DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING SERVICES
Transportation Laboratory
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METHOD OF TEST FOR BRIDGE BEARING PADS

A. SCOPE

This test method is divided into two parts. Part 1, Determination of Coefficient of Friction and Fatigue Life, describes the procedure for determining the fatigue life and coefficient of friction or internal shear resistance of various pad assemblies and Part 2, Determination of Peel Strength, describes the procedure used to determine the peel strength of elastomer bonded to metal reinforcement for elastomeric bearing pads.

B. REFERENCES

ASTM D 413 – Rubber Property – Adhesion to Flexible Substrate
ASTM D 624 – Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D 4014 – Plain and Steel-Laminated Elastomeric Bearings for Bridges
California Standard Specifications – Section 51, "Concrete Structures"

PART 1. DETERMINATION OF COEFFICIENT OF FRICTION AND FATIGUE LIFE

A. SCOPE

Part 1 of this test method describes the procedure for determining the fatigue life and coefficient of friction or internal shear resistance of various bearing pad assemblies such as bronze, elastomeric, PTFE (polytetrafluoroethylene).

B. APPARATUS

The following equipment is required to perform this test.

1. An expansion bearing pad fatigue-testing machine (see photograph and schematic drawing, Figures 1 and 2).

2. Acetone and a stopwatch.

3. Strain gages.

4. A 6-in. steel scale, graduated in $^1/_{32}$ in. divisions.

D. SAMPLES

Clean all test specimens and both platens so that they are free of any foreign substances such as dust, grit, moisture, etc., except for the lubricants used in conjunction with the bronze specimens such as oil, grease, etc. Cut the elastomeric specimens to size (standard size 6 in. × 6 in.) and wipe clean. File smooth any rough edges on the bronze specimens and wipe clean. Use acetone to clean the bearing surfaces of PTFE bonded specimens only.

E. PROCEDURE

1. After the specimen has been centered on the lower platen of the fatigue machine, screw the eight-platen leveling rollers far enough into the platen so that they do not contact the vertical guide plates.

2. Bring the strain indicator to zero.

3. Apply vertical loads by operating Valves Nos. 1 and 2.

4. Then adjust Valve No. 6 to maintain the required pressure as read on Gage No. 2.

5. At this time the loading platens should be parallel; check with steel scale. If loading heads are not parallel, unload and repeat the loading procedure.

6. Remove the "at rest" shims and screw the eight platen leveling rollers finger tight against the guide plates to maintain platen stability.

7. Operate the top-loading platen using the following procedure:

   a. Start the hydraulic pump (start button).

   b. Open Valve No. 5 all the way and then adjust Valve No. 4 to maintain the proper testing speed.

      NOTE: Valve No. 5 must be opened before speed can be adjusted by Valve No. 4.

   c. Adjust the testing speed by the use of a stopwatch.

   d. Measure the horizontal load by use of the P3500 strain indicator.

   e. The pressure indicated on Gage No. 3 is controlled by Valve No. 7. The function of Valve No. 7 is to control the pressure applied to the horizontal ram.

8. At the end of the test period, stop and unload the machine by reversing the loading steps.

F. HORIZONTAL FORCE MEASUREMENTS

During the course of the test, record the strain gage readings to determine the horizontal force.

1. Take static coefficient of friction readings at the instant of impending motion or slip between the surfaces in question. For flexible backed PTFE bearings, measure strain at the point of maximum displacement.

2. Obtain kinetic coefficient of friction readings by taking the average reading while surfaces are sliding. Do this in both directions of movement.

G. CALCULATIONS

$$f = F/N$$

Where:

F = Horizontal force due to friction or internal shear resistance
N = Normal force
f = Coefficient of friction
f_s = Static
f_k = Kinetic

Determine “F” from the strain gage indicator readings by use of Figure 3. Determine "N" from Gage No. 2 (Figure 2) by use of Figure 4.

H. REPORTING RESULTS

1. Report the following test results on test report Form TL-6028:

   a. Maximum static coefficient of friction

   b. Average static coefficient of friction

   c. Average kinetic coefficient of friction

   d. Remarks concerning the specimen’s appearance after completion of test, excessive wear, delamination, etc.

