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RoadTTAP Talk

Traffic Signal Maintenance

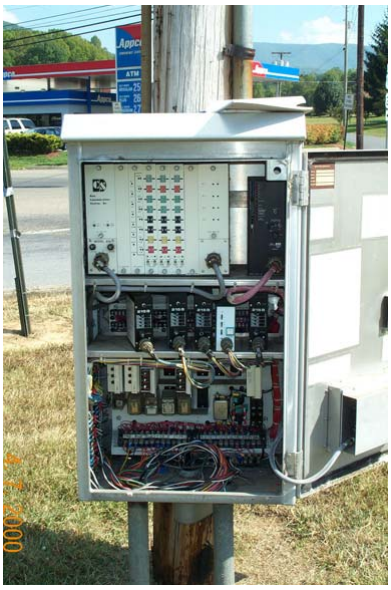
(This article has been updated by Dr. Tom Urbanik, Department of Civil & Environmental Engineering, University of Tennessee. The original article by Fred Orcutt and Darcy Sullivan was published in the 1992 Special Edition of RoadTalk.)

If well designed traffic signals are to succeed in continuing to provide safe and efficient traffic flow, they must be well maintained. Maintenance requires a well trained staff within the operating agency or well-trained contractors who adhere to a well organized maintenance programs. There are three types of maintenance: preventative, responsive and design modification. The goal of a preventive maintenance program is to keep responsive maintenance to a minimum. Design modification is necessary to address changing needs.

Preventive Maintenance

Preventive maintenance is a set of checks and procedures performed at scheduled intervals. It includes inspections, cleaning, replacements based on rated service life of various components, and documentation of work performed. The object of preventive maintenance is to detect and correct potential problems and actual failures that may have gone unreported. This type of maintenance pays dividends in three ways:

- by maximizing proper operation of the traffic signals,



the motoring public actually receives the full benefits of the traffic signals;

- by reducing trouble calls overall traffic signal maintenance costs are reduced; and
- finally, reducing complaints and adverse reactions from citizens that result from malfunctioning equipment and defects that often go undetected and unreported for long periods.

Preventive Maintenance Check Lists

The Institute of Transportation Engineers (ITE) has prepared a detailed checklist suggesting specific tasks to be included in a preventive maintenance program and recommended service intervals for each task. Exhibit 1 illustrates some of the items.

System Timing Maintenance

In addition to the previously described physical maintenance, there are two timing items that require regular and scheduled attention: the timing plan and the updating of time clocks.

The timing plan installed in the controller should be checked against the timing records kept in the cabinet at least twice a year. If discrepancies are identified, a cooperative effort between the operations engineer and the

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RoadTalk is a publication of the Tennessee Transportation Assistance Program (TTAP). TTAP is part of a nationwide Local Technical Assistance Program (LTAP) financed jointly by the Federal Highway Administration (FHWA) and Tennessee Department of Transportation (TDOT). Its purpose is to translate into understandable terms the latest state-of-the-art technologies in the areas of roads, bridges, and public transportation to local highway and transportation personnel.

The views, opinions, and recommendations contained within this newsletter are those of the authors and do not necessarily reflect the views of FHWA and TDOT.

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From the Director

I hope this message finds all of you well. I've just returned from my annual trip to the Transportation Research Board (TRB) Annual Meeting in Washington, DC. There's nothing like a week in Washington in January to make you appreciate Tennessee weather! For those of you that haven't attended, the TRB meeting is a huge event attended this year by 10,400 transportation professionals representing public agencies, universities, engineering and contracting firms, transportation companies, and a galaxy of other organizations having some interest in transportation.

TRB's mission is "to promote innovation and progress in transportation through research." Many approaches and practices that we employ were developed and perfected through TRB sponsored research. A major focus of the annual meeting is the presentation of research results and findings on a host of topics ranging from pavements to drainage to traffic operations. TRB also provides publications and workshops to promote the migration of research findings into practice.

