase omit(s) shall be selected during each cycle or program. Additionally, a phase shall be omitted if its split interval value, for the current split, is zero.

5.7 CROSSING ARTERY CONTROL.

The coordinator shall be programmable for crossing artery synchronization by implementing dual coordinated phases at an intersection(s). The coordinator shall be programmable for two coordinated phases in a ring assignable to primary or secondary coordination. Phase(s) shall assigned to a secondary coordinator shall time the green of the phase until the force off occurs or shall be controlled by call to non-actuated operation.

In addition, the coordinator shall output a crossing artery sync pulse indicating the beginning of the crossing artery phase split interval. This signal shall be used to establish the master zero for the crossing artery system master.

Dual coordination shall also force a selected crossing artery split to be used. This feature shall optimize a particular split in each cycle for dual coordination.

See Section 5.0 for alternate coordination methods and additional artery control.

5.8 FREE.

The coordinator shall provide a free mode of operation. During this mode, all coordination control shall be removed from the controller unit.

Free mode shall be selected by coordination commands, external input, or keyboard entry. Additionally, the coordinator shall revert to free mode when active controller unit inputs, or functions, would interfere with coordination. These inputs or functions shall include the following:

a. Manual Control Enable
b. Stop Time
c. Automatic Flash
d. Preemption

5.9 MANUAL CONTROL.

The controller unit shall allow entry of manual override commands from the keyboard. Manual commands shall permit individual selection of any cycle, any offset, any split or selection of the complete coordination command. When a manual cycle is selected, the sync pulse shall be generated by the time based control section of the controller unit.

5.10 PROGRAM CONTROL.

The alternate method of coordination shall provide manual control that shall select 1 of 16 programs (see Section 6.2.3).

5.11 MODES OF INTERCONNECT.

The coordinator shall be capable of operating with any of the following interconnect types:

a. Internal Time Based Coordination
b. Telemetry
c. Hardwired

The non-interconnected coordination mode shall also serve as a backup mode to communication or hardwired interconnect (see Section 5.1.2).

The coordinator shall be compatible with electromechanical pre-timed interconnect which provides the sync pulse superimposed on the offset lines.

5.12 MASTER COORDINATOR.

The coordinator shall output the coordination commands, including sync. This feature shall permit the controller unit to be used as a time-of-day master in a hardwired electromechanical pre-timed interconnected system. This feature shall be included in all controllers and shall not have restricted use.

6.0 TIME-BASED CONTROL/NON-INTERCONNECTED COORDINATION.

The controller unit shall include time based control. This capability shall be a standard feature and shall include the additional modules and/or software.

6.1 CLOCK/CALENDAR.

The controller unit shall provide a time-of-day (TOD)/99 year clock. The clock shall be programmed for current time (hour, minute, and second), date (month, day, and year), day of week, and week of year. This clock shall be used for all time based control functions.

6.1.1 Clock Accuracy.

The TOD clock shall use the power line frequency as a time base. When power is removed, the time shall be maintained by a crystal oscillator.

The oscillator shall maintain the time to within + 0.005%, as compared to the Universal Mean Coordinated Time Standard. This accuracy shall be maintained over the NEMA Standard temperature range regardless of the number or rate of power failures.

The controller unit shall maintain the TOD clock during power outages for a minimum of 48 hours.

6.1.2 Time and Date Entry.

Time and date information shall be entered in the controller unit through the following methods:

a. The controller unit keyboard
b. Computer via RS-232 port
c. Updated via system communications

6.1.3 Leap Year and Daylight Savings Time.

The TOD clock shall automatically compensate for leap year changes. Daylight savings time changes shall be programmable to occur on a selected week or be omitted if not programmed.

6.2 TIME BASED CONTROL.

6.2.1 Program Format.

Time based control shall utilize a yearly program format. The program shall select from a minimum of 60 programs with cycle, offset, and split operations assignable to a day, days of the week, weekend or any one of, selection of more than one or all 52 weeks in the year.

6.2.2 Holidays.

There shall be a minimum of 35 holiday or exception-day programs. Each holiday-program shall be assignable to occur on a specific month and day. Holiday-programs shall override the current day-program.

Each holiday-program shall be selected to repeat the following year.

6.2.3 Program Selection.

Each program shall permit selection of the following functions:

a. Day program assignment, (Month/Week/Day)
b. Start time, (Hour/Min/Sec)
c. Program, (Cycle/Offset/Split)
d. Control of a minimum of four Special Function outputs
e. Flash
f. Max 1 or 2
g. Free
h. Phase sequence

The cycle/offset/split/sequence or free commands, selected by a program step, shall serve as the coordination program only when the controller unit is operating as a TOD master or operating with time based coordination.

Remaining program step functions shall take effect immediately when the program step becomes active.

6.2.4 Manual Program Selection.

It shall be possible to manually force any of the program steps to override the current program step. The forced step shall be entered from the keyboard and shall remain in effect until removed or until the next programmed step.

6.3 NON-INTERCONNECTED COORDINATION.

6.3.1 Re-sync Time.

When operating in the non-interconnected coordination mode, a programmable synchronization time shall be used as the beginning time for all cycles. All cycles shall be reset to zero, each day, at this time.

6.3.2 Synchronization Point.

The synchronization point will be calculated as defined in the NTCIP standard. Computing this point was described in the coordination section. Computing the synchronization point based on event changes or similar methods will not be accepted.

7.0 CONTROLLER UNIT FEATURES (Stock No; 14-06-2710; 14-06-2720)

7.1 DESIGN REQUIREMENTS.

This specifications set forth the minimum requirements for a shelf-mounted sixteen (16) phase full-actuated solid state controller unit with internal Time-Based Coordination (TBC), railroad / fire (emergency vehicle) preemption, diamond intersection operation, and closed loop master/secondary operation in a traffic signal controller assembly and cabinet assembly.

The controller unit shall meet the requirements of NEMA Standards Publication TS 2 1998 (TS 2), latest edition. Where a difference occurs, these requirements shall govern. The purchase document shall identify either a TS 2 Type 1 interface or TS 2 Type 2 interface. (Stock number for TS2 Controller Timer Unit is **14-06-2710** and TS2 Controller Timer Unit with Ethernet is **14-06-2720**).

The controller unit shall be microprocessor based with additional solid state electronics components for memory and data entry of all timing and traffic control functions described herein. The hardware provided shall meet the NEMA temperature requirements certified by an independent laboratory. A resident program shall start the controller operating when power is first applied, without a failure, providing the functionality described herein. The controller unit shall begin using each programmed data for the first occurrence of the event requiring the data and after data is loaded into memory. All units shall be capable of both master and secondary operations as described by these specifications.

The controller unit shall be shelf mountable enclosure containing electronics and hardware for processor/display, input/output interface, system communications, and power supply functions. The enclosure shall be constructed of sheet aluminum and a maximum of 15 inches wide x 10-1/2 inches high x 10 inches deep. All exterior surfaces shall be finished with a durable protective coating or anodized. Model and serial number shall be permanently attached and/or displayed on the frame of the enclosure.

The controller unit shall provide electronic circuitry to monitor the operation of the microprocessor. Processor and circuitry faults shall be detected and shall set the voltage monitor output FALSE then indicate an error message on the front panel display.

The controller unit power supply shall provide for isolation and protection against power surges, generate all regulated voltages for internal and external use, and provide power monitoring control signals. The minimum power output shall be 24 watts @ 24 VDC. Additional protection shall be designed into the power supply for radio-frequency interference filtration including a differential and common mode noise filter. Fuse protection shall be provided for the 115 VAC input and 24 VDC power output. These fuses shall be mounted on or accessible from the front of the controller without removing the panel held by fasteners requiring tools for removal.

All timing shall be referenced to the 60 Hertz input power. This reference shall control all timing of the controller unit.

A power retaining component, "super cap", shall be provided for maintaining the time-of-day clock and temporary data storage during a primary power outage. The component shall

provide sufficient voltage supply for a power interruption of forty-eight hours. Lead-acid and Ni-Cad batteries are not acceptable.

7.2 KEYBOARD.

The programming of the controller shall be accomplished using a keyboard and shall include vehicle, pedestrian, and preemptor calls during test. The keyboard shall be located on the front panel of the controller unit. The keyboard shall be socket mounted for easy maintenance.

The keyboard contacts shall be constructed to be environmentally sealed, highly resistive to oil, dust, water, and most harsh environments and have a minimum rated lifetime of one million operations per key. All keys shall provide positive tactile feel and/or sound to the user.

All keys shall be clearly labeled indicating their function. Numerical keys shall be arranged in a standard telephone pattern. Keys used for YES/NO or ON/OFF entries shall be appropriately labeled. Additionally, data entry control and cursor keys shall clearly indicate their function.

Cursor keys shall provide directional movement of the cursor to any data entry position desired. The cursor keys shall auto-repeat if depressed for longer than one second, to facilitate locating a data entry.

7.3 EEPROM DATA MODULE.

User programmed settings and intersection configuration data shall be stored in an electrically erasable programmable read only memory (EEPROM). The device shall have the ability to be reprogrammed a minimum of 1500 times. Sectional programming of the EEPROM for each data entry shall be acceptable only if the manufacture guarantees the life of the EEPROM under normal use for a period of 10 years and will be at the discretion of the Department. Designs using a battery to maintain user data entries shall not be acceptable. Additional requirements concerning data references are found in section 8.5.

7.3.1 Data Module.

To facilitate data transfer from one controller unit to another, the EEPROM device shall be mounted on a sub-module (Data Module). The Data Module shall connect to the processor/display module via a DIN type printed circuit connector.

7.3.2 Firmware.

The firmware shall be stored in a Flash ROM. The firmware (proprietary software) updates shall be accomplished by using upload/download unit connected to the controller's RS - 232 port (storage in Flash ROM). It shall not be necessary to physically replace hardware components to update the firmware. Connecting the upload/download unit to a communications port on the controller and transferring the new firmware from files on the PC to the controller's

PROM memory shall accomplish the update procedure. The components shall accept a minimum of one thousand (1000) firmware updates. The following components shall be supplied to accomplish the firmware update:

1. PC compatible software program to accomplish the transfer with a verification routine.
2. One (1) copy of instruction manual for the entire process.

The update process shall be accomplished at a transfer rate of ninety six hundred (9600) baud.

If the requirements of this section conflict with any provision of this specification (TCS 18A), the requirements of this section shall rule. No provision of this specification shall relieve the vendor of supplying a controller that meets the requirements of Section 7.3.2.

7.4 DISPLAY.

A liquid crystal display (LCD) shall be provided on the front panel of the controller unit to display programming and operational status information. The display shall be clearly readable in bright sunlight or dim artificial light without shading the display. The contrast of the display shall be adjustable. If after the Department's evaluation that this requirement is not met, backlighting shall be provided. It shall contain a minimum of four (4) lines with forty (40) alphanumeric characters per line. The display shall have an expected continuous life cycle of ten years while operating in the NEMA temperature range.

7.5 OPERATING DISPLAYS.

The display shall have two (2) modes of operation, dynamic and programming. The dynamic mode shall display operational status information, while the programming mode shall display user-programmable information. The normal display shall be either blank or a dynamic display as stated below.

7.5.1 Dynamic Displays.

The dynamic displays shall provide a visual status of the real-time controller unit operations. Data entry shall be prevented without a display indicating the location for the data and the data that will be entered in this mode. Data entry during this display is acceptable only as an extra method, not as the primary data entry method.

The dynamic displays shall be accessible via the front panel keyboard. The following status displays shall be specific to each of the major functions of the controller unit.

7.5.2 Controller Timing Displays.

The controller timing displays shall be a dynamic display that indicates ring, phase, and coordination status information. Ring status shall include phase timing, current interval and time remaining for both rings, simultaneously. Status messages shall include current vehicle and pedestrian intervals, reasons for phase termination, and Max timer in effect.

Phase status shall indicate the current phase(s) timing and which phase(s) is next to time, vehicle/pedestrian call/recall information and preemptor calls.

The coordinator status display shall indicate the command source, current cycle/offset/split, local/system cycle count, commanded/actual offset, and offset correction. This display shall provide co-ordination relationship to phase operation in real time and be a single display.

The preemptor status display shall indicate calls, preemptor active, and delay period timing. Also indicated shall be preemptor timing, the phase(s) timing while in preemption, interval, and time remaining on the interval.

The detector status display shall indicate activity for all detectors. The display shall indicate detector calls as they are processed by the controller unit.

7.5.3 Programming Displays.

The programming displays shall aid the operator to enter data from the keyboard. These displays shall be arranged in a menu format. The main menu shall allow the user to select one of the major functions of the controller unit. A sub-menu is permissible to display selection of a specific area within that function. Cursor keys shall allow the user to move up, down, left, or right through the data of the menu. Multiple data entries shall be shown at the same time to facilitate programming. It shall be possible to return to the main menu or sub-menu by a maximum of two (2) key strokes.

English language and traffic engineering terminology shall be used throughout the programming displays. Display organization and data entry method shall allow traffic engineers or technicians to program the controller unit without using reference cards or manuals. Mnemonic usage shall be minimized and limited to recognized traffic engineering terms.

All programming entries shall consist of numerical values, YES/NO, ON/OFF, TRUE/FALSE, logical 1's/0's entries. During program entry, the new data shall be displayed as it is entered from the keyboard. For quick entry of data, a repeating or copy function shall be provided. If the data is in error, the user shall be alerted by an error message on the display. Previously programmed entries shall remain until valid data is entered.

7.6 PROGRAMMING.

The programming methods shall not affect normal operation of the controller unit.

Download flexibility shall permit individual transfer of each major programmable category or the entire data base at one time.

Controller unit programming shall be accomplished by the following methods:

a. Front panel keyboard through menu access.
b. Downloading data from a LA DOTD computer with Windows software system (including lap-top) running the appropriate software and using the controller unit terminal interface directly or via a dial-up modem.
c. Data module transfer from one controller unit to another as specified in Section 7.3.

7.7 PROGRAMMING SECURITY.

A four digit code shall be user selected, and stored in EEPROM, for one level of programming security. Display features shall be available without the need to employ the access code. The controller unit shall be supplied with the codes preset to all zeros (0000).

If the access code has not been entered and a data entry attempt is made, then a prompt, requesting the access code, shall appear. Once entering the code, the screen shall revert to the previous display and data entry shall be permitted. The code shall not appear on the screen at any time. No further access code entries shall be required.

When the access code is required for data entry, the controller unit shall automatically set the locked access mode following a period of keyboard inactivity for eight minutes.

The access code shall be changeable only if the previous access code has been entered. Additionally, it shall be possible to prevent changing the access code from the keyboard.

7.8 MEMORY CLEAR.

A memory clear function from the keyboard shall not be permitted for the user to clear data entries. Default values shall be entered by the user to supersede previously programmed data.

7.9 INTERFACE CONNECTORS.

All interface connectors shall be accessible on the front of the controller unit and rigidly secured to the controller by the shell of the connector. Three MS-type connectors (A, B, C), meeting the pin assignment and interface requirements of the NEMA Standard shall be provided. A fourth connector, identified as the D connector shall be provided for auxiliary inputs and outputs as specified within this standard.

Four (4) RS232 ports shall be provided for communications with the system software, portable download/upload unit, conflict monitor and intra-system communications. These four (4) ports shall be keyboard-assignable for any of the communications functions. All four (4)

ports shall be RS-232 serial port accessible through DB-25, twenty-five pin, subminiature, dual-inline connectors. Additional ports required for closed loop secondary operation shall be supplied, if necessary to support the vendor's standard closed-loop application software. Each unit shall support all necessary communication ports for both master and secondary operation.

One SDLC port shall be provided per unit in compliance with NEMA TS-2, 1998 specifications.

All connectors shall be mounted a minimum 1-1/2 inches apart providing hand working room for comfortable installing and removing of the mating connectors.

All inputs and outputs to the controller unit shall conform to the applicable interface and environmental requirements of the NEMA Standard.

7.10 PRINTED CIRCUIT BOARDS.

All printed circuit boards shall meet, as a minimum, the requirements of the NEMA Standard. In addition, they shall also meet the following requirements:

a. All plated-through holes and circuit traces shall be plated with solder to protect exposed copper. Any wire jumpers included on circuit boards shall be placed in plated-through-holes that are specifically designed to contain them. Circuit track corrections by track cuts and jumpers that are tack soldered to circuit tracks are not acceptable.
b. Both sides of the printed circuit board shall be covered with a solder mask material.
c. The circuit reference designation for all components shall be clearly marked adjacent to the component. Pin 1 for all integrated circuit packages shall be designated on all printed circuit boards.
d. All electrical mating surfaces shall be gold-flashed.
e. All ICs, 14 pin and up, shall be installed in machine tooled grade sockets meeting these requirements. All sockets shall be AUGAT-8XX-AG11D or approved equal, meet UL specification 94V-0, be constructed with two-piece, machined contacts and close-ended to eliminate solder wicking. The outer sleeve shall be brass with tin or gold plating and tapered to allow easy IC insertion. The inner contact shall be beryllium copper sub-plated with nickel and plated with gold.

7.11 SERVICEABILITY.

The controller unit design shall use printed circuit boards that plug into an internal harness array and/or connector plug within the unit. All circuit boards shall be mounted vertically. Transformers, capacitors, and transient suppressor components are exempt from the above requirement.

The controller unit design shall allow easy removal or replacement of a circuit board. All printed circuit boards shall be keyed to prevent improper installation.

The controller unit enclosure shall be constructed to allow complete disassembly using hand or standard screwdriver operated fasteners. The unit shall be designed for adequate accessibility to troubleshoot and test one side of any circuit board while the unit is still in operation. If testing cannot be accomplished with boards in their assigned position then extender boards or cables may be used. Only one board at a time shall be required to be moved during testing.

7.12 SERVICE EQUIPMENT (to be provided when stated on order).

One set of cables and/or extender boards shall be provided with each order of ten controllers, two sets for twenty controllers, with a maximum of three sets of cable or extender boards.

One portable controller testing facility shall be provided with each order of ten controllers, two for twenty controllers, and a maximum of three for more than thirty controllers.

The testing facility shall provide switches for testing all NEMA inputs and LED's for all NEMA outputs. In addition, indicators and switches shall be provided for testing all the requirements within this standard except for the communication ports and/or RS-232 connectors.

The facility shall be contained within a weather proof enclosure, with quick release closure latches, and have a carrying handle. All harnesses shall be provided with the standard A, B, and C harnesses permanently wired within the enclosure. The additional harnesses shall be connected within the enclosure with a circular plastic connector meeting the requirements for type and pin assignment for the fourth connector installed in the cabinet. All standard NEMA functions shall be permanently labeled for each indication and switch. All additional inputs and outputs shall be identified with overlays which can be labeled identifying the function.

All servicing equipment shall be identified and documentation shall be provided which includes wiring diagrams and schematics.

8.0 ACTUATED CONTROL.

The controller unit shall provide the actuated control functions and operations required by Sections 2, 13 and 14 of the NEMA Standard. In addition, it shall provide the features described in the following paragraphs.

8.1 PHASE SEQUENCE.

The phase sequence of the controller unit shall be programmable in any combination of sixteen phases to achieve phase reversal individually or by pairs, one to four independent or concurrent timing rings, multiple rings allowing selection of four-phase operated as a concurrent group, or coordination of two rings and one sequential ring divided by one barrier. Sequencing

shall be selected by cycle program or timing plan. Selection of the required sequences shall be programmable from any of the following:

a. Full NEMA and NTCIP operation
b. Select a program number for an established phase sequence
c. Select one to four timing rings, with concurrent or sequential phase assignment
d. Select three or four phase diamond

Specific sequences required by the Department shall be selected from the above operation. Program for selecting phases shall include provisions to disable phases with each program, (phase on - off). Alternate sequences may be used to satisfy the above requirements however mutual coordination of the separate rings will be required. All controller units shall provide these sequences.

Diamond sequences shall include two operational sequences for interstate ramp interchanges. The operation of the controller unit as a 4 phase, and 3 phase diamond shall be keyboard selected and the standard timing function required by NEMA TS1 shall be provided for each phase. The configuration shall operate as two independent four phase rings. There shall be two mutually exclusive inputs as defined in Appendix (pins 12 and 13) that will force the controller unit into 3 phase or 4 phase operation. Additional circuits in this harness shall be for controller and cabinet interlock. Pin 35 listed in Appendix shall be a ground true controller interlock output. The controller shall assert this output when it is present and powered on. Pin 42 listed in Appendix shall be a ground true cabinet interlock input. This input shall be internally pulled up to 24VDC and the controller shall sense this input and operate only when it is present. Special clearance intervals shall be pre-timed programmable and shall be activated within the sequence shown. This shall be overridden while under computer control, TBC control, or by the inputs defined below. Figure 18A-4 illustrates the assignment of phase numbers to the traffic movements. The additional detector inputs shall be provided with these controllers as stated in the pin assignment for the connector.

8.1.1 Four Phase Diamond Operation.

The normal sequence of operation shall be phase 2/5 → 4/5 → 1/6 → 1/8.

The point at which operation may be switched from 4 phase to 3 phase operation shall occur by forcing the sequence into concurrent left turns (inside clearance during Ø1 and Ø5).

The loop detector layout for 4 phase diamond operation shall be as defined in Figure 18A-5. Each detector input shall be to the phase shown and provide the normal phase timing required by NEMA TS1. The controller unit software shall provide the additional logic for Detector Circuit operation in the following description:

a. Detector Circuit #1 -
    1. Shall extend phase 1/6 if phase 1/8 is called.