2. The “maximum friction coefficient”, as determined on Form TL-6028 (Figure 5), is defined as the highest coefficient as averaged over any 50 cycles of the test. The “average friction coefficient” is defined as the average of at least 5 and not more than 10 readings taken between 2,000 and 8,000 cycles. These readings shall be taken at intervals of not less than 500 cycles apart.

PART 2. DETERMINATION OF PEEL STRENGTH

A. SCOPE

Part 2 of this test method describes the procedure used to determine the peel strength of elastomer bonded to metal reinforcement for elastomeric bearing pads.

B. APPARATUS

The following equipment is required to perform this test.

1. A testing machine that can measure loads up to 1,000 pounds with accuracy of ± 1 % and a platen speed of 2 ± 0.2 in./min.

2. A device similar to Figure 7 with rubber grips and jaws at least 1 in. wide. The grips shall be capable of firmly gripping the specimen without slippage during the testing.

3. A saw capable of cutting smoothly through elastomeric bearing pads with metal reinforcement.

C. SAMPLES

One inch section (full thickness) from one side of the bearing pad samples as shown in Figure 6a. The minimum length shall be 6 in.

D. PROCEDURE

1. Cut a 1-in. section (full thickness) from one side of the bearing pad samples as shown in Figure 6a. The minimum length shall be 6 in.

2. Cut the section into test specimens as shown in Figure 6b.

3. Initiate peeling by neatly cutting neoprene back to neoprene-reinforcement interface. See Figure 6c.

4. Initiate uniform peeling by pulling on specimen. Separate the specimen a sufficient distance to permit clamping in the grips of the machine.

5. Install the specimen in the grips of the testing machine as shown in Figure 7. Care should be used in installing the specimen symmetrically so that the tension is applied uniformly. The grips shall concentrically maintain the specimen in a vertical direction during testing.

6. Apply the load at a uniform rate of 2 ± 0.2 in./min for a distance of at least 2 in.

7. Determine and record the peel strength in lb/in. Peel strength is defined as the average load recorded on the testing machine when the specimen is slowly and uniformly peeled without snagging or binding.

E. REPORTING OF RESULTS

Create a form showing the test number, date, bearing pad dimensions, reinforcement thickness, brand, and the peel strength in lbs/in. Record the test data as determined in Part D, Procedure. Indicate compliance to both physical and visual requirements. Notify the fabricator of results.

Except as shown in Parts 1 and 2, all other physical properties of bridge bearing pads shall be determined in accordance with the procedures as outlined in the appropriate American Society for Testing and Materials (ASTM) specifications, as specified in the Standard Specifications.

F. 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:

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

End of Text
(California Test 663 contains 11 pages)

