

PEI

PROGRESSIVE ENGINEERING, INC.



58640 State Rd.15
Goshen, Indiana 46528
Telephone (219) 533-0337

TESTING LABORATORY

PEI STANDARD No. 93-7

**PERFORMANCE REQUIREMENTS FOR
FASTENING GYPSUM BOARD
TO WOOD FRAMING WITH A
TWO PART URETHANE ADHESIVE**



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TO WOOD FRAMING WITH A
TWO PART URETHANE ADHESIVE**

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Written By: Progressive Engineering, Inc.
Ned C. Myers, P.E.
Greg Weeden

TABLE OF CONTENTS

	Page No.
Foreword.....	1
1. Scope.....	2
2. Requirements.....	2
2.1 Cure Time Before Moving.....	2
2.2 Test I.....	2
2.3 Test II.....	2
2.4 Test III.....	2
2.5 Test IV.....	2
2.6 Test V.....	2
2.7 Test VI.....	3
2.8 Test VII.....	3
2.9 Test VIII.....	3
2.10 Container Labeling.....	3
3. General Test Method.....	3
4. Test Methods.....	4
4.1 Test I.....	4
4.2 Test II.....	4
4.3 Test III.....	4
4.4 Test IV.....	5
4.5 Test V.....	6
4.6 Test VI.....	6
4.7 Test VII.....	7
4.8 Test VIII.....	7
5. Test Report.....	8
Drawing No. 1.....	9
Drawing No. 2.....	10
Drawing No. 3.....	11
Drawing No. 4.....	12
Drawing No. 5.....	13
Drawing No. 6.....	14
Drawing No. 7.....	15

FORWARD

This test procedure was written in response to a request from BOCA International for a test procedure that would closely represent ASTM C 557 but, would allow the use of a two part urethane adhesive and it's unique application to construct the test samples.

This test procedure is based on engineering principles, previously confirmed by testing, testing experience using a two part urethane adhesive and practical usage of a two part urethane adhesive.

This test procedure is subject to revision as further investigation and experience may prove to be necessary.

Progressive Engineering, Inc. (PEI) shall not be responsible to anyone for the use of, or the reliance upon this test procedure. PEI shall not be held responsible or liable for damages, including consequential damages, arising out of or in connection with the use, interpretation of, or reliance upon this test procedure.

PEI urges anyone conducting this test procedure to be responsible and provide adequate safeguards for personnel and property.

1.0 SCOPE

This test procedure contains minimum standards for two part urethane adhesives intended for bonding the back surface of gypsum board to wood framing members.

This test procedure does not purport to address all required tests or investigations of a two part urethane adhesive.

2.0 REQUIREMENTS

2.1 Cure time before moving.

All test samples constructed and tested in this test procedure, shall use a controlled time, from the time the test samples are completely sprayed to when the samples are first moved. This time shall be consistent for all test samples and recorded.

2.2 TEST I - Shear strength after 24 hours.

The average shear strength of the test samples shall be not less than 30 psi after 24 hours, when tested as described in section 4.1.

2.3 TEST II - Shear strength after 48 hours.

The average shear strength of the test samples shall be not less than 40 psi after 48 hours, when tested as described in Section 4.2.

2.4 TEST III - Shear strength after cyclic laboratory exposure.

After cycling test samples as described in section 4.3, the average shear strength of these test samples shall be not less than 80% of the average actual values as determined in section 4.2.

2.5 TEST IV - Static load in shear.

Five test samples tested as described in Section 4.4 shall sustain a load of 40 Lbs. for 24 hours at ambient conditions of $73^{\circ} \pm 2^{\circ}\text{F}$ and 50% $\pm 5\%$ relative humidity without failure. Five different test samples shall sustain a load of 25 Lbs. for 24 hours at ambient conditions of $100^{\circ} \pm 2^{\circ}\text{F}$ and 50% $\pm 5\%$ relative humidity without failure.

2.6 TEST V - Tensile strength.

The tensile strength of the samples shall be recorded and averaged showing the mode of failure, when tested as described in Section 4.5.

2.7 TEST VI - Bridging characteristic

The adhesive shall be capable of bridging a 1/4 gap between gypsum board and a framing member while meeting the shear strength requirements in Section 2.3.

2.8 TEST VII - Storage temperature range

The shear values obtained from test samples constructed and tested as described in Section 4.7 shall be not less than the values required in Section 2.3.

2.9 Test VIII - Creep Test

All test sample movement shall be recorded on a displacement vs. time graph for each test sample and an average for all five.

2.10 Container Labeling

Shipped containers of the two part adhesive shall be labeled showing the following information:

1. Two distinct labels for each part of the adhesive.
2. The name or number of the adhesive.
3. Lot or batch number
4. The quantity of the container contents.
5. The manufacturers name.
6. The ratio of component mix for application.
7. First aid warnings
8. Recommended empty container disposal procedure

3.0 GENERAL TEST METHOD

Report the average value determined from five like test samples used in each of the tests listed previously. If two or more of the five samples vary more than 15% from the average, five more samples shall be tested and all ten used for the average.