2. Shall call phase 2/5 if phase B overlap is not green and phase 4/5 is not called.
3. Extend intervals inside left turn clearance interval.

b. Detector Circuit #2 -
1. Shall extend phase 2/5 if phase 4/5 is called.
2. Shall call phase 1/6 if phase A overlap is not green and phase 1/8 is not called.
3. Extend intervals inside left turn clearance interval.

c. Detector Circuit #3 (45P) and #4 (45S) -
During the phase 4/5 red condition the 45P detector shall always be active and the phase 45S detector shall always be inactive. A phase 4/5 green plus a phase 1/6 call plus a 0.2 second gap in 45P detection shall disable the 45P detector and enable the 45S detector until the phase 4/5 signal changes to yellow. The circuits then switch back to normal - 18P active and 18S inactive until the condition is repeated.

d. Detector Circuits #5 (18P) and #6 (18S) -
During the phase 1/8 red condition the 18P detector shall always be active and the phase 18S detector shall always be inactive. A phase 1/8 green plus a phase 2/5 call plus a 0.2 second gap in 18P detection shall disable the 18P detector and enable the 18S detector until the phase 1/8 signal changes to yellow. The circuits then switch back to normal - 18P active and 18S inactive until the condition is repeated.

e. Detector Circuits #7 (25S) and #8 (16S) -
The phase 2/5 detector circuit shall always be active during phase 2/5 red. A phase 25 green plus a 0.2 second gap in detector 25S shall disable this circuit until loss of phase 2/5 green.
The phase 1/6 detector circuit shall always be active during phase 1/6 red. A phase 1/6 green plus a 0.2 second gap in detector 16S shall disable this circuit until loss of phase 1/6 green.
The 0.2 second gaps mentioned above shall be keyboard programmable from 0 to 3.0 seconds in 0.10 second increments or smaller.
The phase 45P detector shall always extend phase 4 during phase 4/6 interval.
The phase 45P detector shall always extend phase 8 during phase 8/2 interval.
An indication shall be provided for both the 45P detector circuit and the 18P detector circuit to indicate when they are active. When a circuit becomes inactive, the indication shall go out and stay out until it again becomes active.

f. Concurrent Timing Requirements -
Refer to Figures 18A-3 for the following descriptions.
The clearance interval phase 4/6 when sequencing from phase 4/5 to 1/6 shall time concurrently with phase 6, however phase 6 may not terminate green until phase 4 yellow interval has timed out.

The clearance interval phase 2/8 when sequencing from phase 1/8 to phase 2/5 shall time concurrently with phase 2, however phase 2 may not terminate green until phase 8 yellow interval has timed out.
All left to right internal clearance (Ø1/ Ø5) times from phase 4/5 to phase 1/8 shall use the same timing settings for minimum green, extension, max green, yellow clearance, and red clearance.
All right to left internal clearance (Ø5/ Ø1) times from phase 1/8 to phase 4/5 shall use the same timing settings for minimum green, extension, max green, yellow clearance, and red clearance.
Separate timing settings for minimum green, extension, max green, yellow clearance and red clearance shall be provided for each of the two external clearance intervals (Ø2/ Ø8 and Ø4/ Ø6 from Ø1/ Ø8 to Ø2/ Ø5 and Ø4/ Ø5 to Ø1/ Ø6).

8.1.2 Three Phase Diamond Operation.

a. Sequence.

The controller unit shall be keyboard selected for 3 phase diamond operation. The normal sequence of operation shall be, except as modified below, 4/8 → 2/6 → 1/5.

The point at which operation may be switched from 3 phase to 4 phase operation shall be from phase 1/5 to 4 phase inside clearance interval phase 1/5.

The path from 4/8 to 2/6 shall be keyboard selected and selected by the TBC (on a time of day basis) for one of the five possible phase combinations of lead/lag left turn clearance movements. These possible phase combinations shall be permitted when individual phase gap time expires.

4/8 → 4/6 → 2/6
4/8 → 4/5 → 2/6
4/8 → 2/6
4/8 → 2/8 → 2/6
4/8 → 1/8 → 2/6

The path from 2/6 to 1/5 shall be keyboard selected and selected by the TBC (on a time of day basis) for either 2/6 → 1/6 → 1/5 or 2/6 → 2/5 → 1/5.

The path from 2/6 to 4/8 shall always be through 1/5 and terminated simultaneously. The sequencing shall be flexible and phases shall be terminated bases on traffic actuation and gaps programmed for the phase.

b. Detector Operation.

The loop detector layout for 3 phase diamond operation shall be as defined in Figure 18A-6.

The 1P detector shall function as a phase 2 calling detector during phase 4 and as a phase 1 extending detector during phase 2.

The 5P detector shall function as a phase 6 calling detector during phase 8 and as a phase 5 extending detector during phase 5.

8.2 TIMING INTERVALS - ALL SEQUENCES.

The controller shall be programmable for the following timing parameters and any of the selected sequences. Each phase shall be timed independently and special clearance phasing described in the diamond sequence may be timed by group.

The following timed intervals shall be programmable in the minimum range for each interval:

TABLE 18A-4 - TIMING INTERVALS

INTERVAL	RANGE (SEC.)	INCREMENT (SEC.)
Vehicle passage	0-25.5	0.1
Yellow clearance	3-25.5	0.1
Red clearance	0-25.5	0.1
Added initial min. green	0-25.5	0.1
Red revert	0-25.5	0.1
Minimum gap	0-25.5	0.1
Delay/extend detector timing	0-25.5	0.1
Walk	0-255	1.0
Pedestrian clearance	0-255	1.0
Time before gap reduction	0-255	1.0
Time to reduce gap	0-255	1.0
Min initial green	0-255	1.0
Maximum added initial green	0-255	1.0
Overlap timing	0-25.5	0.1
Maximum green I, II & III	0-255	1.0
Maximum green extension interval	0-255	1.0

8.2.1 Guaranteed minimum time shall be provided for each phase, overlap, and preempt yellow. Minimum values shall not be changeable or overridden from the programming sources listed in this specification. Guaranteed minimum interval value shall be three seconds.

8.2.2 Maximum Green Intervals.

The controller unit shall provide two maximum green intervals per phase, however three are preferable. Maximum intervals shall be selected by either time-of-day or external input.

8.2.3 Maximum Green Extension.

The controller unit shall be capable of extending a phase maximum green time by continuous vehicle demand. If the phase terminates by expiration of the maximum time for one successive cycle, then its maximum green time in effect (Max 1 or Max 2) shall automatically be extended by a maximum green extension interval. The maximum green time shall be increased, until it equals Max 3, on each successive cycle that the phase green is terminated by the Max 1 or 2. If the phase gaps out for one successive cycle, then the maximum green time shall return to the original Max 1 or 2 value.

An alternate method for providing active traffic responsive timing shall use the volume/occupancy system detectors capability assignment to the phase detector. A preprogrammed cycle plan shall be initiated for providing timing modification to meet the traffic demand.

8.2.4 Volume Density Intervals.

Each phase shall have volume density intervals conforming to NEMA standards.

8.3 OVERLAPS.

The controller unit shall provide sixteen internally generated overlaps: Each overlap may be programmable as standard or protected/permissive. The capability shall be provided for reassignments of a minimum of four phase outputs to overlap operation shall be in the software for implementing special sequencing requirements and shall not require rewiring the controller signal outputs on the back-panel.

8.3.1 Overlap Timing.

Green, yellow and red timing intervals shall be provided for each overlap. These intervals shall permit the overlap to remain green after terminating the parent phase in addition to providing separate yellow and red clearance intervals for the overlap. A programmable feature shall provide a selection of sequencing that would hold all phases red or advance to the next serviceable phase green after the parent phase has terminated and the overlap timing is in effect. In either selection the next serviceable phase interval shall not begin timing until the overlap times have expired. Overlaps shall be controlled by the parent phase if the overlap timing intervals are not programmed. The overlap sequence shall never violate the conventional green,

yellow, red sequence under any circumstance. This timing operation shall be provided during all operational requirement herein specified. Any conflicting operation with this timing requirement shall supersede the timing extensions.

Overlap programming flexibility shall permit the user to assign the timed overlap to follow any parent phase(s).

8.3.2 Multi-Overlap Operation.

The controller unit shall be capable of eight overlaps including the standard four and assigning four phase outputs as overlaps. If a phase output is assigned as an overlap then it shall function as a standard overlap and programmed in the EEPROM. Changing these overlap assignments shall be programmed from the keyboard of the controller unit and provide warning of the impending sequence change.

8.4 RECALL FUNCTIONS.

The controller unit shall provide the following programmable features for each phase.

a. Locking/Non-locking detector memory
b. Vehicle recall
c. Pedestrian recall
d. Maximum recall
e. Soft recall - Locking/Non-locking memory

Soft recall shall return the controller unit to the programmed phases in the absence of all other calls.

8.5 INITIALIZATION.

The controller unit shall permit power start and external start to be individually programmed by phase and interval. Start intervals shall be green, yellow, red, all red or flash. During a power start condition, the controller unit shall be programmable for a timed display of an all red or flash interval before the selected start phase(s) and intervals are displayed. Data reference shall be made to the data in the EEPROM. An error shall keep the controller non-operational until the error is corrected. Resets shall be initiated to correct data integrity and begin the controller operating.

8.6 ADDITIONAL FEATURES.

8.6.1 Last Car Passage.

The controller unit shall provide guaranteed passage operation on a per phase basis. When selected, this feature shall provide a full passage (vehicle extension) interval when a phase gaps out with a gap in effect less than the passage time. The phase shall terminate after the passage interval expires.

8.6.2 Dual Entry.

The controller unit shall provide both single and dual entry operation. When selected, dual entry shall cause the controller unit to insure that one program selected phase is timing in each ring. If calls do not exist in a ring when a barrier is crossed, the controller shall select a programmed compatible phase and operate it concurrently with the phase or phases that have calls. When the selected controller sequence is non-NEMA, then an acceptable method of calling a compatible phase is the use of vehicle detector switching.

8.6.3 Conditional Service.

The controller unit shall provide a programmable conditional service feature when the controller is operated in the standard NEMA sequence. When selected, the controller unit shall service only one odd numbered phase during a sequence, once normal service to that phase has been completed and enough time for additional service exists on the concurrent even phase. The odd phase (left turn) shall be serviced if the vehicle clearance time of the terminating even phase plus a conditional service minimum green is less than or equal to the time remaining on the maximum green timer of the even phase which is still timing.

A conditional service, minimum green time shall be programmable for each phase. This interval shall insure a minimum green if the phase is conditionally served.

The controller shall be programmable to re-service the even phase after conditionally serving an odd phase following the same guidelines stated above. Once an even phase has been conditionally re-serviced, the odd phase shall not be conditionally served again until returning to the concurrent group that is timing.

8.6.4 Pedestrian Functions.

The controller unit shall provide the following additional pedestrian functions:

a. Actuated phase rest in walk
b. Pedestrian clearance protection during manual control
c. Exclusive pedestrian occurring once at a programmable point within each of the previously required sequences.

8.6.5 Backup Protection.

Programming shall be provided to inhibit re-service of odd phases within the same concurrent group. When programmed, backup protection shall take priority before conditional service.

8.6.6 Simultaneous Gap Termination.

The controller unit shall provide a programmable simultaneous gap termination feature. When programmed, phases in both rings must gap out together in order to terminate the green interval and cross the barrier.

9.0 DETECTOR INPUT FUNCTIONS.

9.1 DESIGN REQUIREMENTS.

The controller unit shall provide a minimum of sixteen vehicle detector inputs. Each input shall be assignable to any single phase or group of phases and be programmable for type of function (detector switching).

Detectors 1 through 8 shall meet the NEMA standards for vehicle detector inputs into phases 1 through 8. Remaining detectors shall utilize inputs assigned to the auxiliary functions in the D connector as specified in the appendix.

9.2 DETECTOR INPUT PROGRAMMING.

All vehicle detector input shall be user-programmable for vehicle calls to any or all of the eight phases in the controller. Each shall be selected for multiple applications identified in the following descriptions in addition to the vehicle call inputs. The controller shall include a minimum of three programming plans selected by TOD or cycle/split/offset for assignment of the programmable feature of each detector input.

9.2.1 Standard Detector Input.

All inputs shall default to standard operation, providing one call per actuation and shall be assigned to each phase, (i.e. det 1 to phase 1, det 2 to phase 2, etc.).

9.2.2 Delay and Extend Detector Input Timing.

A minimum of sixty-four (64) detector inputs shall be programmable to delay a vehicle call to the assigned phase(s). The delay timer shall have a range from 0 to 25.5 seconds. The timing shall begin upon activation of the input to the controller. If the input remains when the time has expired then the input shall be directed to the phase(s). The timing shall be reset when the input is removed. The delay timing function shall be inhibited during the selected phase green interval.

A minimum of sixty-four detector inputs shall be programmable for extending the vehicle call to the assigned phase. The extend timer shall have a range from 0 to 25.5 seconds. The extending time shall begin upon removal of the input to the controller and will extend the call to the phase until the expiration of the programmed time.

9.2.3 Phase Extending Detector Input.

All inputs shall be programmable to extend assigned phase or phases green interval timing and once programmed this input will not call the phase for service. All input shall be programmable to switch assigned phases during a programmed red interval and begin extending the assigned phase green interval.

9.2.4 Call Detector Programming.

All inputs shall be programmable to call assigned phase or phases during its red interval and not extend the green time from any actuation.

10.0 PREEMPTION.

The controller unit shall provide a minimum of five priority/non-priority preemption sequences. This capability shall be a standard controller unit feature and shall be provided within the modules and software. All required features specified above shall be available and programmable within the preemption operation.

10.1 PRIORITY/NON-PRIORITY PREEMPTOR DESIGN REQUIREMENTS.

Each of the five priority/non-priority preemptor shall be capable of railroad, fire lane, or emergency vehicle preemption sequences. Any one of the following conditions shall be selected to occur during preemption.

a. Hold phase green
b. Limited phase service, following track clearance
c. All red
d. Flash

10.1.1 Preemptor Call Priority.

Preemptor shall be selected as priority or non-priority. Lowest numbered priority preemptor shall have highest priority and will override a higher numbered priority preemptor calls. A minimum of two preemption phases shall be give equal priority and override higher numbered preempts. Additionally, priority preemptor calls shall override all non-priority preemptor calls. Non-priority preemptor calls shall be serviced in the order received.

10.1.2 Preemptor Call Memory.

Each preemptor shall provide a programmable locking memory feature for preemptor calls. The preemptor in the non-locking mode shall not service a call when it is received and dropped during the delay time.

10.2 PRIORITY/NON-PRIORITY PREEMPTOR TIMING.

The following preemptor timing features shall be provided for each of the priority/non-priority preemptor inputs.

10.2.1 Preemptor Timing Intervals.

All preemptor timing intervals shall be programmable from 0-60 minutes in 1 minute increments, 0-255 seconds in 1-second increments, or 0-25.5 seconds in 0.1-second increments, as indicated for each of the following.

10.2.2 Delay Time.

The delay time interval shall inhibit the start of the preemption sequence for a specified duration. This interval shall begin timing immediately after receiving a preemption call. (0-255 sec., 1 sec increments)

10.2.3 Duration Time.

Each preemptor shall provide a programmable minimum and maximum duration time that a preemptor shall be active, (Min: 0-255 sec., 1 sec. increments, Max: 0-60 mins, 1 min. increments).

10.2.4 Minimum Times.

Phase timing at the beginning of a preemption sequence shall be controlled by the programmable minimum times before advancing to the next sequential interval. Preemptor minimum times shall be programmable for the following intervals:

a. Green / Pedestrian Clearance (0-255 sec., 1 sec. increments)
b. Yellow (3-25.5 sec, 0.1 sec. increments)
c. Red (0-25.5 sec. 0.1 sec. increments)

10.2.5 Pedestrian Timing.

If a phase is timing a walk interval at the beginning of a preemption sequence, then the phase shall advance immediately to the preemption pedestrian clearance. A selectable timing interval shall be provided to time the minimum pedestrian clearance through the vehicular yellow interval, or alternately advance immediately to vehicular yellow.

During preemption, pedestrian indicators shall be user selected to be solid don't walk, blank, or operational during preemption.

10.2.6 Overlap Timing.

Overlaps shall be programmed to operate with the phase(s) or to clear to red then remain red during preemption. Overlaps terminating or forced to terminate when a preemption sequence begins, shall be selectable to time the preemptor minimum yellow and red clearance times or to time programmed overlap timing specified in Section 8.3.

10.2.7 Track Clearance.

Each preemptor sequence shall provide user-programmable green, yellow and red track clearance intervals. Track clearance shall begin timing immediately after the preemptor minimum red interval, (Section 10.2.4).

A minimum of two (2) phases shall be selected as track clearance phases. During the track clearance period, the selected phases shall time the track clearance green, yellow and red intervals once, and then advance to the next programmed interval (Section 10.2.8).

If track clearance phases are not selected, the track clearance intervals shall be omitted from the preemption sequence.

10.2.8 Limited Sequence.

The limited sequence program shall be user selected and begin immediately after track clearance. It shall remain in effect until preemptor duration time, phase minimum times has elapsed, or preemptor call has been removed.

10.2.9 Limited Sequence Phases.

Any active phase, except a track clearance phase(s), shall be selected for operating during limited sequence operation. Those phases not selected shall remain red during preemption. The controller unit shall remain in all red interval during the limited sequence interval when no phases are selected for operation during limited sequence.

If flash is selected for the limited sequence interval, up to two permissive phases shall be selected to flash yellow. The remaining phases shall flash red. Overlaps associated with the phases flashing yellow shall also flash yellow unless they have been forced to terminate in which case they shall remain dark. Flashing shall occur by controlling the appropriate load switch driver outputs.

10.2.10 Limited Sequence Timing.

During the limited sequence interval, the selected phase(s) shall operate normally (as outside of preemption). When preemption is exited, the current phase shall terminate after minimum green time is expired.

If any limited sequence intervals are programmed with zero timing, the equivalent interval time of the controller unit shall be used.

10.2.11 Exit Phases.

Two permissive exit phases shall be selected to time after the preemption sequence has been completed. These phases shall serve as transition phases to return the controller unit to normal operation. Exit phases shall time their normal programmed interval times.

Additionally, it shall be possible to program exit calls on any of the phases used in normal operation. Phases programmed as exit phases shall be served first, while exit calls on the remaining phases shall be served in normal sequence.

10.3 PREEMPTOR ACTIVE OUTPUT.

A preemptor active output shall be provided for the five priority/non-priority preemptor. The output shall be set to ON when the preemption sequence begins and shall remain ON for the duration of the sequence.

10.4 POWER INTERRUPTION.

If a preemptor call is active when power is restored to a controller unit, the voltage monitor output shall be set to FALSE, placing the intersection into the flashing mode of operation. Additionally, if external start is applied during a preemption sequence, the intersection shall be placed into the flashing mode of operation. The flashing mode of operation shall remain in effect until the preemptor call has been removed or the preemptor maximum duration time has elapsed. The controller shall begin operating as described by NEMA during power interruption.

10.5 PREEMPTOR STOP TIME.

A stop time input shall stop the timing of the current active preemptor. The stop time input shall normally be controlled by the conflict monitor unit.

11.0 AUTOMATIC FLASH.

The controller unit shall provide automatic flash selection per the requirements of the Manual on Uniform Traffic Control Devices. The flash phases shall be programmable through the keyboard and flashing shall be controlled by changing the controller outputs to the load switches from the normal sequencing of three outputs to a flashing output to one selected output. The controller shall be programmable for selecting the indication which will flash. Automatic flash shall be selected by external input, system command, or time-of-day from the internal time base clock. Two flashing controls shall be provided that alternate and shall be program selected for assignment as needed to each phase that will prevent a yellow/yellow conflict.

12.0 CONFLICT MONITOR.

The conflict monitor shall conform to NEMA TS-1, Section 6, in addition to the requirements of this specification. A six (6) channel monitor or twelve (12) channel monitor shall be provided with the controller as required on the order or plans.

Each conflict monitor shall utilize and be provided with a programming card specified in the above mentioned NEMA standards.

12.1 MECHANICAL DESIGN.

The frame shall be completely enclosed within sheet aluminum housing with a durable protective finish. The housing shall be removable for service to the internal circuitry.

The programming card shall be inserted through the front panel of the conflict monitor. Card guides should be provided for aligning the edge connector of the card with the mating jack. The cards shall be removable without use of tools or disassembling of the housing.

All printed circuit boards shall meet, as a minimum, the requirements of the NEMA Standard. In addition, they shall also meet the following requirements:

a. All plated-through holes and circuit traces shall be plated with solder to protect exposed copper. Any wire jumpers included on circuit boards shall be placed in plated-through-holes that are specifically designed to contain them. Circuit track corrections by track cuts and jumpers that are tack soldered to circuit tracks are not acceptable.
b. Both sides of the printed circuit board shall be covered with a solder mask material.
c. The circuit reference designation for all components shall be clearly marked adjacent to the component. Pin 1 for all integrated circuit packages shall be designated on all printed circuit boards.
d. All electrical mating surfaces shall be gold-flashed.
e. All ICs 14 pin and up shall be installed in machine tooled grade sockets meeting these requirements. All sockets shall be AUGAT-8XX-AG11D or approved equal, meet UL specification 94V-0, be constructed with two-piece, machined contacts and close-ended to eliminate solder wicking. The outer sleeve shall be brass with tin or gold plating and tapered to allow easy IC insertion. The inner contact shall be beryllium copper sub-plated with nickel and plated with gold.

12.2 ELECTRICAL DESIGN.

Liquid crystal displays shall be provided for displaying load switch outputs during normal operation, operations selected from a menu, and fault sensed. When a fault is detected,

the display shall present two displays, sequentially, one showing all load switch outputs at the time of the fault detection, and one showing the specific fault and date/time detected.

Circuitry shall be provided to detect sequential failure and indicate the channel on which the failure occurred. This feature shall be programmable to select either enable or disable for each channel. The following shall be failure indicated as sequential failures:

a. Yellow indication on for less than 2.5 seconds.
b. No yellow indication after green.
c. Simultaneous display of two or more indications within the same signal head, except as allowed by the MUTCD.
d. Combinations of any above.

All solid state components shall be mounted on printed circuit boards. The electronic components and printed circuit board(s) shall comply with the requirements outlined for the controller in Section 7.10 of this standard.

The conflict monitor shall be capable of recording and holding in memory (logs) the last ten conflicts detected and the last ten power failures. The time and date shall be indicated for each conflict and power failure. The memory shall be non-volatile during power loss and meet the requirements for the controller in Section 7.3, excluding Section 7.3.1. A log of the sequence of 20 events prior to a fault detection shall be retrievable prior to resetting the monitor and accessible through the communication port.