This technology transfer process is an essential part of research. To be of practical value, research results must be taken from the laboratory, turned into usable products, and passed on to practitioners. All too often, research results languish because these key steps are never performed.

Centers like TTAP serve a key function in technology transfer. We take research results generated by federal, state, and university laboratories and help you to make practical use of them. I am happy to say that TTAP has recently developed a formal technology transfer relationship with the Southeastern Transportation Center (STC), the federally funded Region 4 University Transportation Center comprising the University of Tennessee and 9 other southeastern universities. As the STC theme is "Comprehensive Transportation Safety," most of the center's research is safety focused. As safety is a high priority on our local roads, we believe that partnership with STC will be productive.

As always, our mission at TTAP is to help you. Please feel free to contact us for technical assistance, training, or information.

Partial Preventative Maintenance Checklist (#)				
Task	Recommended Interval			
	Months			Years
	3	6	12	2 to 5
Cabinet				
*Clean filters		X		
*Replace filters			X	
*Check operation of fan and heater	X			
*Repaint exterior (if originally painted)				X
Signal Heads				
*Clean lenses, signs, and reflectors			X	
*Check LED/Replace lamps			X	
*Check alignment		X		
*Replace defective lenses and reflectors		X		
*Check for wear on the span wire, signal wire and mechanical hardware (clevis pins, clamps, etc.)		X		
*Repaint exterior of signal (if originally painted)				X
Detectors (per approach)				
Loop Sensors *Visually check roadway along loop saw cut for exposed wires, cracks, potholes, etc.		X		
Loop Amplifiers *Check if the detector is detecting vehicles within its design zone of detection		X		
*Clean/ Align Video Detection		X		
Solid State, Analog, and Microprocessor based Control Equipment				
*Replace CMU/MMU with bench certified unit			X	
Verify controller timing		X		

#The tasks included in this list and the recommended time intervals are taken from the *Traffic Signal Installation and Maintenance Manual* published by the Prentice-Hall, Inc., (1989) and available from Institute of Transportation Engineers, with minor additions to reflect technology changes. That Manual should be consulted for a complete list of tasks for a preventive maintenance program and a method of estimating the costs and resources needed to implement such a program.

signal maintenance technicians will probably be necessary to determine whether the discrepancy is due to incorrect settings or adjustments due to trouble calls (e.g, hardware problems or detection issues) or complaints.

Time clocks, program timers and computer system schedulers all need to be updated periodically to reflect changes to and from daylight savings time, changes in the operation of special event generators, the start and end of school, school holidays, special holidays and special shopping days. These activities should be started well enough in advance to allow for the need to do more work than anticipated without creating crises. Calendars should be marked to this effect at the beginning of each year so the activity will not "slip up" on the engineering and maintenance staffs unexpectedly.

Corrective or Response Maintenance

Response maintenance is the repair of failed or damaged traffic signal equipment and its restoration to safe, normal operation — if it breaks, fix it! There are several guidelines that are appropriate in this context.

To minimize potential liability claims each agency should establish a problem identification, notification and response process based on the agency's organizational structure and capabilities. The process should consider the elements discussed below.

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Build a Crashworthy Work Zone Sign Stand

by Lloyd H. Rue. Design-Safety-Traffic Engineer, Federal Highway Administration, Helena, Montana
(Article reprinted with permission from Montana LTAP Matters, Winter 2007)

Where there are cars, there will be collisions. When there are collisions, people will get hurt.

How do we lessen the chances of injuries when there are collisions with sign stands in our work zones?

We make sign stands 'crashworthy.' Once upon a time, work zone devices were not held to a crashworthy standard. Crashworthy work zone devices now, and for the last decade, follow an industry standard.

Making a crashworthy device can be complicated. The ultimate proof for a crashworthy device is testing at highway speeds with test vehicles. One test criteria examines whether there is an intrusion into the occupant compartment. A gaping hole in the windshield, for example, would cause the test to fail.

