STATE OF CALIFORNIA—BUSINESS, TRANSPORTATION AND HOUSING AGENCY

DEPARTMENT OF TRANSPORTATION
ENGINEERING SERVICE CENTER
Transportation Laboratory
5900 Folsom Boulevard
Sacramento, California 95819-4612

METHOD OF TEST FOR FUNCTION AND PRE-INSTALLATION INSPECTION OF TRAFFIC SIGNAL SYSTEMS

A. SCOPE

The general procedure and equipment to be used in the evaluation of traffic signal equipment prior to field installation are described in this method. All inspection and testing procedures outlined in this test method are only a guideline to those necessary to assure compliance with contract specifications. Some of these procedures may be superseded by the contract specifications and plans or by later editions of the Standard Specifications. It is of the utmost importance that the Standard Specifications, contract special provisions, and contract plans be completely understood before contract specification testing is done.

B. REFERENCES

California Standard Specifications
California Test 667

C. APPARATUS

1. Electric stop clock capable of measuring accurately time lapse of 0.01 second and greater for manually monitoring of events.

2. Necessary cabling and connectors to interconnect the monitoring devices to the system under test.

3. Variable voltage source capable of supplying adequate AC power for the system under test. This supply shall be variable from 110 v. AC to 130 v. AC.

4. Transient test equipment per latest California Test 667.

5. Equipment to measure resistance, AC and DC currents and voltages.

6. Lamp load rack.

D. CONTROL FACTORS

1. Perform this test method in a suitable area specified by the Transportation Laboratory, or their designee, where controlled conditions can be maintained.

2. Perform all tests in this test method while the unit is being supplied with a voltage source of 120 volts ± 5 volts, 60 Hz, in an ambient temperature of 75°F ± 5°F. Also, test for satisfactory operation at the voltage extremes specified in the contract specification.

E. TOLERANCES

All tolerances which are not definitely stated in the Standard Specifications or Special Provisions are assumed to be those tolerances used by ASA, NEMA, ASTM and other regulations and codes as stated in Section 86-1.02 of the Standard Specifications, applicable to the unit under inspection.

F. INSPECTION

The visual and physical inspection shall include mechanical, dimensional, and assembly conformance of all parts of the Specification which can be checked visually or manually with a simple measuring device.

1. Check the equipment received against the invoice. Notify vendor of any shortages immediately.

2. Obtain the contract specifications and reduced plans. Check plans and specifications to verify that all the required equipment, manuals, schematics, etc., have been submitted.

3. Visually and physically check all the equipment (cabinet, manuals, schematics, modules, printed circuit boards, conductors, cabling, etc.), for compliance with the contract specifications. Use the "Traffic Signal Controller Check List", Figure 1, as the basic list and add the unique features specified in the contract special provisions and plans.

4. Arrange and connect the equipment in the cabinet as shown in the cabinet layout diagram. Check for blocked or stacked equipment. Check for ease of using controls and ease of equipment removal.

G. TESTING

The testing for compliance with contract specifications shall include electrical characteristics such as capacity, sensitivity, power consumption, etc., and operations and functions such as phasing sequences, timings, standard and auxiliary functions, etc. Figures 2 is provided as a reference for tstes to be performed and Figure 3 is a sample for logging data.

1. After arranging and connecting the equipment as shown in the cabinet layout diagram, connect lamp loads of 25 watts or more to each signal output load switch to simulate signals at the intersection. At least one load switch in each cabinet should be tested loaded with 1,000-watt incandescent lamps.

2. Place the main switch in the cabinet to the "Off" position.

3. Make certain that the proper polarity and the specified power is connected to the cabinet main power terminals. Turn the main switch "On".

4. Check every switch (power switches, flash switches, push buttons, etc.) by actuation to verify proper operation.

5. Check the cabinet light and fan for proper operation.

6. Check the convenience outlet for proper polarity.

7. Set the timing adjustments to some convenient values. Place "recall switch" on all traffic and pedestrian phases. Check to see if the phase sequencing is as specified.

8. Connect the transient test unit to the cabinet power input and test according to California Test 667, "Method of Test for the Power Line Transient Susceptibility of Traffic Control Systems".

9. One at a time, remove and replace the controller fuses (AC and DC), the conflict monitor fuse, the railroad preemptor fuse, and fire preemption fuse. The intersection should go into flashing operation after each fuse removal.