Each conflict monitor will be supplied with a 4-foot RS-232 cable with male connectors on each end. The monitor shall have a 9 pin communication port on the front of the monitor. The communication port shall be as defined herein, compatible with EIA-RS-232 standards for connection to a portable computer, printer, or other electronic devices. Communications shall be full or half duplex using FSK transmissions. The data transmission rate shall be selected baud. Control of the port shall be selected in menu form on the monitor display or request through the communication port. Data transfer to other electronic devices shall be provided with download commands from the device.

The monitor display shall present a selection menu for various data and programs available. This shall include, but not limited to, date and time set, review of programmed permissive phases and various logs.

12.3 COMMUNICATIONS.

The conflict monitor shall generate a report to the controller each time a change in status occurs. The report shall include the following as a minimum:

a) The configuration of the programming card.
b) The channels which have the NEMA plus features enabled.
c) A listing of the phases which are monitored for short yellow times.

Additionally, the conflict monitor shall store and report at least five (5) failures containing the information listed above when interrogated directly via the portable download/upload unit.

The report shall list at least the last five (5) failures from the monitor which contain the following:

a) Time of the occurrence of the failure.
b) The channels (Green, Yellow, Red and Walk) active at the time of the failures.
c) The status of the CVM input and the +24 V 1 and 2 inputs.
d) The type of failure (conflict, switch failure, red failure, etc.)

The conflict monitor will be capable of transmitting (via RS-232 port) an ASCII report to the controller unit.

The conflict monitor shall provide three (3) reports for interrogation. The first is an ASCII record of all data entries and programming card configurations. The second is an ASCII formatted record of all failures and each power on/off cycle. The last ten of these failure records will be available in report form. The third report will be a sampling report and will contain the twenty (20) samples of all of the inputs to the conflict monitor. Each sample will be taken at 0.1 second intervals so that the last two (2) seconds of real-time outputs of the load switches can be viewed.

Each of the reports will have the appropriate headings and will consist of ASCII lines of not greater than eighty (80) characters so that a clear presentation of the data can be viewed from the screen of a notebook computer using the standard ASCII character codes.

The monitor port shall be programmed in the following format:

a) Standard EIA-232 convention
b) Each word shall be eleven (11) bits long: eight (8) data bits, one (1) start bit, one (1) stop bit, no parity.
c) 2400 to 9600 baud
d) The note book or traffic controller unit will send a message of one byte to the monitor requesting each of the reports. After the one-byte message, the controller will issue an XON command to start the data flow. The data flow can be stopped with an XOFF command at any time.
The data sent to the notebook or controller unit in response to the request message will be the ASCII report requested. The last byte sent by the monitor will be an EOT (End Of Text- 04H).

If the controller issues an XOFF during a reporting request, the monitor will stop the data flow. If an XON is not issued within 30 seconds, the monitor will time out and set its pointer to the beginning of the report.

The next XON will then start at the beginning of the requested report. A report will also perform the XOFF function to the conflict monitor.

Definitions of the requests are as follows:

Request report 1:	31H
Request report 2:	32H
Request report 3:	33H
XON (DC1)	11H
XOFF (DC3):	13H

13.0. SOLID STATE SIGNAL LOAD SWITCHES.

The load switches shall follow those standards previously set forth. In addition to those, each load switch shall have indicators on the front showing the input state of operation with the indicators vertically aligned and the red input on top, yellow in the middle, and green below.

14.0 SIGNAL FLASH TRANSFER RELAY.

The transfer relays shall be electro-mechanical and shall be energized during normal sequential operation of the traffic signals with the operational switch in the normal position. This relay shall be de-energized when the indications are to be flashing. The relay shall transfer the field signal circuits to the flashing circuits and energize the flasher.

14.1 PHYSICAL DESIGN.

The relay shall be enclosed in a transparent case for protection against dust, dirt and other foreign objects. The case shall be a maximum of 2.671 inches high, 2.375 inches wide and 1.75 inches deep. The insulated base shall extend 0.625 inch from the case and shall be 1.990 inches wide and 1.120 inches deep. The contacts of the plug shall be flat blades arranged in two (2) parallel rows, 0.475 inch apart with the flat side of the blades in line with the row. The contacts of the plug shall be 0.250 inch wide, 0.060 inch thick, and extend past the insulated base 0.520 inch. Each row shall have four (4) contacts. The base shall be keyed with a pin that has a diameter of 0.156 inch and extend past the insulated base 0.685 inch. The pin shall be centered between the row of contacts and centered in line with contacts 5 and 6 of the plug. The contacts of the plug shall be numbered for wiring purposes, from 1 through 8. The top row shall be consecutively numbered from left to right using the odd numbers and the bottom row shall be consecutively numbered from left to right using even numbers.

14.2 ELECTRICAL DESIGN.

The relay coil shall be rigidly supported by the insulated base. The contacts shall be 2 Form C, rated at 20 Amps, and shall be 3/8 inch diameter, silver cadmium-oxide. The relay's life shall be 5 million mechanical operations and 100,000 electrical operations. Each contact shall be rated for power bus control and 1 KW tungsten at 120 VAC. The coil shall be 110 VAC and shall pick up at 80% of nominal voltage. Maximum power requirement of the coil shall be 10

VA. The relay shall be wired and the socket pin assignments arranged according to the following table:

TABLE 18A-5
TRANSFER RELAY WIRING

PIN	FUNCTION	PIN	FUNCTION
1	Relay Coil	5	Common Circuit #1
2	Relay Coil	6	Common Circuit #2
3	NC Circuit #1	7	NO Circuit #1
4	NC Circuit #2	8	NO Circuit #2

The base, relay, and enclosure shall have a minimum rating of 1500 volts.

15.0 SOLID STATE FLASHER.

The flasher shall comply with NEMA TS-1, Section 8 and Section 7.2.3.2. The flasher shall be a two circuit flasher rated at 15 amps per circuit. (Type 3)

16.0 VEHICLE AND PEDESTRIAN DETECTORS.

Vehicle detectors shall be fully digital, microprocessor designed, auto-tune, card rack mounted and have four channels of detection per card, Type 8. Unless otherwise noted the detectors shall be provided with the order for controller in Types 3, 5, 6, and 7 cabinets. Detector units shall conform to applicable environmental, functional, dimensional, and design required in NEMA TS 1, Section 15. The amplifier shall not consume more than 385 ma of current at the rated voltage. Delay and extension timings shall meet this standard when the order or plans require the detector to have such timing. Each channel shall have an erasable, write-on surface for channel identification.

Pedestrian detectors shall be of an approved model accepted by the Department under the appropriate Traffic Control Standard. Each order or plans shall identify the type and quantity of detectors in each cabinet.

16.1 SENSITIVITY AND ACCURACY.

Detector units shall conform to NEMA TS1, Section 15. Each detector shall be accurate for detecting all vehicles from motorcycles to tractor-trailer combinations which ordinarily travel public streets and highways and are comprised of sufficient conductive material, suitably located to permit recognition and response by the detector system. There shall be a minimum of sixteen selected sensitivity ranges located on the front of the unit for each channel. The range of sensitivity shall be, nominally, between 0.00 % - 1.250% change in total loop inductance.

16.2 OPERATING MODES.

Each channel shall be self-tuning in accordance with the NEMA standards. Response time for compensation from extended detection, re-tuning to track the changing electrical characteristics of the loop and recovery from power interruption shall be accomplished within 50 milliseconds. Each channel shall have an on and off switch. Each detector card shall have a momentary push switch to reset all channels.

16.3 FAIL SAFE.

The detector shall operate when sensor loop shorted to ground or not in good condition. The unit shall generate a continuous call when re-tuning failed sensor loop or failed detector unit.

16.4 CONTROL VOLTAGE.

All controls shall be DC voltage in accordance with the NEMA standards. The control circuit from the delay/extension feature shall follow this requirement.

16.5 CONTROL SWITCHES.

All switches, connectors, and fuses shall be located on the front of the card. Each switch shall be permanently labeled to identify its function. Each position shall be labeled to identify its mode of operation. Each mode of operation shall be simple to program with one switch position assigned to one function.

16.6 PRINTED CIRCUIT BOARD DESIGN.

The PC board shall be in accordance with NEMA TS1 Section 15. All pressure contracts shall be gold flashed. All components mounted and soldered to the PC board shall be easily removed and replaced without causing damage to the board or traces. Each individual PC board shall be identified by manufacturer and a serial number or part number clearly stamped or etched on the board. All PC boards shall be coated with an epoxy or approved equal type material to prevent erratic performance due to high humidity, condensation and growth of fungus and mildew. This coating will not cover the component on the board, but once the components are in place, they and the soldered joints shall be covered with a moisture and fungus proof, clear type of acrylic lacquer. This coating shall not be injurious to the board or components and shall not interfere with the repair of the circuitry or the replacement of components.

16.7 PEDESTRIAN DETECTOR ISOLATION.

Two - two channel pedestrian isolation circuit boards shall be provided. There shall be two circuits using optical and transformer isolation designed and tested for a minimum of 2500 volts D.C. between the inputs and outputs. Each circuit shall recognize a minimum 5 millisecond switch closure between conductor pairs from the pedestrian push button operated on a maximum of 5 volts and 20 milliamps. Transient protection shall be on the input and shall withstand a 10 microfarad capacitor charged to 2,000 volts to be discharged between input pins

or between input pin and chassis ground. When the input switch closure occurs, the circuitry shall close the pedestrian call circuit between the controller input and logic ground and remain closed for a minimum of 100 milliseconds or the time the pedestrian push button is closed, whichever is larger. Additional circuits shall be provided to maintain isolation, lock the pedestrian actuation, and reset when an input from the DC level from the controller activates the walk and raises the potential of the field circuit from five volts to 24 volts. Each board shall have a fused power supply. Output status indicators shall be located on the front panel for each channel. A three position switch shall be provided on the front of the unit for each input circuit and provide "on", "off", and momentary "on". Alternate designs will be reviewed at the time of bid for pedestrian actuation and annunciator located at the pedestrian push button.

The card shall fit into the vehicle detector card rack. The dimension characteristics shall follow the Type 7 card detectors standards Section 15 in NEMA TS1 1989.

16.8 PEDESTRIAN ISOLATION CARD CONNECTOR.

The isolation card shall be designed with an edge connector. The connector shall be 22 position, dual inline type connector with the following position assignments:

TABLE 18A-6
PEDESTRIAN ISOLATION CARD CONNECTOR ASSIGNMENT

PIN	FUNCTION	PIN	FUNCTION
2A/1	SPARE/CH 1 ØWALK	N	AC(+) 120 V
B/2	SPARE/CH 2 ØWALK	P	SPARE
C	SPARE	R	SPARE
D	INPUT #1	S	SPARE
E	INPUT COMMON	T	SPARE
F	OUTPUT #1 (COLLECTOR)	U	SPARE
H	OUTPUT #1 (EMITTER)	V	SPARE
J	INPUT #2	W	OUTPUT #2 (COLLECTOR)
K	INPUT COMMON	X	OUTPUT #2 (EMITTER)
L	CHASSIS GROUND	Y	SPARE
M	AC (-) 120 V	Z	SPARE

16.9 DETECTOR CARD RACK.

Detector card racks shall be designed with top and bottom card guides for four-four channel detector cards mentioned above, two-two channel isolation cards, and a power supply

installed in type 6 cabinets and two-four channel detector cards mention above, two-two channel isolation cards, and a power supply in Types 3 and 5 cabinets.

The housing shall be constructed of 5052 aluminum alloy of a minimum thickness 0.062 inch with a protective coating (painted or anodized). Removable covers shall be provided on top, bottom, and back allowing access to the internal hardware and circuitry. Each cover shall be easily removable with the use of conventional hand tools.

The dimension of the rack in Types 3 and 5 cabinets shall be approximately 10 inches wide, 6 inches high and 9 inches deep and in Type 6 cabinets shall be approximately 14 inches wide, 6 inches high and 9 inches deep. The rack shall be mounted on the inside of the door of Type 3 cabinets as shown in drawing 18A-1 and attached to the bottom shelf in Types 5 and 6 cabinets, hinged to swing out to provide access to the rear assembly without removing the shelf(s).

The card rack for Type 3 cabinets shall be as above except: the top shall be rain proof with a drip edge to prevent water from running across the lower side of the top and into the rack and shall have a power supply, two - four channel detector cards positions, and two - two channel isolation cards. These shall be wired as follows: first card detector to vehicle call input 1 through 4, second card detector to special detector inputs 1 through 4, first isolator card to pedestrian detector inputs phases 2 and 4, and second isolator to preemptions 1 and 2.

The power supply shall meet the dimensional requirement of a four channel card rack detector type 8, operate on 120 VAC, 60 Hz, and the AC+ into the power supply shall be fused. The fuse shall be located on the supply card, permanently labeled indicating the fuse and size. The supply shall meet NEMA specifications and provide 24 VDC, 385 ma, regulated as specified in NEMA TS-2-1998, Section 15.2.6.2. A power indicator and a fuse shall be provided on the front of the supply for each output. A pull handle shall be on the front of the unit. The power supply shall be located on the left side of the rack when viewed from the front. DC voltage from the power supply shall not be supplied to the isolator positions.

The rack shall be wired with a separate power cord and individual wires to each card position. The power cord shall have each wire identified with a sleeve marked, DR-AC+, DR-AC-, and DR-Gr, and terminated with a spade terminal connected to the terminal for the controller power. Each module slot shall be wired directly to the card edge connector with color coded harness. The harness shall meet the requirements for wiring elsewhere in this standard. Each detector lead in from the field wiring shall be a twisted pair. A sufficient amount of slack in the wiring harness shall allow the rack to be moved for visual inspection and mechanical repairs. The wiring shall be cabled together into a harness, attached to the back right side (viewed from the front) with an approved cable clamp, and routed to the back and detector panel.

The cards in the rack shall be numbered from left to right viewed from the front in order to identify the position function. For Type 6 cabinets, the first position will be the power supply; the second, a four channel detector for phases 1, 2, 3, and 4; the third, a four channel detector for phases 5, 6, 7, and 8; the fourth, a four channel detector for special detectors 1, 2, 3, and 4; the fifth, a four channel detector for special detectors 5, 6, 7, and 8 ; and the sixth and seventh, each

a two channel isolation card for pedestrian detection to phase 2, 4, 6, and 8 respectively. For Types 3 and 5 cabinets, the first position will be the power supply; the second, a four channel detector for phases 1, 2, 3, and 4; the third position, a four channel detector for special detectors 1, 2, 3, and 4; the fourth and fifth position each a two channel isolation card for pedestrian detection to phase 2 and 4, and preemption input to 1 and 2.

Wiring from each detector and isolator output shall be directly to and terminated to the front of the back panel at their associated terminals of the controller. The control circuit wiring for each detector and isolator input shall be made directly from the associated terminals of the controller. The wiring for the field input to the card rack shall be terminated with the associated terminal on the detector panel. Each wire from the card rack to the back panel shall be terminated using a spade type compression terminal and an identification sleeve identifying each as follows: Detector position one, VD-1-1, VD-1-2, VD-1-3, and VD-1-4; the input to these card positions shall be identified as: VD-1-1G, VD-1-2G, VD-1-3G, and VD-1-4G. The remainder of the detector wiring shall be identified in a similar manner. The pedestrian detector isolator cards outputs shall be identified as: Isolator position nine: PD-1-1 and PD-1-2, the inputs: PD-1-1W and PD-1-2W. The other isolator shall be identified similarly using PD-2-, etc.

17.0 MECHANICAL CONSTRUCTION OF ENCLOSURES. (Also in TCS 36)

The cabinet shall be constructed of sheet or cast aluminum alloy.

17.1 SHEET ALUMINUM.

The sheet aluminum alloy shall be ASTM No. 5052-H32 or equivalent, and shall have a minimum sheet material thickness of approximately 1/8 inch.

17.2 CAST ALUMINUM.

The cast aluminum alloy shall be ASTM No. 356-75 or equivalent. Flat cast surfaces exceeding 12 inches in both directions shall be a minimum of 1/4 inch (0.25 inches) in thickness. Flat cast surfaces not exceeding 12 inches in both dimensions shall be a minimum 3/16 inch (0.1875 inches) in thickness.

17.3 OUTLINE DIMENSIONS.

Outline dimensions shall be as shown in Table 18A-7. All dimensions are outside of cabinet and in inches exclusive of hinges, handles, overhang(s), vent housing and adapters. Cabinet heights are measured to the lowest point of the top surface of the cabinet. The combined overhangs of the top of the cabinet shall not exceed 4 inches. Type 4 cabinets will be a combination of an empty, Type 2 cabinet or a meter base cabinet on bottom and a Type 2 or 3 cabinet on top.

TABLE 18A-7
CABINET DIMENSIONS

CABINET TYPE	WIDTH	HEIGHT	DEPTH
2 (14-06-1440)	22 (-0 + 15%)	45 (-0 + 10%)	15 (-0 + 15%)
3 (14-06-1450)	22 (-0 + 15%)	45 (-0 + 10%)	15 (-0 + 15%)
5 (14-06-1480)	30 (-0 + 10%)	46 (-0 + 18%)	16 (-0 + 15%)
6 (14-06-1485)	38 (-0 + 10%)	52 (-0 + 15%)	24 (-0 + 15%)
7 (14-06-1492)	38 (-0 + 10%)	72 (-0 + 15%)	24 (-0 + 15%)

17.4 FINISH AND SURFACE PREPARATION.

17.4.1 Painted Aluminum Cabinets (When specified).

The color shall be medium green, OAAA #144. The surfaces of the cabinet shall be suitably prepared prior to priming. Unpainted interior surfaces shall be permissible in aluminum cabinets. Exterior surfaces shall be primed and painted to provide a durable exterior finish. If the primed surfaces are scratched or damaged, the affected area shall be re-primed prior to painting.

17.4.2 Unpainted Aluminum Cabinets (Shall be provided unless otherwise noted).

Unpainted aluminum cabinets shall be fabricated from mill finished material and shall be cleaned with appropriate methods that will remove oil film, weld black, mill ink marks and render the surface clean, bright, smooth and non-sticky to the touch.

17.5 SHELVES.

Cabinets shall be provided with a minimum of one shelf in Types 2 and 3, two shelves in Types 5 and 6, and three shelves for Type 7 to support control equipment. Types 2 and 3 cabinets shall have provisions for positioning the shelf between 10 inches from the bottom and within 8 inches from the top. Types 5, 6, and 7 cabinets shall have provisions for positioning shelves between 24 inches of the bottom of the cabinet and to within 8 inches of the top of the cabinet in increments of not more than 2 inches. The adjustment of the shelves shall be accomplished by using small hand tools. Rivets are not acceptable. All shelves shall have a raised back edge to stop equipment from passing the back edge of the shelf. This edge shall be a minimum of 1/2 inch from the rear wall of the cabinet and be constructed from one continuous piece of metal.

All cabinets shall have a 1-1/2 inch drawer, mounted directly beneath the lowest shelf. This drawer shall have a hinged top cover and shall be capable of storing documents and miscellaneous equipment. The drawer shall open and close smoothly. Drawer dimensions shall make maximum use of the available depth offered by the cabinet and controller shelf, and shall have approximately the same width as the corresponding back panel. The bottom of the drawer shall have drain holes sufficient to drain any amount of accumulated water in the drawer.

17.6 TOP SURFACE CONSTRUCTION.

Cabinets shall be manufactured to prevent the accumulation of water on its top surface and slope in a manner to drain water to the back side of the cabinet. The highest point of the top surface shall be limited to a maximum of six (6) inches added to the overall height of the cabinet.

17.7 DOORS.

17.7.1 Main Cabinet Door.

Cabinets shall have a single hinged main door which permits access to all equipment within the cabinet and visual inspection of all indicators and controls. Unless otherwise specified, the door shall be hinged on the right side of the cabinet as viewed from the outside facing the cabinet door opening. Type 4 cabinets shall have two main doors equally dividing the height of the cabinet front with clearances at top, middle, and bottom.

17.7.2 Hinges.

All cabinet doors shall incorporate suitable hinges utilizing stainless steel hinge pins. Hinges shall be protected to prevent being removed or dismantled when cabinet door is closed. Attachment to the cabinet shall produce a smooth finish, protruding fasteners are not acceptable.

17.7.3 Door Stop.

Each cabinet shall be provided with a door stop which holds the door open at positions of $90° \pm 10°$ and $170° \pm 10°$. A means shall be provided to minimize accidental release of the door stop. Type 7 cabinets shall have the door stop located at the bottom of the door and all other cabinets shall have the stop located at the top of the door.

17.7.4 Locking Mechanism.

All cabinets shall incorporate a main door lock constructed of nonferrous or stainless steel materials, which shall operate with a traffic industry conventional #2 key. A minimum of one key shall be included with each main cabinet door lock.

A three - point lock on the strike edge of the door shall be provided with all types of cabinets except when specified to be different on the order or plans. The three (3) points of the lock shall be located at the top, bottom, and middle of the strike edge of the door.

The lock shall prevent operation of the mechanism when in the locked position.

The door handle shall rotate inward from the locked position so that the handle does not extend beyond the perimeter of the door at any time. The operation of the handle shall not interfere with the key, police door or any other cabinet mechanism or projection. The handle shall have the mechanical strength to operate the mechanism and shall be made from non-corrosive material.

Cabinets with three-point lock shall be provided with a means of externally padlocking the mechanism. A minimum 3/8 inch diameter lock shackle shall be accommodated. The lock shaft shall be 5/8 inches in diameter.

17.7.5 Door Opening.

The main door opening of all cabinets shall open on and be centered within the front side having the width dimensions listed in the previous table and shall be at least 69% of the area of the side. Necessary clearances shall be provided allowing unrestricted movement of the door from closed position to open position. The door shall seal against a minimum of one inch wide neoprene sponge gasket with tight seams. The top gasket shall be the width of the door, the side gaskets shall begin below the top gasket and the bottom gasket shall be within the side gaskets. A gasket retaining ring shall be installed on the inside of the gasket.

17.7.6 Police Compartment.

A hinged police compartment door shall be mounted on the outside of the main cabinet door. The door shall permit access to a police panel compartment for operation of switches defined elsewhere in these standards. The compartment shall be constructed to restrict access to exposed electrical terminals or other equipment within the cabinet. The door shall seal against a neoprene sponge gasket in the same manner as stated above for the main door.

