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# METHOD OF TEST FOR TESTING DURABILITY OF MAST ARM-MOUNTED LUMINAIRES

## A. SCOPE

These methods describe the procedures for determining the durability of luminaires mounted on mast arms of lighting standards by (1) measuring the amount of permanent set of slipfitter clamping brackets, and (2) evaluating resistance of the luminaire and all associated hardware to fatigue failure by cyclic testing in two critical directions.

The luminaire furnished for testing in Part I may be reused with new slipfitter clamping brackets and bolts in both tests required in Part II, or new luminaires may be supplied for each phase of testing, as the manufacturer chooses.

## B. PROCEDURES

### PART 1. METHOD USED FOR DETERMINING THE AMOUNT OF PERMANENT SET OF CLAMPING BRACKETS OF SLIPFITTER ASSEMBLIES

### 1A. APPARATUS

1. 2 in. diameter pipe tenon (2 3⁄8 in. actual outside diameter).
2. Torque wrench.
3. Dial indicator accurate to 0.00078 in..
4. Luminaire housing and complete slipfitter connection.

### 1B. TEST PROCEDURE

1. Measure and record the initial shape of new slipfitter bracket(s). This may be done by tracing the profile of the initial bracket(s), or making reference readings with a dial indicator at critical bracket locations which have been permanently marked.
2. Assemble and torque mounting bolts securing the slipfitter clamping bracket(s) as per manufacturer's installation instructions.
3. Remove the bracket assembly and determine maximum permanent set in the bracket(s).

### 1C. PRECAUTIONS

Brackets shall not be permitted to bottom out against the top of mounting bosses when the bolts are tightened. Brackets which have bottomed out may show an erroneously small amount of permanent set. Bracket contact with the tops of the bosses may prevent adequate clamping forces on the mast arm stub from being developed.

## 1D. REPORTING OF RESULTS

Report test results on Form TL-6052 (see Figure 1).

## PART 2. METHOD USED FOR EVALUATING THE FATIGUE DURABILITY OF LUMINAIRES.

## 2A. APPARATUS

1. Any vibrating fatigue testing machine capable of cycling luminaires with constant acceleration of up to 3.0 g's peak-to-peak (or 1.5 g's peak) in the vertical direction, and be able to keep the vibration frequency under resonant frequency of the test fixture and luminaire.

2. A suitable test fixture with a 2 in. pipe tenon (2 3⁄8 in. outside diameter) to be used for attaching luminaires to the vibrating machine.

3. Accelerometer.

4. Oscillograph.

5. Counter to determine the number of cycles.

6. Torque wrench.

7. Scale capable of weighing up to 55 lb with an accuracy of ± 0.02 lb.

## 2B. CALIBRATION OF APPARATUS

To calibrate the accelerometer, the following steps should be taken:

1. Place the accelerometer on a flat surface and adjust the signal conditioner to obtain a suitable zero point on the oscillograph.

2. Turn the accelerometer over, $180^0$ for 2 g's, and adjust the gain of the signal conditioner so that the oscillograph shows a deflection of 2 in. which equals 1 g. per inch.

## 2C. PREPARATION OF TEST SPECIMENS

1. Obtain the required number of luminaires.

2. Install an approved lamp currently used by Caltrans in each luminaire.

3. Weigh each luminaire head (lb); call this "W".

4. Determine the center of gravity and mark the position on each luminaire on each luminaire head.

## 2D. TEST PROCEDURES

1. Horizontal Cyclic Loading Test (critical for ground-mounted luminaires).

a. Position the slipfitter bracket on the luminaire housing to accept a 2 in. pipe tenon.

b. Slide the luminaire onto the 2 in. diameter pipe tenon of the test fixture. Make sure the luminaire contains an internal ballast. Orient the luminaire head so that the cyclic testing will simulate movement in the horizontal plane perpendicular to the direction of the mast arms. Tighten the slipfitter bolts according to the manufacturer's recommended installment procedure.

c. Determine the center of gravity of the luminaire, position the counter weigh, and attach the accelerometer at the luminaire's center of gravity.

d. Turn on the vibration testing machine and adjust the vibrating frequency and displacement until 1.5-g peak-to-peak (or 0.75-g peak) acceleration is obtained.

e. Cycle the luminaire until 2 million cycles are reached or failure of a critical part occurs, whichever comes first. If a critical part fails, record the maximum number of cycles attained and note the type of failure.

