



COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION

GUIDELINES FOR THE MAINTENANCE OF TRAFFIC SIGNAL SYSTEMS

PUB 191
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1.0 INTRODUCTION

The Vehicle Code requires that local authorities obtain approval of the Department of Transportation prior to erecting a traffic signal on any state or local highway. Specific approval is not required in those municipalities with a traffic engineer, although the traffic engineer must be qualified in accordance with Department of Transportation regulations.

Consequently the approval granted by the Department for erecting a traffic signal is accompanied by the responsibility for operation and maintenance by the municipality where the traffic signal is located.

Since the failure of a traffic signal has the potential for critical consequences it is essential that those responsible for the maintenance provide for a reduction in the possibility of failures and to repair those failures, when they do occur, within a reasonable time period.

Therefore, the purpose of this publication is to provide general guidelines to those responsible for the maintenance of traffic signals.

2.0 MAINTENANCE CLASSIFICATIONS

These guidelines address three classifications of traffic signal maintenance.

- o Response Maintenance - Repair failures when they occur and restore the traffic signal to normal operation.
- o Preventive Maintenance - A program of periodic inspections and procedures that will minimize the probability of a failure requiring response maintenance.
- o Design Modifications - Modify the design and operation of the traffic signal to provide for changes in traffic conditions.

The municipality will be responsible for evaluating its maintenance requirements and capabilities to determine what level of traffic signal maintenance to provide (preventive or response) and will it be provided by municipal personnel or a private maintenance contractor.

Various options are available utilizing a maintenance contractor which range from the contractor providing all labor and materials to other combinations where the contractor would provide a specific segment of labor and/or materials with the remaining functions provided by the municipality.

If the decision is to provide maintenance with municipal personnel it is essential, for the program to be effective, that the staff be provided appropriate training opportunities. This will assure they are well-versed and up-to-date in all aspects of traffic signal equipment and proper maintenance procedures. In addition to being adequately trained, traffic signal maintenance personnel, both contractor and municipal, should satisfactorily complete a certification program sponsored by a nationally recognized organization such as International Municipal Signal Association.

Additional details regarding contractor maintenance are provided in Section 8.0 and 9.0.

3.0 DOCUMENTATION

Regardless of the maintenance classification or how it's performed one important but often neglected requirement of traffic signal maintenance is relevant and up-to-date documentation. Documentation includes as-built plans, wiring schematics, controller time settings, conflict monitor programming sheet, manuals, technical publications, maintenance records, etc.

Examples of forms for maintenance records are provided in Section 10.0.

4.0 RESPONSE MAINTENANCE

Response maintenance is the immediate repair of a traffic signal failure. Repairs can be classified as either Final Repair or Temporary Repair.

Final Repair - Restore the traffic signal to operate in accordance with the Traffic Signal Permit.

Temporary Repair - Use alternate means to restore the traffic signal to safe operation until final repair can be made. As a minimum, signals should be set to operate in the flashing mode, they should not be left in an unlighted condition.

Before any "on street" repairs are performed provide the applicable traffic control devices indicated in the Department of Transportation Publication 203, Work Zone Traffic Control.

Complete a report indicating the location, date, name of person performing the repair and description of the repairs performed. Place one copy of the report in the controller cabinet and another in a central file.

SIGNAL HEADS

- o Restore unlighted signal.
- o Correct misaligned signal.
- o Repair or replace mounting hardware.
- o Repair or replace damaged signal head or parts thereof (e.g.) visor, lens, and reflector.
- o Cleaning lens and reflector should be routinely included in any signal head maintenance function.

CONTROLLER ASSEMBLY

- o Restore correct time setting in controller unit.
- o Repair or replace malfunctioning:
 - Controller Unit
 - Conflict Monitor
 - Flasher
 - Load Switch
 - Time Clock
 - Relay
- o Verify that fan is operating and clean or replace air filter as a routine function during any controller assembly maintenance.

SUPPORTS

- o Repair or replace defective poles or other supporting hardware.
- o Restore the required clearance between the roadway and the bottom of signals and/or signs located over the roadway.

DETECTORS (VEHICULAR)

- o Tune or adjust detector amplifier.
- o Repair or replace malfunctioning detector amplifier.
- o Repair or replace malfunctioning detector sensor.

DETECTORS (PEDESTRIAN PUSH BUTTON)

- o Repair or replace malfunctioning push button.
- o Repair or replace signs directing use of push button.

SIGNS (SIGNS ON TRAFFIC SIGNAL PERMIT)

- o Correct misaligned signs.
- o Repair or replace damaged or missing signs.

PAVEMENT MARKINGS

- o Restore pavement markings (e.g. stop lines, cross walks, etc.) that are the responsibility of the permittee as indicated on the Traffic Signal Permit.

5.0 PREVENTIVE MAINTENANCE

GENERAL

Inspect each signalized intersection and perform preventive maintenance for the items and at intervals outlined in the Preventive Maintenance Summary. The description provides general guidelines to aid in performing the individual task. Follow the specific requirements unique to a particular manufacturer.

Before any "on street" checks or tests are performed provide the applicable traffic control devices indicated in the Pennsylvania Department of Transportation Pub. 203 Work Zone Traffic Control.

Complete an inspection report indicating the location, date, inspectors name, a list of maintenance tasks performed and problems encountered. Place one copy of the report in the controller cabinet and another in a central file.