Space shall be allowed for the switch controls and storing of the manual control cord in the police panel compartment with the door closed. The minimum internal dimensions shall be 3-1/2 inches high, 6-3/4 inches wide and 2 inches deep. Additionally, the volume shall be not less than seventy (70) cubic inches.

Police doors shall be equipped with a lock which can be operated by a police key, Corbin Type Blank 04266, or equivalent. A minimum of one key shall be included for the police compartment of each cabinet.

The police compartment shall be located above the bottom of the main door as shown in the following table:

TABLE 18A-8
POLICE COMPARTMENT LOCATION

CABINET TYPE	LOCATION
2 and 3	2.5" ± 10% from bottom and left of center, see Drawing #18A-1
5	30" ± 10%
6 and 7	39" ± 10%

17.8 CABINET MOUNTING.

17.8.1 Pole Mounted Cabinets, Types 2 and 3.

The cabinets shall be provided with provisions to attach a pole bracket to a reinforcement plate permanently mounted to the back, top, and center of the cabinet. The reinforcement to the cabinet shall be designed to support the weight of the cabinet and the equipment intended to be contained within and the structural loads referred to in this specification. The minimum width of the adapter shall be six (6) inches wide and three (3) inches high, tolerance of both -0 inch, +6 inches. Two 3/8 inch holes shall be drilled through the cabinet, within the reinforced area, 2 inches from center line of the width of the cabinet. Countersink each hole on the outside of the cabinet for flat head screws. Install two 5/16" flathead screws in the mounting holes with the top of the screw heads to be flush with the surface of the cabinet wall.

The cabinet shall be pre-drilled for two (2), 3 inch wire entrance holes, one in the top and one in the bottom, both at the back edge and centered on the width of the cabinet and one (1) 2 inch entrance hole adjacent to the 3-inch hole on the bottom as shown in the attached drawing. Three hubs shall be provided with Types 2 and 3 cabinets. The hubs shall centered on the entrance holes and attached to the cabinet using four (4) 5/16 inch-18-tpi by 1-1/2 inch long hex head bolts, with lock washers and hex nuts. The hubs and cabinet shall be pre-drilled for mounting the hubs to the cabinet with the above mentioned bolts using a bolt pattern of 2-1/8 inches centered on a line perpendicular to the back of the cabinet, by 3-3/4 inches parallel to the back of the cabinet. The centers of the bolt pattern on the hub and the wire entrance hole shall coincide. The location of the hubs shall allow minimum clearance for box end wrenches to fit onto the nuts within the cabinet.

17.8.2 Pedestal mounted cabinets, Type 2 or 3.

When specified on the order or plans the requirement for a pedestal mounted cabinet shall meet the following requirements. The specified cabinet shall be provided and equipped with a reinforced bottom, 1/4" aluminum plate, and a slip fit adapter for attachment to a standard 4-inch inside diameter pipe. The bottom of the cabinet shall be provided with an access hole for cable (min. 4 inches) and mounting holes for the adapter located in the center of the bottom. The adapter shall be bolted to the cabinet with 5/8" bolts and fitted on a 6-1/2" bolt circle. The attachment to the standard 4-inch pipe shall be secured with four (4) square headed set screws.

The holes drilled for pole mounting hardware and wiring shall be covered with gaskets and blank hubs.

17.8.3 Base mounted cabinets, Types 5, 6, and 7 (types as specified on order or plans).

The cabinet or its base adapter shall be so constructed that it can be mounted on the foundation shown in Figure 18A-2.

The interior anchor brackets shall transverse the cabinet. Each bracket shall attach to one edge adjacent to the bracket. The strength of the bracket shall prevent the cabinet from being lifted from the concrete base with a load of fifty (50) pounds acting at the top, front or back of the cabinet.

17.8.4 Anchor bolts.

Anchor bolts for base mounted cabinets shall be 3/4 inch diameter and 16 inches long. A 90° bend with a 2-inch leg on one end and a minimum of 3 inches with a UNC-10 thread shall be provided. Anchor bolts shall be steel with hot dipped galvanized finish. Each anchor bolt shall be furnished with one (1) 3/4 inch UNC-10 HDG steel nut and one (1) 3/4 inch HDG flat steel washer. Two (2) anchor bolts shall be provided with each cabinet.

17.9 CABINET STRUCTURAL TESTS (mounting shall withstand the following):

17.9.1 Hinges and Door.

The hinge and door assembly shall be of sufficient strength to withstand a load of 30-pound-per-vertical-foot of door height. This load shall be applied vertically to the outer edge of the door when it is opened to the 90 degree position. There shall be no permanent deformation or impairment of the door, locking mechanism, or door seal function after the load is removed. A stiffener shall be installed the width and at mid height of the door. The door panel shall be flat after fabrication.

17.9.2 Door Stop.

Both the door and door stop mechanisms shall be of sufficient strength to withstand a simulated wind load of 5 pounds per square foot of door area applied independently to the inside and outside surfaces without failure, permanent deformation, or any major movement of the door positions. For test purposes, a test load shall be applied to the vertical midpoint of the outer edge of the door at a right angle to the plane of the door. The test load shall equal one half of the calculated wind load. The force shall be applied first on the inside edge, then on the outside edge. These tests shall be performed with the door at 90degree and 170 degree positions.

17.9.3 Lock.

The door handle and associated cabinet locking mechanism shall withstand a torque of 100-foot lbs. applied in a plane parallel with the door to the handle in the locked position. The

door handle and the external padlock mechanism shall meet the same requirement without the internal locking mechanism securing the handle.

17.9.4 Shelves and Drawer.

Shelves shall support a load equivalent to 2 pounds per inch of length without deforming more than 1%. The test load shall be applied at two points, 6 inches to each side of the shelf's center, with the shelf installed in the cabinet. The drawer shall support up to 50 pounds in weight when fully extended.

17.10 EQUIPMENT PROTECTION.

Cabinets are intended to provide protection for the housed equipment. Prying open or dismantling the doors, walls, or tops, shall be prevented with the cabinet securely closed.

When completely and properly installed, cabinets shall have provision for rain water drainage. The cabinet shall not permit water to enter the equipment cavity above any live part, insulation, or wiring.

17.11 RAIN TEST.

All cabinets shall be designed to meet the requirements of the following tests. To insure realistic testing, the enclosure and enclosed equipment shall be mounted as intended for use.

A continuous water spray, using as many nozzles as required, shall be applied against the entire top and all exposed sides of the enclosure for 10 minutes at a minimum rate of 18 inches per hour of equivalent rain at an operating pressure of 4 to 5 pounds per square inch. The distance of the nozzles to the cabinet shall be a minimum of 36 inches and a maximum of 48 inches and located above the top edge of the cabinet.

The enclosure is considered to have met the requirement of this test if there is no significant accumulation of water within the enclosure and no water is visible on the live parts, insulation materials, or mechanism parts.

A rain test which is performed in accordance with Underwriters Laboratories, Inc., "Rain Tests of Electrical Equipment, Bulletin of Research #23, September, 1941", is considered to be equivalent to this test.

17.12 AUXILIARY EQUIPMENT.

17.12.1 Fan and cooling system.

All cabinets shall be equipped with a cooling system of sufficient capability to pass the test described in NEMA TS1-2.2.04. The fan shall be capable of operating continuously for a minimum of 6000 hours in a 122°F (50°C) environment without need for after-installation maintenance and deliver 100 CFM in free air. The fan shall be thermostatically controlled by

switching the 120 VAC supply to the fan. The thermostat shall be field adjustable to switch on and off at any temperature between 70° and 160°F.

The exhaust shall be vented through the upper portion of the cabinet. All ventilation shall be rain-tight and shall prevent any water from dripping into the cabinet.

The cooling system shall be constructed to allow cleaning of the vents, screens and fan. Fasteners for removing panels to gain access to perform the above requirement of cleaning shall be removable with the use of simple hand tools, except as noted in Section 17.12.2.

An additional duplex receptacle (for use with communications modems) shall be mounted and wired in the upper left side of the cabinet assembly. This receptacle shall be wired on the load side of the 20 amp circuit breaker.

17.12.2 Air Filter.

The cabinet shall be equipped with a secured, replaceable filter for the incoming ventilation air. The air filter shall be removable without the use of tools. The filter size shall be: 7-1/2 inches high x 7 inches wide x 1 inch deep for the Types 2 and 3 cabinets, 10 inches high x 20 inches wide x 1 inch deep for the Type 5 cabinets, and 14 inches high x 25 inches wide x 1 inch deep for Types 6 and 7 cabinets. The filter shall have clearly indicated on it the size and direction of air flow. A metal grid shall be on both sides of the filter. The filter shall meet ASHRAE standard 52-76 for disposable, Type II, glass fiber air filters. The air resistance shall be 0.08 inch WC, measured on 24 inches x 24 inches sample at 300 FPM. The efficiency of the filter shall be a minimum of 75 percent.

17.12.3 Cabinet Light.

A fluorescent bulb and fixture shall be installed in cabinet Types 2 and 3. The fixture shall be mounted against the cabinet top and the strike edge for the door. The fixture shall not extend beyond the strike edge at the top of the cabinet and shall not restrict the opening of the door. Mounting supports shall be on the front of the cabinet. The fixture shall have an on/off switch mounted on the side of the fixture. The fluorescent bulb shall be a F8T5WW.

A fluorescent bulb and fixture shall be installed in cabinet Types 5, 6, and 7; and when specified in other cabinets. The fixture shall be within the upper 3 inches from the top and toward the door side of the cabinet. It shall illuminate the interior of the cabinet without hampering the vision of service personnel while inspecting the cabinet. The fluorescent bulb shall be a 15 watt, T-12, 18 inches in length. The fixture shall be of a sturdy construction to hold and operate the above mentioned bulb. For Types 5, 6, and 7, the cabinet light shall be turned on when the cabinet door is opened and turned off when the cabinet door is closed.

17.12.4 Cabinet Hubs.

The hubs for the cabinets shall be cast aluminum, ASTM B-108 and those standard specifications referenced therein. The bolt pattern shall be as detailed in the Figure 18A-1. The

blank shall be a flat plate, 1/4 inch thick. All other hubs shall have a conduit threaded collar that shall be a minimum of 2 inches from the base of the hub. The threaded opening shall be centered within the 3-3/4 inches dimensions of the hub with outside edge of the threaded collar in line with the base of the hub. All hubs shall be provided with stainless steel bolts casted into the hub. The outside of the hub shall provide a smooth design. On the hubs with larger threaded collar(s), the bolting pattern shall be maintained. The following table describes the designations and type of hubs that will be specified on the order or plans.

TABLE 18A-9
CABINET HUB DESCRIPTION

TYPE	OPENING(S) SIZE	OPENING DESCRIPTION
Blank	-0-	no opening, flat plate, 1/4" minimum thickness
Single	3/4 in.	one opening, 3/4" conduit thread
Single	1 in.	one opening, 1" conduit thread
Single	1-1/2 in.	one opening, 1-1/2" conduit thread
Single	2 in.	one opening, 2" conduit thread
Single	2-1/2 in.	one opening, 2-1/2" conduit thread
Single	3 in.	one opening, 3" conduit thread
Double	3/4 in.	two openings, 3/4" each conduit thread
Double	1 in.	two openings, 1" each conduit thread

17.12.5 Clamp Pole Mounted Cabinet.

A pole clamp shall be provided with the controller cabinet, Types 2 and 3 for mounting the cabinet to the pole. The clamp shall be cast aluminum meeting the requirements for the cabinets and designed to hold the weight of the mentioned cabinets and the equipment contained within. The design shall provide four contact points with the pole and shall be adjustable for pole diameters from 10 inches to 12 inches. The clamp shall be divided into two parts, one half to be attached to the cabinet and the other half to be installed on the "back" side of the pole. The clamp shall have a slotted opening for coupling the clamp together using 5/8-inch galvanized all thread bolts and nuts. The clamp shall have a flat surface area, 4-1/2 inches x 2 inches minimum that attaches to the cabinet. Two (2) 5/16 inch - 18 tpi, drilled and tapped holes spaced 4 inch center to center shall be centered within the flat area. The flat area shall space the back of the cabinet a minimum of 2 inches from the pole.

17.12.6 Adapter Pole Mounted Cabinet.

When specified, an adapter shall be provided, excluding lag bolts or steel bands. The adapter shall be conformable for mounting to round poles with a 4-1/2 inches or larger diameter.

Material for the adapter shall be comparable with aluminum alloy 6061 and have the mechanical strength to hold the weight and loading requirements for the cabinet. The adapter shall accommodate lag bolts up to ½ inch and steel banding up to 1 inch wide. The adapter shall have the same mounting bolt pattern and wire way requirement as the hubs stated in Section 17.12.4. The adapter shall be mounted to the cabinet using the same mounting bolts as the hubs, and additional gaskets shall be used between the cabinet, hub, and adapter.

17.12.7 Adapter Slip-fit, 4-Inch pipe.

The adapter shall slip-fit to a standard 4-inch pipe and shall secure to the pipe with four (4) square headed set screws. The adapter shall be made of cast aluminum or steel designed to hold the weight of the cabinet and the loading characteristics required for the cabinet. The length of the adapter shall be approximately 8 inches long. The adapter shall be attached to the cabinet with 5/8-inch bolts and fitted on a 6-1/2-inch bolt circle.

18.0 CABINET INTERIOR PANELS.

18.1 GENERAL REQUIREMENTS.

All panels shall be made from structural grade sheet aluminum equal to 2024 or 5052 aluminum alloy. Approval from the Department is needed if different material than listed above is used for the panels. The panels shall be attached to the cabinet walls with bolts, nuts, and washers specified elsewhere in this standard. Each panel shall be completely removable or capable of folding down from the cabinet wall without the need to remove any other panel or shelf so that inspections and repairs may be made behind each panel. All panels shall be grounded to the cabinet using a braided copper conductor equaling #6 AWG. All panels shall be sized to fit within the minimum dimension of the cabinet it is specified for as listed in Table 18A-7.

18.2 GENERAL WIRING DESIGN REQUIREMENTS.

The inspection and repair of any panel shall not require disconnecting or removing wires. When multiple panels are required in the cabinet then the cable shall follow a single route and shall be from the detector/auxiliary panel to back panel to power panel to police panel. Cabling shall conform to the previously stated requirements for servicing each panel. Cable(s) shall be secured to the panels at the point where it leaves and/or enters each panel. The cable shall be secured to the cabinet wall with a cable clamp at two (2) points equally spaced between the panels on the above stated route. Wiring requirements for ventilation, temperature monitoring, and cabinet lighting shall be from the power panel to each device and shall be neat and in accordance with good wiring practices. A separate, parallel cable route shall be used from the field terminal to the back panel solid state load relay outputs.

18.3 IDENTIFICATION OF COMPONENTS, TERMINALS, AND CONNECTORS.

Each terminal position, sockets, switches, filters, relays, and fuses shall be permanently labeled by painting, printing or engraving directly onto the panel or terminal strip identifying the

position number and/or function of the terminal or device (paper labels of any type will not be accepted). Each harness shall be permanently labeled to identify function or connector with only the following:

TABLE 18A-10
HARNESS LABELS

HARNESS	LABEL	HARNESS	LABEL
NEMA Connector A	"A"	Conflict Monitor	"CMA"
NEMA Connector B	"B"	Conflict Monitor	"CMB"
NEMA Connector C	"C"	All Harnesses	Labeled with function
Controller Connector D	"D"	Additional harnesses may be identified later.	

18.4 IMPLEMENTATION OF EQUIPMENT CAPABILITIES.

The wiring between the panels shall connect the functional inputs and outputs needed to implement the operational capabilities of the equipment and requirements of this standard. Input circuits to the controller for external controls shall not be wired: i.e.; hold, omit, force off, CNA I&II, control status bids, phase next, phase on, phase check, red omit, pedestrian recycle, max I&II, max inh. There shall be no discrete circuit, components or active devices attached to any panel or cabinet wall except as specified. Printed circuit boards are not allowed on any panel.

18.5 BACK PANEL.

The back panel shall be located on the lower half of the back cabinet wall. The controller and conflict monitor harnesses shall be terminated on the upper portion and shall be secured to the top left corner of this panel with non-chafing cable clamps as described elsewhere in this standard. All wires shall be installed for the D and E connector functions listed in the appendix, between terminal positions and a receptacle on the back panel. The receptacles shall be square flange, with sockets connector, permanently mounted on the back panel, D receptacle - AMP206438-1, E receptacle - AMP2064038-1. The D connector on the harness shall be an AMP 206437-1 or an exact equivalent. An E harness connected to the Emergency Vehicle Detection System shall be provided with the EVDS equipment. The E connector on the harness shall be an AMP 206039-1 or an exact equivalent. The pins and sockets shall be gold finished. (Engineering note: EVDS equipment is specified in a separate document. All cabinets provided to DOTD shall be equipment to receive the EVDS equipment and provide the required functions as stated elsewhere in these standards.)

The wires from the controller harnesses, panel mounted receptacle, and other required devices shall be grouped by associated functions and terminated individually at a position on a terminal strip, (example - all inputs, by cycle, offset ... etc.). The terminal blocks and cabling for each harness shall be separate and have no wires crossing others from a different harness. Each

terminal position shall be permanently identified with the associated function in the connecting equipment. Wiring to this panel from other equipment specified elsewhere in this specification shall be given extra lengths to allow movement between controller terminal positions for field changes.

All harnesses shall be 5 feet long from the point that is held by the cable clamp to the connector on the free end. The connector on the free end of the harnesses shall be a designated connector by the manufacturer. Any additional connectors and harnesses necessary to implement the controller and system operations specified herein shall be supplied by the manufacture meeting this standard.

For Types 2 and 3 cabinets, the panels shall be constructed in accordance with LA DOTD drawings #18A-3. The harnesses for Types 2 and 3 cabinets shall be 3 feet long from the point that is held by the cable clamp to the connector free end.

18.5.1 Connectors.

Controller and monitor harnesses shall utilize Mil-C-26482 Series 1 and AMP CPC type series 2 connectors. The controller harness connectors shall be as described elsewhere in this standard. The monitor harness connectors shall be as follows:

TABLE 18A-11
MONITOR CONNECTORS

MONITOR Number of Channels	CONNECTOR
6	MS 3116F-22-55SY
12 Connector A	MS 3116F-22-55SZ
12 Connector B	MS 3116F-16-26S

18.5.2 Harness Wire Termination.

The monitor's signal input channels and voltage monitoring circuits shall be terminated on the appropriate terminals. The following shall be terminated at one position in all cabinets: harness wiring listed in NEMA-TS-1, Section 13 except as noted above, each input and output of the load switches, input and output of the controller, and the output of the flash transfer relays. The terminal blocks shall be either single row feed-through or double row type (electrical requirements described elsewhere in this standard). Exceptions to the requirement for single position termination for each wire are AC-, chassis ground, logic ground and flashing outputs. Listed below are the minimum terminals required for each:

a. Logic Ground - Three (3) adjacent positions
b. AC- - a separate copper or brass multi-terminal bus bar shall be mounted near the lowest portion of the panel, adjacent to and horizontally aligned with the signal field terminals. It shall be insulated from the cabinet and

connected to AC- on the power panel with a single #6 AWG insulated wire. The bus bar shall be sized to accept 5 - #14 AWG solid wires at each terminal and shall have a minimum of 12 positions. This bus shall be used to terminate all the neutral circuits from cable wired to the signal heads.

c. Flashing outputs - each circuit of the transfer relay shall have different flashing circuits.

All terminations shall be grouped by function as listed in NEMA TS-1 Standards, Section 13, Tables 13-1 and 13-2. The signal load switch inputs shall be terminated below all other controller and monitor harness termination.

Panels for cabinet Types 2 and 3 shall only have terminations of all voltage, monitoring, and coordinator circuits of the controller. The controller load switch controls shall be wired to the load switch receptacle and other requirements shown in drawings #18A-3. A single harness shall contain the circuits for A and B connectors. The connectors shall be offset along the end of the harness by 6 inches. Load switches shall be provided as follows: eight (8) switches, four phase, two (2) overlaps, two (2) pedestrians (Additional details shown on drawing #18A-3).

Panels for cabinet Type 5 shall have the phase overlap outputs "A" and "B" shall be wired respectively to load switches 5 and 6. Pedestrian outputs for phase 2 and 4 shall be wired to load switches 7 and 8 respectively.

Type 6 cabinets shall have overlap outputs "A" through "D" wired respectively to load switches 9 through 12. Wiring shall be arranged on the back panel to facilitate connecting the pedestrian outputs to the load switch inputs by moving wires, without adding wire, connectors, or terminal blocks.

(Engineering Note: The only controller outputs and load switch inputs circuits that are to be terminated on terminal strips are those circuits used for overlap and pedestrian indications. In accordance with the specification these circuits shall be provided to change the inputs of these load switches from either overlap or pedestrian outputs. In addition this will allow the reset circuit for pedestrian isolator cards to be terminated with the correct controller output. This requirement shall be for both the Type 5 and 6 cabinets. In reference to logic ground within the cabinets this notation shall apply to all circuits. All reference to logic ground shall be through connector "A" of the controller. In cases where specific controls are used in connector "D", then logic ground of this harness may be used. In all cases logic ground through any connector shall be the same reference within the controller.)

When specified on order or plans, overlaps shall be terminated at different positions than specified above.

18.5.3 Load Switches and Flash Transfer Relays.

Signal load switches shall be provided, one for each phase and each overlap. When specified, additional positions and load switches shall be provided for four pedestrian signals in

line with the load switches previously specified. All flash transfer relays shall be located on the back panel, adjacent to the load switches. A solid state flasher shall be provided and located as stated below.

The position of the load switches, flashers, and transfer relays shall be between the terminals for the load switch inputs and outputs. In Types 2 and 3 cabinets the position of the load switches, flashers, and transfer relays shall be in accordance with drawings #18A-3. The area above the load switches and flasher shall be open to allow the ventilation to flow freely away from the load switches.

The AC+ for the signal load switches shall be terminated as previously specified and be capable of carrying 60 amps, equally distributed to each signal load switch from a terminal strip on the back panel.

The transfer relays shall be operated directly by the voltage to transfer the signal operation from sequential to flashing. No intermediate relay shall be used between the transfer relays and signal operate/flash circuit. The transfer relays shall be energized during normal operation to connect the signal load switches to the field terminals.