10. Turn off the cabinet power for more than 1.0 second, then turn the power back on. The controller should start in phase A yellow change interval and calls shall be placed on all phases.

11. Turn the cabinet power off for less than 0.5 second, then turn the power back on. The controller should continue to operate in cyclic operation and shall retain all actuations registered prior to power interruption.

12. Place the controller in flashing operation by the "Signal-Flash" switch in the police panel. The controller should stop-time when the cabinet stop-time switch is on the "flash" circuit.

13. Place the "intersection" on flashing operation by the internal "Signal-Flash" switch. The phasing and indication should be as specified. The controller should not be stop-times.

14. Test the "Monitoring Device" by simulating every possible conflicting phase indication as follows:

    a. Remove all recalls. Place a call on phase to be tested. Wait until phase to be tested rests in green. Apply 120 volt rms directly to a conflicting phase green load switch output. Apply the conflict for 200 ms or less; controller shall operate normally. Apply conflict for 500 ms or greater; the conflict monitor shall put the signal system on flash.

    b. Repeat 14 (a), except use 25 volts rms.

    c. Repeat 14 (a), except use a diode in series with the line to apply half wave voltage. Make certain that the conflict monitor operates with positive and negative halfwave.

    d. Repeat 14 (a), except use 14 volts rms. The controller shall operate normally regardless of the conflict duration.

15. Timings: Remove "recall switches", and place vehicle and pedestrian calls manually to simulate intersection traffic patterns. Check and record all the timings on the timing form. Check that all the measured timings are within specified tolerances. All the indicating lamps should be operating. Repeat the

timing tests with several of the timings set at the lower and the upper extremes. The timing measurements should be made at the lamp load whenever possible.

a. Minimum Initial Portion: Place a vehicle call on a phase and time the minimum initial portion.

b. Yellow Change Interval: Place a vehicle call on a phase and time the yellow change interval.

c. Red Clearance Interval: Place vehicle calls on conflicting phases and time the red clearance interval.

d. Computed Initial Portion: Place appropriate number of vehicle calls during the red interval of the phase to be timed. While checking the computed initial portion, place an opposing vehicle call so that the phase being tested does not go to rest condition.

e. Rest Condition: Check to see that the initial portion is followed by a "rest condition" in the absence of an opposing call.

f. Pedestrian Period: Place a pedestrian call and check the "Walk" and the flashing "Don't Walk" periods. Also, at this time, check to see if the pedestrian period overrides the initial period, repeats without change in vehicle indication when there are no opposing calls, and is not extended by successive actuations.

g. Unit Extension: Place a constant call on the phase being tested until "Initial" has timed out, then place an opposing call. Remove the continuous call and simultaneously time the remaining green period.

h. Reducible Unit Extension: Disable "guaranteed passage time" if provided. Set some convenient timings. Place a constant call on the phase being tested. After initial has timed out, place an opposing call. Wait for a convenient time. Remove the continuous call from phase being tested, and simultaneously time the remaining green interval. Also, verify that a call is placed to return to the phase being tested. Note: Follow manufacturer's instructions for making calculations.

i. Maximum Limit: Place a continuous call on the phase being tested. Place an opposing call. The total green interval for the phase being tested should be equal to the "maximum limit" time setting. Also, verify that a call is placed to return to the phase being tested.

16. Memory Feature:

a. Pedestrian Actuations: Place a pedestrian call on the phase to be tested during steady "Don't Walk" indication. Call shall be remembered and the pedestrian phase shall be answered. Place a pedestrian call during flashing "Don't Walk" indication. The call should be remembered and answered in the normal phase sequence.

b. Vehicle Actuation: Place a vehicle call during yellow indication of the phase being tested. The call shall be remembered and answered in the normal phase sequence. Place a vehicle call during red indication of the phase to be tested. The call shall be remembered and answered in the normal phase sequence. Disable the memory circuit on all phases. While an opposing phase is timing "initial" place a vehicle call on the phase to be tested. Verify that if the vehicle call is removed while the opposing phase is timing "initial" the controller will not answer the call. Also, verify that if the call is kept until the opposing phase enters the clearance interval, the controller answers the call.