4.0 TEST METHODS

4.1 TEST I - Shear strength after 24 hours.

A. Test Sample Preparation

The test samples shall be constructed using an 8"x10" piece of Gypsum board attached to a 2x2x13" piece of Spruce-Pine-Fir. See the attached drawing No. 1. The gypsum board and 2x2s shall be pre-conditioned at 73° ±2°F and 50% ±5% relative humidity for a minimum of 24 hours before applying the adhesive to them. The paper grain on the gypsum shall be parallel with the 10" dimension. Five test samples shall be prepared with no gap between the gypsum and 2x2 and five test samples shall be prepared with 1/8" of gap between the gypsum and 2x2. After the test samples are sprayed, condition them at 73° ±2°F and 50% ±5% relative humidity for 24 hours. Care should be taken to ensure that the 2x2s are square with the gypsum and that the 2x2s have square cut ends. Care should also be taken to use good materials without major defects that could effect the test results.

B. Test Procedure

After carefully trimming off excess adhesive, clamp the test sample in a shear fixture as shown on drawing No. 3. Be sure that the sample is square with the load table and that the load is parallel with the 2x2. Apply load to the 2x2 at a rate of .5 in/min. until an ultimate load is reached. Examine the test sample and record the ultimate load reached and the mode of failure.

4.2 Test II - Shear strength after 48 hrs.

A. Test Sample Preparation

Test samples shall be constructed as described in Section 4.1-A. The conditioning time between spraying and testing shall be 48 hrs.

B. Test Procedure

The test samples shall be tested as described in Section 4.1-B.

4.3 Test III - Shear strength after cyclic laboratory exposure

A. Test sample preparation

Test samples shall be constructed as described in Section 4.1-A. After the samples are sprayed, condition them at 73° ±2°F. and 50% ±5% relative humidity for 48 hours.

B. Cyclic exposure

Cycle the test samples four complete cycles as described below;

1. 4 hrs at $140^{\circ} \pm 5^{\circ}\text{F}$. and 85% $\pm 5\%$ relative humidity
2. 4 hrs at $32^{\circ} \pm 2^{\circ}\text{F}$. and 90% $\pm 5\%$ relative humidity
3. 16 hrs at $140^{\circ} \pm 5^{\circ}\text{F}$. and 10% $\pm 5\%$
4. 6 hrs at $140^{\circ} \pm 5^{\circ}\text{F}$. and 85% $\pm 5\%$ relative humidity
5. 18 hrs at $140^{\circ} \pm 5^{\circ}\text{F}$. and 10% $\pm 5\%$
6. Store test samples at $73^{\circ} \pm 2^{\circ}\text{F}$. and 50% $\pm 5\%$ relative humidity for 48 hours between cycles.

Store test samples at $73^{\circ} \pm 2^{\circ}\text{F}$. and 50% $\pm 5\%$ relative humidity for a minimum of 48 hours before testing.

C. Test Procedure

The previously cycled test samples shall be tested as described in Section 4.1-B.

4.4 Test IV - Static Load in Shear

A. Test Sample Preparation

Ten test samples shall be constructed as described in Section 4.1-A. After the samples are sprayed, condition them at $73^{\circ} \pm 2^{\circ}\text{F}$. and 50% $\pm 5\%$ relative humidity for 48 hours.

B. Test Procedure

Apply a static load of 40 pounds to five of the test samples in ambient conditions of $73^{\circ} \pm 2^{\circ}\text{F}$. and 50% $\pm 5\%$ relative humidity for 24 hours.

Apply a static load of 25 pounds to five of the test samples in ambient conditions of $100^{\circ} \pm 2^{\circ}\text{F}$. and 50% $\pm 5\%$ humidity for 24 hours. See drawing No. 4 for test set-up.

4.5 Test V - Tensile Strength

A. Test Sample Preparation

The test samples shall be constructed using an 8"x10" piece of gypsum board attached to a piece of 2x4 Spruce-Pine-Fir. See drawing No. 2.

The gypsum board and 2x4s shall be pre-conditioned at 73 \pm 2^oF. and 50% \pm 5% relative humidity for a minimum of 24 hrs. before applying the adhesive to them. Five test samples shall be prepared with no gap between the gypsum and 2x4s. Five test samples shall be prepared with 1/16" of gap between the gypsum and 2x4s. After the test samples are sprayed, condition them at 73 \pm 2^oF. and 50% \pm 5% relative humidity for 24 hrs. Care should be taken to ensure that the 2x4s are square with the gypsum and that the 2x4s have square cut ends. Care should also be taken to use good materials without major defects that could effect the test results. Plywood can be laminated to the opposite side of the gypsum for reinforcement if needed to develop enough strength in the gypsum to produce on adhesive bond failure.

B. Test Procedure

Clamp the test sample in a load machine as shown on drawing No. 5. Attach the 2x4 to the moveable head of the load machine as shown on drawing No. 5. Take care to ensure that the load is applied parallel with the 2x4. Apply load at a rate of 60 Lbs. per minute until an ultimate failure is obtained. Examine the test sample and record the ultimate load reached and the mode of failure.