18.5.4 Signal Field Circuits.

The output from the load switches shall be located on the lowest terminal strip at the bottom of the back panel. Wiring from the signal heads shall be terminated separately for each indication and there shall be no internal cabinet wiring terminated on the same terminal. The inputs and outputs of the flash transfer relay shall be terminated above and adjacent to the load switch outputs. The arrangement of these terminal strips shall allow the selection of either red or yellow signal indications to flash without needing to un-solder or solder connections. The number of signal circuits which will be transferred to flashing circuits shall equal the maximum number of load switch positions specified. No wiring shall be installed on the terminal for the field wiring.

18.6 POWER PANEL.

The power panel shall be mounted on the lower right inside of the cabinet. It shall receive a single phase, 120 VAC, 60 Hz electrical service and shall have three (3) separate terminals for terminating the wires from the service source. This panel shall provide the power required and necessary functions, including cabinet ground, to each panel. The service terminals shall be a mechanical compression type, sized to accept a wire range from #8 to #2 AWG, stranded wire. A ground bus bar shall be located on the lower portion of this panel and terminate all ground circuit within the cabinet. All ground circuits shall be designed for a single path to the ground bar and no ground loops shall be created. The ground bus bar shall be a separate copper or brass multi-terminal bus bar. It shall be mounted directly to the panel and connected to chassis ground input terminal with a single #6 AWG green insulated wire. The bus bar shall be sized to accept 5 - #14 AWG solid wires at each terminal and shall have a minimum of 12 positions. This bus shall be used to terminate all the ground circuits from cable wired to the

signal heads. All internal ground wiring to this bar shall be on one end using a maximum of 4 positions.

The power panel components for Types 2 and 3 cabinets shall be incorporated on the back panel. Both neutral and ground bus bars shall be located conveniently for installing field wiring. All other requirement mentioned above shall be adhered to. Switches shall be located for easy reach and away from energized parts. (Details shown on drawing #18A-3)

18.6.1 Control Switches.

The following switches shall be located on the power panel and shall perform the functions listed below and labeled as shown:

a. Cabinet light - ON/OFF - this switch shall control the AC+ to the cabinet light specified elsewhere in this standard. For Types 2, 3, and 4 cabinets the switch shall be part of the fixture.
b. Test - FLASH/AUTO - The "flash position" of this switch shall allow the signal indications to flash and the control equipment to cycle in its normal manner. The "auto" position will not affect the normal operation of the equipment.

18.6.2 Breakers.

Breakers shall be provided in each type of cabinet. The AC+ power shall have one input and shall be bussed to three (3) separate circuits. The breakers shall be a single pole, molded case, screw mounted on this panel with two (2) #10 screws on a 4-1/2-inch pattern. Each breaker shall indicate visually that the breaker has been tripped. The following are the functions and labels for each breaker:

a. Controller power - ON/OFF - this shall be rated for ten amps and control the AC+ power to the controller and conflict monitor. (filtered and suppressed)
b. Main Power - ON/OFF - this shall be rated for 60 amps and control the AC+ power into the cabinet for all equipment. The power for the auxiliary circuits shall not be controlled by this switch.
c. Detector Panel Power - ON/OFF - this shall be rated for 10 amps and control the AC+ power to the detector panel used for interconnect relay outputs. This circuit shall not be used for detector card rack and shall not be connected to the suppressor on the power panel.
d. Auxiliary Power - ON/OFF - this shall be rated for 20 amps and control the AC+ power to the ventilation fan, cabinet light, and convenience outlet. (filtered)

18.6.3 Surge Protection and Filtration.

The power for the control equipment shall be protected by a RFI line filter and high voltage surge arresters. The line filter shall be rated at 60 amps on each AC+ and AC- line. Terminals on the filter shall be for suppression on the main power, neutral, and ground; and separate terminals for line in and out, neutral out supplying the controller and detector panel power to the breakers. The filter shall attenuate signals both from line to load and load to line. The attenuation in both directions shall be a minimum of 50 decibels over the frequency range of 200 KHz to 75 MHz. The impulse life of the protector shall be capable of operating 20 times at peak current. The clamp voltage shall be 340 volts at 20K amps and shall respond to over voltage conditions within 300 nanoseconds. The minimal capability of the protector shall be to discharge a single impulse with a wave shape of 8/20 and current to be 20K amps on each side to ground. The insulation resistance between line to ground shall be 100 mega-ohms.

18.6.4 Signal Bus Operation.

The signal bus power shall be switched individually by normally opened solid state relays rated a minimum of 60 amps, control voltage 120 VAC (Crydon series 1 - A2475 or equal). The solid state relay shall operate within the NEMA temperature range by de-rating the device and using necessary heat sinks. All switches are specified elsewhere and the circuit design shall limit the switched current to 10 amps max.

18.6.5 Convenience Outlet.

The receptacle shall be a feed through, ground fault interrupter type, 20 amps, duplex receptacle. The receptacle shall have three (3) wires from the device to the appropriate terminal on the power panel, (Ground, AC-, and AC+). The feed through shall supply power to the fan and light.

The convenience outlet installed in Types 2 and 3 cabinets shall be mounted on the door. The electrical details shall meet the following requirements and details in drawing 18A-3. The convenience outlet in Type 5 and above cabinets shall be mounted on the power panel.

18.6.6 Power Panel Isolation.

A clear, non-breakable, 1/4-inch Lexan insulating cover shall be used to shield all open connections and not cover any switch, breaker levers, terminals blocks, bus bars, or convenience outlet. The cover shall be secured in place with screw fasteners and be removable by hand or simple hand tools.

18.7 DETECTOR AND AUXILIARY CONTROL PANELS.

A detector panel shall be provided in cabinet Types 3, 5, 6, and 7, and located on the left inside wall of the cabinet, except as noted for Type 3 cabinets in Section 18.7.2. The terminals and wires for detector card inputs, controller vehicle detector input test switches, remote communications, and additional functional inputs/outputs specified shall be on this panel. The

upper portion of this panel shall be used for mounting any required terminal blocks. The middle of the panel shall be for vehicle/pedestrian test button and control circuit and field wiring terminals. A six (6) position terminal block with suppressor shall be positioned on the bottom of the panel for communications. There shall be no splices in the wiring.

A separate panel shall be provided for the auxiliary controls including relay bases for interconnection controls, isolating the field circuits and the controller inputs.

18.7.1 Auxiliary Control Function (supplied with all Type 2 cabinets and when specified with any other cabinet).

This panel shall be located on the left lower inside wall of all cabinets, below the detector panel when present, and shall be separate from other panels. Relay bases shall be mounted at the top of this panel and the quantity of bases shall be supplied that will provide the functions required or as indicated on the order. The relays bases shall be wired isolating the field wiring and the controller inputs/outputs for hardwired interconnect. Field wiring will be terminated at fuse blocks, specified elsewhere in this standard. Additional wiring requirements are given below. The relay bases shall be for two-pole octal relays and have screw terminals for all relay pins. The required functions for hardwired interconnect are; resets, cycles, splits, free, flash, and remote common. Wiring from the interconnect terminations described above shall not be included with any wiring or harnesses on the detector panel.

A terminal block shall be provided below the relay bases where the following are to be terminated. Power for this panel shall be supplied by a separate breaker on the power panel. A minimum of three adjacent positions shall be provided for each AC+, AC-, and ground. This power shall be used for supplying master interconnect power and providing power to external equipment. This power shall not be used for equipment power within the cabinet. Logic common from the controller shall also be terminated on a terminal strip. Controller system operations for dials 2, 3, and 4, split 2, 3, and 4, and offset 1, 2, 3, and 4, shall be terminated on the back panel as stated within this standard. Each system operation terminal shall be wired to the front side of the terminal blocks on the back panel and terminated using a compression spade lug to the inputs of the controller. Each wire shall be identified with a sleeve marked, D-2, D-3, D-4, SP-2, SP-3, SP-4, O-1, O-2, O-3, and O-4 respectively. Two terminal positions shall be provided for free in and out, and two positions for flash in and out. Wiring shall be provided for each, one for free and one for flash, from these terminals to the terminals on the front of back panel, terminated using compression spade lugs. Each identified with a sleeve, free marked FR and flash marked FL. This panel shall conform to drawing 18A-3 of this standard.

(Engineering Note: For railroad preemption inputs, we intended to use the pedestrian isolator cards between field and controller inputs. For hardwired interconnect controls, we will move the wiring on the back panel for master or secondary operation. Similar methods of moving wires will be used to implement other required functions as needed.)

18.7.2 Detector Panel for Types 3 and 5 Cabinets.

The detector panel shall be located on the inside right wall of Type 3 cabinets and the left wall of Type 5 cabinets. The panel shall have terminal positions for the specified field input circuits. The wiring requirements stated above shall be followed. Terminals shall be provided for eight (8) vehicle and four (4) pedestrian detector input circuits.

The card rack shall follow the specified requirements elsewhere stated, however positions shall be provided for one power supply, two-four channel vehicle detector cards, and two pedestrian isolator cards. The wiring for the rack shall be formed to follow the hinge of the door without damage to the wiring.

18.7.3 Detector Panel Test Switches.

Detector test switches shall be provided on all detector panels. These switches shall be positioned in between the terminal blocks for the field wiring and adjacent to the input of the channel that the switch is for. Access to the switches shall not be interfered with wires or suppressor. Each switch shall be a momentary push button, normally open switch. There shall be a switch for each detector channel supplied in the cabinet and for each pedestrian call circuit (2 for 4-phase, and 4 for 8-phase), as per this specification, order, plans, or any addendum. Each switch shall be permanently labeled with the nomenclature of the function it provides (Ø # or Ø ##). The function of the switches shall be to place a logic ground on the controller vehicle, pedestrian, and system detector inputs. The wiring shall be terminated on the front of the back panel at the associated controller input terminal. A compression type spade lug shall be use and each wire marked with a identification sleeve as follows: VB-Ø1, VB-Ø2, VB-Ø8, PB-Ø2, PB-Ø4, etc.

18.7.4 Field Wiring - Detector and Auxiliary Panels.

The loop lead-in, pedestrian field push button shall be terminated on the sides of the detector panel, the communications shall be terminated on the bottom of the detector panel, and the interconnect and field inputs/outputs shall be terminated on the bottom of the auxiliary panel. Each channel, vehicle and pedestrian, shall be terminated at two adjacent positions for inputs. On the auxiliary panel six NON type fuse holders and one remote common terminal shall be positioned on the bottom of the panel for hardwired interconnect.

The specified lightning protection shall be connected to the designated field terminals.

18.7.5 Communication Harnesses.

All additional harnesses required for connecting the modem, line drivers, controller, master, and system hardware in addition to the specified connectors shall be provided and terminated in a fashion required by the manufacturer. Additional harnesses shall not negate any harness specific by this standard. Approval of these harnesses shall be obtained from the Department.

18.7.6 Lightning Protection.

All detector and data field wiring shall be terminated on the required terminal block. Minimum voltage clamping shall be 30 volts for both differential and common mode. Current carrying capabilities shall be 400 amps in differential mode and 1000 amps in common mode. Response time for detector protection shall be 40ns and for data lines shall be 1 to 5 ns. The devices shall be mounted to the panel and the leads terminated on each field terminal.

All 120 volt field circuits shall be protected on the equipment side of the fuse by a surge protector. Operating line voltage shall be 120VAC, peak surge trip point for 600 volts/microsecond impulse shall be less than 890 volts. Response time shall be less the 200 nanosecond at 10KV/microsecond. Surge handling ability shall be 20K amps. The device shall be mounted on the grounding stud adjacent to the protected terminal.

18.8 POLICE PANEL.

The police panel shall be located in the police compartment previously specified and provide switches which are accessible when the police compartment door is opened. The following list of switches shall be located on this panel and be wired to their appropriate circuits to provide the functions identified below:

a. Flash Control Switch - Flash/Normal - this switch shall control the signal output from the controller to cause them to flash in the "Flash" position and to initialize the controller to the start-up phase unless the conflict monitor has detected a conflict. If the monitor has placed the equipment on flash, then this switch shall be inactive. The "Normal" position of the switch shall cause no effect to the signal circuits and shall allow the control equipment to function in its prescribed manner.

b. Signal Shut-Down - On/Off - the "On" position of this switch shall allow the signals to operate in normal manner. The "Off" position of the switch shall cause the signal indications to become dark, regardless of whether the signals were flashing or operating normally and to initialize the controller to the start up phase unless the conflict monitor has detected a conflict.

c. Manual Control - Auto/Manual - All necessary wiring, (manual control enable, interval advance, logic ground) shall be routed to the panel and terminated. A switch shall be provided only when specified and switch the function of the controller from normal operation in the "Auto" position to a manual advance operation in the "Manual" position by a manual push button to advance the controller in accordance with the NEMA standards. In addition to the switch, a manual control shall be provided. The cord shall be terminated on a terminal strip attached to the back of the police panel. The cord shall be weatherproof and coiled, having a maximum retracted length of eight inches and a minimum extended length of five feet. The cord shall be attached to the panel with a cable clamp, and fitted with strain relief bushing at the point it is routed through a five-eighths

inch hole in the panel. The manual control shall be on the free end of the cord. The manual control and the connection to the cord shall be weatherproof. A hand grip shall be constructed for normal use by being held in one hand and a momentary contact switch can be activated with the thumb. This control shall be operable between the above mentioned lengths.

d. Emergency Vehicle Detection System Enable - On/Off - All necessary wiring shall be routed to the panel and terminated. A switch shall be provided to activate the EVDS when it is in the on position and the EVDS equipment is installed in the cabinet. In the off position the EVDS equipment shall be disabled and, all functions connected to the Traffic Control System Equipment shall be disabled allowing the control equipment to operate as programmed. When the EVDS equipment is not installed in the cabinet then this switch shall not effect the operation of the Traffic Control System Equipment.

The back of the panel shall have an aluminum shield to prevent personnel from accidentally coming in contact with the terminals of the switches or terminal strip. With the cover in place, it shall provide visual inspection of the back of the panel and shall not interfere with any equipment when the main door is closed.

19.0 CABINET WIRES AND WIRING.

The wiring in the cabinet shall withstand the environmental temperature range as stated in NEMA TS-1. The insulation shall remain flexible over the temperature range and will not begin melting, causing the insulation to reduce in thickness. The insulation shall meet Specification MIL-W-16878D, 105 degrees, 600V, (MIL), heat resistant, polyvinylchloride or approved equal. The wire shall be 600 volts and color coded according to the following list:

TABLE 18A-12
WIRING COLOR CODE

HARNESS	COLOR
Controller harness and wiring	Blue
Conflict monitor Harness and wiring	Red
Detector, preemptor, and interconnect wiring	Yellow
All AC+	Black
All AC-	White
All Controller Logic Ground	White/Black Stripe or White/Green Stripe
All Chassis Ground	Green

The wire shall be stranded copper and sized to carry 125% of the design current and a minimum #22AWG. All signal circuit wiring shall meet the above stated size and be a minimum of #16AWG. All circuits shall be wired using a single conductor; therefore, parallel wiring is not an acceptable method of meeting wire size requirements as stated above. The wires shall be terminated individually by a solder less compression type spade lug appropriately sized or by soldering. All wiring shall be installed having a zero tension after installation.

Wire bundles shall be held in cable form by lacing tape, spiral wrap, or plastic sheathing. The lacing tape shall be flat, braided nylon and 0.090 inch wide, equal to ICO-Rally type LTN-2. The spiral wrap shall be correctly sized to fit the wire bundle and be a weather-resistant polyethylene equal to Panduit spiral wrapping. The insulating tubing shall be clear colored and sized to fit the wire bundle, equal to Alpha PVC-105 plastic tubing. Cable ties are restricted from use on cable bundles between panels and equipment harnesses. Cable ties may be used to bundle wire on panels only. Cable ties shall be self-locking and have properly applied tension according to the manufacturer's specifications. The ties shall be weather resistant nylon equal to T & B ties (MX series).

20.0 CABINET MECHANICAL AND ELECTRICAL HARDWARE.

All hardware shall meet the environmental requirements of the controller. All fastening devices, (bolts, washers, screws, etc.), shall not rust when exposed to weather. These shall be hot dipped galvanized, stainless steel or brass. All electrical hardware shall be sealed and electrical contacts protected against moisture and corrosion.

20.1 TERMINAL BLOCKS.

Terminal blocks shall be multiple terminal, one piece, rated at a minimum of 300 VDC for all 24 VDC control circuit terminations and a minimum of 600 VDC for all 120 VAC circuits. All field terminal blocks shall be multiple terminal, one piece, rated a 600 VDC and 20 amps. Exceptions to the above requirement for 600 VDC terminal blocks used with the 120 VAC terminations are the 120 VAC terminations of the controller, monitor, and detectors, which are permitted to be terminated on a 300 VDC terminal block. Another exception is where intermixing terminal blocks would result from the above requirement then the block to be used shall be determined by the voltage of the largest number of terminations on that block. The minimum current rating of all terminal blocks shall be 15 amps unless otherwise specified. The minimum amperage for the 120 VAC termination on the power panel shall be 60 amps. Any contradiction between circuit description and hardware restriction shall be resolved by using the larger requirement specified.

In addition to the above requirements for voltage terminations a minimum size screw shall be used. The terminal blocks shall have a minimum screw of #6 for low voltage circuits for the electronic equipment and #8 for all field termination. The power terminal shall be a barrel type screw tightened lug.

20.2 WIRING TERMINALS.

All compression terminals shall be constructed with a base material of fine grade high conductive copper per QQ-C-576 and tin plated per MIL-T-10727 plating process for durable corrosion resistance against salt spray and most chemical fumes. The insulation shall be made of vinyl. The terminal shall be installed with tooling recommended by the manufacturer to meet the performance requirements of MIL-T-7928. The use of ring or spade terminals is not being precluded by the above requirement. Each terminal shall be correctly sized to fit the wire and terminal screw.

All soldered connections shall be made using the designed temperature for the solder being used and the location of the connection. The connection shall be made preventing a cold solder joint and excessive winking of the solder into the wire. The insulation of the wire shall not be damaged by excessive overheating at any point on the wire.

20.3 MULTIPLE PIN CONNECTORS.

All multiple pin connectors shall be wired in accordance with the connector manufacturer's recommendations or applicable MIL specifications. The type of connector shall be in accordance with this standard, NEMA TS-2 TYPE 2, and as listed below.

Unused sockets and pins shall not be installed in the D connector. A cable clamp designed for each connector shall be installed securely to prevent excessive strain on the wires from being transmitted to the contacts inside the connector housing.

20.4 SWITCHES.

All switches, except the detector push button test switches, shall be heavy duty toggle switches and meet the MIL-MS-35059 Series Standards, rated at 20 Amps/125 VAC. The level shall have a seal for sand, dust, and 15-foot water submersion. The terminals shall be threaded for screws and have a tinned finish. Mounting shall be by two (2) hex nuts and two (2) internal-tooth, lock washers on a 1/2-inch shank through which the toggle lever is mounted. The number of poles and lever positions shall be determined by the applications previously stated.

20.5 LOAD SWITCH AND RELAY BASES.

The load switch and the flash transfer relay sockets shall be rigidly mounted on the back panel. The insulating ridge on the front of the socket shall be reinforced with a metal mounting ring designed by the manufacturer of the socket. This ring shall be secured to the socket with a minimum of two (2) screws and the ring fastened to the panel. Both sockets shall a minimum current rating of 15 amps, individual contacts, voltage rating of 1750 volts rms, pre-grounded, or grounding pin connected to chassis ground.

All relay bases used for special circuits specified previously, and not otherwise specified, shall be rated a 300 VDC and 10 Amps. Bases shall be front-panel mounted and shall have a closed back for insulation from the panel. The socket shall be octal and wired to barrier type

terminals permanently numbered. Terminal screws shall be tinplated, #6-32 with captive nuts, and shall accept #20 to #12 AWG wire.

20.6 CABLE CLAMPS.

All cable clamps shall have a metal loop and cushion made with a general purpose neoprene. The metal shall be aluminum 20204-T4 or stainless steel per Specification MIL-S-6721, annealed (321 or 347). The neoprene shall meet AMS Specification 3209. The clamp shall be sized to grip the cable it is being used on without damaging any insulation.

20.7 FUSES AND HOLDERS.

All fuses located on the all removable electronic equipment shall be a 1/4 inch by 1-1/4 inch glass tube fuse rated at a minimum of 125 VAC. All panel mounted fuses shall be U.L. Class "H" fuses rated at 250 VAC, fast acting. Fuses shall be provided and equal to Type NON 0-30 Amps.

The fuse holder shall be constructed of a general purpose phenolic material U.L. listed for 250 VAC. The fuse holders shall have barriers on each side of the fuse and shall have a screw type terminal.

20.8 RELAY AND MOTOR SUPPRESSOR.

A suppressor shall be installed on all AC relay coils and motor inputs. The suppressor shall be a series resistor-capacitor, 100 ohms-0.1 microfarad, and rated for 600 volts.

20.9 IDENTIFICATION SLEEVES.

Identification sleeves shall be supplied on specified wires. The sleeve shall have the required identification printed or typed with a minimum size of pica-pitch 10. The sleeve shall be installed on the sire providing a self-laminating protective shield over the legend. Acceptable material shall be transparent, 3.5 mil, vinyl film with acrylic pressure sensitive adhesive. The operating temperature range shall be -40° C to 80° C. The size of the label shall provide sufficient area for the printed identification.

Application of the sleeve onto the wire shall be neat and smooth completely protecting the identification label.

21.0 TESTING.

A test(s) shall be performed on the cabinet containing the completely assembled equipment and control equipment by the manufacturer prior to shipment. Malfunctions or defects shall be corrected and the equipment retested. The complete log beginning with the first test, showing the results of the all tests, shall be delivered with the equipment. The manufacturer shall furnish certification with the documentation required in Section 24, stating that the results of the test are true and accurate and stating the name and title of the person conducting the test.

The test shall require the operation of the equipment with each signal circuit connected to an incandescent load of at least 600 watts. The equipment shall operate sequentially and continuously for at least 48 hours, as stated above, in an environment having a minimum temperature of 140°F.

The complete system, including all local controllers, cabinets, on-street master controller, and modems shall be assembled and interconnected at the point of manufacture.