17. Recall: Place all the pedestrian and vehicle recall switches in the "Off" position. The phase sections shall function normally with the right of way being granted only upon a vehicle or pedestrian actuation, or both.

    a. Minimum Recall: Place all vehicles' "recall" switches in the "Minimum Recall" position. Note that the controller sequences appropriately through each phase with a green time equal to "minimum initial portion".

    b. Maximum Recall: Place all vehicle "recall" switches in the "Maximum Recall" position. Note that the controller sequences appropriately through each phase and the green time is equal to "Maximum Limit".

    c. Pedestrian Recall: Place all vehicle "recall" switches in the "Off" position. Place all pedestrian "recall" switches to the "On" position. Note that each pedestrian phase is being answered through normal controller sequence.

18. Manual Circuit: If hand control is supplied, use the hand control to advance the controller through intervals in compliance with the specifications. Also, make the necessary connection on the "manual circuit" terminals per manufacturer's instruction. Advance the controller through various intervals by applying the required signal to "manual circuit" terminal.

19. Stop Timing: Make the necessary connection to the "Stop Timing" terminals per manufacturer's instructions. Test the stop timing function for compliance with specifications by applying the required signal at all timing intervals.

20. Hold: Make the necessary connection to the "Hold" terminals. Test the hold function for compliance with specifications by placing an opposing phase on recall and applying the required signal at every green and pedestrian timing interval.

21. Special Termination or "Force-Off": Make the necessary connections to the "Force Off" terminals per manufacturer's instructions. Test the "Force-Off" function by applying the required signal at all timing intervals. Check the operation for compliance with specifications.

22. Check Circuit: Make the necessary connections to the "check circuit" terminal per manufacturer's instructions. Place a continuous vehicle call on the phase that is being tested. Check for signal on the "check circuit" terminals. Also, test for "check circuit" indication by placing pedestrian call on the phase under test.

H. SPECIAL FEATURES

1. Mutual Coordination: When "mutual coordination" has been provided, make the necessary connection between the two controllers. Place a side street call on one of the controllers. Note that both controllers terminate the main street green simultaneously, provided the minimum green has been timed out on both intersections.

2. Dual Maximum Green Period: When "Dual Max" has been provided, make the necessary terminal connection per manufacturer's instructions. Set the "Max 1" timing different from the "Max 2" timing. Apply the required signal to the terminal. Place a continuous vehicle call on the phase being tested, then check to make certain that "Max 2" is timing when signal is applied and "Max 1" is timing with the signal removed.

3. Omit Skip: When "Omit Skip" feature is provided, make necessary terminal connection per manufacturer's instructions. Apply the required signal to the terminal, place a call on a phase not in the normal sequence, and verify that the controller does not skip the phase next in the normal sequence.

4. Omit All-Red: When "Omit All-Red" feature is provided, make the necessary terminal connections per manufacturer's instructions. Apply the required signal and observe that the all-red clearance feature is omitted.

5. Selectable Semi-Actuated Mode: When "Selectable Semi-Actuated" feature is provided, make the necessary terminal connections per manufacturer's instructions. Apply the required signal to the terminal. Observe that the phase under test is performing as a non-actuated phase and that the controller performs in compliance with specifications.

6. Detector Switching: Place the detector switching control to the "On" position. Place continuous calls on both phases (opposite direction on same road) provided with the detector switching feature. Place an opposing phase on recall. When the extension interval is being timed, remove the call from one of the phases. Observe that the green is not terminated due to gap sensing. Remove the call from the opposite direction. Observe that both phases terminate green due to gap sensing. Again, place continuous call on both phases with detector switching feature. When the extension interval is being timed, remove the call from one phase, then place the call back and remove the call from the other phase. Observe that as long as there is a call on one phase, the other phase does not terminate the green except by maximum time limitation.

7. Calling Detectors: When calling detectors are provided, place a call through that detector during the associated green intervals. Observe the indicator light to determine that a call is not being placed to the controller. Also, place a call during yellow and red interval and verify that the call is answered.

8. Railroad Preemption: When railroad preemption is provided, make the necessary terminal connections per manufacturer's instruction. Apply the required signal to the terminal during every timing interval of every phase. Verify that the sequence of the railroad preemption operation is in accordance to the specifications. Verify that vehicle and pedestrian calls are placed on all phases. Verify that all the calls

remain locked in until a green indication has been given for that vehicular or pedestrian phase. Also, verify flashing operations due to conflict are not preempted.