4.6 TEST VI - Bridging Characteristic

A. Test sample preparation

Test samples shall be constructed as described in Section 4.1-A using a minimum of 1/4" Gap between the gypsum board and 2x2.

B. Test Procedure

The test samples shall be tested as described in Section 4.1-B.

4.7 TEST VII - Storage Temperature Range

A. Test Sample Preparation

Test samples shall be constructed as described in Section 4.1-A after cycling each part of the urethane adhesive as follows; Condition approximately 5 gallons of each part of the adhesive at the lowest recommended storage temperature for 24 hours. Immediately after cold conditioning place in an environment of the highest recommended storage temperature for 24 hours. Repeat this cycle two more times. After the third cycle, allow the materials to return to room temperature and spray the test samples within 24 hours.

B. Test Procedure

The test samples shall be tested as described in Section 4.1-B.

4.8 Test VIII - Creep Test

A. Test Sample Preparation

The test samples shall be constructed using 5/8" thick APA rated plywood with gypsum board back paper glued to the face with PVA adhesive. Six inch long 2x6 blocks of SPF, with a hole for mounting weights, shall be attached to the gypsum paper. See the attached drawing No. 6. All materials shall be pre-conditioned at 73°F ±2°F and 50% ±5% relative humidity for 24 hours before application of the foam adhesive. Five test samples shall be prepared with zero gap between the 2x6 and gypsum paper. The adhesive bead shall be applied to one side of two (2) 2x6 blocks on each test sample. After the test samples are sprayed, condition them at 73°F ±2°F and 50% ±5% relative humidity for 24 hours.

B. Test Procedure

After carefully trimming off excess adhesive to achieve a 1" wide x 3/4" bead, place the five (5) test samples in the load fixture as shown on drawing No. 7. Be sure that the samples are square with the load table so that dial indicators line up with 2x6 blocks. Position two (2) dial indicators, one at the bottom end of each 2x6 to measure deflection. A 20 pound static weight shall be centered between the 2x6 blocks.

A temperature of 158°F \pm 5°F shall be maintained with uncontrolled humidity, not to exceed 35% relative humidity. Humidity shall be recorded during test.

The dial indicators shall be read at the beginning of the test prior to elevating the temperature and then once every 24 hours until completion of the test.

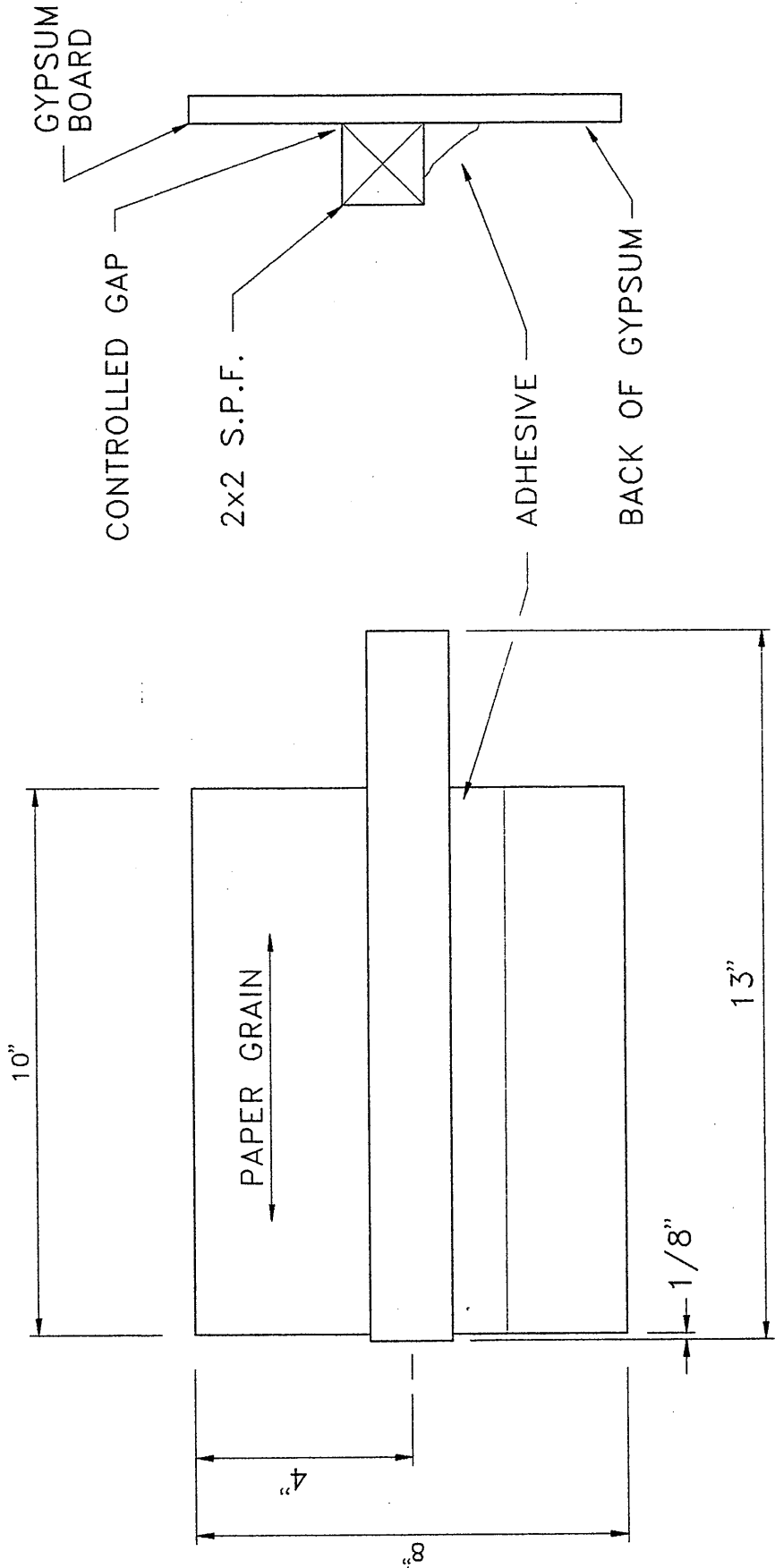
The test samples shall be maintained at 158°F for 500 hours or until there are 120 hours with no movement, whichever is reached first. If after 500 hours there is movement within a 24 hour period, the test shall be continued until there is no movement in one 24 hour period.