MAINTENANCE FUNCTION	RECOMMENDED INTERVAL		
	6 Mo.	12 Mo.	As Required

CONTROLLER CABINET

o paint steel cabinet to prevent rusting			x
o lubricate door hinges and locks		x	
o clean air filter	x		
o replace air filter		x	
o check gasket around door		x	
o check for obstructions in drainage if evidence of water accumulating in cabinet			x
o check the integrity of lightning arrestor.			x
o check electrical ground (rod, clamp, wire)			x
o check fan operation (thermostat set to operate at 85 - 90 degrees Fahrenheit).			x
o check relays for burned or pitted contacts			x
o check flasher for proper operation			x
o verify operation of each switch position			x
o verify operation of conflict monitor	x		
o verify operation of vehicle detectors (including timing of delayed or extended output)	x		
o clean inside cabinet			x
o visually check wiring and connectors	x		

CONTROLLER UNIT (ELECTROMECHANICAL)

o check time settings			
o check dial assembly for wear, burned contacts, key positions.			x
o check cam assembly for wear, cracks, burned contacts, tension on contacts, clean and lubricate, as required.			x

PREVENTIVE MAINTENANCE SUMMARY

MAINTENANCE FUNCTION	RECOMMENDED INTERVAL		
-----	6 Mo.	12 Mo.	As Required

CONTROLLER UNIT (SOLID STATE)

- | | | | |
|------------------------------------|---|---|--|
| o check time settings | x | | |
| o check response to detector input | x | | |
| o check indicator lamps | | x | |
| o check real time on clock | x | | |
| o check battery(s) | x | | |

VEHICLE DETECTORS

- | | | | |
|---|---|--|---|
| o loop detector - visually inspect the sensor in the roadway for sealant failure, cracks or potholes. | x | | |
| o check for false actuations by vehicles in adjacent lanes. | x | | |
| o check for abnormal accumulation of water in junction boxes. | | | x |
| o check sensor/lead in splices | | | x |

PEDESTRIAN PUSH BUTTONS

- | | | | |
|---|---|--|--|
| o verify the operation of each push button | x | | |
| o check the time provided for the pedestrian crossing. | x | | |
| o check push button signs for location, legibility, damage. | x | | |

SUPPORTS (MAST ARM, STRAIN POLE, SPAN WIRE)

- | | | | |
|---|--|---|---|
| o paint | | | x |
| o inspect for rust and cracks especially at seams and joints. | | x | |
| o inspect anchor bolts verify that nuts have not loosened. | | x | |
| o span wires - check sag, cable lashing, supporting brackets and hardware. | | | x |
| o handhole - check integrity of splices in signal cable, check ground rod, clamp and ground wire connections. | | | x |
| o adequately secure handhole covers. | | | x |

PREVENTIVE MAINTENANCE SUMMARY

MAINTENANCE FUNCTION	RECOMMENDED INTERVAL		
	6 Mo.	12 Mo.	As Required

o check signal cable for wear at entrance to poles, brackets, signal heads and where it's lashed to span wire.		x	
o check bonding of span wire and tether wire to strain pole.		x	
o check for obstructions in drain at pole base		x	
 SIGNAL HEADS			
o paint exterior of metallic signal head			x
o clean lenses and reflectors	x		
o replace lamps (595 lumens/ 2&7/16 inch L.C.L. for 8 inch lens, 1750 lumens/3 inch L.C.L. for 12 inch lens).		x	
o check mounting hardware	x		
o check alignment (aim toward center of approach at a point approximately 150 feet in advance of stop bar).		x	
o check the clearance between the roadway and the bottom of signals and/or signs located over the roadway.		x	
o check for signals obscured by foliage		x	
o check security of louvers, visors and backplates		x	
o clean signs		x	
 PAVEMENT MARKINGS			
o restore pavement markings			x

6.0 DESIGN MODIFICATIONS

When conditions at an existing traffic signal cause excessive delays to vehicles and/or pedestrians consideration must be given to modifying the design to alleviate the delays.

Following are some factors to consider when it has been determined that design modifications are necessary.

- Signal Phasing
- Signal Timing
- Vehicular Volumes and Speeds
- Pedestrian Volumes
- Turning Movements
- Number and Width of Lanes
- Parking
- Turning Lanes

Any design modification must be approved by the Department of Transportation, except those municipalities that have a Department approved traffic engineer.

7.0 MAINTENANCE CAPABILITY

Traffic signal maintenance requires qualified personnel, maintenance equipment and an inventory of traffic signal equipment.

The following forms are used by the Department to evaluate the maintenance capability of a municipality contemplating an agreement to maintain traffic signals to be constructed with the aid of federal or state funds.

The maintenance capability checklist, maintenance material inventory and manpower summary may be used as a guide by the municipality in determining their capability and to aid in deciding whether or not to utilize a private contractor for traffic signal maintenance.

7.1 MAINTENANCE CAPABILITY CHECKLIST

General

1. Total number of signalized intersections: _____
 - o Number of electromechanical controllers: _____
 - o Number of solid state controllers: _____
 - o Number of other controllers: _____

2. What is your annual maintenance budget including salaries, and equipment? (exclude utility and capital improvement costs) \$ _____

3. Complete the attached Maintenance Material Inventory

4. Which of the following maintenance records are kept?

a. Wiring details	Yes	No
b. Time setting details	Yes	No
c. Detector tuning details	Yes	No
d. Changes made at the intersection	Yes	No
e. Preventive maintenance performed	Yes	No
f. Emergency maintenance performed	Yes	No
g. The time a failure complaint is registered	Yes	No
h. The time the intersection is reached by a maintenance crew	Yes	No
i. The time taken to return operation to normal	Yes	No

5. Do you hire a contractor for electromechanical controller maintenance? Yes No

6. Do you hire a contractor for solid state controls repair? Yes No

Maintenance by Municipality

If answer to question 5 or 6 is no, fill out the following information.