Crash-testing a work zone device (TTI).

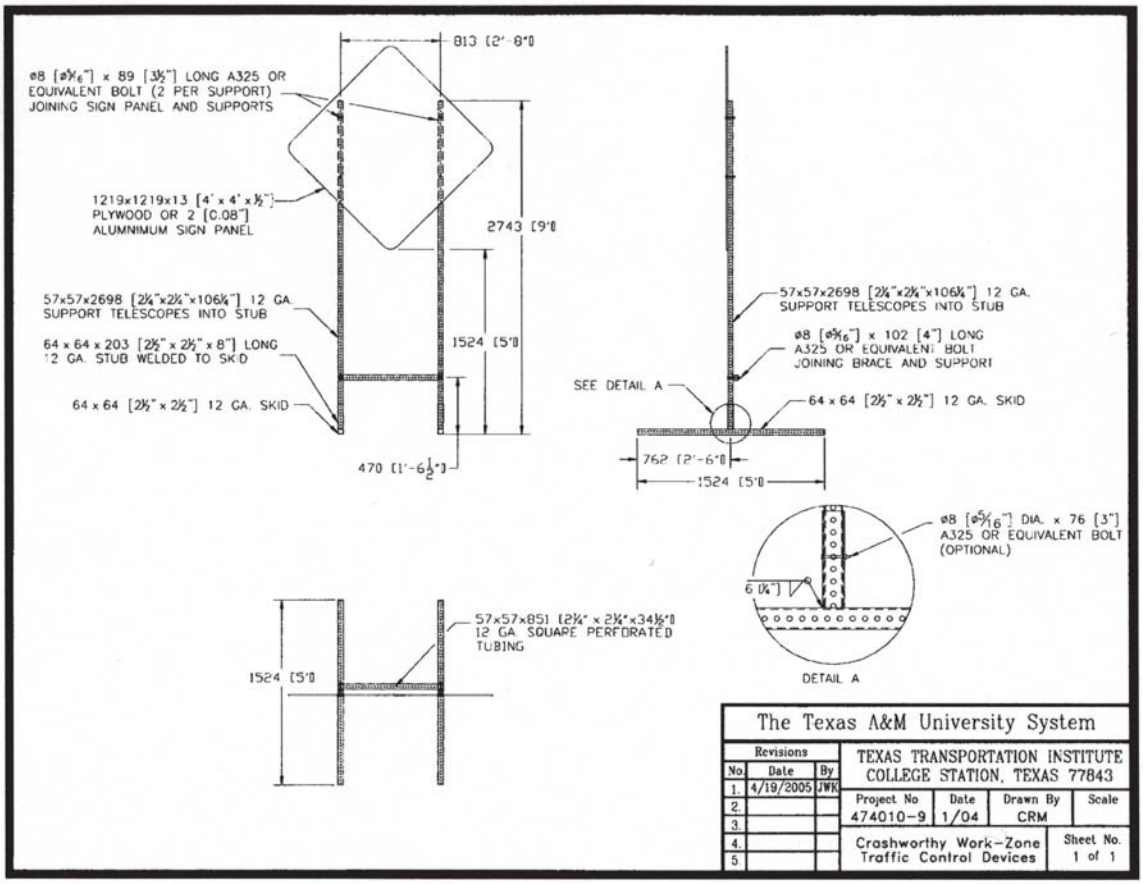

Figure 9.8. Details of the strong dual-upright sign support system with sign panel mounted at a height of 1.5 m (5 ft).

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Numerous types of crashworthy sign stands can be purchased from suppliers. Often these sign stand designs are patented. Patented or proprietary devices usually are more costly than those fabricated in a local shop.