3. All dial indicator readings shall be recorded and an average displacement vs. time graph shall be created for each test sample.

5.0 TEST REPORT

- 5.1 The test report must include enough information to thoroughly describe the tests that were performed, including:
 - identification of all materials
 - accurate drawings of test samples
 - accurate drawings of test set-ups
 - all loads reached and averages
 - conclusions

The ultimate loads reached shall be expressed in pounds per square inch of adhesive contact area on the gypsum and wood separately. The contact area should be measured to the nearest 1/16 of an inch.



GYPSUM BOARD

CONTROLLED GAP

2x2 S.P.F.

ADHESIVE

BACK OF GYPSUM

10"

PAPER GRAIN

4"

1/8"

13"

DWR. BY: G. WEEDEN
 DATE: 2/15/93
 SCALE: 6" = 12"
 DRAWING NUMBER
1

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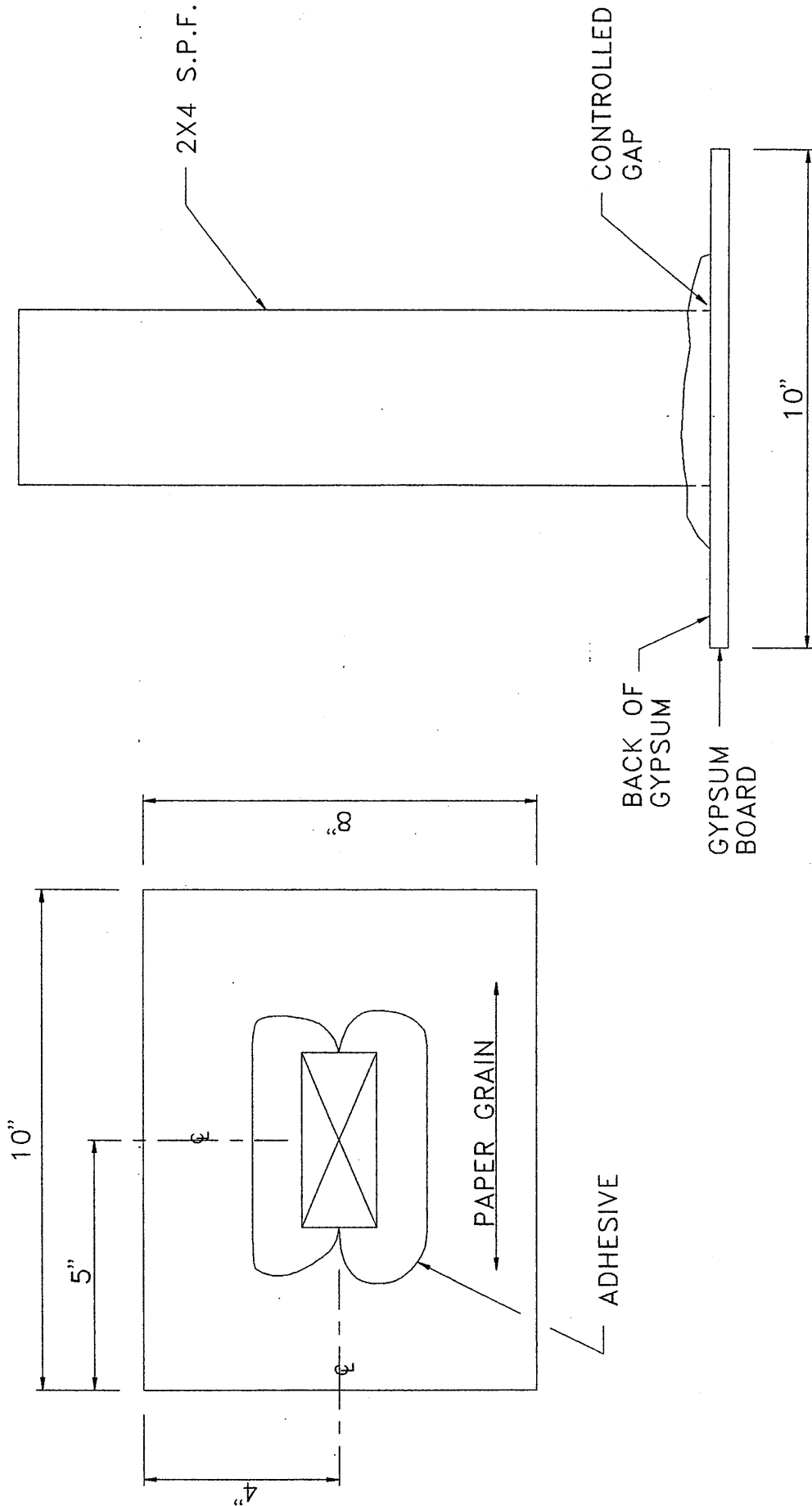
TITLE:
SHEAR SAMPLE