7. Upon failure of solid state control, does your crew repair the failure in the controller cabinet only by replacing each detachable device until the failed device(s) is identified and replaced? Yes No
 (Explanation: If your crew is capable of identifying and replacing, in the field, the failed component or module, then answer no to this question.)

8. Is majority of failed solid state equipment repaired in your shop? Yes No

9. Complete the attached Manpower Summary Sheet

10. Indicate the quantity of each type of equipment you have:

	<u>Type</u>	<u>Quantity</u>
Field	Bucket Truck	_____
	Ladder Truck	_____
	Platform Truck	_____
	Dump Truck	_____
	Automobile	_____
	Panel Truck	_____
	Other	_____
Shop	Multimeter	_____
	Oscilloscope	_____
	Controller Test Fixture	_____
	Detector Test Fixture	_____
	Frequency Generator	_____
	Frequency Counter	_____
	Variac	_____
	Transistor Checker	_____
	Conflict Monitor Tester	_____
	Other	_____

11. Are your maintenance vehicles equipped with:
 two-way radio communications? Yes No
 tone/voice electronic pager? Yes No
12. Does the maintenance group have responsibilities
 other than for traffic control equipment? Yes No
 If yes, what are they? _____
 What percent of time? _____

Contractor Maintenance

If answer to Question 5 or 6 is Yes, then fill out the following information:

13. Upon failure of solid state control, does the contractor's crew repair the failure in the Controller cabinet only by replacing each detachable device until the failed device(s) is identified and replaced? Yes No
 (Explanation: If the contractor's crew is capable of identifying and replacing, in the field, the failed component or module, then answer No to this question.)
14. If answer to question 13 is No, then answer the following question:
 Does the contractor repair the majority of the failed equipment in his shop? Yes No

15. Does the contractor charge by the hour for

emergency repair?

Yes No

If yes, does the rate include:

o Material?

Yes No

o Equipment?

Yes No

o Travel?

Yes No

What is the hourly rate?

\$ _____ /hour

If a controller fails, is the operation of the intersection returned to normal within 24 hours?

What is the average repair time? _____ (hours/days)

16. Does the contractor return the failed equipment to you for repair?

Yes No

Response Maintenance

17. Does response time to the intersection to verify and identify the reported problem exceed 1 hour?

Yes No

18. If a solid state controller fails in the field, can your crew or contractor return the operation of the intersection to normal (permit) within 24 hours?

Yes No

19. If answer to question 18 is no, then answer the following question:

If normal operation is not possible, can your crew or contractor use an alternate means or mode to temporarily restore the system to safe operation within 24 hours until normal repair can be completed?

Yes No

20. Was final repair completed within 30 days?

Yes No

21. Do you hire a contractor for your response maintenance program?

Yes No

If yes, does the contractor charge by the hour for response maintenance?

Yes No

If yes, does the rate include:

o Material?

Yes No

o Equipment?

Yes No

o Travel?

Yes No

What is the hourly rate?

\$ _____ /hour

Preventive Maintenance

22. Do you have an active preventive maintenance program (other than relamping)? Yes No
23. Do you hire a contractor for the preventive program? Yes No
If yes, does the contractor charge by the hour for preventive maintenance? Yes No
If yes, does the rate include:
- o Material? Yes No
 - o Equipment? Yes No
 - o Travel? Yes No
- What is the hourly rate? \$ _____/hour

7.2 MAINTENANCE MATERIAL INVENTORY

MATERIAL	INVENTORY
----------	-----------

Cabinet

- Cabinet (shell)
- Primer
- Paint
- Oil
- Filter
- Gasket
- Anchor Bolt
- Duct Sealant
- Grounding Clamp
- Fan
- Heater
- Thermostat
- Lock and keys
- Radio Interference Filters
- Motor
- Contacts
- Synchronizing Relay
- Amphenol Socket
- Miscellaneous Hardware

Cam Assembly

- Cam
- Advancing Mechanism
- Ratchet and Pawl
- Contacts and Spring
- Shaft Bearing
- Oil
- Relay (Crouse-Hinds type)

Relays

- Dial Transfer Relay
- Flash Relay
- Contacts
- Relay Connector

Flashers

- Flasher Unit
- Contacts and Motor for Mechanical Type Flasher
- Flasher Connector
- Components

MAINTENANCE MATERIAL INVENTORY - (continued)

MATERIAL	INVENTORY
----------	-----------

Switches

- Switches
- Time Switch

Conflict Monitor

- Conflict Monitor
- Components as Listed by Manufacturer

Analog Controllers

- Potentiometers
- Indicators
- Load Relays
- Miscellaneous Components
- Controller

Solid State and Microprocessor-based Controllers

- Load Switch
- Power Supply for Load Switches
- Load Switch Components
- Solid State Replacement Relay for Load Switcher
- Controller Unit
- Module and Board
- Power Supply for Controller
- Other Components as Recommended by Manufacturer

Auxiliary Logic

- Backup Components per Logic Card (preemptor)