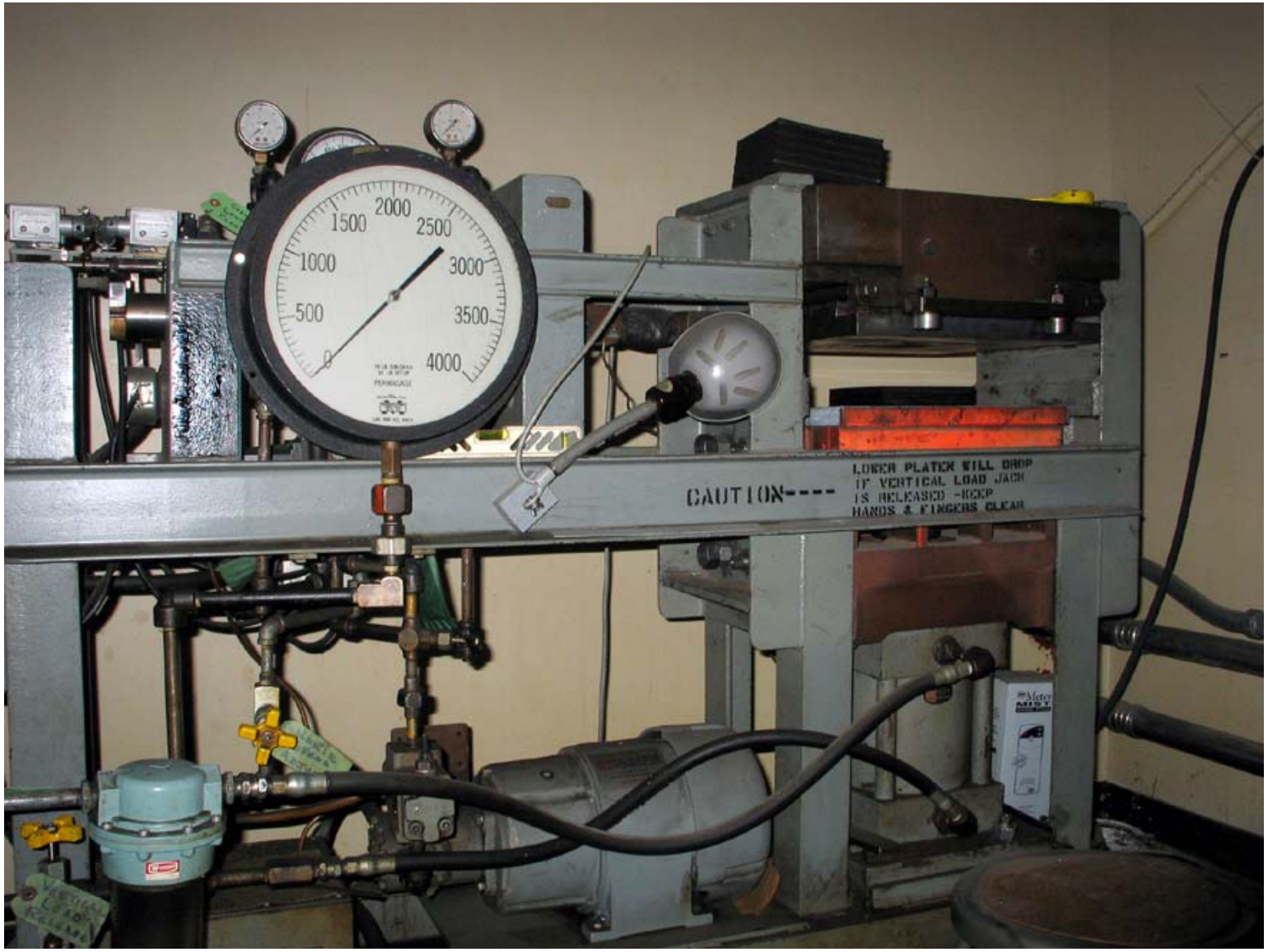


FIGURE 1. Actual Fatigue