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 Testing Laboratory



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 GOSHEN, INDIANA 46528
 Telephone (317) 533-0337



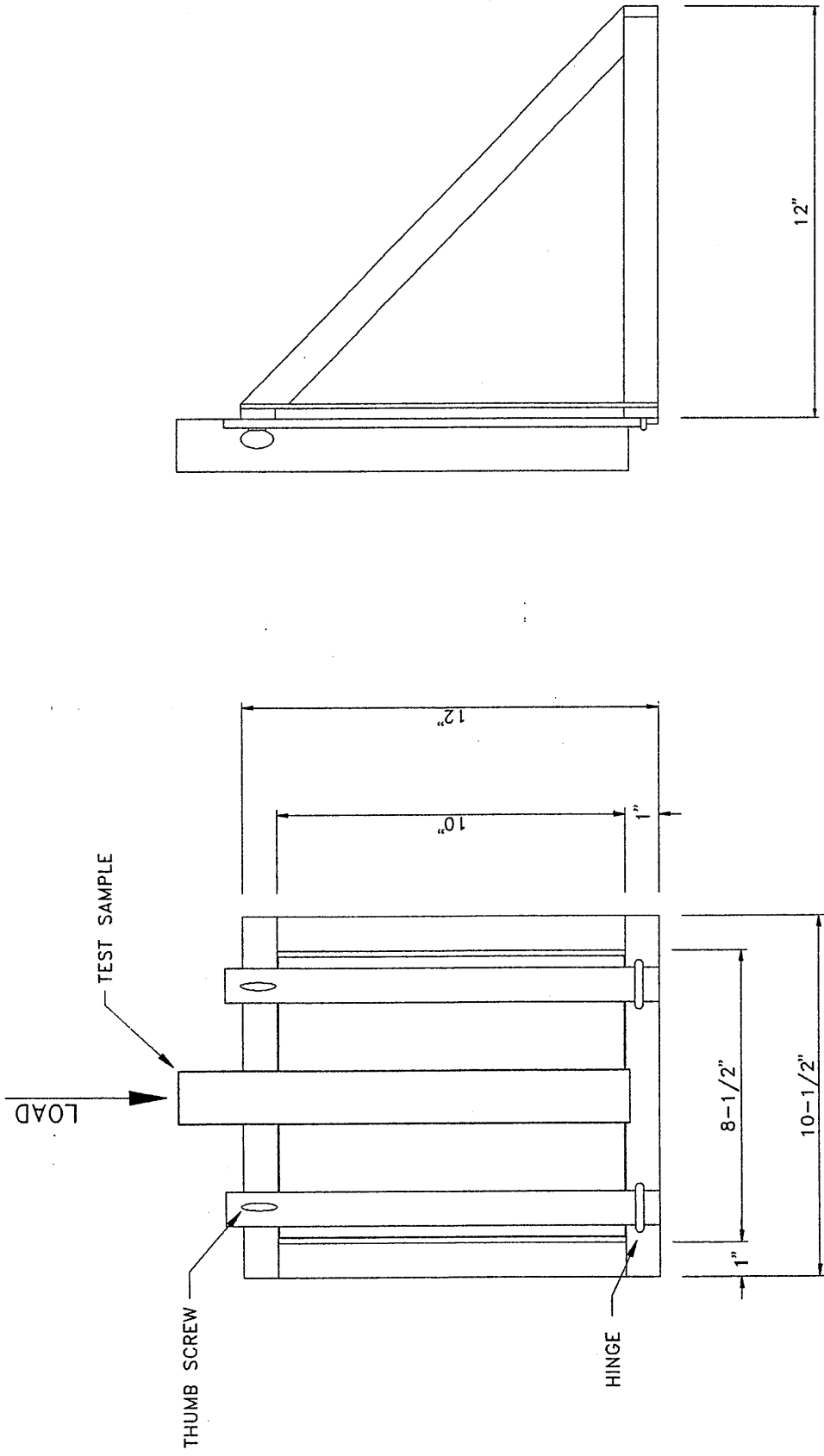
DWN. BY: G. WEEDEN
 DATE: 2/15/93
 SCALE: 6" = 12"
 DRAWING NUMBER
2