There is a crashworthy, non-patented sign-stand design that uses commonly available materials – thanks to some recent research. The sign-stand design (among other devices tested) is outlined in a research report from the National Cooperative Highway Research Program, *Report 553: Crashworthy Work-Zone Traffic Control Devices*. And, the Federal Highway Administration issued an acceptance letter on the device (September 8, 2006, WZ-240).

The following figures show the basic dimensions and components for the design. One figure shows dimensions for a 5-foot mounting height, while the other figure shows dimensions for a 7-foot mounting height. Either plywood or aluminum sign substrates may be use.

If you need new sign stands for your county or city crews, here is a non-patented design that you can use.

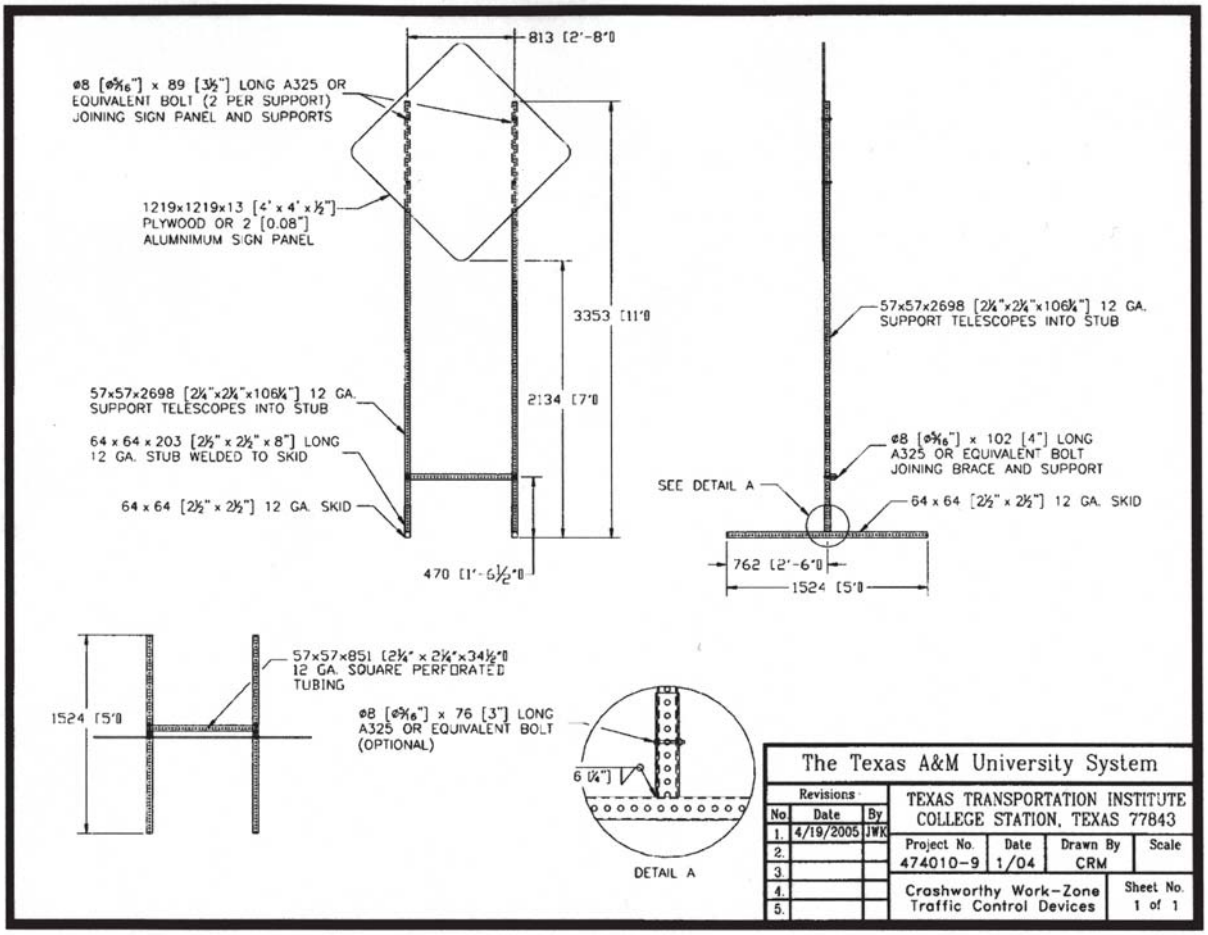

Figure 9.9. Details of the strong dual-upright sign support system with sign panel mounted at a height of 2.1 m (7 ft).