2. Vertical Cyclic Loading Test (critical for Bridge-Mounted Luminaires).

a. Position the slipfitter bracket on the luminaire housing to accept a 2 in. diameter pipe tenon.

b. Remove the internal ballast from the luminaire housing.

c. Slide the luminaire onto the 2 in. pipe tenon of the test fixture and orient the luminaire head so that the lens faces the floor. Tighten the slipfitter bolts according to manufacturer's recommended procedure.

d. Measure the distance (in.) between the luminaire's center of gravity and the center of the test fixture); call this "L".

e. Determine the distance from the center of the test fixture to the center of the counter weigh (see Figure 2) using the following equation:

$$d = \frac{W * L}{B}$$

where:

d = distance between the center of the fixture and the center of the counterweight (in.).

W = the weight of the luminaire head (lb).

L = distance between the luminaire's center of gravity and the center of the text fixture (in.).

B = the weight of the counterweight (lb).

f. Adjust the position of the counterweight.

g. Attach the calibrated accelerometer at the luminaire's center of gravity.

h. Turn on the testing machine, adjust the vibrating frequency and displacement until 3.0 g's peak-to-peak (or 1.5 g's peak) acceleration is obtained. Be sure the frequency is kept under the resonant frequency of the test fixture and luminaire.

i. Cycle the luminaire until 2 million cycles are reached or failure of a critical part occurs, whichever comes first. Referring to Figure 1, record the permananet set of the slipfitter bracket(s). If a critical part fails, record the maximum number of cycles attained and note the type of failure.

## 2E. REPORTING OF RESULTS

Report test results from horizontal cyclic loading (perpendicular to the direction of the mast arm) on Form TL-6053 (see Figure 3). Report test results from vertical cyclic loading on Form TL-6054 (see Figure 4).

If the slipfitter clamping bracket or bolts fail in either test, note the type of failure in the Remarks column of this form. Also note any other parts of the luminaire which have failed or show signs of failure in the Remarks column.

## C. 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 611 contains 8 pages)**

TRANSPORTATION LABORATORY
TEST DATA SHEET FOR RECORDING PERMANENT
SET OF SLIPFITTER BRACKET(S)

MANUFACTURER _____

LUMINAIRE MODEL NUMBER _____

SIZE AND NUMBER OF MOUNTING BOLTS _____

CLAMPING BOLT TORQUE
(EACH) ft·lb _____

DATE TESTED _____

THICKNESS / GAGE OF STEEL
IN CLAMPING BRACKET(S) _____

ROCKWELL HARDNESS OF BRACKET(S) _____

| POINT ON BRACKET | INITIAL MEASUREMENT (in.) | FINAL MEASUREMENT (in.) | PERMANENT SET (in.) | REMARKS |
|---|---|---|---|---|
| | | | | |

NOTE: Include picture/profile of clamping bracket(s).

TL-6052 (Original 3/89)