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TENSILE SAMPLE

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DWG. BY: G. WEEDEN
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 SCALE: 4" = 12"

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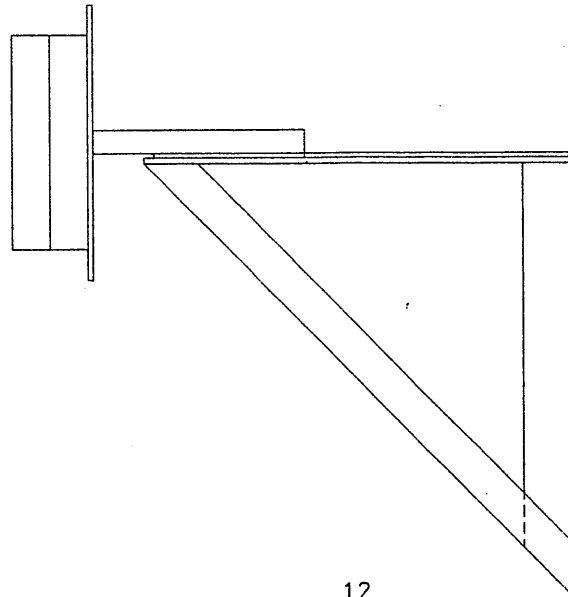
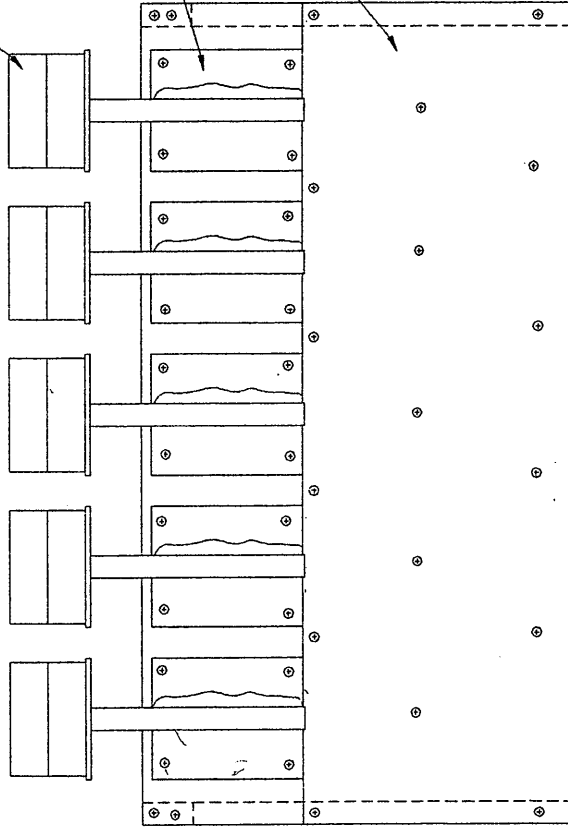
TITLE: SHEAR FIXTURE

DRAWING NUMBER
3

LOAD UNITS

TEST SAMPLE

BEARING



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DATE: 2/15/93
SCALE: 1.5" = 12"
DRAWING NUMBER