Interconnect Equipment

- Backup Master
- Interface Unit
- Dial Unit (synchronizer)
- Coordination Unit
- Miscellaneous Components

MAINTENANCE MATERIAL INVENTORY - (continued)

MATERIAL

INVENTORY

Signal Head (Pedestrian and Vehicle)

Lamp
Lens
Visors
Reflector
Lamp Socket
Signal Sections
Signal Mounting Hardware
Signal Cable
Primer
Paint

Mast Arms, Poles, and Span Wire Poles

Primer
Paint
Mast Arm
Pole Shaft or Pedestal
Anchor Bolt
Handhole Cover
Grout
Miscellaneous Hardware

Span Wire

Messenger Cable Tensioner (come along)
Cable Clamp
Span Wire
Tether Wire
Miscellaneous Hardware

Push Buttons

Push Button Assembly
Sign
Push Button Post
Miscellaneous Hardware

Detector

Splice Kits
Sealant
Sensor
Loop Wire
Lead-in Cable
Detector Amplifier
Power Supply for Amplifier
Components

MAINTENANCE MATERIAL INVENTORY - (continued)

MATERIAL	INVENTORY
----------	-----------

Junction Boxes and Handholes

Junction Box Cover
Miscellaneous Hardware

Electromechanical Controller

Dust Cover
Dial Assembly
Dial Unit
Cycle Gear
Key

Signs

Signs
Posts
Post Anchors
Hardware

7.3 MANPOWER SUMMARY SHEET

Job Classification or Title	Number of Persons	Description of Duties	Education Requirements	Annual Salary (nearest \$1,000)
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

8.0 MAINTENANCE AGREEMENT

The following exhibits are typical of the traffic signal maintenance agreement entered into when the municipality agrees to accept traffic signals constructed with federal or state funds.

Exhibit A

PREVENTIVE MAINTENANCE

The SUBDIVISION or its contractor will provide preventive maintenance for each individual component of the traffic signal installation covered by this agreement at intervals not less than those indicated in the Preventive Maintenance Summary, PA DOT Pub. 191. This is the recommended level of maintenance to keep the intersection control equipment and signals in mechanically, structurally and aesthetically good condition.

RESPONSE MAINTENANCE

The SUBDIVISION or its contractor will provide response maintenance in accordance with the provisions of the Response Maintenance Schedule. It encompasses the work necessary to restore a traffic signal system to proper and safe operation. Includes Emergency Repair and Final Repair.

FINAL REPAIR:

Repair or replace failed equipment to restore system to proper and safe operation in accordance with permit within a 24 hour period.

EMERGENCY REPAIR:

Use alternate means or mode to temporarily restore system to safe operation within 24 hour period. Final repair must then be completed within 30 days unless prohibited by weather conditions or availability of equipment.

RESPONSE MAINTENANCE SCHEDULE

	<u>TYPE OF REPAIR PERMITTED</u>
<u>KNOCKDOWNS</u>	
Support - Mast Arm	Emergency or Final
Support - Strain pole	Emergency or Final
Span wire/tether wire	Final Only
Pedestal	Emergency or Final
Cabinet	Emergency or Final
Signal heads	Final Only
<u>EQUIPMENT FAILURE</u>	
Lamp burnout (veh. & ped.)	Final Only
Local controller	Emergency or Final
Master controller	Emergency or Final
Detector sensor	
Loop	Emergency or Final
Magnetometer	Emergency or Final
Sonic	Emergency or Final
Magnetic	Emergency or Final
Pushbutton	Emergency or Final
Detector amplifier	Emergency or Final
Conflict monitor	Final Only
Flasher	Final Only
Time clock	Emergency or Final
Load switch/relay	Final Only
Coordination unit	Emergency or Final
Communication interface, modem	Emergency or Final
Signal cable	Final Only

Exhibit B

RECORD KEEPING

Accurate and up-to-date record keeping is an essential component of a good traffic signal maintenance program. In recognition of this fact, the SUBDIVISION is willing to prepare, retain, and make available to the COMMONWEALTH, on request, a record of all preventative and response maintenance activities performed on the traffic signal equipment covered by this agreement.

The SUBDIVISION agrees to establish a separate file for each installation and keep its records in the municipal building, signal maintenance shop, or other weather protected enclosure.

As a minimum, the following records will be kept by the SUBDIVISION or its contractor for each intersection. These forms can be found in Section 10.0 Maintenance Forms, PA DOT Publication 191.

Form 1 - Master Intersection Record

This form, which lists all maintenance functions performed at the intersection, should be updated within one day of the activity but no more than one week later.

Form 2 - Response Maintenance Repair Record Sheet

Each time response maintenance is required at the intersection, this form is to be completed. Once the pertinent information is transferred to the master intersection record, this form is to be placed in the intersection file.

Form 3 - Preventative Maintenance Record

This form will be used to provide a record of the preventative maintenance activities performed at each intersection. The date, the activities performed, and the signature of the person in charge of the work must be recorded in the form.

This form may be kept at the intersection, if it is adequately protected from the weather. Form 1 must be updated at the central file, however, to reflect the date and activity.

Exhibit C

SIGNAL MAINTENANCE ORGANIZATION

Personnel Requirements

In order to properly maintain the traffic signal equipment covered by this agreement, the subdivision agrees to provide, as a minimum, the following staff throughout the useful life of the equipment:

	Classification	Number
1.		
2.		
3.		
4.		
5.		