The system shall be completely performance tested and a written test report submitted in the documentation required in Section 24. The Engineer reserves the right to an on-site system inspection at the point of manufacture to witness the system operation and the performance test of the system.

After installation and debugging of all central control equipment, local controllers, detectors, communications, and other system hardware and software elements, the system shall be required to complete a 30 day period of acceptable operation. The system test shall fully and successfully demonstrate all system functions using live detector data and controlling all system-controlled intersections.

22.0 TRAINING.

Formal classroom training and "hands-on" operations training shall be provided for personnel designated by this agency. The engineering, operations and maintenance training shall take place at locations within the state of Louisiana designated by this agency. The technician training shall take place at the manufacturer's facility. Classroom training shall be given for the engineering, operations and maintenance sessions.

Five (5) training sessions are required during the contract period. Three (3) maintenance sessions, one (1) engineering session and one (1) technician session shall be given. The engineering session shall provide for a maximum of twenty-five (25) people. Each maintenance session shall provide for a maximum of fifteen (15) people. The technician session shall provide for a maximum of four (4) people. Copies of course materials shall be supplied to and retained by each attendant. Training shall occur after delivery of initial order, but before one year after date of final acceptance of initial order. The manufacturer shall submit for each type of session, syllabuses to the Traffic Signal Engineer for approval before classes are scheduled.

22.1 OPERATIONAL TRAINING.

Training for the operation of the system shall include analyzing system performance and revision of system operating parameters based on the analysis. The session shall be a minimum of two (2) days and presented at an engineering level.

The training topics shall include as a minimum:

a. How to enter commands (System software, utilities, and disk management)

b. Operation of all devices
c. Generation and editing of arterial master and intersection controller databases
d. Uploading/downloading of arterial master and intersection controller databases
e. Procedure for enabling dynamic displays
f. Explanation of the communication system

22.2 MAINTENANCE TRAINING.

Training for maintenance personnel shall include detailed, field level troubleshooting and basic interrogation of the controller unit. The training shall consist of three (3) sessions. Two (2) sessions shall be remedial and one (1) session shall cover more advanced material. Each session shall be three (3) days in length. Course content shall emphasize information required to successfully pass the below specified tests.

Maintenance personnel shall be tested by the vendor as to their ability to repair and/or diagnose simulated failures, and to gather basic information about a particular controller unit (i.e., min time, conflicting and non-conflicting phases, etc.). There shall be at least ten (10) controller/cabinet configurations per session type. Cabinets, controllers and miscellaneous materials shall be supplied by the Department. Wiring and programming necessary to conduct the tests shall be performed by the vendor. The vendor shall recommend at least ten (10) simulated failures, timing schemes and other configurations to be used for each type of test. The Department shall supply the vendor with the final, approved test configurations, however, the vendor shall not be required to perform more than six (6) hours of wiring or programming in development of the test configurations.

Final test questions shall be supplied by the Department. A Department representative will be present at all time to assist the vendor in administering the test.

22.3 TECHNICIAN TRAINING.

The manufacturer shall provide a minimum of two (2), four-day sessions at their facility for a maximum of three (3) Department employees per session. The manufacturer shall be responsible for all costs associated with such training except for the cost of travel.

Training sessions shall be highly technical and include as a minimum the following topics:

a. Architecture of controller unit.
b. Controller troubleshooting to component level.
c. Cabinet wiring and troubleshooting
d. Advanced controller programming including diamond sequencing.

22.4 ENGINEERING TRAINING.

Training for engineering personnel shall focus on implementing traffic engineering data with the controller. The manufacturer shall provide one (1) two-day session for a maximum of twenty –five (25) participants.

The first day of the session shall emphasize basic operation and interrogation of the controller. The second day of the session shall emphasize implementing traffic engineering data and include, at a minimum the following:

a. Programming an actuated, coordinated controller based on intersections provided by the Department.
b. Theory and operation of volume density operation and associated programming methods.
c. Theory and operation of three- and four-phase diamond sequencing and associated programming methods.

23.0 WARRANTY.

The system equipment shall be warranted for a minimum of one year. All warranty periods shall begin at the date of acceptance by the Department.

24.0 DOCUMENTATION.

Detailed technical information on material being offered shall be supplied with the bids for equipment directly shipped to the Department and with the material submittal for equipment being installed on projects. Information shall be for all items required by this specification and on the order or in the plans.

Manuals shall be supplied for all equipment and components of the system. The manuals supplied for software, peripherals, and modems shall be from the original source. The manual shall be comprehensive, easy to use and understand, and completely descriptive of the product.

24.1 CLOSED LOOP SYSTEM OPERATION MANUAL.

a. Step-by-step system installation procedures
b. Operating instructions
c. System set-up procedures
d. Explanations and descriptions of data entry procedures
e. Menu item descriptions

24.2 EQUIPMENT MANUALS.

a. Technical descriptions
b. Operating instructions
c. Theory of operation

d. Detailed schematic diagrams
e. Assembly drawings
f. Wiring diagram
g. Troubleshooting procedures to assist the maintenance staff in the identification and isolation of malfunctions
h. Parts list

24.3 CABINET WIRING.

Complete wiring details shall be shown on the drawings. The drawings shall use the same nomenclature to identify the various components as referred to in this standard. If no name was mentioned in this standard then a reasonable nomenclature shall be used. A legend shall be provided on all drawings identifying acronyms and symbols. Two (2) drawings shall be provided with each cabinet. The DOTD specification shall be followed when supplying documentation for projects.

APPENDIX

PIN/SOCKET ASSIGNMENTS FOR D CONNECTOR ON BACK PANEL

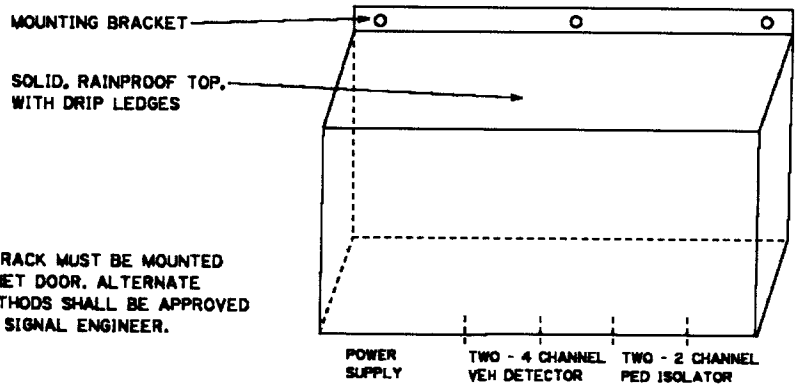
PIN	FUNCTION
1	OFFSET 1 IN
2	CYCLE 2 IN
3	CYCLE 3 IN
4	FLASH IN
5	OFFSET 2 IN
6	OFFSET 3 IN
7	INTERCONNECT FREE
8	SPLIT 2 IN
9	SPLIT 3 IN
10	SPL FUNCTION 2 OUT (TBC)
11	COMPUTER ON-LINE
12	THREE PHASE DIAMOND SELECT
13	FOUR PHASE DIAMOND SELECT
14	RESERVED
15	RESERVED
16	EXT RESYNC INPUT
17	MASTER SELECT
18	SYNC INPUT
19	PREEMPT 1 IN
20	PREEMPT 2 IN
21	PREEMPT 3 IN
22	PREEMPT 4 IN
23	PREEMPT 5 IN
24	PREEMPT INTERLOCK
25	SYSTEM DET. 1/DETECTOR 45P INPUT
26	SYSTEM DET. 2/DETECTOR 25S INPUT
27	SYSTEM DET. 3/DETECTOR 18P INPUT
28	SYSTEM DET. 4/DETECTOR 16S INPUT
29	SYSTEM DET. 5/DET. #2b-1P INPUT
30	SYSTEM DET. 6/DET. #2a INPUT
31	SYSTEM DET. 7/DET. #1b-5P INPUT
32	SYSTEM DET. 8/DET. #1a INPUT
33-34	SPARE
35	CONTROLLER INTERLOCK DIAMOND
36	COMP. SEL 1
37	COMP. SEL 2
38	COMP. SEL 3
39-41	SPARE (DO NOT USE)
42	CABINET INTERLOCK DIAMOND
43	SPL FUNCTION 1 OUT (TBC)
44	SPLIT 3 OUT
45	SPLIT 2 OUT
46	INTERCONNECT FREE OUT
47	OFFSET 3 OUT
48	OFFSET 2 OUT
49	FLASH OUT
50	CYCLE 3 OUT
51	CYCLE 2 OUT
52	OFFSET 1 OUT
53	+24 VDC
54	LOGIC GROUND
55	CHASSIS GND
56	RESERVED
57	RESERVED

PIN/SOCKET ASSIGNMENTS FOR E CONNECTOR ON BACK PANEL

PIN	FUNCTION
1	AC +
2	AC-
3	CHASSIS GROUND
9	PREEMPT 1
10	PREEMPT 2
11	PREEMPT 3
12	PREEMPT 4
13	PREEMPT 5
15	LOGIC GROUND

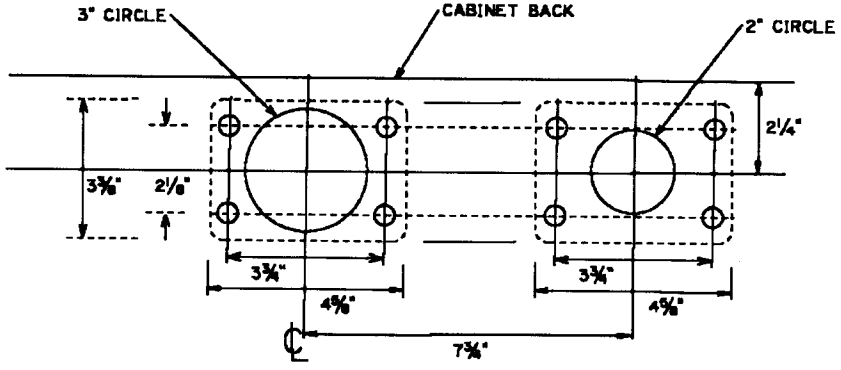
DETECTOR CARD RACK MOUNTING SCHEME

TYPE 3 CABINET ONLY

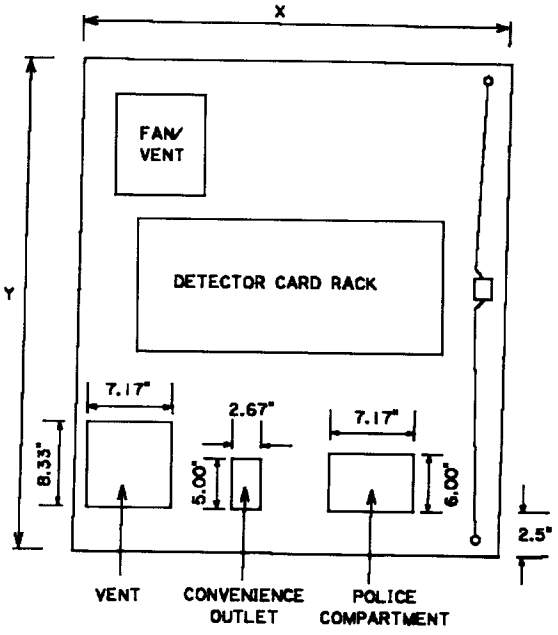


NOTE: CARD RACK MUST BE MOUNTED ON THE CABINET DOOR. ALTERNATE MOUNTING METHODS SHALL BE APPROVED BY THE DOTD SIGNAL ENGINEER.

TYPE 2 & 3 CABINET BOTTOM - PLAIN VIEW



PANEL DETAIL (TYPE 3 CABINET DOOR)



NOTES: DIMENSIONS DEFINE MAXIMUM AREA THAT SHALL BE USED BY ALL COMPONENTS AND MOUNTING HARDWARE FOR THAT DEVICE OR COMPARTMENT.

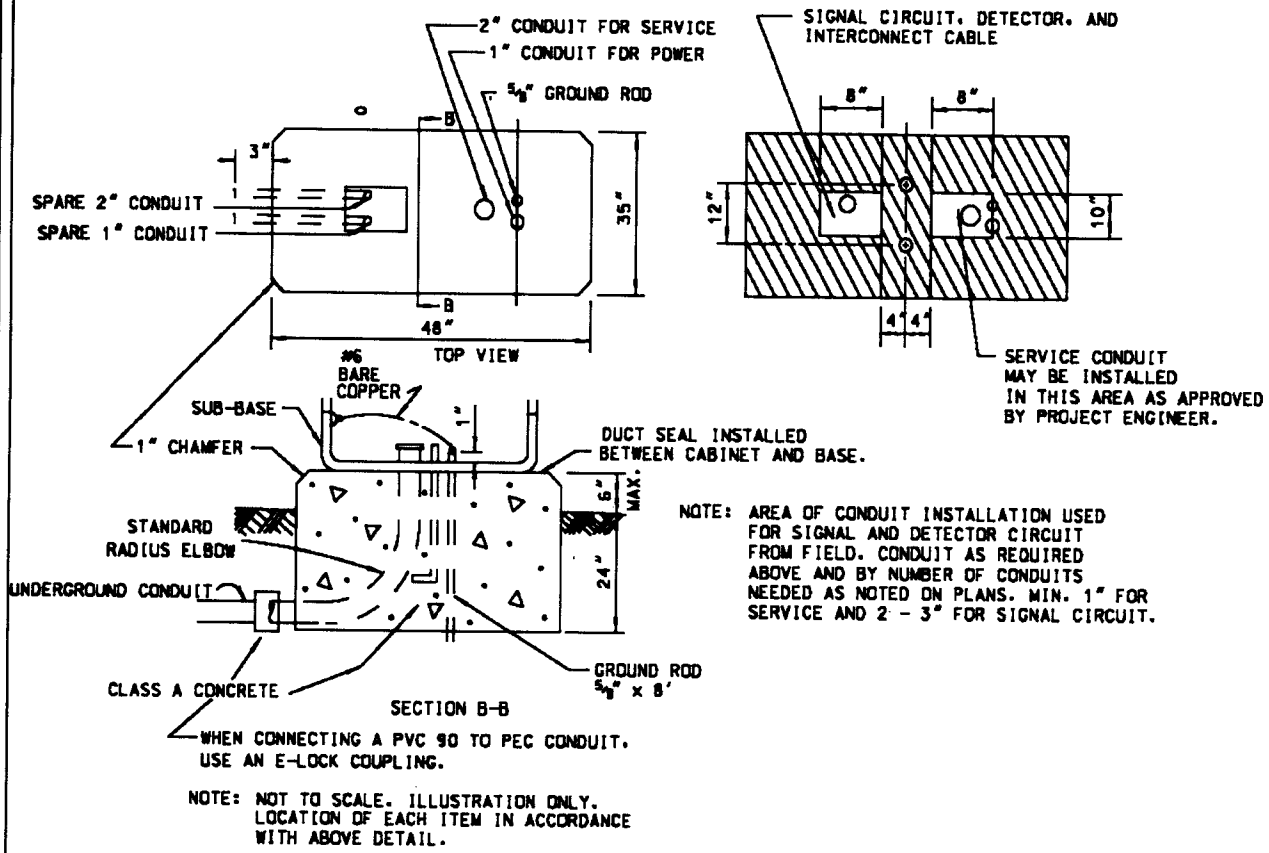
VENT, CONVENIENCE OUTLET, POLICE COMPARTMENT AND LOCK ARM SHALL BE EVENLY SPACED ACROSS THE WIDTH OF CABINET DOOR.

FOR X AND Y DIMENSIONS, SEE TCS 18A.

LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
TRAFFIC CONTROL STANDARD NO. 18-A
CABINET DOOR MOUNTING SCHEME
REVISION DATE: 01/12/2008 FIGURE NO. 18A-1

CONTROLLER FOUNDATION

NOTE: FOR TYPE 5, 6, AND 7 CABINETS
D.O.T.D. - T.C.S. #18



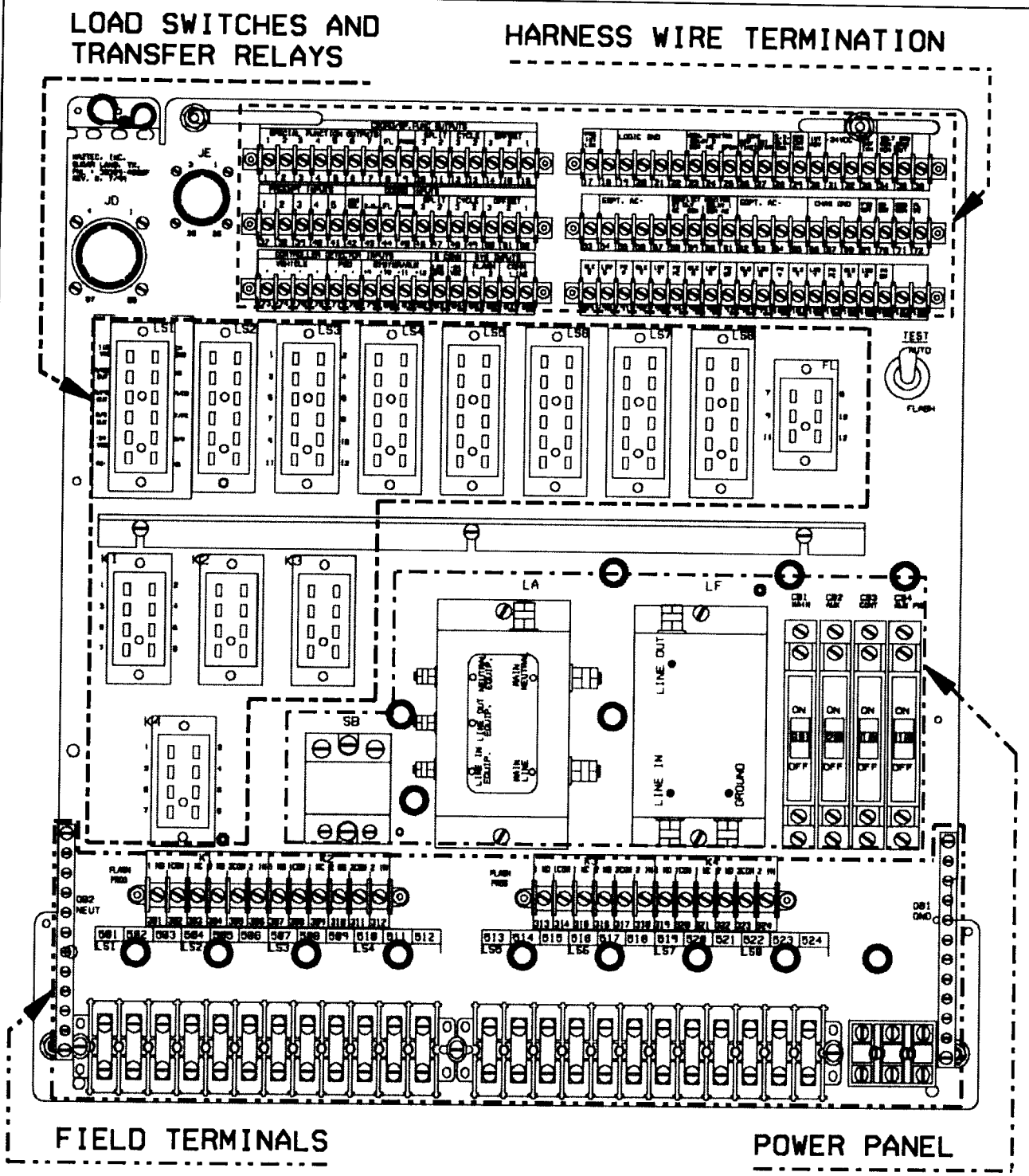
NOTE: AREA OF CONDUIT INSTALLATION USED FOR SIGNAL AND DETECTOR CIRCUIT FROM FIELD. CONDUIT AS REQUIRED ABOVE AND BY NUMBER OF CONDUITS NEEDED AS NOTED ON PLANS. MIN. 1" FOR SERVICE AND 2 - 3" FOR SIGNAL CIRCUIT.

NOTE: NOT TO SCALE. ILLUSTRATION ONLY. LOCATION OF EACH ITEM IN ACCORDANCE WITH ABOVE DETAIL.