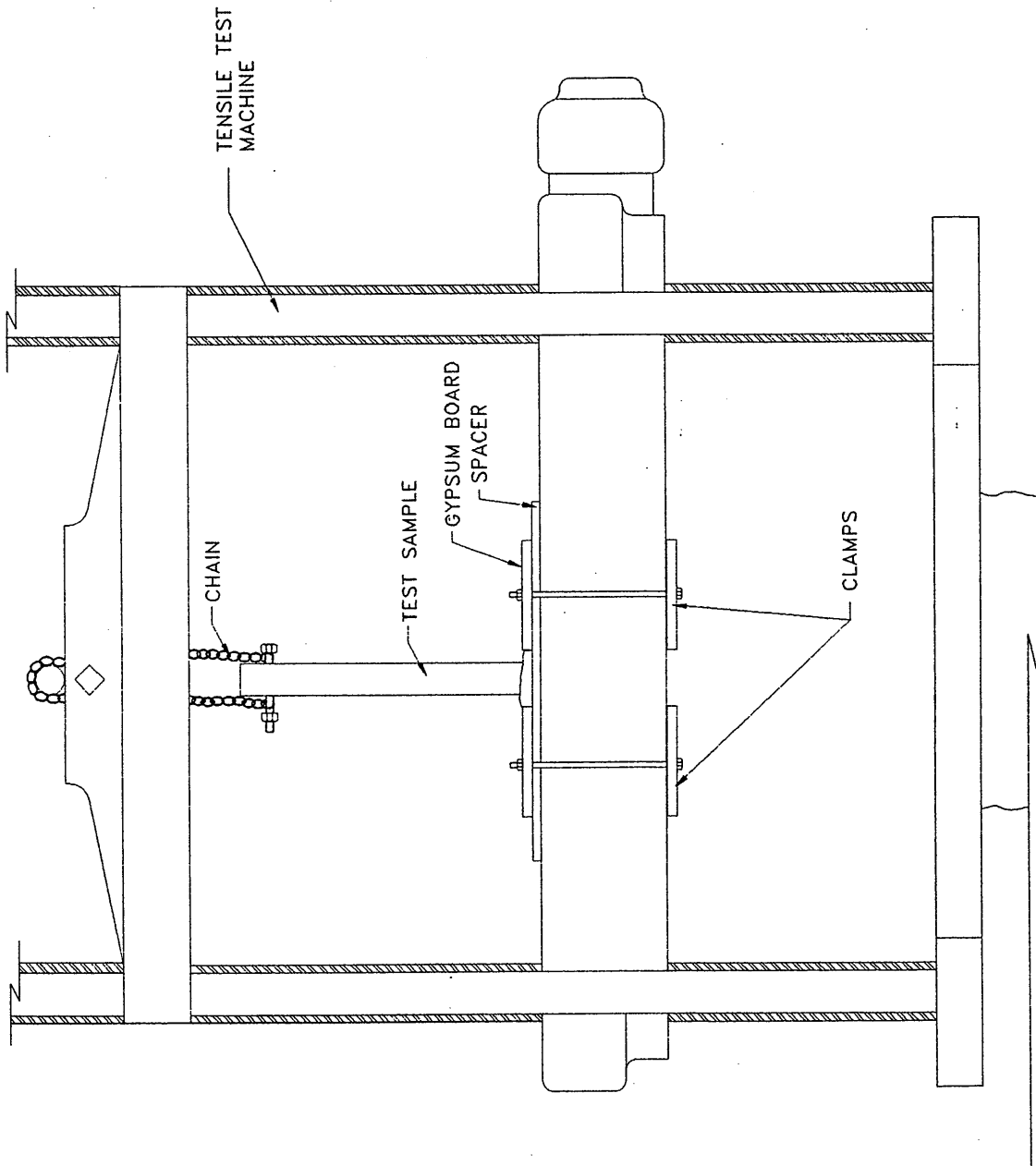
4

TITLE: STATIC LOAD

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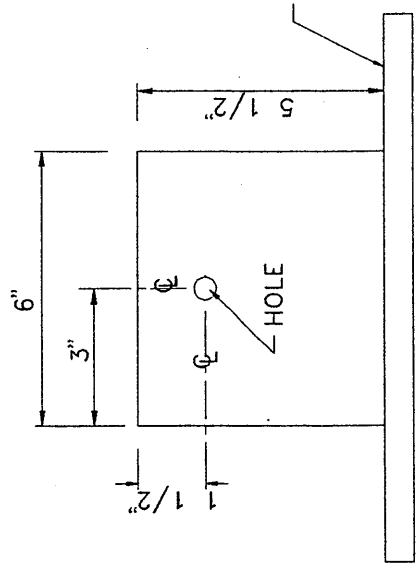
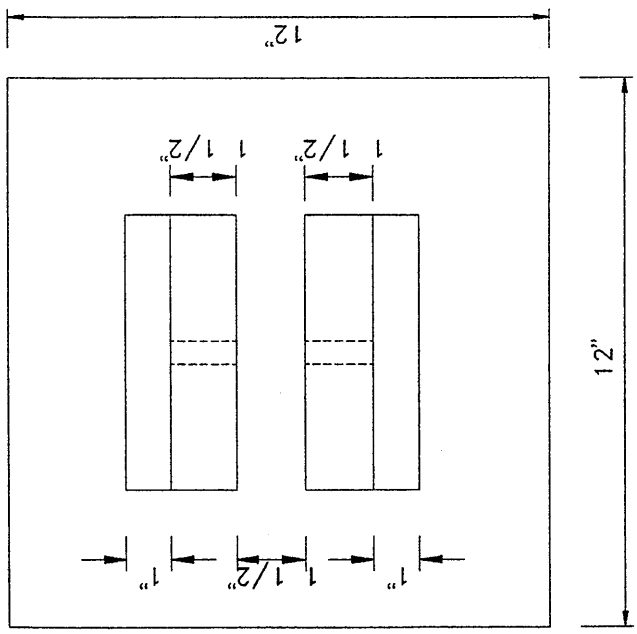
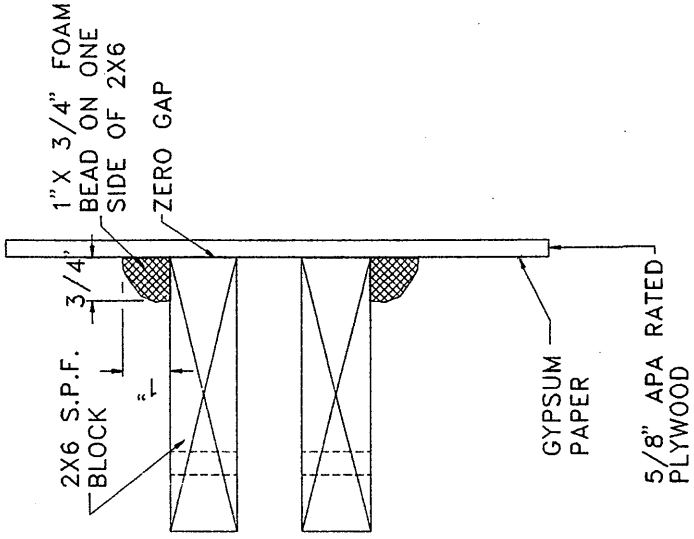
DWR. BY: G. WEEDEN
 DATE: 2/15/93
 SCALE: 2" = 12"
 DRAWING NUMBER