Training

In order to upgrade the ability of its present staff to properly perform the required maintenance functions, the subdivision agrees to secure the following training for the listed personnel classifications.

	Classification	Training Required
1.		
2.		
3.		
4.		
5.		

Budget Requirements

The subdivision agrees to provide, in their annual operating budget, dedicated funds which are sufficient to cover the cost of the personnel, training, contractors (if utilized) and specialized maintenance equipment which are required, by virtue of this agreement.

Personnel Classifications

When referred to in this agreement, the following definitions will be used to describe personnel classifications as they relate to the maintenance and operation of traffic signal equipment.

- A. Traffic Engineer - The administrative position which has prime responsibility for the proper operation of all traffic signal equipment. The principal function of this position is the supervision and control of subordinate personnel and the planning of their activities to insure adequate preventative and response maintenance programs.

Minimum Position Requirements

1. A thorough understanding of traffic signal design, installation and maintenance.
2. A working knowledge of the interaction between the following traffic characteristics:
 - (a) Intersection geometry
 - (b) Traffic flow theory
 - (c) Control type (fixed time, actuated, etc.)
 - (d) Signal phasing and timing
 - (e) Signal intersection
3. An ability to supervise subordinate personnel effectively in the assignment of their work.
4. Possession of a college degree in engineering, which includes course work in traffic engineering.
5. Either four years experience in the field of traffic engineering or its equivalent in graduate college work.

B. Signal Specialist - The individual responsible for the diagnostics and repair of all traffic signal equipment including solid state equipment.

Minimum Position Requirements

1. Extensive training and troubleshooting skills in electronics and software.
2. Ability to repair modules in the shop and to design test equipment needed to diagnose and repair a problem.
3. Ability to make design and modifications to implement or omit special functions.
4. Ability to implement a record keeping system to include maintenance activities, inventory control and identification of recurring problems.
5. Ability to perform all tasks required of a signal technician.

- C. Signal Technician - Individual responsible for the operation and maintenance of traffic signals and electro-mechanical equipment.

Minimum Position Requirements

1. Ability to perform response maintenance on solid state equipment up to the device exchange level.
2. Capability to diagnose a vehicle loop failure and initiate corrective action.
3. Ability to tune detector amplifiers.
4. Ability to follow wiring schematics; check and set timings from plan sheets; and check all field connections.
5. Ability to perform preventative maintenance on all equipment and to maintain accurate records of all work performed.

9.0 CONTRACTOR SPECIFICATIONS

The following is an example of a specification for maintenance to be provided by a private contractor and as such its use would require modifications to reflect the specific requirements of the user.

GENERAL PROVISIONS

Work To Be Performed

The work to be performed shall include preventive and/or response maintenance at the locations listed.

New Installation, Increased or Decreased Quantities

Whenever the quantity of work is increased or decreased due to addition or deletions of installations, the Municipality will notify the Contractor in writing. This notification shall give the following information: (1) A description of the installation, unit or item to be added or removed, (2) the location of the installation, unit, or item, and (3) effective date of change.

Additional Awards of Contracts

The Municipality may undertake or award other contracts for additional work. The Contractor shall cooperate fully with such other contractors and Municipal employees and fit his own work to such additional work as may be directed by the Engineer. The Contractor shall not commit or permit any act which will interfere with the performance of work by any other contractor or by Municipal employees.

The Municipality also reserves the right to solicit and award contracts for the purchase of materials to be used by the contractor, when determined to be in the best interest of the Municipality. The contractor shall be allowed one (1) hour at the lowest Hourly Repair Charge rate for obtaining and transporting the materials from the municipal shop.

Inspection

The Municipality reserves the right to assign an inspector to the contractor's operation for the purpose of determining compliance with the specifications and maintaining records, including the time records for service charges. Any work or materials found to be substandard or not in accordance with the provisions of this contract, shall be repaired or replaced to the satisfaction of the Municipality at the sole expense of the contractor.

Work Performance

It shall be the contractor's responsibility to insure that he does not damage any material, equipment or structure during his operations. If the contractor damages any materials, equipment and structure, he shall repair or replace it to the satisfaction of and at no expense to the Municipality.

All electrical work shall meet the electrical regulations of all state and local codes and otherwise as contained in the latest edition of the National Electrical Code of the National Board of Fire Underwriters.

All work shall be performed in a neat and workmanlike manner. All material or equipment replaced, shall be held available for inspection by the municipality prior to disposal by the contractor.

Maintenance and Protection of Traffic

The maintenance and protection of traffic during the maintenance operation shall be the responsibility of the contractor in accordance with the Pennsylvania Department of Transportation Publication 203, Work Zone Traffic Control. The contractor will be allowed to close one (1) lane of traffic, when necessary to provide the service required under the proposal, between the hours of 9:30 AM and 3:30 PM Monday through Friday, except holidays.

Damaged Parts, Materials and Equipment

Surplus or damaged parts, materials or other equipment which are salvageable shall be taken by the contractor to a place designated by the Municipality unless indicated otherwise. Any damaged poles, broken concrete or other such materials that cannot be repaired shall be disposed of by the contractor.

Method of Payment

The method of payment shall conform to the type of maintenance performed as outlined in the agreement.

Transportation

The contractor shall be responsible for providing transportation. There shall be no additional charge for transportation.

Test Equipment and Tools

The contractor shall provide all the necessary test equipment and tools.