9. Fire Preemption: When fire preemption is provided, make the necessary terminal connections per manufacturer's instructions. Apply the required signal to the terminal during every timing interval of every phase. Verify that the sequence of the fire preemption operation is in accordance to the specifications. Verify that vehicle and pedestrian calls are placed on all phases. Verify that all the calls remain locked in until a green indication has been given for the vehicular or pedestrian phase. Also verify flashing operation due to conflicts are not preempted.

11. Manual Phase Selector: When manual phase selector is provided, turn the manual phase selector control on. Verify that all pedestrian push button and vehicle detector inputs are disconnected. Select every vehicle and pedestrian phase and observe that the controller unit times the programmed clearance timings before advancing to the selected phase. Also, note that the indicator lights provided for manual phase selector operate only during manual phase operation.

I. HEALTH AND SAFETY

It is the responsibility of the user of this test method to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Prior to handling, testing or disposing of any materials, testers must be knowledgeable about safe laboratory practices, hazards and exposure, chemical procurement and storage, and personal protective apparel and equipment.

Caltrans Laboratory Safety Manual is available at: correlate

http://www.dot.ca.gov/hq/esc/ctms/pdf/lab_safety_manual.pdf

Users of this method do so at their own risk.

End of Text
(California Test 658 contains 12 pages)

Test No. _____
Contract: _____
Date: _____

A. Cabinet

1. Type
2. Keys
3. Doors
4. Finish
5. Fan
6. Special features

B. Conductors

1. Size
2. Cabling
3. Insulation

C. Terminal Strips

1. Type
2. Capacity
3. Voltage rating
4. Terminal wiring

D. RFI Suppressors

1. For flashers
2. For load switches
3. For flashing beacons
4. For other current interrupting devices

E. Switches

1. Type
2. Capacity
3. Labeled

F. Circuit Breakers/Fuses

1. Voltage rating
2. Current rating
3. Labeled

FIGURE 1. Traffic Signal Controller Check List

G. Relays

1. Type
2. Base type
3. Coil VA rating
4. Capacity
5. Keyed mounting
6. Labeled

H. Load Switches

1. Type
2. Capacity vs. load
3. Base
4. Keyed
5. Labeled

I. Flasher

1. Type
2. Capacity vs. load
3. Flash rate
4. Dwell (percent)
5. Labeled

J. Controllers

1. Type
2. Phases
3. Indicators
4. Connectors
5. Modules
6. Keyed mounting of modules
7. P. C. boards
8. Quality of Parts
9. Soldering
10. Accessibility of controls
11. Workmanship
12. Board contact pin plating
13. Timing ranges
14. Overlay harness
15. Specified functions brought out
16. Specified functions control equipment
17. Will emergency control equipment fit in cabinet and function properly?
18. Modules labeled

FIGURE 1. Traffic Signal Controller Check List (cont.)

K. Arrangement

1. Equipment stacked
2. Equipment blocked
3. Ease of equipment removal

L. Detectors

1. Type
2. Plug connection
3. Pulse mode
4. Presence mode

FIGURE 1. Traffic Signal Controller Check List (cont.)

A. Detectors

1. Pulse length
2. Presence hold time

B. Controller

1. Specified phasing
2. Various timings
3. Indicators
4. Pedestrian phase
5. Auxiliary functions and interconnects
6. Flash mode
7. All possible conflicts for fail-safe
8. Rail and fire preemption interruption with every function and phase
9. Load switches at 1,000 watts
10. Flashers at capacity
11. Interrupted power test
12. Positive and negative 300-volt transient test with all functions and phases
13. Timings and operation at input voltage of 105 and 130 VAC
14. Fail-safe trip voltage

FIGURE 2. Operational Testing

Test No. _____ Date: _____

Manufacturer _____

Equipment _____

Temperature _____ Voltage _____

Timing _____

Setting	∅1	∅2	∅3	∅4	∅5	∅6	∅7	∅8	
									Initial
									Yellow
									Passage
									Added Initial
									Cars Before
									Max.
									Time Wait
									Gap
									All Red
									Walk
									Ped. Clear
									Max. Initial

Force Off _____

Hold _____

Manual _____

Stop Time _____

Semi Mode _____

Memory Omit _____

Init. Recall _____

Max. Recall _____

Indicators _____

Check Circuit _____

Phase Sequencing _____

Power Interruption >0.5 Sec. _____

Power Interruption <0.5 Sec. _____

Fail-safe _____

105 – 130 VAC _____

Transient Test _____

FIGURE 3. Traffic Signal Controller Test Log