



RADCO TEST REPORT
Test Report No. RAD-3033
Project No. C-7695
Lab No. TL-2029

Properties Tests on Expandable Polystyrene Foam Board

Prepared for

K-2 Construction, Inc. (dba R-Tight Panel)
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by

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1.0 INTRODUCTION

At the request of K-2 Construction Inc. (dba R-Tight Panel), shear and tensile bond strength tests were conducted on the EPS foam core of their sandwich panels. The panels were fabricated at the K-2 Construction, Inc. manufacturing facility in Jeffersonville, VT and witnessed by RADCO personnel on March 27, 2001. The panels were received at RADCO's testing facility in Long Beach, California on April 16, 2001. The foam core was selected from regular inventory by RADCO personnel at the Carpenter Corporation in Fogelsville, PA on February 27, 2001.

The purpose of these tests is to establish the allowable stresses of the foam core, in order to conduct panel analysis for transverse load tests.

2.0 MATERIAL DESCRIPTION

The foam core is a Type I EPS foam manufactured by Carpenter Company (Insulation Division). The specimens tested were sampled from sandwich panels that had undergone transverse load tests in accordance with ASTM E 72-98 and AC04.

Tensile Bond Strength Tests Specimens

Five (5)- 4" x 4" x 1" thick EPS foam core specimens were cut from the transverse load tested panels. The specimens were then bonded to 5" x 8" x $\frac{3}{8}$ " thick steel plates and allowed to cure for 24 hours prior to testing. The specimens were conditioned for 40 hours at $73^{\circ}\text{F} \pm 4^{\circ}\text{F}$ temperature and $50\% \pm 3\%$ relative humidity prior to testing.

Shear Tests Specimens

Five (5) - EPS foam core specimens of size 12" x 2" x 1" thick were cut from the transverse load tested panels. The specimens were bonded to the metal loading plates as specified in ASTM C 273 and conditioned at $73^{\circ}\text{F} \pm 4^{\circ}\text{F}$ temperature and $50\% \pm 3\%$ relative humidity for 40 hours.

Compressive Strength Test Specimens

Five (5)- EPS foam core specimens of size 4" x 4" x 3" thick were cut from the transverse load tested panels. The specimens were conditioned at $73^{\circ}\text{F} \pm 4^{\circ}\text{F}$ temperature and $50\% \pm 3\%$ relative humidity for 40 hours.

3.0 TEST PROGRAM

The specimens were tested to the following:

Test	Referenced Standard
Tensile Bond Strength	ASTM C297-94, "Standard Test Method for Flatwise Tensile Strength of Sandwich Constructions"
Shear Strength	ASTM C273-00, "Standard Test Method for Shear Properties of Sandwich Core Materials"
Compressive Strength	ASTM D1621-00, "Standard Test Method for Compressive Properties of Rigid Cellular Plastics"

4.0 TENSILE BOND STRENGTH PER ASTM C297

Test Procedure

The specimen/plate assembly was mounted in the RADCO United Table Model Electro mechanical Testing Machine, Model Number TM-20. Specimens were loaded in tension at a rate of 0.05-inch per minute. The rate was selected such that failure occurred between 3 and 6 minutes. Load vs. machine cross-head movement was recorded.

The testing was conducted at RADCO's testing laboratory in December 2001. (See Appendix C-1

Test Results

Table No. 1- Tensile Bond Strength

Specimen No.	Surface Area (in²)	Ultimate Load (lbs)	Tensile Bond Strength (psi)	Type/Location of Failure
1	16.39	356.53	21.81	Cohesive/foam
2	16.37	371.49	22.69	Cohesive/foam
3	15.39	318.99	20.72	Cohesive/foam
4	15.85	309.07	19.50	Cohesive/foam
5	16.38	284.04	17.40	Cohesive/foam
average	16.06	328.02	20.43	

5.0 SHEAR STRENGTH AND SHEAR MODULUS PER ASTM C273

Test Procedure

The specimen/plate assembly was mounted in the RADCO United Table Model Electro mechanical Testing Machine, Model Number TM-20. Specimens were loaded in tension at a rate of 0.02 inch per minute. The rate was selected such that failure occurred between 3 and 6 minutes. Load vs. deflection data was recorded. (See Appendix A-1)

Testing was conducted at RADCO's testing laboratory in February 2002. (See Appendix D-1)