Education and training opportunities are available through the University of Tennessee Center for Transportation Research (CTR), Southeast Transportation Center (STC), and Tennessee Transportation Assistance Program (TTAP). This listing of courses currently available includes both TTAP and TATE courses that are offered in conjunction with the University of Tennessee Department of Civil and Environmental Engineering and the Tennessee Section of the Institute of Transportation Engineers. Local roadway departments can benefit from all of the workshops. Because of this, we ask that you please share this listing with others who might be interested in our workshops. The Center for Transportation Research is always eager to meet your research and training needs. If you have a special course in mind or would like a course held on site especially for your employees, please contact Wilma Wilson at 1-800-252-ROAD.

***CEU and PDH credit hours available.**

Workshop	Date/s	Locations	Instructor/s
Railroad Track Inspection and Safety Standards	Mar 12-16	Knoxville	Dave Clarke
Work Zone Traffic Control/Flagging	Mar 12	Nashville	Frank Brewer
Work Zone Traffic Control/Flagging	Mar 15	Jackson	Frank Brewer
Designing Streets for Bicyclists & Pedestrians	Mar 19-20	Knoxville	Michael Ronkin/ Michael Moule
Work Zone Traffic Control/Flagging	Mar 22	Knoxville	Frank Brewer
TMOST(Tractor/Mower Operator Safety Training)	April 2	Jackson	Jim Green
TMOST(Tractor/Mower Operator Safety Training)	April 3	Nashville	Jim Green
TMOST(Tractor/Mower Operator Safety Training)	April 4	Knoxville	Jim Green
TMOST(Tractor/Mower Operator Safety Training)	April 5	Chattanooga	Jim Green
Signs & Pavement Markings	April 17	Knoxville	Matt Catt
Drainage Rehabilitation	April 18	Knoxville	Dave Clarke
Drainage Rehabilitation	April 19	Nashville	Dave Clarke
Traffic Access Management & Site Impact	April 20	Nashville	Dave Clarke
Design of At-Grade Intersections	April 30	Nashville	Alan Childers
Roadway Drainage	May 1	Knoxville	Dave Clarke
Timber & Steel Railroad Bridge Inspection, Maintenance and Safety	May 16-18	Knoxville	Richard Bennett/ Dave Clarke
Work Zone Traffic Control/Flagging	May 18	Johnson City	Frank Brewer
Urban Uses of Concrete	Jul 31	Nashville	Various
Urban Transportation Planning	Sep 6-7	Nashville	Dave Clarke
Signs & Pavement Markings	Sep 12	Jackson	Matt Catt
Work Zone Traffic Control/Flagging	Sep 17	Jackson	Frank Brewer
Work Zone Traffic Control/Flagging	Sep 19	Nashville	Frank Brewer
Work Zone Traffic Control/Flagging	Sep 20	Chattanooga	Frank Brewer
GeoTech Design/Earthwork: What makes a Good Sub-grade	Oct 4-5	Nashville	Eric Drumm
Design of At-Grade Intersections	Oct 15	Knoxville	Alan Childers
Drainage Rehabilitation	Oct 30	Jackson	Dave Clarke
Introduction to Geometric Design	Nov 13	Nashville	Matt Catt
Pavement Rehabilitation	Nov 27	Nashville	Dave Clarke

11th Southeast Local Roads Conference (May 13-15, 2007)
Orange Beach, Alabama.
Contact: Alabama Technology Transfer Center (Tel: 334-844-4370)

Citizens, police patrol or agency employees usually identify signal problems. The notification procedure should provide for input from all of these sources. A record keeping system must be established to document the source, nature, time and disposition of all reports.