Testing Machine

SCHEMATIC DIAGRAM OF FATIGUE TESTING MACHINE

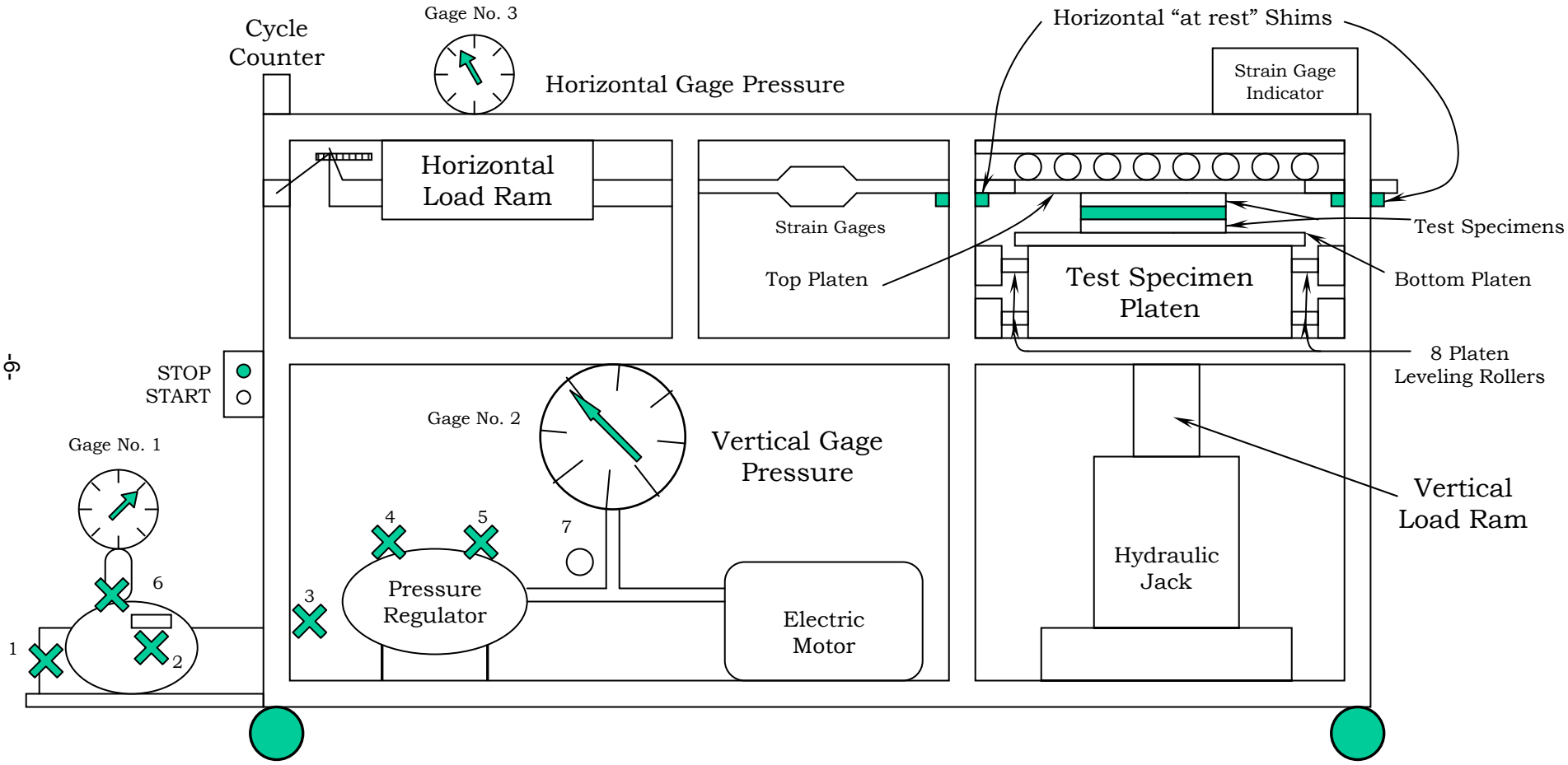
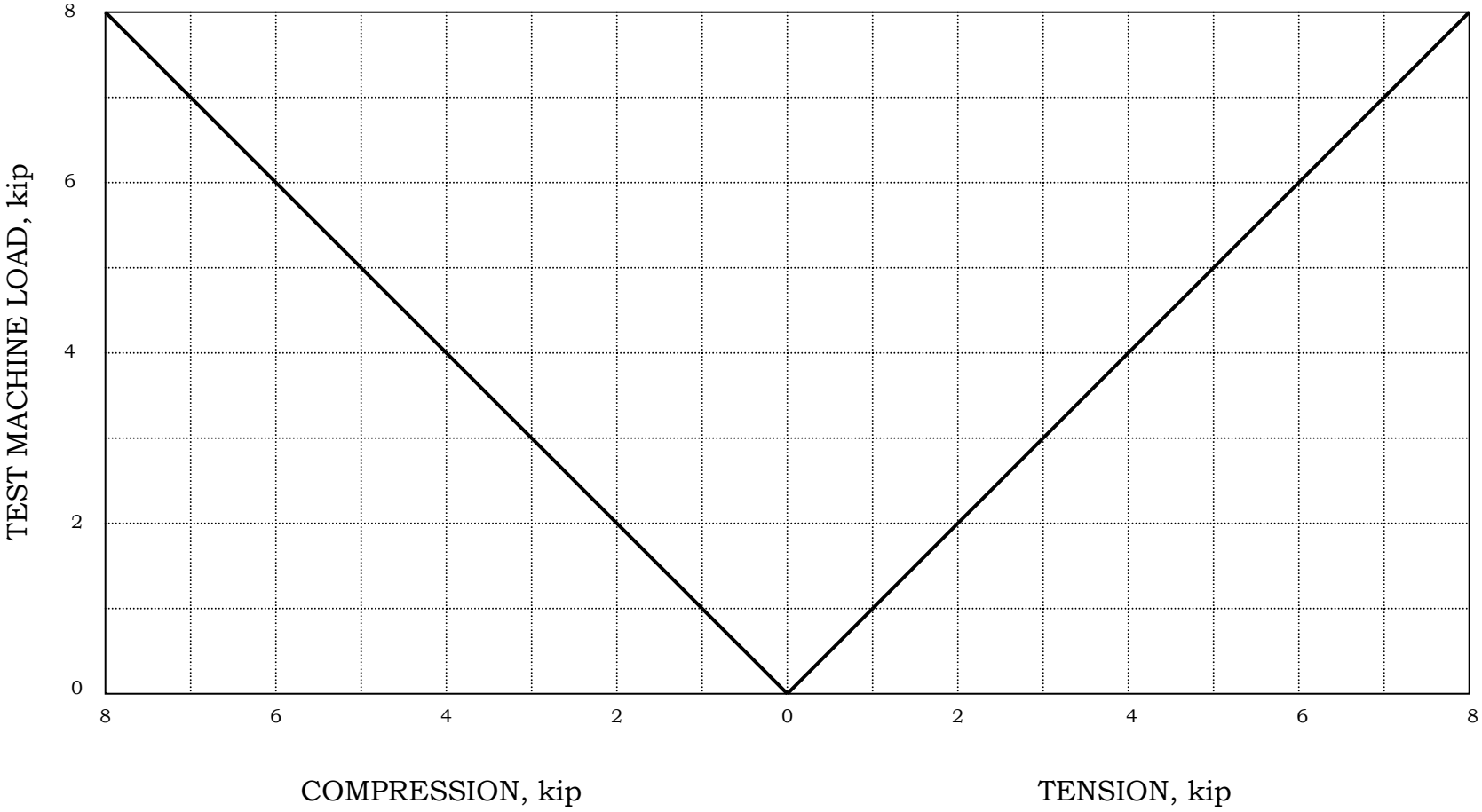