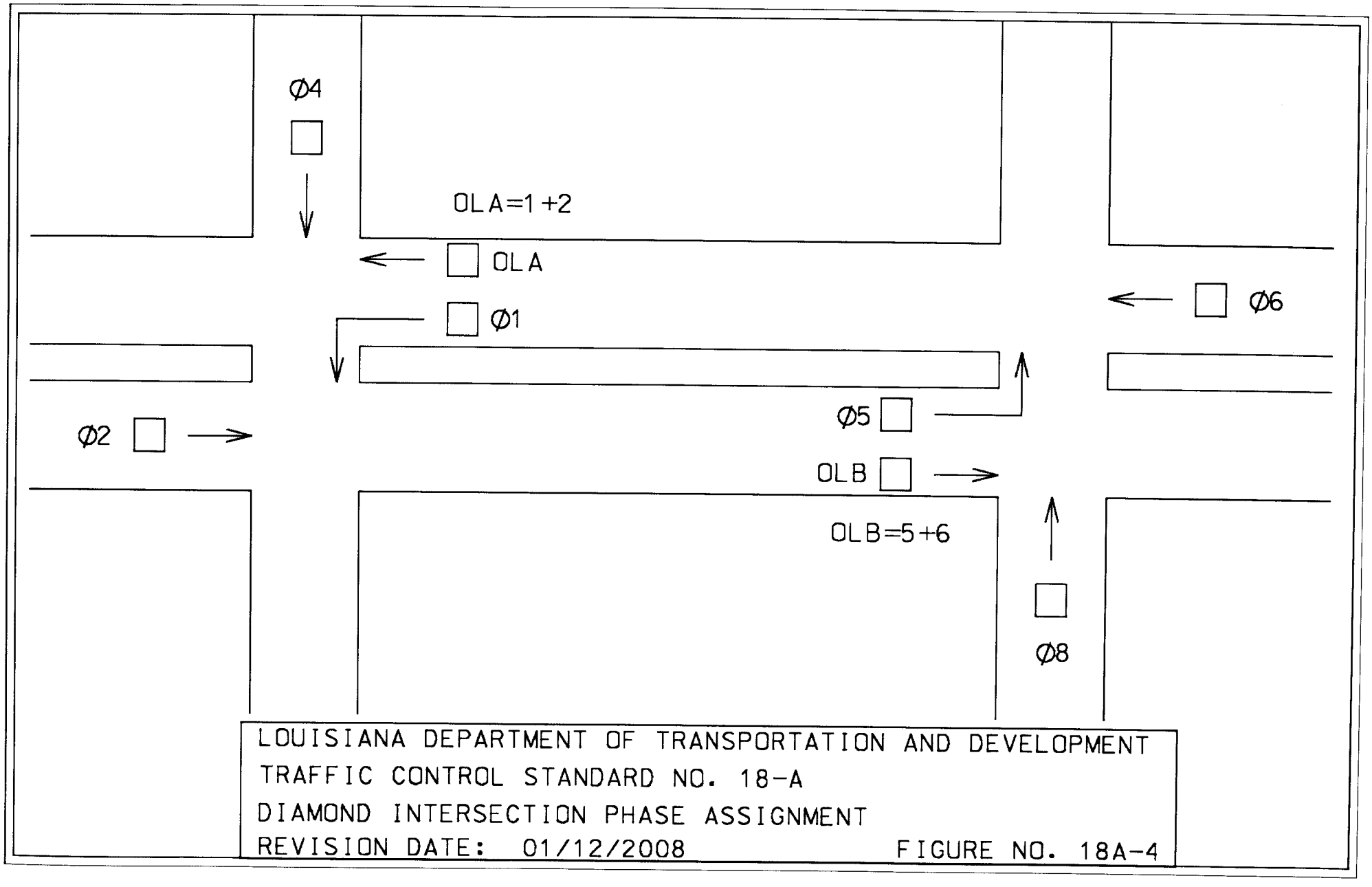
NOTES:

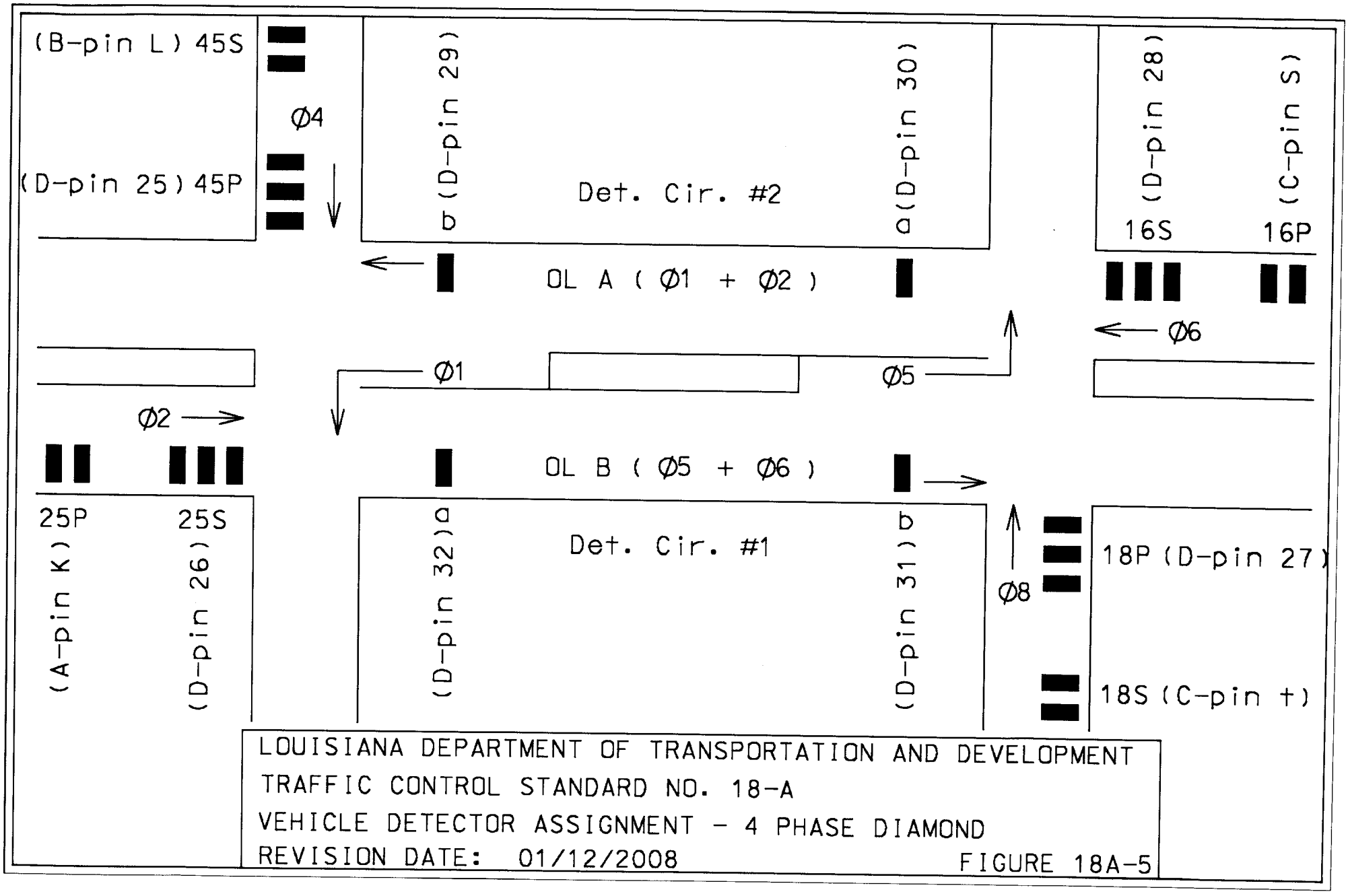
1. ALL GROUND MOUNTED CONTROLLERS TO HAVE SPARE 2" CONDUIT STUBBED OUT 24" BELOW GRADE & 24" OUT FROM BACK OF CABINET IN ADDITION TO OTHER REQUIRED, CONDUITS. SPARE CONDUIT SHALL BE CAPPED.
2. ALL EXPOSED CONCRETE EDGES SHALL HAVE A 1" CHAMFER.
3. ALL CONDUIT, GROUND ROD AND ANCHOR BOLTS SHALL BE INSTALLED WITH 1" ± 1/2" EXPOSED ABOVE BASE.
4. CONTROLLER FOUNDATION SHALL BE MARKED TO SHOW THE LOCATION AND DIRECTION OF ALL SPARE CONDUIT.
5. FOUNDATION SHALL BE ORIENTATED AS SHOWN ON THE PLANS. TYPICALLY, DOOR SIDE SHALL BE AWAY FROM TRAFFIC.
6. #6 AWG BARE COPPER WIRE ON GROUND ROD, ONE SIDE TO BE CONNECTED TO GROUND LUG ON PANEL.

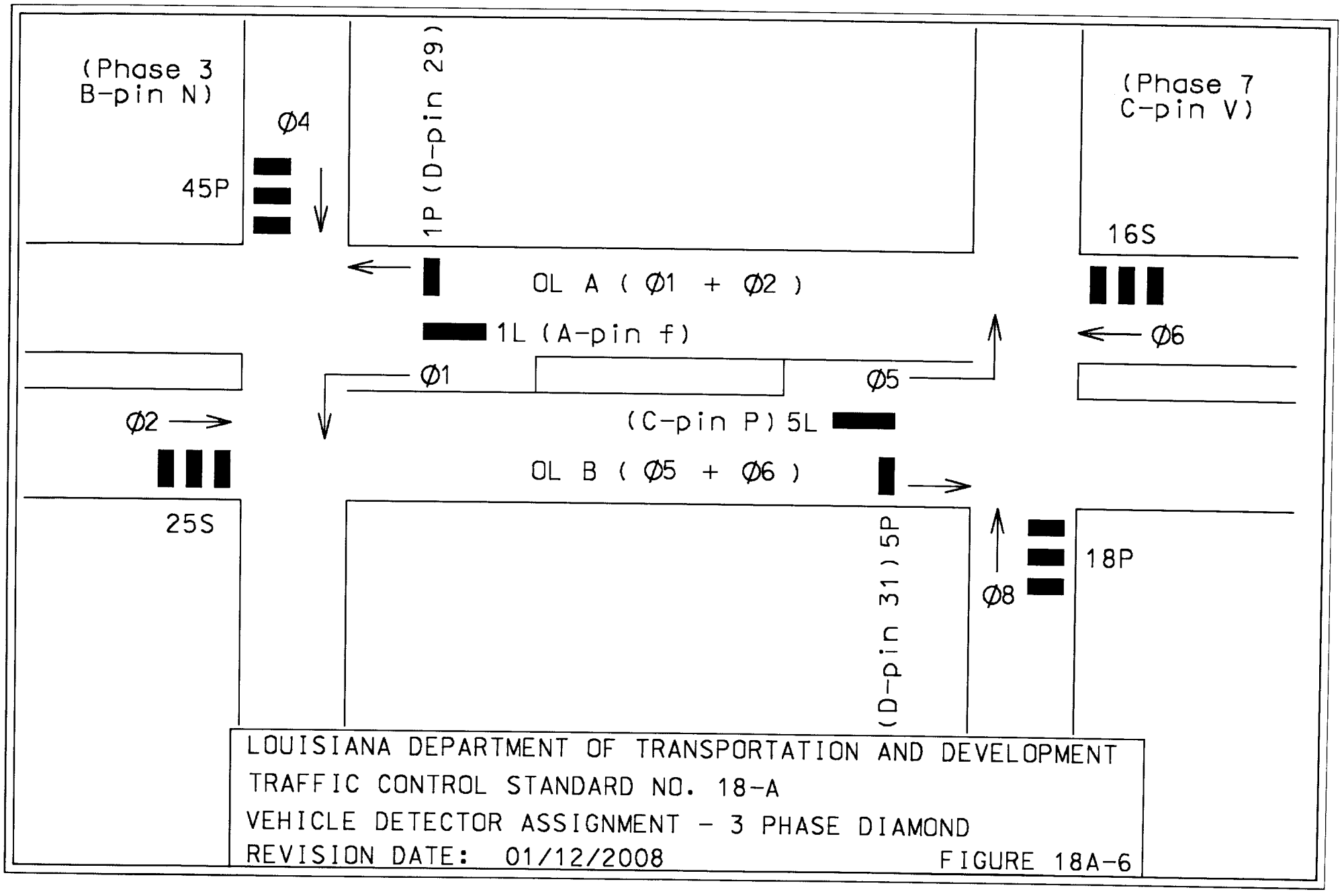
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
TRAFFIC CONTROL STANDARD NO. 18-A
CONTROLLER FOUNDATION
REVISION DATE: 01/12/2008 FIGURE NO. 18A-2



LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
TRAFFIC CONTROL STANDARD NO. 18-A
CABINET BACK PANEL MOUNTING SCHEME
REVISION DATE: 01/12/2008 FIGURE NO. 18A-3

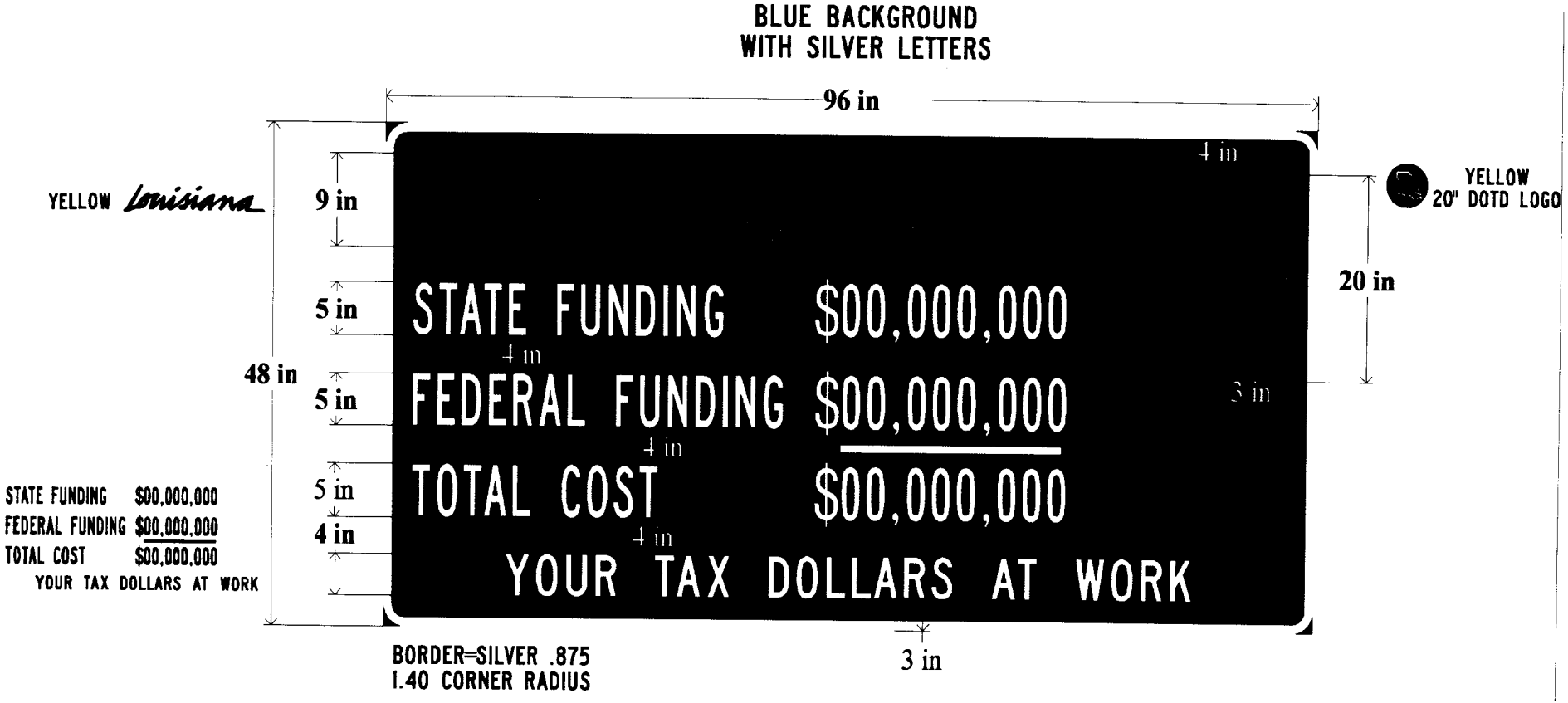

Ø4
OLA=1+2
OLA
Ø1
Ø6
Ø2
Ø5
OLB
OLB=5+6
Ø8
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
TRAFFIC CONTROL STANDARD NO. 18-A
DIAMOND INTERSECTION PHASE ASSIGNMENT
REVISION DATE: 01/12/2008
FIGURE NO. 18A-4


(B-pin L) 45S
(D-pin 25) 45P
Ø4
b (D-pin 29)
Det. Cir. #2
a (D-pin 30)
(D-pin 28) 16S
(C-pin S) 16P
OL A (Ø1 + Ø2)
Ø6
Ø1
Ø5
Ø2
OL B (Ø5 + Ø6)
25P (A-pin K)
25S (D-pin 26)
(D-pin 32) a
Det. Cir. #1
(D-pin 31) b
Ø8
18P (D-pin 27)
18S (C-pin +)
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
TRAFFIC CONTROL STANDARD NO. 18-A
VEHICLE DETECTOR ASSIGNMENT - 4 PHASE DIAMOND
REVISION DATE: 01/12/2008
FIGURE 18A-5


(Phase 3
B-pin N)
45P
Ø4
1P (D-pin 29)
(Phase 7
C-pin V)
16S
OL A (Ø1 + Ø2)
1L (A-pin f)
Ø6
Ø1
Ø5
Ø2
(C-pin P) 5L
OL B (Ø5 + Ø6)
25S
(D-pin 31) 5P
Ø8
18P
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
TRAFFIC CONTROL STANDARD NO. 18-A
VEHICLE DETECTOR ASSIGNMENT - 3 PHASE DIAMOND
REVISION DATE: 01/12/2008
FIGURE 18A-6

PROJECT SIGN
LA TAX DOLLARS AT WORK
(COLOR ARTWORK FURNISHED UPON REQUEST)

Silver Font – TRAFFICAD C



STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT

CONSTRUCTION PROPOSAL INFORMATION FOR

STATE PROJECT NO. 001-09-0084
TURN LANES at US 80 and DOWNING PINES ROAD
ROUTE US 80
OUACHITA PARISH

BID BOND

A Bid Bond is required when the bidder's total bid amount as calculated by the Department in accordance with Subsection 103.01 is greater than $50,000. *(See Section 102 of the Project Specifications.)*

_____, as Principal (Bidder)
and _____, as Surety,
are bound unto the State of Louisiana, Department of Transportation and Development, (hereinafter called the Department) in the sum of five percent (5%) of the bidder's total bid amount as calculated by the Department for payment, of which the Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, as solidary obligors.

Signed and sealed this _____ day of _____, 20_____.

The condition of this obligation is such that, whereas the Principal has submitted a bid to the Department on a contract for the construction of **STATE PROJECT NO. 001-09-0084, TURN LANES at US 80 and DOWNING PINES ROAD, located in OUACHITA PARISH, ROUTE US 80,** if the bid is accepted and the Principal, within the specified time, enters into the contract in writing and gives bond with Surety acceptable to the Department for payment and performance of said contract, this obligation shall be void; otherwise to remain in effect.

_____	_____
Principal (Bidder or First Partner to Joint Venture)	If a Joint Venture, Second Partner
By _____	By _____
Authorized Officer-Owner-Partner	Authorized Officer-Owner-Partner
_____	_____
Typed or Printed Name	Typed or Printed Name

_____
Surety

By _____ (Seal)
Agent or Attorney-in-Fact

_____
Typed or Printed Name

To receive a copy of the contract and subsequent correspondence / communication from LA DOTD, with respect to the bid bonds, the following information must be provided:

_____	_____
Bonding Agency or Company Name	Address
_____	_____
Agent or Representative	Phone Number / Fax Number

07/07
Form CS-2A

Louisiana Department of Transportation and Development

Proposal Schedule of Items

Contract ID: 001-09-0084 **Project(s):** 001-09-0084

SECTION: 1 GENERAL

Proposal Line Number	Item ID	Description Unit Price (In Words, Ink or Typed)	Approximate Quantity	Unit of Measure
0001	202-01-00100	Removal of Structures and Obstructions		LUMP SUM
		_____ Dollars		
		_____ Cents		
0002	202-02-05000	Removal of Building LT. OF STA. 5+54.54, DOWNING PINES RD. (12' X 18')	1.000	EACH
		_____ Dollars		
		_____ Cents		
0003	202-02-06100	Removal of Concrete Walks and Drives	1,759.000	SQYD
		_____ Dollars		
		_____ Cents		
0004	202-02-06140	Removal of Curbs (Concrete)	2,220.500	LNFT
		_____ Dollars		
		_____ Cents		
0005	202-02-32500	Removal of Portland Cement Concrete Pavement	231.000	SQYD
		_____ Dollars		
		_____ Cents		
0006	202-02-38500	Removal of Surfacing and Stablized Base	604.800	SQYD
		_____ Dollars		
		_____ Cents		
0007	203-05-00100	Excavation and Embankment		LUMP SUM
		_____ Dollars		
		_____ Cents		
0008	203-07-00200	Borrow (Vehicular Measurement) (Selected Soils)	437.000	CUYD
		_____ Dollars		
		_____ Cents		

Contract ID: 001-09-0084 **Project(s):** 001-09-0084

SECTION: 1 GENERAL

Proposal Line Number	Item ID	Description / Unit Price (In Words, Ink or Typed)	Approximate Quantity	Unit of Measure
0009	204-02-00100	Temporary Hay or Straw Bales	164.000	EACH
		_____ Dollars		
		_____ Cents		
0010	204-05-00100	Temporary Sediment Check Dams (Hay)	25.000	EACH
		_____ Dollars		
		_____ Cents		
0011	204-06-00100	Temporary Silt Fencing	3,478.000	LNFT
		_____ Dollars		
		_____ Cents		
0012	302-02-01600	Class II Base Course (5 1/2" Thick) (Stone)	236.000	SQYD
		_____ Dollars		
		_____ Cents		
0013	401-02-00100	Aggregate Surface Course (Adjusted Vehicular Measurement)	27.000	CUYD
		_____ Dollars		
		_____ Cents		
0014	502-01-00100	Superpave Asphaltic Concrete	1,219.600	TON
		_____ Dollars		
		_____ Cents		
0015	502-01-00200	Superpave Asphaltic Concrete, Drives, Turnouts and Miscellaneous	42.700	TON
		_____ Dollars		
		_____ Cents		
0016	509-01-00100	Cold Planing Asphaltic Pavement	2,163.000	SQYD
		_____ Dollars		
		_____ Cents		

Contract ID: 001-09-0084 **Project(s):** 001-09-0084

SECTION: 1 GENERAL

Proposal Line Number	Item ID	Description Unit Price (In Words, Ink or Typed)	Approximate Quantity	Unit of Measure
0017	509-02-00100	Contractor Retained Reclaimed Asphaltic Pavement	-121.000	CUYD
		_____		Dollars
		_____		Cents
0018	510-02-00100	Pavement Widening	1,377.200	SQYD
		_____		Dollars
		_____		Cents
0019	601-01-00100	Portland Cement Concrete Pavement (8" Thick)	3,816.300	SQYD
		_____		Dollars
		_____		Cents
0020	701-03-01000	Storm Drain Pipe (15" RCP/PP)	602.000	LNFT
		_____		Dollars
		_____		Cents
0021	701-03-01020	Storm Drain Pipe (18" RCP/PP)	112.000	LNFT
		_____		Dollars
		_____		Cents
0022	701-03-01040	Storm Drain Pipe (24" RCP/PP)	128.000	LNFT
		_____		Dollars
		_____		Cents
0023	701-03-01060	Storm Drain Pipe (30" RCP/PP)	4.000	LNFT
		_____		Dollars
		_____		Cents
0024	701-05-01040	Side Drain Pipe (18" RCP/PP/CMP)	80.000	LNFT
		_____		Dollars
		_____		Cents