Test Results

Shear strength = P/Lb

Where; P = Ultimate load (pounds)
 L = Length of specimen (inches)
 b = Width of Specimen (inches)

Shear Modulus = $\frac{S \times t}{Lb}$

Where; S = Slope of the initial linear portion of load/deflection curve, Lb/in
 t = specimen thickness in inches
 L = specimen length in inches
 b = specimen width in inches

Table No. 2: Shear Strength and Shear Modulus

Specimen No.	Length, L (in)	Width, b (in)	Ultimate Load, P (lbs)	Shear Strength (psi)	Shear Modulus (psi)	Mode of Failure
1	12.00	2.00	322.08	13.42	395.93	In all specimens tested, failure occurred at the core
2	12.00	2.00	370.63	15.44	354.13	
3	12.00	2.00	317.35	13.22	186.78	
4	12.00	2.00	382.16	15.92	320.96	
5	12.00	2.00	328.21	13.68	329.62	
average	12.00	2.00	344.08	14.34	317.48	

6.0 COMPRESSIVE STRENGTH PER ASTM D1621

Test Procedure

The specimen was mounted in the RADCO United Table Model Electro mechanical Testing Machine, Model Number TM-20. Specimens were loaded in compression at a rate of 0.3 inch per minute. The rate was selected such that failure occurred between 3 and 6 minutes.

Test Results

All tests were conducted at RADCO's laboratory in Long Beach, CA on 5/2/2002.

SPECIMEN NO.	Specimen Size (inches)			Specimen area (in ²)	Comp Load at 10% defl (lbf)	Comp Stress at 10% defl (psi)
	L	W	Thk			
1	4.00	4.00	3.14	16.00	223.00	13.94
2	4.00	4.00	3.14	16.00	219.00	13.69
3	4.00	4.00	3.14	16.00	233.00	14.56
4	4.00	4.00	3.14	16.00	231.00	14.44
5	4.00	4.00	3.14	16.00	227.00	14.19
Average					226.60	14.16
Std Deviation					5.73	0.36

*****END OF REPORT*****

APPENDIX

Shear Test- Load vs. Deflection (A-1)

Charts- Specimen 1 to 5 (B-1 of 5)

Test Setup for Tensile Bond Strength Tests (C-1)

Test Setup for Shear Strength Tests (D-1)

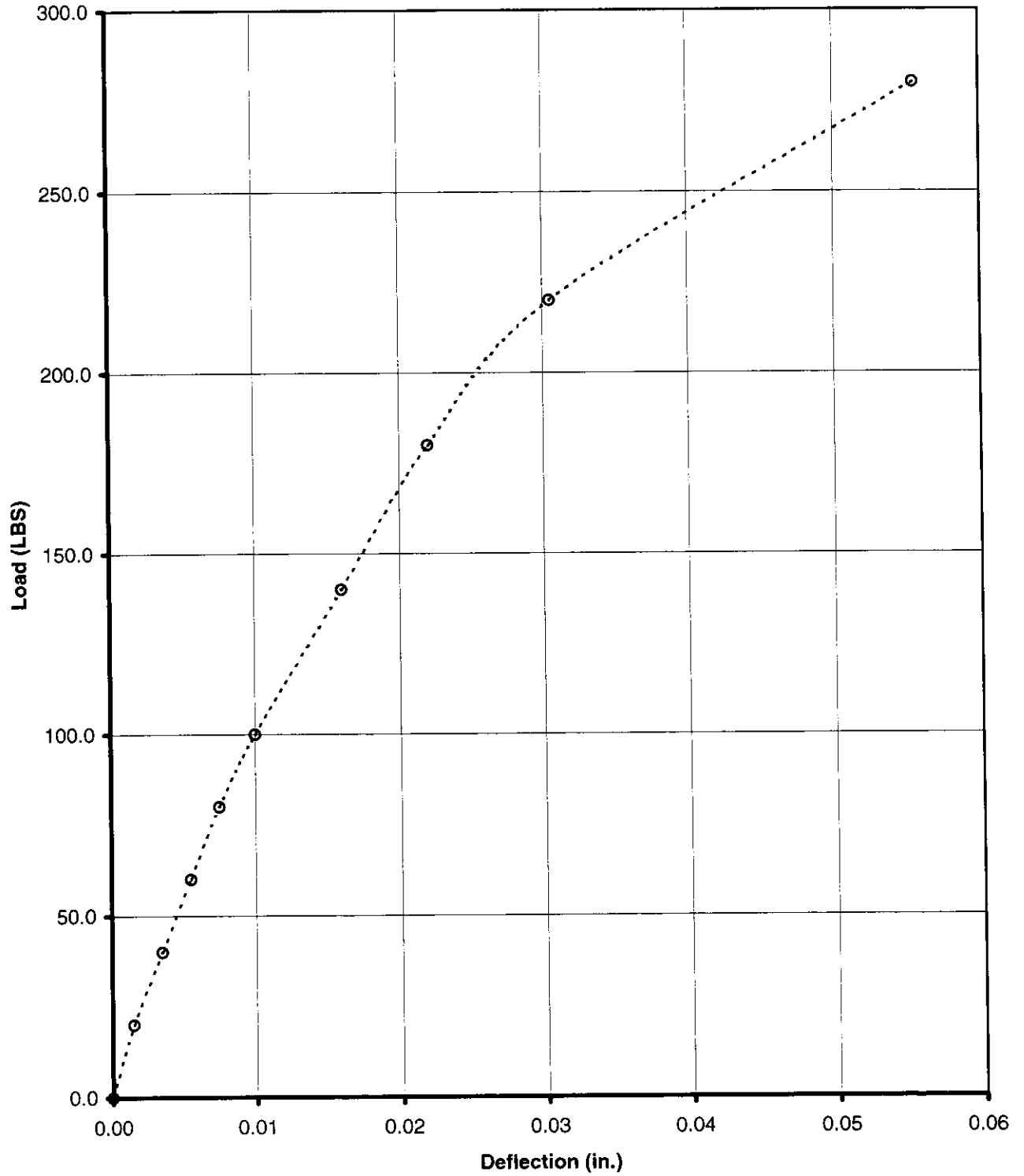
Test Setup for Compressive Strength Tests (E-1)