Problem severity cannot usually be determined from the original complaint. Unless the report comes from the police or other source of known reliability, a trip to the site may be required to verify the problem and establish problem severity. Maintenance personnel should take the time to thoroughly investigate the complaint and diagnose the trouble. Personnel should be very hesitant about reporting "nothing wrong" without adequate investigation. The elapsed time from notification to initial response and verification should not exceed one hour.

Following verification, decide on an appropriate action — either an emergency repair or final repair depending on the nature of the problem. Establish a chain of command in advance to avoid any confusion or delay in making a decision to take action. Select the method of repair based on the capability of the maintaining agency. Demonstrate "responsible" action.

Correct all identified problems, if possible, before leaving the site. Actions necessary to return the intersection to ''reasonably safe" operation should be completed before the intersection is left unattended. If basic signal operation cannot be restored, consider placing the intersection on flash, installing temporary STOP signs, or leaving the intersection under police officer control. Never leave a traffic signal in a state which may result in unsafe operations.

Completing a final repair restoring the intersection to operation in accordance with the original permit or specifications within 24 hours is always the objective. If a final repair is not possible, complete an emergency repair restoring the intersection to safe operation within the same 24 hour period. Establish a schedule to complete final repairs within 30 days.

A responsible program will call for the review of all completed work orders at least weekly to identify and schedule work that may require additional attention and to identify repeat calls to the same location. At least twice a year, this same review should be conducted by a signal engineer using a sample month's work orders. All locations with repeat calls should be thoroughly checked by a senior technician, because there will often be a subtle or intermittent failures that require attention. If not detected and repaired, such failures can result in accidents and in unnecessary tort liability.

Design Modification

Design modifications include timing changes, phasing changes, detection upgrades, controller upgrades, and the addition of coordination. As traffic conditions change the original design may become obsolete, making design modifications desirable. The need for a left turn phase, for example, may require an extensive investment to reduce delay and or improve safety. Identifying the need for these types of changes should be a part of the overall maintenance program.

LED Signals

LEDs are now required for all new traffic signals. While these indications last longer, they deteriorate over time. Develop a maintenance schedule to replace these indications before they deteriorate to an unacceptable level of light output.

Record Keeping

Good record keeping is one of the critical aspects of maintenance. It helps to assure that operation is consistent with overall objectives to identify problems needing attention, to protect the agency in the case of a lawsuit by demonstrating good practice. The following are the types of records that should be maintained:

- Master Record – A master log of all service calls listing the date, type of maintenance performed, and signature(s) of the maintenance personnel performing the work;
- Preventive Maintenance Record – A log for each preventive maintenance service call of the date, tasks performed, and signature(s) of the maintenance personnel performing the work; and
- Response Maintenance Record –A complete record for each call, notifications details, prevailing conditions, work performed, parts replaced or repaired, time and condition on departure, and the signature(s) of the maintenance personnel performing the work.

Conclusion

An effective signal maintenance program will reduce overall costs, reduce motorist frustration, and protect against costly liability resulting from lawsuits.

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TALK TO TTAP

We are always looking for your comments, ideas and suggestions to help make the TTAP Program more useful to you. Please fill out and fax the form below to TTAP at (865) 974-3889 or mail to TTAP; Suite 309 Conference Center Building, Knoxville, TN 37996-4133.

1. Please send me more information on the following articles mentioned in this newsletter.

_____
_____
_____

2. Please list any additional training workshops you would be interested in attending.

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3. Please list topics for videos you would like TTAP to obtain.

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4. Please list any other ideas or suggestions on how TTAP could assist you.

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