Contract ID: 001-09-0084 **Project(s):** 001-09-0084

SECTION: 1 GENERAL

Proposal Line Number	Item ID	Description Unit Price (In Words, Ink or Typed)	Approximate Quantity	Unit of Measure
0025	701-06-01020	Side Drain Pipe Arch (18" Equiv. RCPA/CMPA)	24.000	LNFT
		_____ Dollars		
		_____ Cents		
0026	702-03-00100	Catch Basins (CB-01)	8.000	EACH
		_____ Dollars		
		_____ Cents		
0027	702-03-00500	Catch Basins (CB-06)	4.000	EACH
		_____ Dollars		
		_____ Cents		
0028	702-03-00600	Catch Basins (CB-07)	4.000	EACH
		_____ Dollars		
		_____ Cents		
0029	702-03-00700	Catch Basins (CB-08)	2.000	EACH
		_____ Dollars		
		_____ Cents		
0030	702-04-00100	Adjusting Manholes	5.000	EACH
		_____ Dollars		
		_____ Cents		
0031	702-04-00200	Adjusting Catch Basins	9.000	EACH
		_____ Dollars		
		_____ Cents		
0032	702-08-00100	Side Drain Safety End (Type I)	1.000	EACH
		_____ Dollars		
		_____ Cents		

Contract ID: 001-09-0084 **Project(s):** 001-09-0084

SECTION: 1 GENERAL

Proposal Line Number	Item ID	Description Unit Price (In Words, Ink or Typed)	Approximate Quantity	Unit of Measure
0033	705-02-00100	Combination Mesh & Barbed Wire Fence	297.000	LNFT
		_____		Dollars
		_____		Cents
0034	706-02-00200	Concrete Drive (6" Thick)	1,104.700	SQYD
		_____		Dollars
		_____		Cents
0035	707-01-00100	Concrete Curb	2,434.300	LNFT
		_____		Dollars
		_____		Cents
0036	707-03-00100	Combination Concrete Curb and Gutter	1,914.400	LNFT
		_____		Dollars
		_____		Cents
0037	708-01-00100	Right-of-Way Monument	24.000	EACH
		_____		Dollars
		_____		Cents
0038	708-02-00100	Right-of-Way Monument Witness Post	24.000	EACH
		_____		Dollars
		_____		Cents
0039	713-01-00100	Temporary Signs and Barricades		LUMP SUM
		_____		Dollars
		_____		Cents
0040	713-02-00300	Temporary Pavement Markings (8" Width)	744.000	LNFT
		_____		Dollars
		_____		Cents

Contract ID: 001-09-0084 **Project(s):** 001-09-0084

SECTION: 1 GENERAL

Proposal Line Number	Item ID	Description Unit Price (In Words, Ink or Typed)	Approximate Quantity	Unit of Measure
0041	713-02-00500	Temporary Pavement Markings (24" Width)	1,141.000	LNFT
		_____ Dollars		
		_____ Cents		
0042	713-03-01000	Temporary Pavement Markings (Broken Line) (4" Width) (4' Length)	2.621	MILE
		_____ Dollars		
		_____ Cents		
0043	713-03-02000	Temporary Pavement Markings (Broken Line) (4" Width) (10' Length)	0.373	MILE
		_____ Dollars		
		_____ Cents		
0044	713-04-01000	Temporary Pavement Markings (Solid Line) (4" Width)	3.622	MILE
		_____ Dollars		
		_____ Cents		
0045	713-05-00100	Temporary Pavement Legends & Symbols (Arrow)	11.000	EACH
		_____ Dollars		
		_____ Cents		
0046	713-05-00300	Temporary Pavement Legends & Symbols (ONLY)	11.000	EACH
		_____ Dollars		
		_____ Cents		
0047	716-01-00100	Mulch (Vegetative)	4.200	TON
		_____ Dollars		
		_____ Cents		
0048	717-01-00100	Seeding	63.000	LB
		_____ Dollars		
		_____ Cents		

Contract ID: 001-09-0084 **Project(s):** 001-09-0084

SECTION: 1 GENERAL

Proposal Line Number	Item ID	Description Unit Price (In Words, Ink or Typed)	Approximate Quantity	Unit of Measure
0049	718-01-00100	Fertilizer	2,108.000	LB
		_____		Dollars
		_____		Cents
0050	726-01-00100	Bedding Material	396.900	CUYD
		_____		Dollars
		_____		Cents
0051	727-01-00100	Mobilization		LUMP SUM
		_____		Dollars
		_____		Cents
0052	729-01-00100	Sign (Type A)	10.000	SQFT
		_____		Dollars
		_____		Cents
0053	731-02-00100	Reflectorized Raised Pavement Markers	1,859.000	EACH
		_____		Dollars
		_____		Cents
0054	732-01-01040	Plastic Pavement Striping (8" Width) (Thermoplastic 90 mil)	559.000	LNFT
		_____		Dollars
		_____		Cents
0055	732-01-01080	Plastic Pavement Striping (24" Width) (Thermoplastic 90 mil)	715.000	LNFT
		_____		Dollars
		_____		Cents
0056	732-01-02080	Plastic Pavement Striping (24" Width) (Thermoplastic 125 mil)	174.000	LNFT
		_____		Dollars
		_____		Cents

Contract ID: 001-09-0084 **Project(s):** 001-09-0084

SECTION: 1 GENERAL

Proposal Line Number	Item ID	Description Unit Price (In Words, Ink or Typed)	Approximate Quantity	Unit of Measure
0057	732-02-02000	Plastic Pavement Striping (Solid Line) (4" Width) (Thermoplastic 90 mil)	2.672	MILE
		_____ Dollars		
		_____ Cents		
0058	732-03-02000	Plastic Pavement Striping (Broken Line) (4" Width) (Thermoplastic 90 mil)	0.373	MILE
		_____ Dollars		
		_____ Cents		
0059	732-04-01020	Plastic Pavement Legends and Symbols (Arrow - Straight)	1.000	EACH
		_____ Dollars		
		_____ Cents		
0060	732-04-01080	Plastic Pavement Legends and Symbols (Arrow - Left Turn)	4.000	EACH
		_____ Dollars		
		_____ Cents		
0061	732-04-01100	Plastic Pavement Legends and Symbols (Arrow - Right Turn)	2.000	EACH
		_____ Dollars		
		_____ Cents		
0062	732-04-15020	Plastic Pavement Legends and Symbols (ONLY)	7.000	EACH
		_____ Dollars		
		_____ Cents		
0063	732-05-00100	Removal of Existing Markings	1.716	MILE
		_____ Dollars		
		_____ Cents		
0064	732-06-00100	Removal of Existing Raised Pavement Markers	691.000	EACH
		_____ Dollars		
		_____ Cents		

Contract ID: 001-09-0084 **Project(s):** 001-09-0084

SECTION: 1 GENERAL

Proposal Line Number	Item ID	Description Unit Price (In Words, Ink or Typed)	Approximate Quantity	Unit of Measure
0065	735-01-00100	Mailboxes	25.000	EACH
		_____		Dollars
		_____		Cents
0066	735-02-00100	Mailbox Supports (Single)	1.000	EACH
		_____		Dollars
		_____		Cents
0067	735-03-00100	Mailbox Supports (Double)	1.000	EACH
		_____		Dollars
		_____		Cents
0068	735-04-00100	Mailbox Supports (Multiple)	6.000	EACH
		_____		Dollars
		_____		Cents
0069	736-01-00100	Trenching and Backfilling	62.000	LNFT
		_____		Dollars
		_____		Cents
0070	736-04-03080	Signal Support (30' Steel Strain Pole)	4.000	EACH
		_____		Dollars
		_____		Cents
0071	736-05-02000	Signal Heads (3 Section, 12" Led Lens, R, Y, G)	7.000	EACH
		_____		Dollars
		_____		Cents
0072	736-05-02020	Signal Heads (3 Section, 12" Led Lens, R, LT, Y, LT. G)	1.000	EACH
		_____		Dollars
		_____		Cents

Contract ID: 001-09-0084 **Project(s):** 001-09-0084

SECTION: 1 GENERAL

Proposal Line Number	Item ID	Description Unit Price (In Words, Ink or Typed)	Approximate Quantity	Unit of Measure
0073	736-05-04000	Signal Heads (5 Section, 12" Led Lens, R, LT. Y, Y, LT. G, G)	3.000	EACH
		_____ Dollars		
		_____ Cents		
0074	736-05-04020	Signal Heads (5 Section, 12" Led Lens, R, Y, RT. Y, G, RT. G)	2.000	EACH
		_____ Dollars		
		_____ Cents		
0075	736-08-02000	Signal Controller (TS-2, Type 2; Type 3 Cabinet)	1.000	EACH
		_____ Dollars		
		_____ Cents		
0076	736-10-00200	Underground Junction Box (Type E)	1.000	EACH
		_____ Dollars		
		_____ Cents		
0077	736-10-00500	Underground Junction Box (Type H)	1.000	EACH
		_____ Dollars		
		_____ Cents		
0078	736-11-00300	Conduit (2" HDPE, Schedule 80)	48.000	LNFT
		_____ Dollars		
		_____ Cents		
0079	736-11-00400	Conduit (3" HDPE, Schedule 80)	28.000	LNFT
		_____ Dollars		
		_____ Cents		
0080	736-12-02000	Conductor (3c, 6 gauge / #6 awg)	48.000	LNFT
		_____ Dollars		
		_____ Cents		

Contract ID: 001-09-0084 **Project(s):** 001-09-0084

SECTION: 1 GENERAL

Proposal Line Number	Item ID	Description Unit Price (in Words, Ink or Typed)	Approximate Quantity	Unit of Measure
0081	736-12-04000	Conductor (6c, #14 awg)	66.000	LNFT
		_____		Dollars
		_____		Cents
0082	736-12-06000	Conductor (10c, #14 awg)	1,712.000	LNFT
		_____		Dollars
		_____		Cents
0083	740-01-00100	Construction Layout		LUMP SUM
		_____		Dollars
		_____		Cents
0084	NS-500-00220	Sawing and Sealing Longitudinal Joints in Asphaltic Concrete Overlay	5,829.000	LNFT
		_____		Dollars
		_____		Cents
0085	NS-500-00240	Sawing and Sealing Transverse Joints in Asphaltic Concrete Overlay	2,092.000	LNFT
		_____		Dollars
		_____		Cents
0086	NS-500-00260	Sawcuts in Asphaltic Concrete Lifts	15,842.000	LNFT
		_____		Dollars
		_____		Cents
0087	NS-500-00360	Saw Cutting Asphaltic Concrete Pavement Over Portland Cement Concrete Composite Pavement	8,330.000	INLF
		_____		Dollars
		_____		Cents
0088	NS-600-00220	Saw Cutting Portland Cement Concrete Pavement	19,040.000	INLF
		_____		Dollars
		_____		Cents

Contract ID: 001-09-0084 **Project(s):** 001-09-0084

SECTION: 1 GENERAL

Proposal Line Number	Item ID	Description Unit Price (In Words, Ink or Typed)	Approximate Quantity	Unit of Measure
0089	NS-713-00001	Dynamic Message Sign Unit	2.000	EACH
		_____ Dollars		
		_____ Cents		
0090	NS-736-00020	Video Detector (MVP) Device	4.000	EACH
		_____ Dollars		
		_____ Cents		
0091	NS-736-00040	Video Detector (MVP) System	1.000	EACH
		_____ Dollars		
		_____ Cents		
0092	NS-MSC-00120	Drainage Structure PAVED GUTTER DRAIN	7.000	EACH
		_____ Dollars		
		_____ Cents		

Section: 1 **Total:** _____.___

Total Bid: _____.___

CONSTRUCTION PROPOSAL SIGNATURE AND EXECUTION FORM

THIS FORM, THE SCHEDULE OF ITEMS, AND THE PROPOSAL GUARANTY MUST BE COMPLETED AS INDICATED AND SUBMITTED TO THE LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT (DOTD) TO CONSTITUTE A VALID BID

STATE PROJECT NO. **001-09-0084**

FEDERAL AID PROJECT NO. **N/A**

NAME OF PROJECT **TURN LANES at US 80 and DOWNING PINES ROAD**

I (WE) HEREBY CERTIFY THAT I (WE) HAVE CAREFULLY EXAMINED THE PROPOSAL, PLANS AND SPECIFICATIONS, INCLUDING ANY AND ALL ADDENDA, AND THE SITE OF THE ABOVE PROJECT AND AM (ARE) FULLY COGNIZANT OF ALL PROPOSAL DOCUMENTS, THE MASTER COPY OF WHICH IS ON FILE AT DOTD HEADQUARTERS IN BATON ROUGE, LA., AND ALL WORK, MATERIALS AND LABOR REQUIRED THEREIN, AND AGREE TO PERFORM ALL WORK, AND SUPPLY ALL NECESSARY MATERIALS AND LABOR REQUIRED FOR SUCCESSFUL AND TIMELY COMPLETION OF THE ABOVE PROJECT AND TO ACCEPT THE SUMMATION OF THE PRODUCTS OF THE UNIT PRICES BID ON THE SCHEDULE OF ITEMS ATTACHED HERETO AND MADE A PART HEREOF MULTIPLIED BY THE ACTUAL QUANTITY OF UNIT OF MEASURE PERFORMED FOR EACH ITEM, AS AUDITED BY DOTD, AS FULL AND FINAL PAYMENT FOR ALL WORK, LABOR AND MATERIALS NECESSARY TO COMPLETE THE ABOVE PROJECT, SUBJECT TO INCREASE ONLY FOR PLAN CHANGES (CHANGE ORDERS) APPROVED BY THE DOTD CHIEF ENGINEER OR HIS DESIGNEE. THIS BID IS SUBMITTED IN ACCORDANCE WITH THE GENERAL BIDDING REQUIREMENTS IN THE CONSTRUCTION PROPOSAL AND ALL SPECIAL PROVISIONS, PLANS, SUPPLEMENTAL SPECIFICATIONS, AND THE LOUISIANA STANDARD SPECIFICATIONS FOR ROADS AND BRIDGES (2006 EDITION). I (WE) UNDERSTAND THAT THE SUMMATION OF THE PRODUCTS OF THE UNIT PRICES BID ON THE SCHEDULE OF ITEMS MULTIPLIED BY THE ESTIMATED QUANTITY OF UNIT OF MEASURE FOR EACH ITEM, ALONG WITH ANY OTHER FACTORS SPECIFIED TO BE APPLICABLE SUCH AS CONSTRUCTION TIME AND/OR LANE RENTAL, SHALL BE THE BASIS FOR THE COMPARISON OF BIDS. I (WE) UNDERSTAND THAT THE SCHEDULE OF ITEMS MUST CONTAIN UNIT PRICES WRITTEN OUT IN WORDS AND THAT THE SCHEDULE OF ITEMS SUBMITTED AS PART OF THIS BID IS ON THE FORM SUPPLIED BY DOTD IN THE BID PROPOSAL. MY (OUR) PROPOSAL GUARANTY IN THE AMOUNT SPECIFIED FOR THE PROJECT IS ATTACHED HERETO AS EVIDENCE OF MY (OUR) GOOD FAITH TO BE FORFEITED IF THIS BID IS ACCEPTED BY DOTD AND I (WE) FAIL TO COMPLY WITH ANY REQUIREMENT NECESSARY FOR AWARD AND EXECUTION OF THE CONTRACT, AS WELL AS, SIGN AND DELIVER THE CONTRACT AND PAYMENT/PERFORMANCE/RETAINAGE BOND AS REQUIRED IN THE SPECIFICATIONS.

NONCOLLUSION DECLARATION (APPLICABLE TO FEDERAL-AID PROJECTS)

I (WE) DECLARE UNDER PENALTY OF PERJURY UNDER THE LAWS OF THE UNITED STATES AND THE STATE OF LOUISIANA THAT I (WE) HAVE NOT DIRECTLY OR INDIRECTLY, ENTERED INTO ANY AGREEMENT, PARTICIPATED IN ANY COLLUSION, OR OTHERWISE TAKEN ANY ACTION IN RESTRAINT OF FREE COMPETITIVE BIDDING IN CONNECTION WITH THE CONTRACT FOR THIS PROJECT NOR VIOLATED LA. R.S. 48:254.

BIDDER'S DBE GOAL STATEMENT (APPLICABLE TO DBE GOAL PROJECTS)

IF THIS PROJECT IS DESIGNATED BY SPECIAL PROVISION AS A DISADVANTAGED BUSINESS ENTERPRISE (DBE) GOAL PROJECT IN ACCORDANCE WITH THE DBE PROVISIONS OF THIS CONTRACT, THE BIDDER ASSURES DOTD THAT HE/SHE WILL MEET OR EXCEED THE DBE CONTRACT GOAL, OR IF THE BIDDER CANNOT MEET THE REQUIRED DBE GOAL, THE BIDDER ASSURES DOTD THAT HE/SHE HAS MADE AND CAN DOCUMENT GOOD FAITH EFFORTS MADE TOWARDS MEETING THE GOAL REQUIREMENT IN ACCORDANCE WITH THE CONTRACT AND DBE PROGRAM MANUAL INCORPORATED HEREIN BY REFERENCE.

THE APPARENT LOW BIDDER SHALL COMPLETE AND SUBMIT TO THE DOTD COMPLIANCE PROGRAMS OFFICE, FORM CS-6AAA AND ATTACHMENT(S) AND, IF NECESSARY, DOCUMENTATION OF GOOD FAITH EFFORTS MADE BY THE BIDDER TOWARD MEETING THE GOAL, WITHIN TEN BUSINESS DAYS AFTER THE OPENING OF BIDS FOR THIS PROJECT. RESPONSIVENESS OF INFORMATION SUPPLIED IN THIS SECTION OF THIS CONSTRUCTION PROPOSAL SIGNATURE AND EXECUTION FORM IS GOVERNED BY THE DBE REQUIREMENTS INCLUDED WITHIN THE SPECIFICATIONS AND DBE PROGRAM MANUAL.

CERTIFICATION OF EMPLOYMENT OF LOUISIANA RESIDENTS TRANSPORTATION INFRASTRUCTURE MODEL FOR ECONOMIC DEVELOPMENT (TIME) PROJECTS (APPLICABLE TO TIME PROJECTS)

IF THIS PROJECT IS DESIGNATED BY SPECIAL PROVISION AS A TRANSPORTATION INFRASTRUCTURE MODEL FOR ECONOMIC DEVELOPMENT (TIME) PROJECT AS DEFINED IN ACT NO. 16 OF THE 1989 FIRST EXTRAORDINARY SESSION OF THE LEGISLATURE WHICH ENACTED PART V OF CHAPTER 7 OF SUBTITLE II OF TITLE 47 OF THE LOUISIANA REVISED STATUTES OF 1950, COMPRISED OF R.S. 47:820.1 THROUGH 820.6.

THE BIDDER CERTIFIES THAT AT LEAST 80 PERCENT OF THE EMPLOYEES EMPLOYED ON THIS TIME PROJECT WILL BE LOUISIANA RESIDENTS IN ACCORDANCE WITH LOUISIANA R.S. 47:820.3.

NON PARTICIPATION IN PAYMENT ADJUSTMENT (ASPHALT CEMENT AND FUELS) STATEMENT

IF THIS PROJECT IS DESIGNATED BY SPECIAL PROVISION AS BEING SUBJECT TO PAYMENT ADJUSTMENT FOR ASPHALT CEMENT AND/OR FUELS, THE BIDDER HAS THE OPTION OF REQUESTING EXCLUSION FROM SAID PAYMENT ADJUSTMENT PROVISIONS THAT ARE ESTABLISHED BY SPECIAL PROVISION ELSEWHERE HEREIN.

IF THE BIDDER DESIRES TO BE EXCLUDED FROM THESE PAYMENT ADJUSTMENT PROVISIONS,

THE BIDDER IS REQUIRED TO MARK HERE ☐

FAILURE TO MARK THIS BOX PRIOR TO BID OPENING WILL CONSTITUTE FORFEITURE OF THE BIDDER'S OPTION TO REQUEST EXCLUSION.

STATE PROJECT NO. **001-09-0084**

BIDDER SIGNATURE REQUIREMENTS (APPLICABLE TO ALL PROJECTS)

THIS BID FOR THE CAPTIONED PROJECT IS SUBMITTED BY:

Name of Principal (Individual, Firm, Corporation, or Joint Venture)

If Joint Venture, Name of First Partner

(Louisiana Contractor's License Number of Bidder or First Partner to Joint Venture)

(Business Street Address)

(Business Mailing Address, if different)

(Area Code and Telephone Number of Business)

(Telephone Number and Name of Contact Person)

(Telecopier Number, if any)

If Joint Venture, Name of Second Partner

(Louisiana Contractor's License Number of Second Partner to Joint Venture)

(Business Street Address)

(Business Mailing Address, if different)

(Area Code and Telephone Number of Business)

(Telephone Number and Name of Contact Person)

(Telecopier Number, if any)

ACTING ON BEHALF OF THE BIDDER, THIS IS TO ATTEST THAT THE UNDERSIGNED DULY AUTHORIZED REPRESENTATIVE OF THE ABOVE CAPTIONED FIRM, CORPORATION OR BUSINESS, BY SUBMISSION OF THIS BID, AGREES AND CERTIFIES THE TRUTH AND ACCURACY OF ALL PROVISIONS OF THIS PROPOSAL, INCLUSIVE OF THE REQUIREMENTS, STATEMENTS, DECLARATIONS AND CERTIFICATIONS ABOVE AND IN THE SCHEDULE OF ITEMS AND PROPOSAL GUARANTY. EXECUTION AND SIGNATURE OF THIS FORM AND SUBMISSION OF THE SCHEDULE OF ITEMS AND PROPOSAL GUARANTY SHALL CONSTITUTE AN IRREVOCABLE AND LEGALLY BINDING OFFER BY THE BIDDER.

(Signature)

(Printed Name)

(Title)

(Date of Signature)

(Signature)

(Printed Name)

(Title)

(Date of Signature)

CONTRACTOR'S TOTAL BASE BID $ _____

IT IS AGREED THAT THIS TOTAL, DETERMINED BY THE BIDDER, IS FOR PURPOSES OF OPENING AND READING BIDS ONLY, AND THAT THE LOW BID FOR THIS PROJECT WILL BE DETERMINED FROM THE EXTENSION AND TOTAL OF THE BID ITEMS BY DOTD.

CS-14AA
08/06