PREVENTIVE MAINTENANCE

Description of Work

Maintenance provided shall be as outlined in the Preventive Maintenance Summary. All records and documentation shall be maintained as part of the contract.

Materials Supplied

The contractor shall procure all material required for maintenance of the signal and control equipment.

Methods of Payment

The estimate of total maintenance cost (less material) submitted in the bid or prepared by the Municipality shall be paid monthly upon receipt of a detailed report of work performed.

A separate invoice detailing the material shall be submitted to the Municipality.

RESPONSE MAINTENANCE

Description of Work

The contractor shall designate in writing an emergency telephone number where he may be contacted concerning response on-call service. The contractor shall be on-call twenty four (24) hours seven (7) days a week including holidays, for the purpose of making repairs. When a system or installation is not in operation or illuminated due to equipment failure or external damage, an authorized person (Manager, Chief of Police, etc.) will notify the contractor of such failure. The contractor shall respond to correct the failure within a specified response time.

The response time for the contractor is classified into the following categories:

1. When notification is received between 7 AM and 4 PM Monday thru Friday. The response time shall be no more than one hour.
2. When notification is received any other time or day. The response time shall be no more than four hours.
3. When an emergency or dangerous situation exists, in which case the contractor shall immediately dispatch qualified personnel to eliminate such conditions.

The contractor shall restore normal operation in the field within 24 hours. In the event, the contractor is unable to restore normal operation in the field, substitute equipment shall be supplied at no additional cost to the Municipality until repairs to the existing equipment can be made.

The existing equipment shall be repaired and returned to the field in no more than fifteen (15) days.

All repairs and testing of the failed equipment shall be done by the contractor.

Complete record of the work performed and log-in sheet of the intersection shall be completed.

Material

All material for the repair shall be supplied by the contractor.

Method of Payment

Payment shall be made at the contract price per unit/hour for the respective item.

There will be a monthly service charge of _____ for the 24 hour on call service.

In addition there shall be a minimum service charge per call of 2 hours regardless of the actual time spent.

The service charge time shall include only that time spent in repairing or restoring the installation. No compensation will be paid for break periods or down time.

A detailed description of the work performed and a separate invoice detailing the material shall be submitted to the Municipality.

Penalties

If the contractor response time exceeds the time as outlined in the previous section, a penalty of _____ per each additional hour will be charged. If the contractor response time exceeds by 8 hours of the agreed upon limit, another contractor will be notified to repair the failed intersection at the expense of the original contractor. The Municipality shall deduct this amount from the contractor's monthly billing.

10.0 MAINTENANCE RECORD FORMS

The following are examples of forms that may be used to record traffic signal maintenance activities.

MASTER INTERSECTION RECORD

Intersection	Type of Maintenance (Check Type)			Work Performed by (Signature)	
	Date	PREVENTIVE	RESPONSE		DESIGN MODIFICATION
			Emergency		Final
1.					
2.					
3.					
4.					
6.					
7.					
8.					
9.					
10.					

RESPONSE MAINTENANCE RECORD

Instructions: Please fill in the blanks and/or check the appropriate answer(s).

Municipality: _____				
Location: _____	Location Number: _____	Date: _____		
Reported by: _____	AT: _____ AM _____ PM	Police Notified: _____ AM Yes No _____ PM		
Officer's Name and Rank: _____				
Reported Trouble: _____				
Weather Conditions: <input type="checkbox"/> Clear <input type="checkbox"/> Rain <input type="checkbox"/> Snow <input type="checkbox"/> Ice <input type="checkbox"/> Fog		Ambient Temperature: _____ °F		
Given to: _____ At: _____ AM _____ PM		Truck Number: _____		
Condition Found on Arrival: _____ _____ _____		Time of Arrival _____ AM _____ PM		
Work Performed: _____ _____ _____				
<table style="width:100%; border:none;"> <tr> <td style="width:50%; border:none;"> <input type="checkbox"/> 1. Lamp Out <input type="checkbox"/> 2. Detector Sensor Failure <input type="checkbox"/> 3. Detector Amplifier Failure <input type="checkbox"/> 4. Load Switch Failure <input type="checkbox"/> 5. Conflict Monitor Failure <input type="checkbox"/> 6. Timing Incorrect <input type="checkbox"/> 7. Signal Stuck <input type="checkbox"/> 8. Signal Out <input type="checkbox"/> 9. Lack of Progression <input type="checkbox"/> 10. Interconnect Failure <input type="checkbox"/> 11. Systems Masters Failure </td> <td style="width:50%; border:none;"> <input type="checkbox"/> 12. Power Failure <input type="checkbox"/> 13. Signal Damaged <input type="checkbox"/> 14. Pole Knockdown <input type="checkbox"/> 15. Controller Knockdown <input type="checkbox"/> 16. Guy Wire Down <input type="checkbox"/> 17. Span Wire Down <input type="checkbox"/> 18. Other _____ _____ _____ _____ </td> </tr> </table>			<input type="checkbox"/> 1. Lamp Out <input type="checkbox"/> 2. Detector Sensor Failure <input type="checkbox"/> 3. Detector Amplifier Failure <input type="checkbox"/> 4. Load Switch Failure <input type="checkbox"/> 5. Conflict Monitor Failure <input type="checkbox"/> 6. Timing Incorrect <input type="checkbox"/> 7. Signal Stuck <input type="checkbox"/> 8. Signal Out <input type="checkbox"/> 9. Lack of Progression <input type="checkbox"/> 10. Interconnect Failure <input type="checkbox"/> 11. Systems Masters Failure	<input type="checkbox"/> 12. Power Failure <input type="checkbox"/> 13. Signal Damaged <input type="checkbox"/> 14. Pole Knockdown <input type="checkbox"/> 15. Controller Knockdown <input type="checkbox"/> 16. Guy Wire Down <input type="checkbox"/> 17. Span Wire Down <input type="checkbox"/> 18. Other _____ _____ _____ _____
<input type="checkbox"/> 1. Lamp Out <input type="checkbox"/> 2. Detector Sensor Failure <input type="checkbox"/> 3. Detector Amplifier Failure <input type="checkbox"/> 4. Load Switch Failure <input type="checkbox"/> 5. Conflict Monitor Failure <input type="checkbox"/> 6. Timing Incorrect <input type="checkbox"/> 7. Signal Stuck <input type="checkbox"/> 8. Signal Out <input type="checkbox"/> 9. Lack of Progression <input type="checkbox"/> 10. Interconnect Failure <input type="checkbox"/> 11. Systems Masters Failure	<input type="checkbox"/> 12. Power Failure <input type="checkbox"/> 13. Signal Damaged <input type="checkbox"/> 14. Pole Knockdown <input type="checkbox"/> 15. Controller Knockdown <input type="checkbox"/> 16. Guy Wire Down <input type="checkbox"/> 17. Span Wire Down <input type="checkbox"/> 18. Other _____ _____ _____ _____			
Condition on Departure: _____ <input type="checkbox"/> Emergency Repair <input type="checkbox"/> Final Repair		Time of Departure: _____ AM _____ PM		
Parts Replaced or Repaired: _____ _____ _____				
Signature of Supervisor: _____		Signature of Repair Person: _____		