SHEAR TEST- LOAD VS. DEFLECTION ON EPS FOAM PER ASTM C273

Specimen load (lbs)	1	2	3	4	5
	Deflection (inches)				
0.0	0.0000	0.0000	0.0000	0.0000	0.0000
20.0	0.0015	0.0015	0.0020	0.0015	0.0000
40.0	0.0035	0.0040	0.0060	0.0035	0.0025
60.0	0.0055	0.0065	0.0100	0.0060	0.0045
80.0	0.0075	0.0085	0.0150	0.0085	0.0070
100.0	0.0100	0.0110	0.0195	0.0110	0.0095
140.0	0.0160	0.0160	0.0285	0.0165	0.0150
180.0	0.0220	0.0210	0.0360	0.0215	0.0205
220.0	0.0305	0.0275	0.0475	0.0285	0.0285
280.0	0.0555	0.0405	0.0780	0.0445	0.0510
Ultimate Load (lbs)	322	370	317	382	328
Slope	9502.262	8499.096	4482.759	7703.109	7910.923
Shear Modulus	395.9276	354.129	186.7816	320.9629	329.6218
Shear Modulus Avg.					317.4846

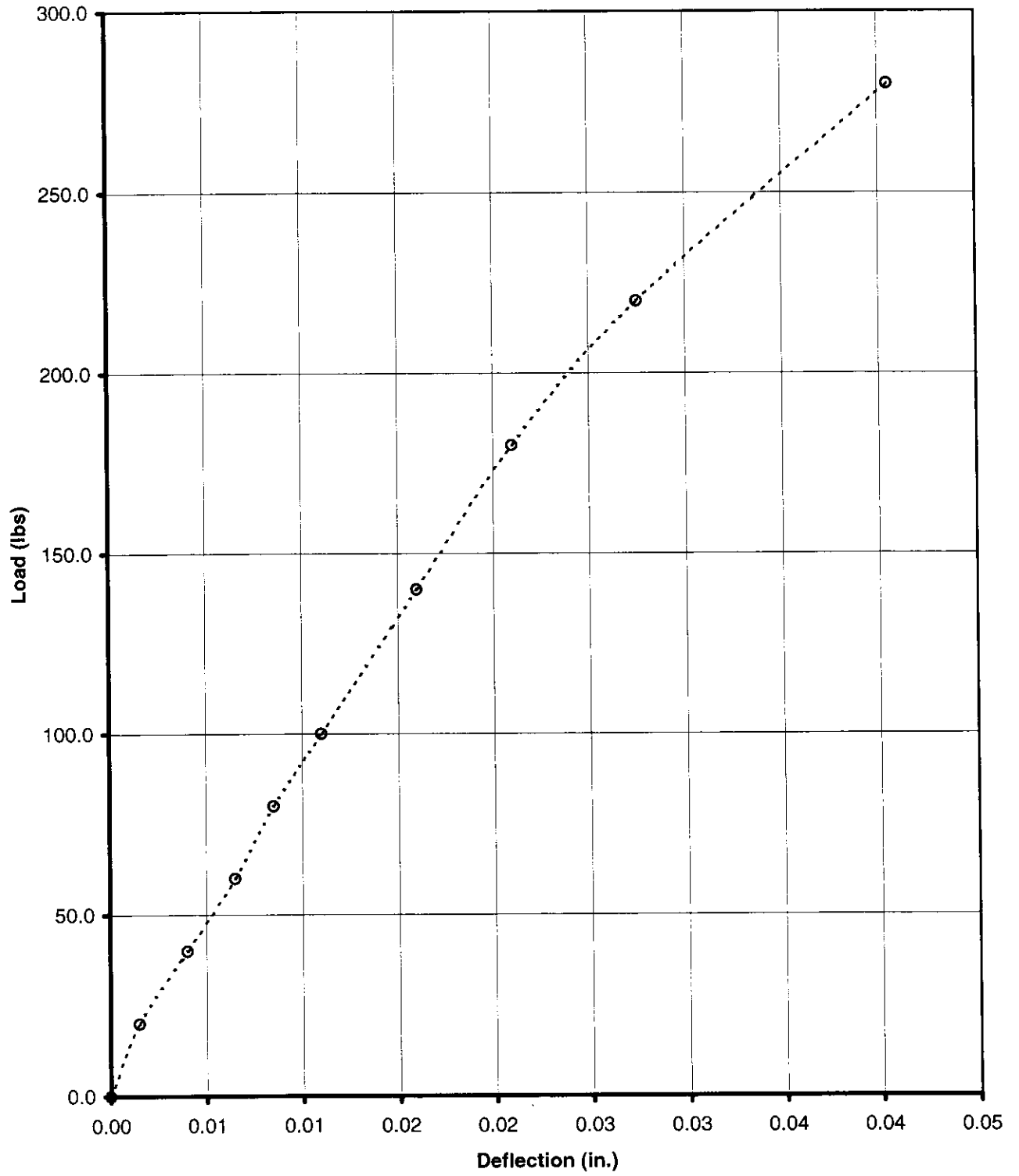
Specimen 1: Shear Tests

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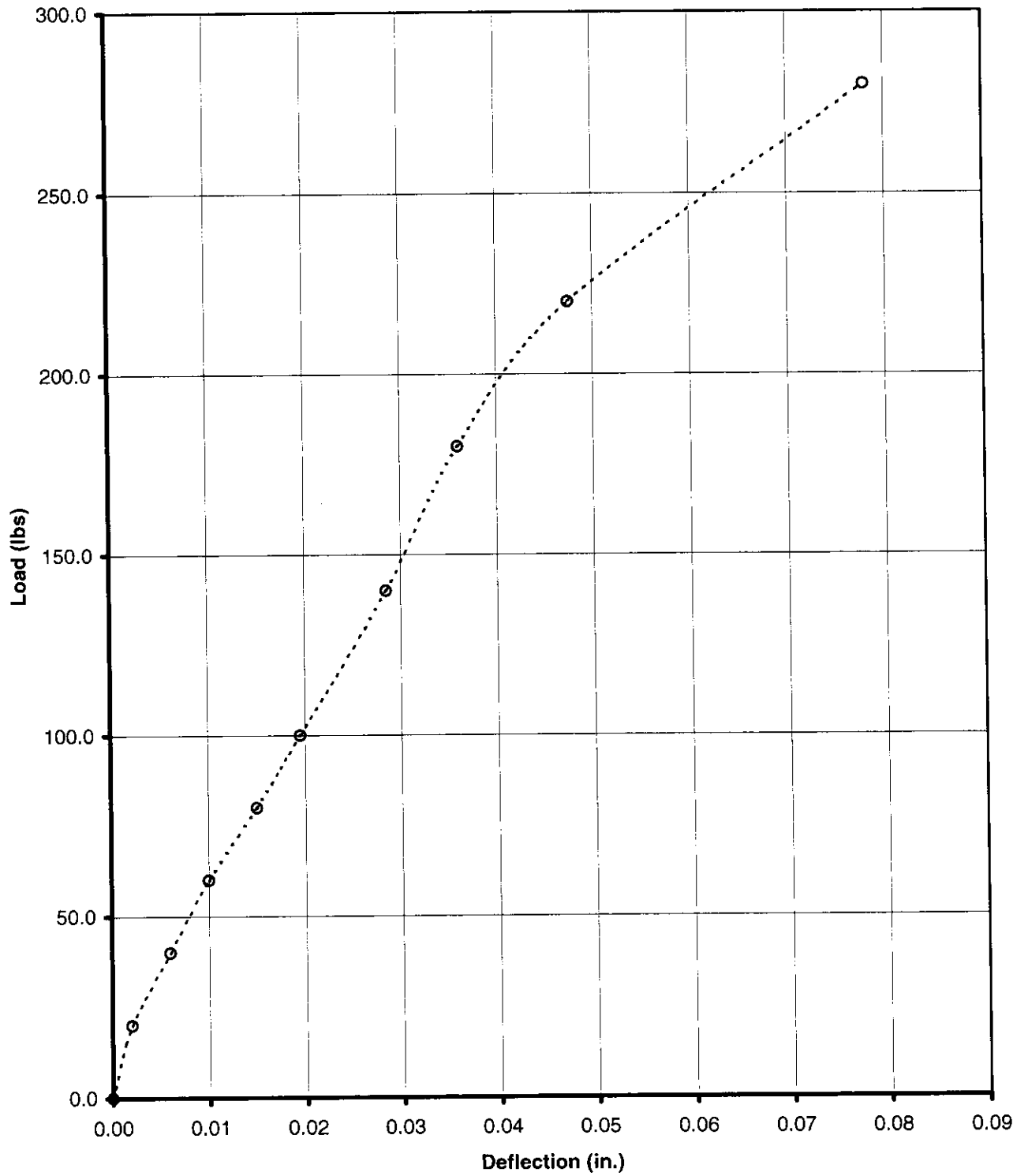


Specimen 2: Shear Tests

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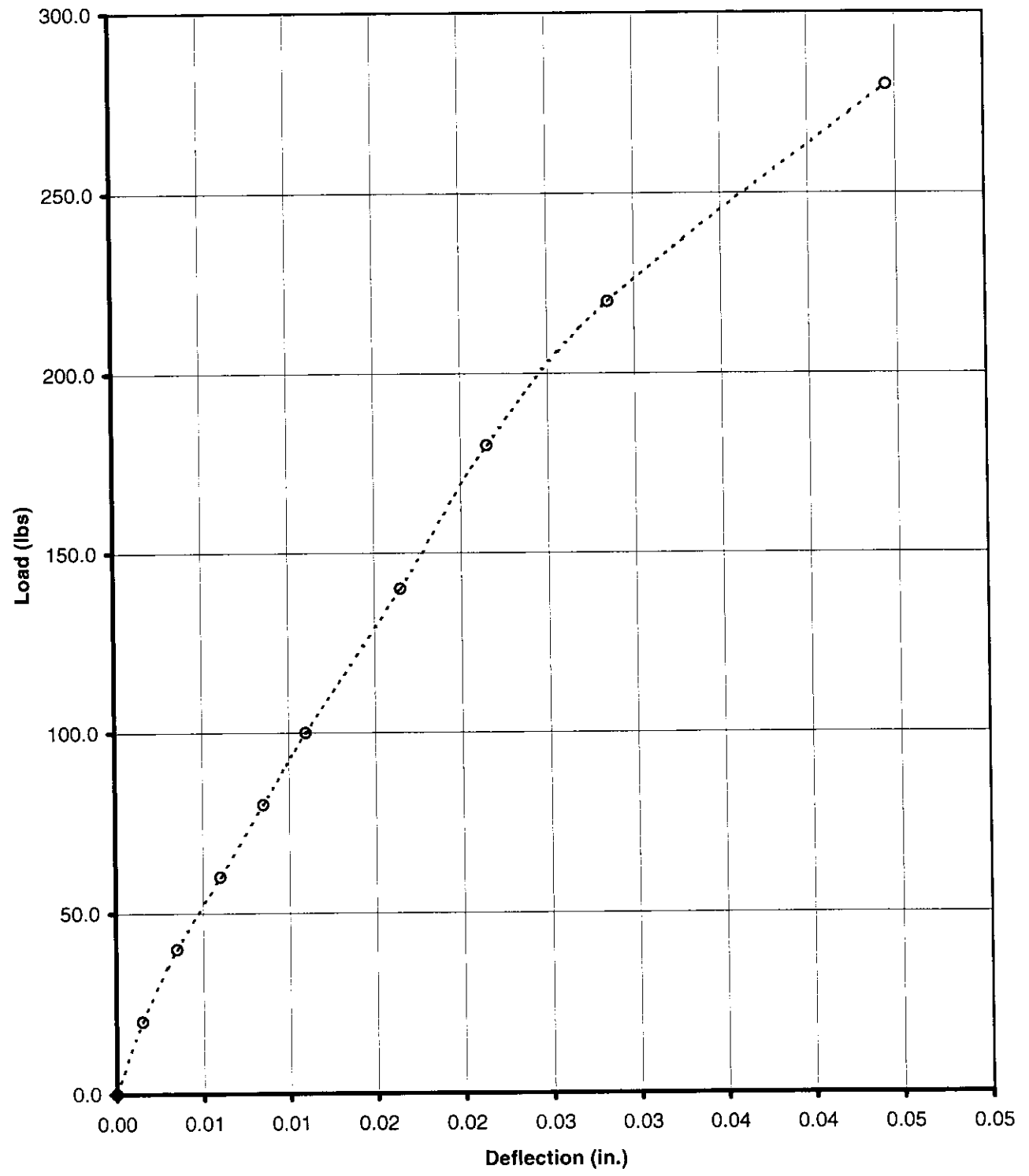