FIGURE 2. Fatigue Testing Machine

BEARING PAD FATIGUE TESTING MACHINE
HORIZONTAL LOAD CELL CALIBRATION



STRAIN INDICATOR 20 TURN MODEL HW2-D

SETTINGS – FB+	NO LOAD BALANCE – 10 kip
ua	CALIBRATION RESISTOR = 20 kip SETTING
GAGE FACTOR = 0.28 ±	CALIBRATION RESISTOR = PC 44.8 kip

FIGURE 3. Load Cell Calibration Curve 1

BEARING PAD FATIGUE TESTING MACHINE
VERTICAL LOAD CALIBRATION CURVE

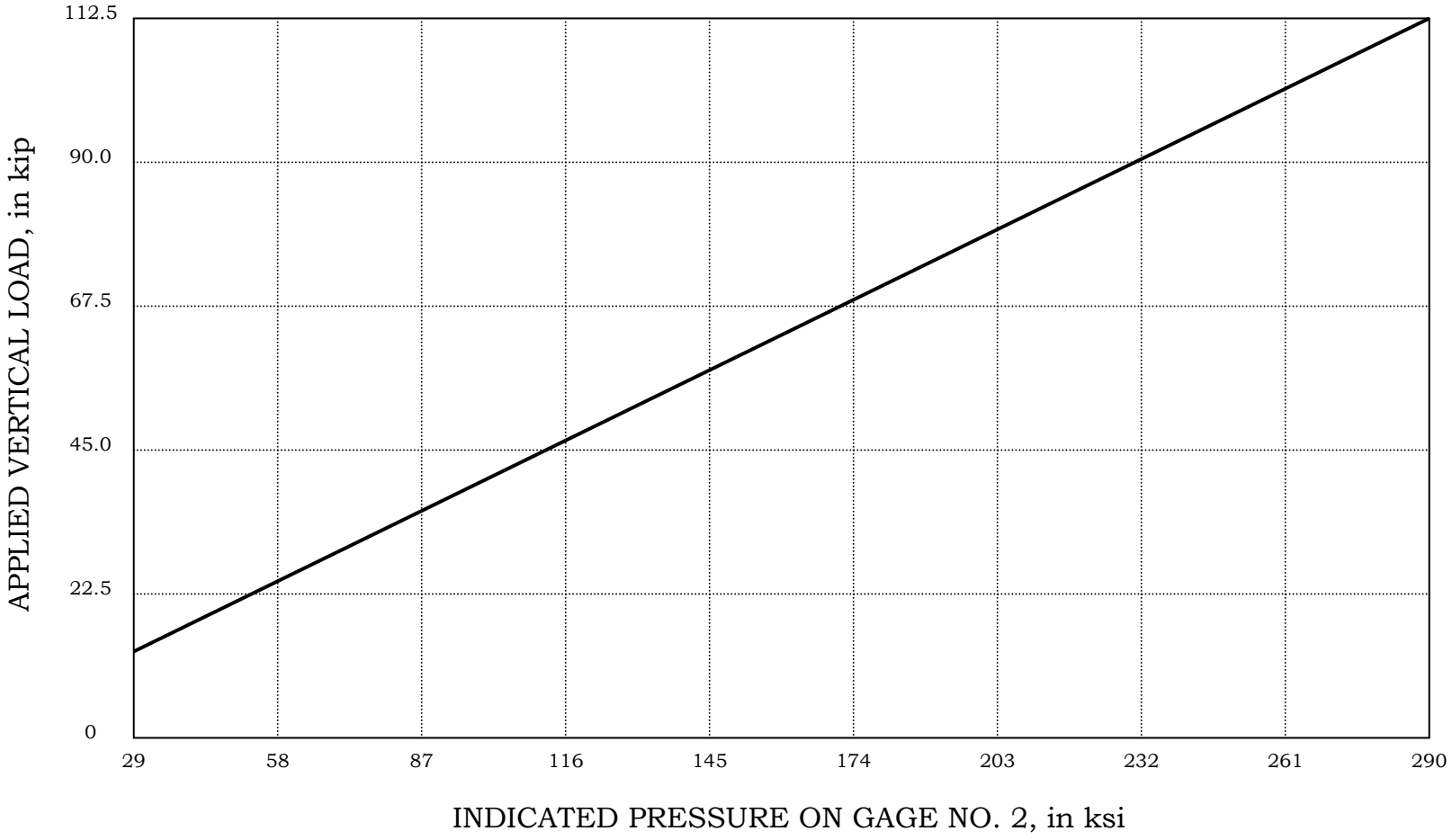


FIGURE 4. Load Calibration Curve 2