PREVENTIVE MAINTENANCE RECORD

Intersection _____		Maintenance Performed			
		Recommended Interval in Months			
		6	12	6	12
Task	Date				
Cabinet (per unit)					
• lubricate hinges and lock					
• clean filters					
• replace filters					
• check weatherproof seal (gasket)					
• check anchor bolts					
• check for water accumulation and duct sealant					
• check ground rod clamp and wire					
• check wiring schematics and records					
• check operation of fan and heater					
• check radio interference filter and lightning arrester					
• check circuit breaker					
• check ground fault receptacle					
• measure voltage at service inputs in cabinet					
• check and record current being drawn					
• repaint exterior (if originally painted)					
Signal Heads (per unit)					
• clean lenses, signs, and reflectors					
• replace lamps					
• check alignment					
• check for wear on the span wire, signal wire					
• check mast arms, free swinging signals, check clevis and chain					
• check for cracks or rust in the hardware					
• check for bent hoods, wing nuts, hinges					
• replace substandard parts					
• replace defective lenses and reflectors					
• check locking ring (surface); install proper locking devices as required					
• check condition of back plates (if used)					
• perform nighttime check for visibility					
• repaint exterior of signal (if originally painted)					
Mast Arms and Poles (per unit)					
• inspect for rust and spot paint as required					
• inspect joints for rust and cracks at arm/upright location and at base plate					
• inspect anchor bolts for rust and tightness					
• inspect horizontal and vertical angle of the arm					
• repaint exterior (if originally painted)					
Span Wire and Poles (per unit)					
• inspect poles					
• check span wire					
• check clamps and hardware					
• check guy wire, anchors, and guards					

PREVENTIVE MAINTENANCE RECORD - continued

Task	Date	Maintenance Performed			
		Recommended Interval in Months			
		6	12	6	12
Push Buttons (per unit)					
• check and actuate push buttons on each end of actuated crosswalks and visually verify pedestrian signal operation; verify timing					
• check push button lamp (if one exists) for operation					
• check push button signs; clean or replace if necessary					
• check push button sign alignment					
Detectors (per approach)					
Sensors					
• visually inspect roadway along loop detector saw cut for exposed wires, cracks, potholes, etc.					
• check alignment for sonic, magnetic, and radar-type detectors; verify call inputs to controller phases					
• check anchorage for pressure detector frame and contact units					
Amplifiers					
• check if the detector is detecting vehicles within its design zone of detection					
• tune the detector if necessary					
• check if the connectors are tight and secure					
Junction Boxes and Handholes (per unit)					
• check integrity of the splices					
• check the ground rod and clamp connection, and bonding of conduits					
• check the insulation					
• check for abnormal amount of water					
• check lid for abnormal condition and fit					
Electromechanical Control Equipment (per unit)					
Dial Assembly					
• check for wear on key follower					
• check for burned, pitted, or discolored contacts					
• check for key positions					
• check for cycle gear size and mesh					
• check dial motor operation					
• check all dials according to manufacturer's recommendations					
• if controller is part of a system, check offset					
• check duration of the advance pulse					
Cam Assembly					
• check for end play					
• clean and lubricate as required by manufacturer					