Specimen 3: Shear Tests



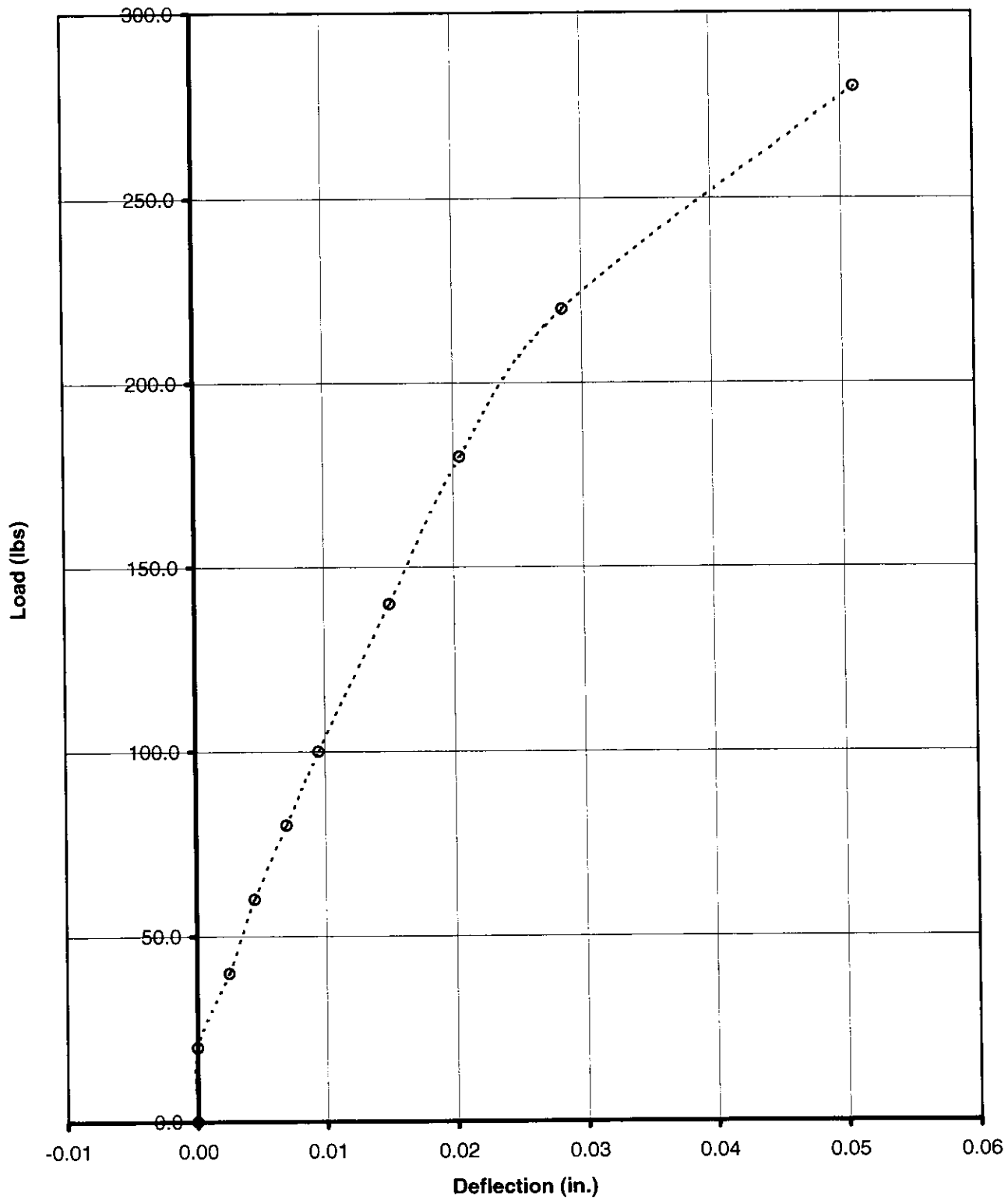
Specimen 4: Shear Tests