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TITLE: TENSILE TEST

5

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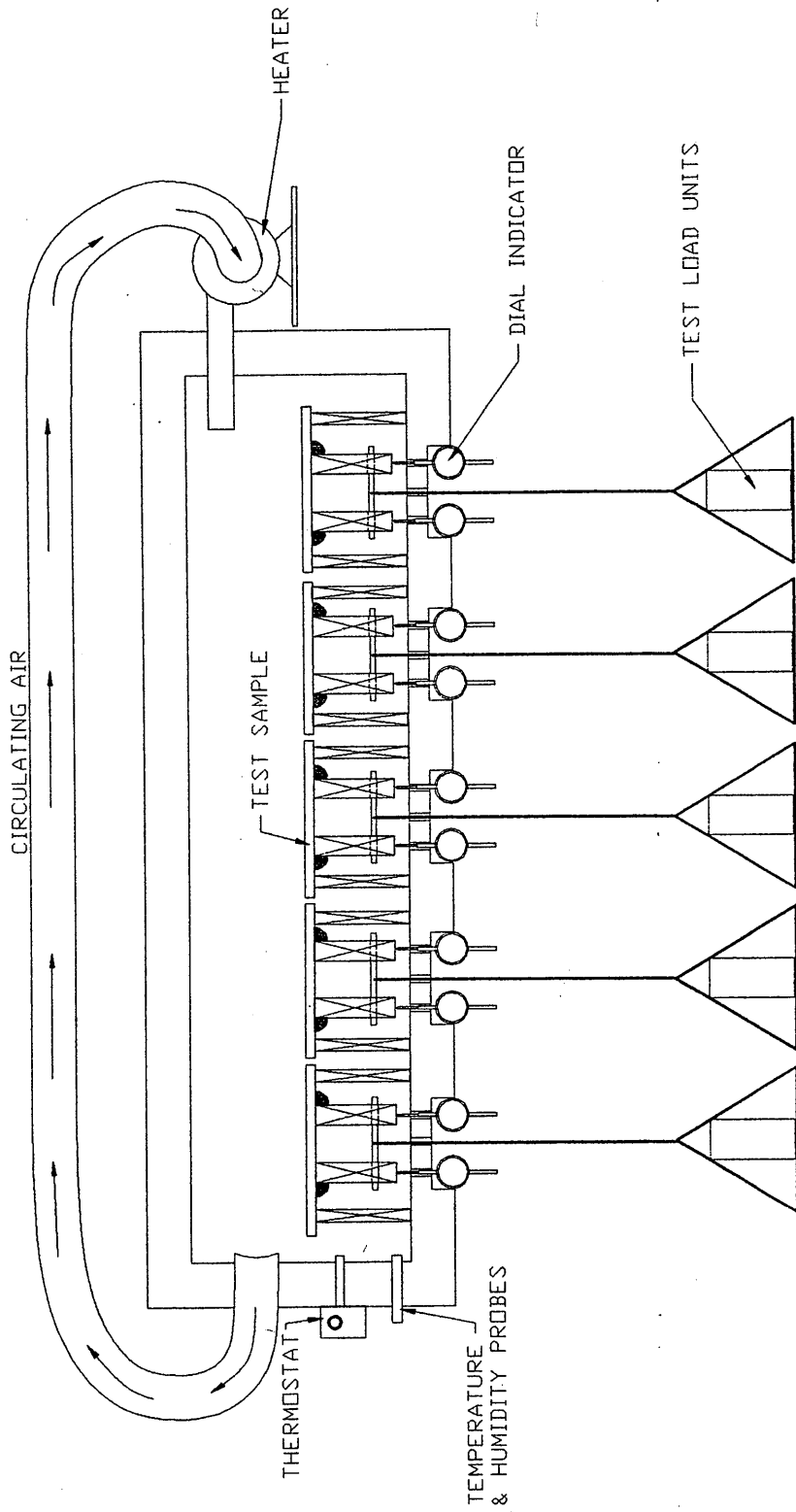


OWN. BY: M. PETTIT
 DATE: 5/18/93
 SCALE: 3" = 12"
 DRAWING NUMBER
 6

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TITLE:
 TEST SET-UP

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 CUSHEN, INDIANA 46526
 Telephone (219) 533-0337



DWN. BY: M. PETTIT DATE: 5/13/93 SCALE: 1.5" = 12"	This drawing and all information contained herein is the property of PROGRESSIVE ENGINEERING, INC. and shall not be reproduced without the expressed written permission of PROGRESSIVE ENGINEERING, INC. PROGRESSIVE ENGINEERING, INC. assumes no responsibility for unauthorized use of this drawing.	PE PROGRESSIVE ENGINEERING, INC. Testing Laboratory	58640 State Road 15 GOSHEN, INDIANA 46526 Telephone (219) 639-0337
DRAWING NUMBER 7			