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FATIGUE AND COEFFICIENT OF FRICTION TEST DATA SHEET

DRAWING OF SPECIMEN

TYPE: _____

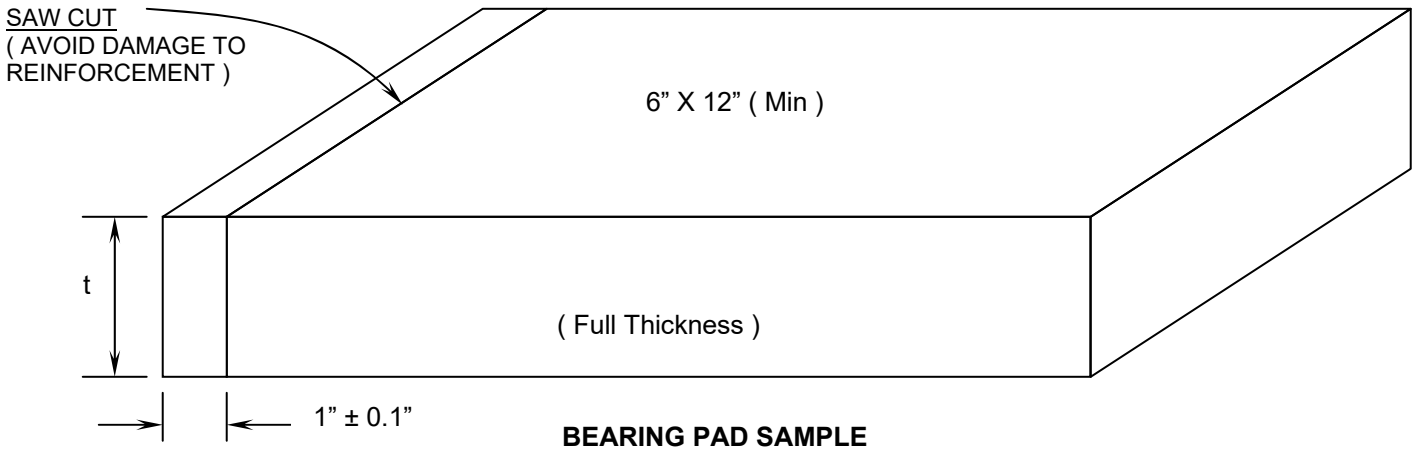
SIZE: _____

DATE: _____ LOAD: _____

STROKE: _____ SPEED: _____

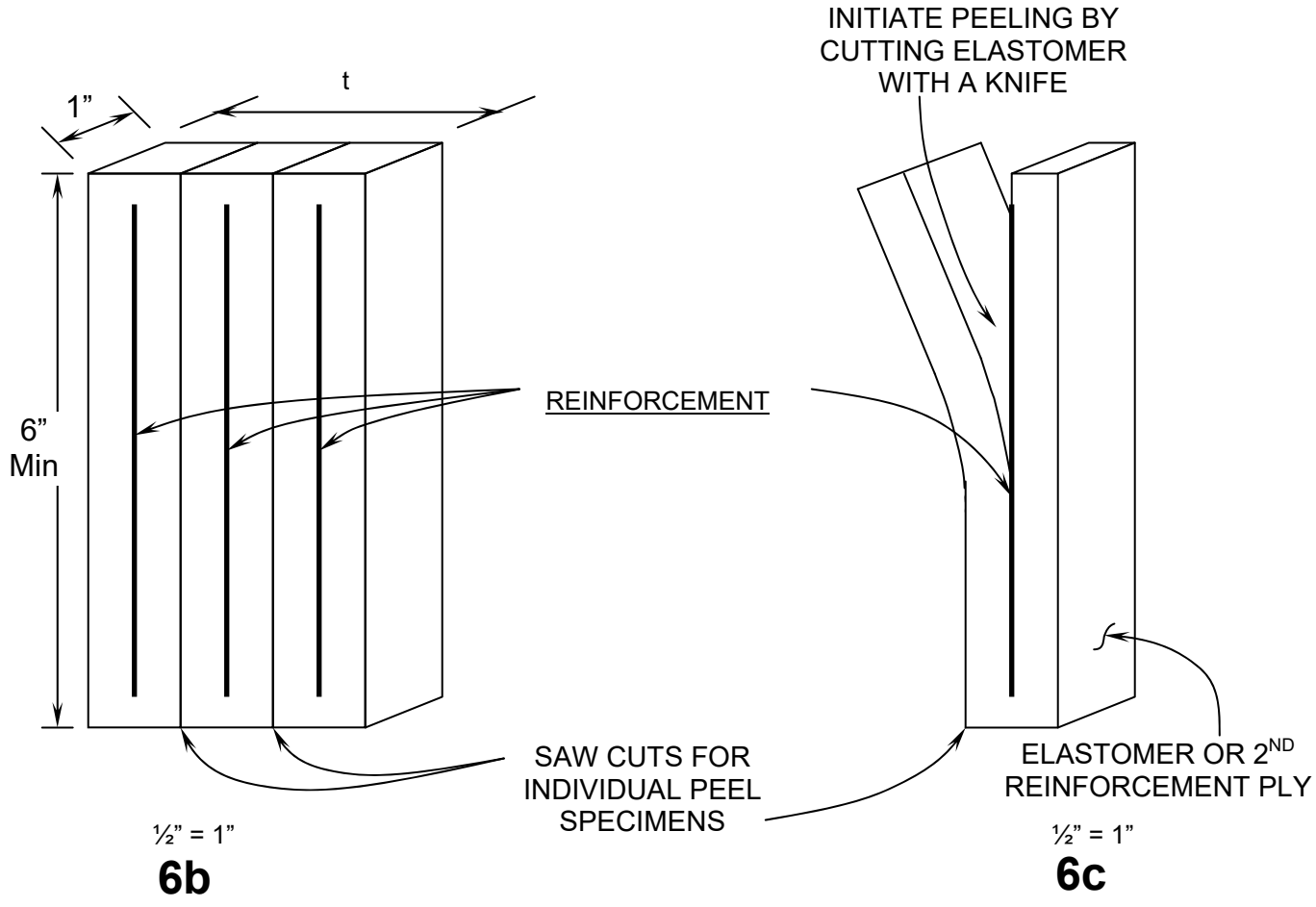
CYCLES	SPEED INCHES/ MINUTE	+ READING	- READING	MOVING AVERAGE	GAGE PRESSURE	N KIPS	+ f KIPS	- f KIPS	MOVING f KIPS	+ u	- u	THICKNESS INCHES	REMARKS