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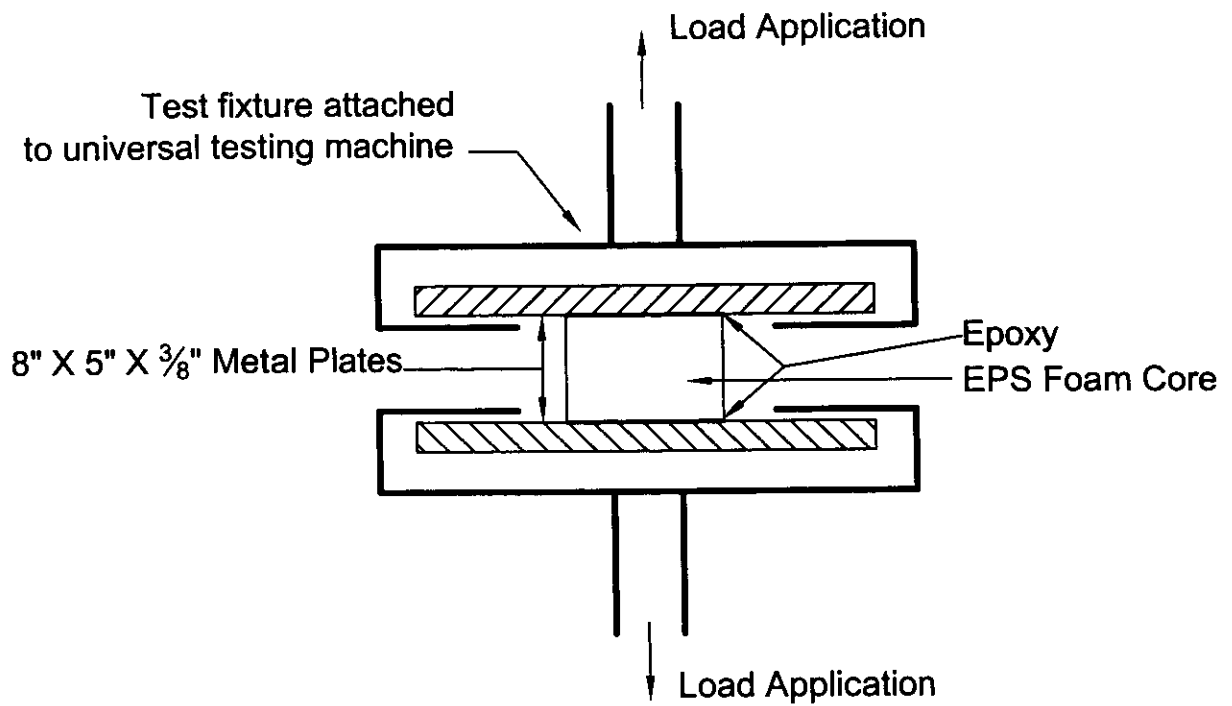