**FIGURE 1. Required Form for Recording Permanent Set of Slipfitter Bracket(s).**

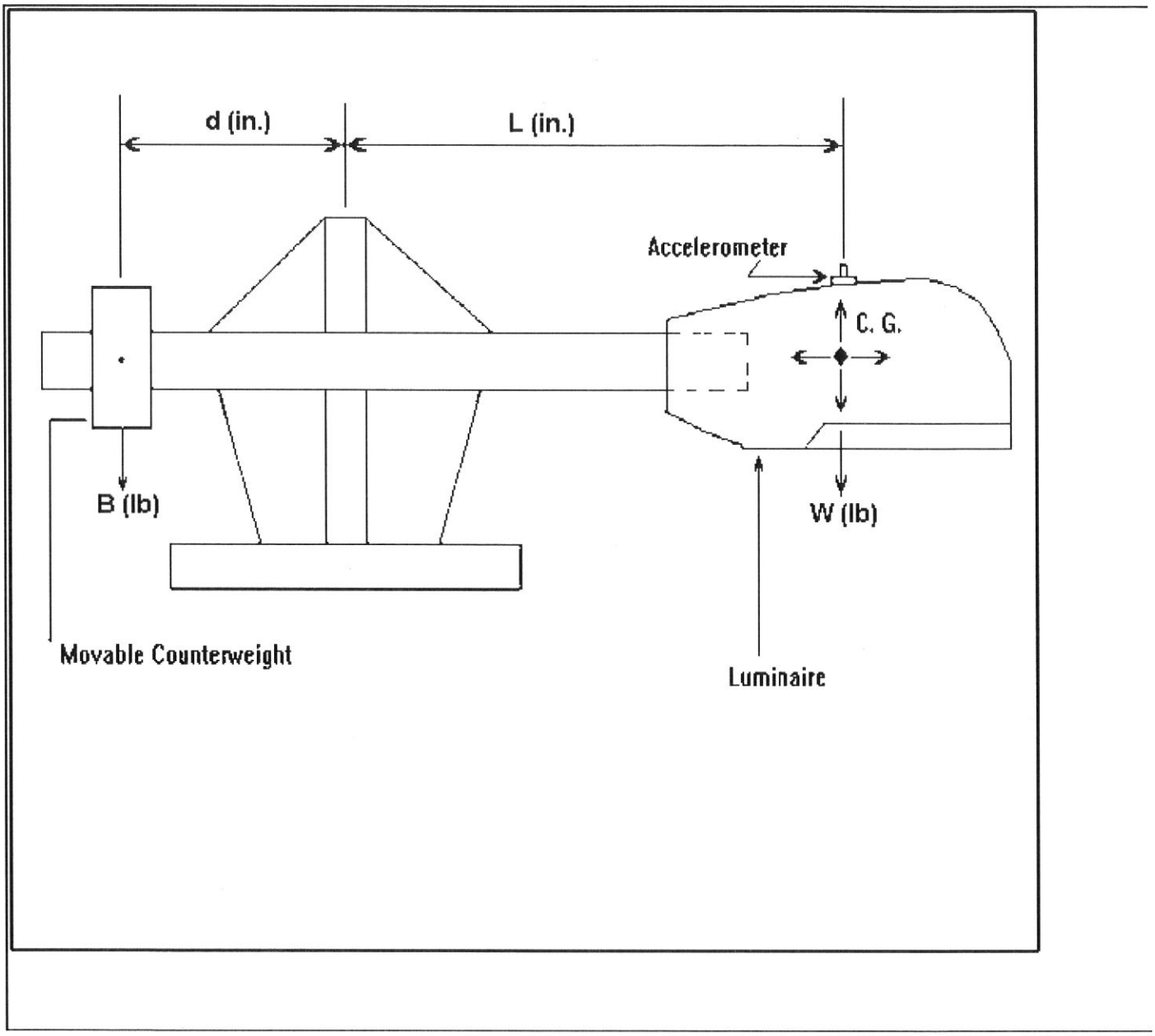


**FIGURE 2. Positioning of Counterweight on Fatigue Test Fixture to Balance System**

**TRANSPORTATION LABORATORY**
TEST DATA SHEET FOR CYCLIC LOADING OF LUMINAIRE - HORIZONTAL DIRECTION

MANUFACTURER _____

LUMINAIRE MODEL NO._____

DATE TESTED _____

| | | | | | Drawing of Specimen | |
|---|---|---|---|---|---|---|
| TEST NO. | TORQUE ON SLIPFITTER BRACKET BOLTS (ft·lb) | TEST ACCELERATION g's (Pk-to-Pk) | TEST FREQUENCY (HZ) | NO. OF CYCLES TESTED | DISPLACEMENT OF C. G. OF LUMINAIRE TEST TABLE (in.) | REMARKS |
| | | | | | | |

**FIGURE 3. Test Data Sheet for Cyclic Loading of Luminaire – Horizontal Direction**

**TRANSPORTATION LABORATORY**
TEST DATA SHEET FOR CYCLIC LOADING OF LUMINAIRE - VERTICAL DIRECTION

MANUFACTURER _____

LUMINAIRE MODEL NO._____

DATE TESTED _____

| Drawing of Specimen |
|---|
| |

| TEST NO. | TORQUE ON SLIPFITTER BRACKET BOLTS (ft·lb) | TEST ACCELERATION g's (Pk-to-Pk) | TEST FREQUENCY (HZ) | NO. OF CYCLES TESTED | DISPLACEMENT OF C. G. OF LUMINAIRE TEST TABLE (in.) | REMARKS |
|---|---|---|---|---|---|---|
| | | | | | | |

**FIGURE 4. Test Data Sheet for Cyclic Loading of Luminaire – Vertical Direction**