PREVENTIVE MAINTENANCE RECORD - continued

		Maintenance Performed			
		Recommended Interval in Months			
		6	12	6	12
Task	Date				
<ul style="list-style-type: none"> visually inspect for abnormal wear or cracks check for burned, pitted, or discolored contacts check spring tension on contacts check for loose wiring to contacts check for operation of advancing mechanism to conform with manufacturer's requirement check if all connections are secure and tight visually inspect wires for wear, rubbing, deterioration of insulation install dust cover as required 					
Relays					
<ul style="list-style-type: none"> check for burned, pitted, or discolored contacts check for tight and secure fit into the sockets for latch-type relays, check for latch operation per manufacturer's recommendations 					
Flashers					
<ul style="list-style-type: none"> check flash rate check operation check for burned, pitted, or discolored contacts check for tight and secure fit into the sockets 					
Switches					
<ul style="list-style-type: none"> verify operation of each switch position 					
Terminal Connections					
<ul style="list-style-type: none"> check visually for signs of corrosion or any abnormal condition tighten all terminal connections 					
Solid State, Analog, and Microprocessor-based Control Equipment (per unit)					
General					
<ul style="list-style-type: none"> check if the time settings match the master time sheet check if all indicator lamps on the modules are working; replace failed lamps check for extension by detector actuation check if modules are fitting tight and secure into the frame check if connectors are tight and secure wipe dust off controller, detectors, and auxiliary equipment 					
Conflict Monitor					
<ul style="list-style-type: none"> replace with bench-tested unit 					

PREVENTIVE MAINTENANCE RECORD - continued

Task	Date	Maintenance Performed			
		Recommended Interval in Months			
		6	12	6	12
Load Switches					
• check if load switch packs are fitting tight and secure into their chassis					
Auxiliary Logic					
• check operation					
Relays					
• check mercury relays (if used) for excessive splash					
Flashers					
• check if firm in socket; check on/off ratio and flash rate					
Switches					
• check for loose wires					
Terminal Connections					
• check for discoloration and tightness					
Interconnected Equipment (per unit)					
• check if controller operates in the mode selected by the supervisory master (i.e., time-based coordinator)					
• disconnect from the master supervisory system and check for "free" or backup operation					
• check any special equipment per manufacturer's recommendations					
Miscellaneous					
• record all changes in timing, wiring, or any function					
• periodically check electric bill for indication of leaky insulation					
• record current flow at unmetered installations					
		As required			
		As required			
		Monthly			
		As required			

Preventive Maintenance Record Codes

Code	Description
N	No maintenance function performed.
C	Visual inspection test and/or normal maintenance performed with no problems identified. Service at next regular interval.
P	Visual inspection and/or test performed. Problem identified and repair or replacement completed. Complete Preventive Maintenance Problem Record and schedule follow-up inspection within 30 days.
I	Visual inspection and/or test performed. Intermittent problem present but cause not identified. Complete Preventive Maintenance Problem Record and schedule follow-up inspection within 30 days.

11.0 TRAFFIC SIGNAL PERMIT

The following is an example of a Traffic Signal Permit which is issued by the Department to approve the installation and operation of a traffic signal.

As stated in the permit the Permittee assumes all liability for damages or injury occurring from faulty maintenance or operation of such traffic signal. Therefore, it is in the best interest of the Permittee to maintain the traffic signal to operate in accordance with all aspects of the permit and to keep adequate records of all maintenance activities regardless of how insignificant the activity may appear.

A copy of the current permit should be maintained on file and in the controller cabinet.

TRAFFIC SIGNAL PERMIT

PS 564 (5-80)



TRAFFIC SIGNAL PERMIT

Permit No. 12345
Sheet 1 of 2

In accordance with the Vehicle Code, the Secretary of Transportation hereby approves the installation and operation of a traffic signal at the intersection of Main Street and First Street

in the Municipality, County of Penn

This permit is issued to, and accepted by the Municipality

hereinafter known as the Permittee, as follows:

This installation shall be in accordance with the Vehicle Code and the Regulations for traffic signs, signals and markings of the Department of Transportation, and shall conform to the following requirements and those contained on the attached sheets.

Type of Controller Vehicular and pedestrian actuated

Type of Signal Mounting Post mounted and overhead

Hours of Operation as "Stop" and "Go" When not operating as flashing

Hours of Operation as "FLASHING" As indicated on the attached diagram

Controller Operation Controller to provide the phasing, timing and signal display indicated on the attached diagram

All work performed by the Permittee in the erection of the traffic signal shall be under and subject to the direction of the Secretary of Transportation or his authorized representatives. The said Permittee shall use due diligence in the execution of the work authorized under this permit and shall not obstruct or endanger travel along the said road. All operations must be conducted so as to permit safe and reasonable free travel at all times over the road within the limits of the work herein permitted.

The Permittee covenants and agrees to fully indemnify and save harmless the Department of Transportation and assume all liability for damages or injury, occurring to any person, persons or property through or in consequence of any act or omission of anyone working on the construction, or from faulty maintenance or operation of such traffic signal.

The Secretary of Transportation, by law, reserves the right to revoke and annul this permit if the Permittee shall at any time willfully or negligently fail to comply with the conditions contained in this permit, or, upon changes in traffic conditions, fail to make any changes in the construction or operation of this signal, or to remove it, when so ordered by the Secretary of Transportation; or if this installation is not in operation within twenty-four (24) months of the receipt of this permit. The Permittee shall maintain the signal in a safe condition at all times. The Permittee shall not make any change in the construction or operation of this traffic signal without prior written approval of the Secretary of Transportation.

This permit cancels and supersedes all previous permits issued for this location upon completion of the installation specified herein.

DATE October 9, 1987

APPROVED Sec'y. of Transp.
SECRETARY OF TRANSPORTATION

BY _____
 CHIEF, TRAFFIC ENGINEERING & OPERATIONS DIVISION
BUREAU OF HIGHWAY SERVICES
 DISTRICT ENGINEER