Specimen 5: Shear Tests

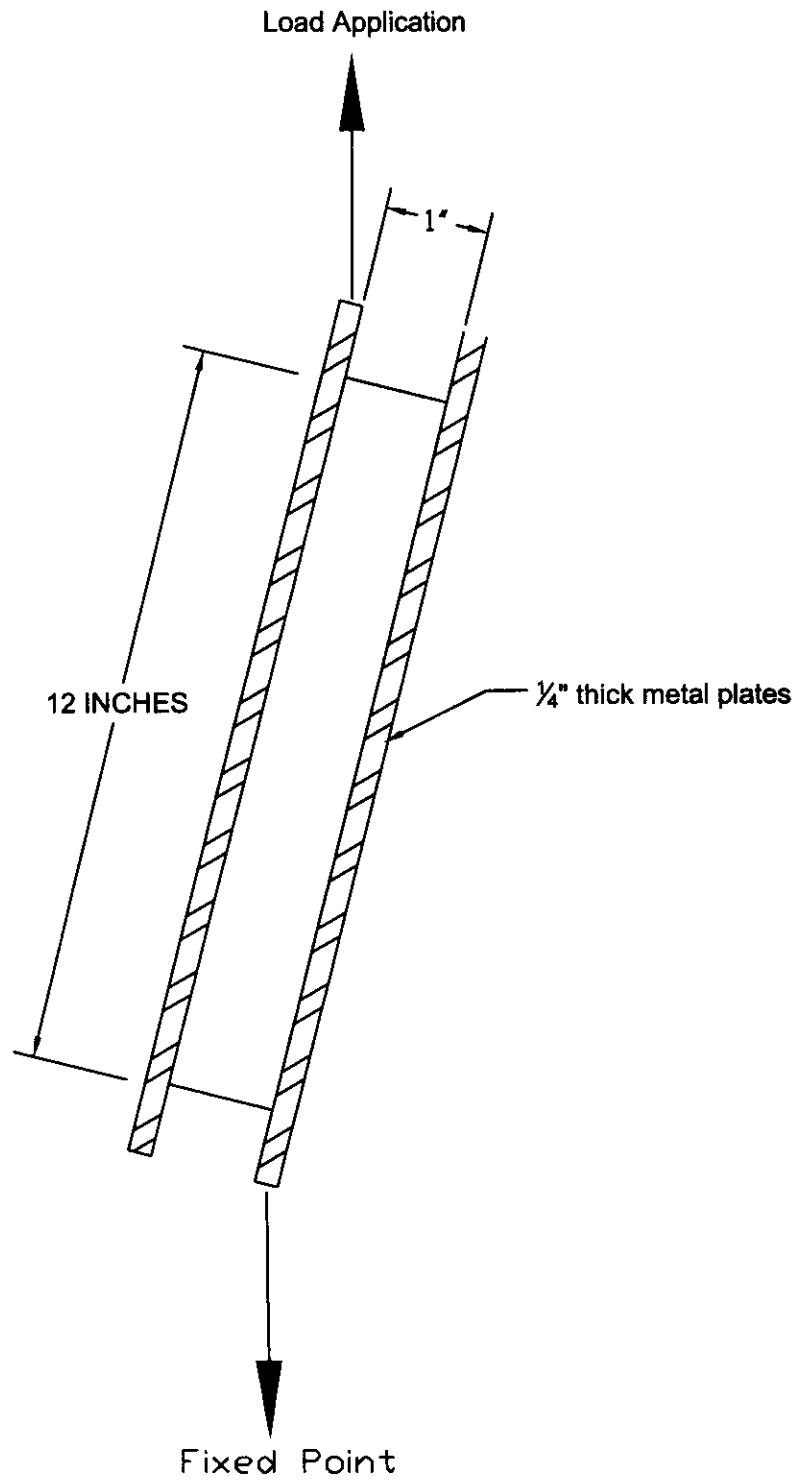
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**TEST SETUP FOR BOND STRENGTH TESTS
OF EPS FOAM CORE**



TEST SETUP FOR SHEAR STRENGTH
TESTS OF EPS FOAM CORE



TEST SETUP FOR COMPRESSIVE STRENGTH
TESTS OF EPS FOAM CORE