T.L. - 6028 (Orig. 11/66)



BEARING PAD SAMPLE
3/8" = 1"

6a



½" = 1"

6b

½" = 1"

6c

FIGURE 6a, 6b, 6c. Specimen Preparation

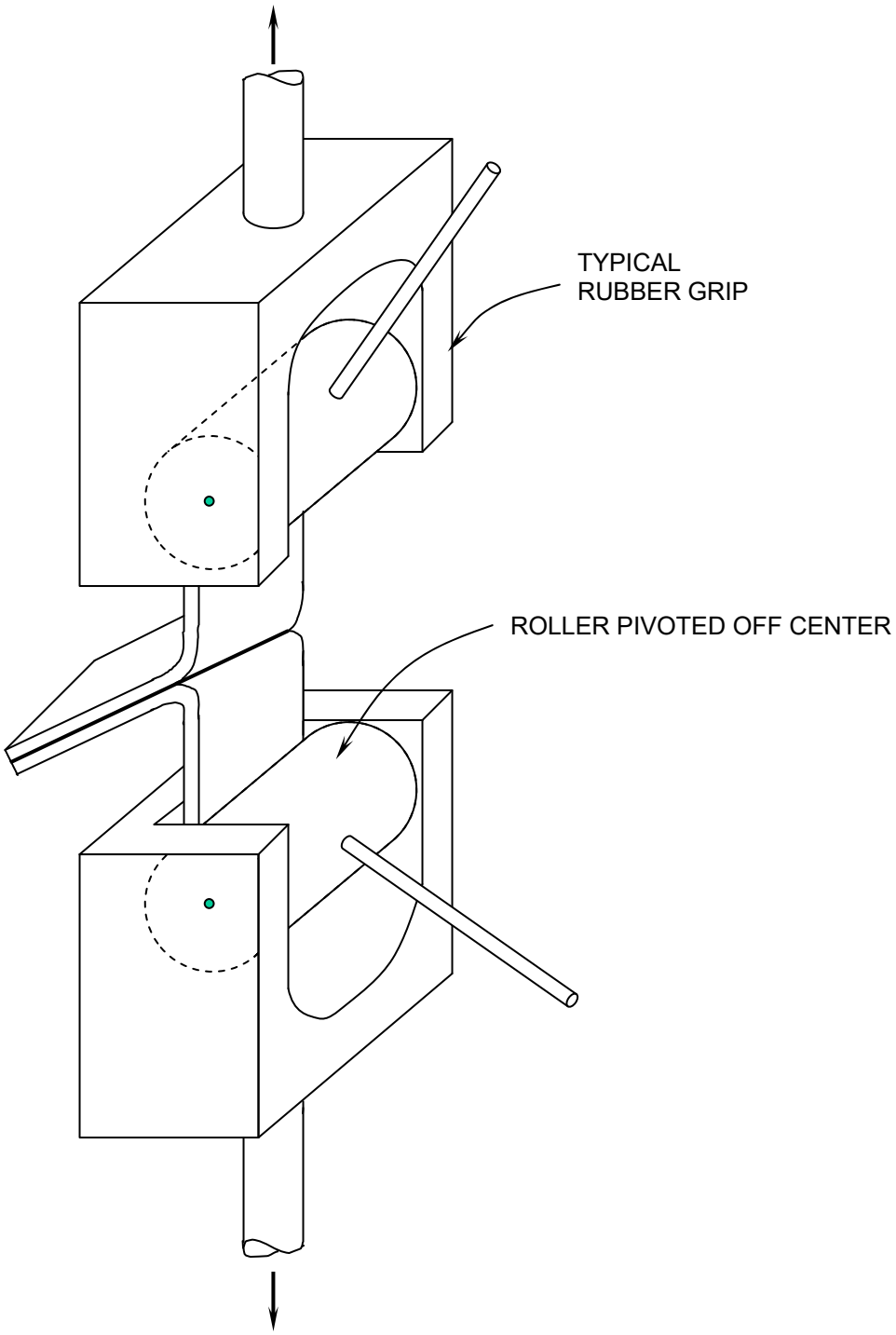


FIGURE 7. Peel Test