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REPORT NO. EVT 17-90

COMPARISON OF STANDARD
ISSUE AND ANCRA
INTERNATIONAL MILVAN
RESTRAINT BEAMS IN STATIC
AND DYNAMIC ENVIRONMENTS

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Prepared for:
U.S. Army Troop Support Command
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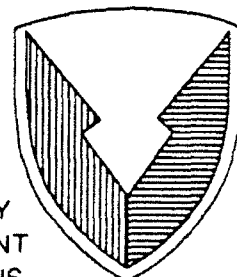
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19. ABSTRACT (Continue on reverse if necessary and identify by block number) The U.S. Army Defense Ammunition Center and School (USADACS), Validation Engineering Division (SMCAC-DEV), was tasked by the U.S. Army Troop Support Command (TROSCOM), to evaluate a second source of Military Van (MILVAN) restraint beam assemblies. The evaluation consisted of a comparison between standard issue restraint beams that are delivered with a MILVAN to a beam supplied by ANCRA International. Comparison of the restraint beams was accomplished in two phases. The first phase was to determine static load characteristics of the beams. Loading was applied over a small cross section at the end of the beams and the center of the beams. A third load was applied over a cross section at the center of the beams. The second phase of testing was a complete transportability test of loaded MILVANs. The ANCRA International beams performed equally as well as the standard issue beams supplied by Kinedyne Corporation (formerly Aeroquip).					
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SAVANNA, IL 61074-9639

REPORT NO. EVT 17-90

COMPARISON OF STANDARD ISSUE AND ANCRA MILVAN RESTRAINT BEAMS
IN STATIC AND DYNAMIC ENVIRONMENTS

APRIL 1990

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PART 1

INTRODUCTION

A. BACKGROUND. The U.S. Army Defense Ammunition Center and School (USADACS), Validation Engineering Division (SMCAC-DEV), was tasked by the U.S. Army Troop Support Command (TROSCOM), to evaluate a redesigned Military Van (MILVAN) restraint beam. The redesigned restraint beam was designed by ANCRA International. Currently fielded restraint beams are fabricated by Kinedyne Corporation. Testing was accomplished in two phases. The first phase consisted of a series of static loading tests. The second phase was dynamic with the beams used to restrain a fully-loaded MILVAN exposed to a standard transportability test environment.

B. AUTHORITY. This test was conducted IAW mission responsibilities delegated by the U.S. Army Armament, Munitions and Chemical Command (AMCCOM), Rock Island, IL. Reference is made to Change 4, 4 October 1974, to AR-740-1, 23 April 1971, Storage and Supply Operations; AMCCOMR 10-17, 13 January 1986, Mission and Major Functions of USADACS.

C. OBJECTIVE. The objective of these tests was to compare standard issue MILVAN restraint beams to the redesigned restraint beam from ANCRA International.

D. CONCLUSION. The ANCRA International restraint beams were found to be equivalent to the standard issue restraint beams manufactured by Kinedyne Corporation in static and dynamic loading situations. None of the beams were damaged during rail, road, and Shipboard Transportation Simulator (STS) testing. No damage occurred to the maximum weight loads as a result of these tests.

E. RECOMMENDATION. It is recommended that ANCRA International be approved as a source of supply for MILVAN restraint beams.

PART 2

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PART 3

TEST PROCEDURES

A. STATIC BEAM LOADING. There are two different types of restraint beams currently available for MILVANS. One type is the restraint beam issued with the MILVAN when it was first procured. The second type is that of a new manufacturer obtained through the federal supply system. The primary supplier for these beams is Kinedyne Corporation. ANCRA International has developed a restraint beam which it requests be considered as a source of supply. Before any of the ANCRA International restraint beams can be used to restrain loads in MILVANS, the beams must be approved by the Association of American Railroads/ Bureau of Explosives (AAR/BOE) and U.S. Coast Guard (USCG). To determine acceptability, two test sequences were developed. One was a static pull test, the second, an actual transportation scenario based on Transportability Testing Procedures, EVT-TP-1-86. The static pull test consisted of normally restraining a sample restraint beam in a MILVAN and applying an increasing load force on the beam until the beam failed. Failure is the point at which the beam permanently deforms or no longer holds an increasing load. The test load force was applied to a restrained test beam bearing at three distinct locations. The force locations were at the ends of the beam where it attached to the container belt rail, a point load at the center of the beam, and an equally distributed surface load along the beam centerline. Each test load was applied to a different beam. The test load force was increased until permanent damage was observed in the beam. Each test was performed on three different samples to obtain representative characteristics of that beam group. The load force applied to a beam was measured with a load cell. The strain developed in the beam was measured with a strain gage mounted on the beam. The strain gage was located at the middle of the beam, both horizontally and vertically. The strain gage was placed opposite from the applied load force. As the load force was applied to each beam, the applied load force and strain in the beam was electronically recorded.

B. RAIL IMPACT TEST. The test load or vehicle was positioned in/on a railcar. For containers, the loaded container is positioned on a container chassis and securely locked in place using the twist locks at each corner. The container chassis was then secured to a railcar. Equipment needed to perform the test included the specimen (hammer) car, five empty railroad cars connected together to serve as the anvil, and a railroad locomotive. These anvil cars were positioned on a level section of track with air and hand brakes set and with the draft gear compressed. The locomotive unit pulled the specimen car several hundred yards away from the anvil cars, then pushed the specimen car toward the anvil at a predetermined speed, then disconnected from the specimen car approximately 50 yards away from the anvil cars, which allowed the specimen car to roll freely along the track until it struck the anvil. This constituted an impact. Impacting was accomplished at speeds of 4, 6, and 8 mph in one direction and at a speed of 8 mph in the opposite direction. The 4 and 6 mph impact speeds were approximate; the 8 mph speed was a minimum. Impact speeds were determined by using an electronic counter to measure the time required for the specimen car to traverse an 11-foot distance immediately prior to contact with the anvil cars.

C. HAZARD COURSE. The specimen being tested was subjected to the road hazard course. Using a suitable truck/tractor or tactical vehicle, the vehicle/specimen of test method no. 1 was towed/driven over a hazard course two times at a speed of approximately 5 mph. The speed was increased or decreased, as appropriate, to produce the most violent load response.

D. ROAD TRIP. Using a suitable truck/tractor and trailer, or tactical vehicle, the tactical vehicle/specimen load was driven/towed for a total distance of at least 30 miles over a combination of roads surfaced with gravel, concrete, and asphalt. Test route included curves, corners, railroad crossings, cattle guards, stops and starts. The test vehicle traveled at the maximum speed suitable for the particular road being traversed, except as limited by legal restrictions. This step provides for the tactical vehicle/specimen load to be subjected to three

full airbrake stops while traveling in the forward direction and one in the reverse direction, while traveling down a 7 percent grade. The first three stops were at 5, 10, and 15 mph, while the stop in the reverse direction was approximately 5 mph.

E. WASHBOARD COURSE. Using a suitable truck/tractor, and/or tactical vehicle, the specimen was driven/towed over the washboard course at a speed which produced the most violent response in the particular test load (as indicated by the resonant frequency of the suspension system beneath the load).

F. SHIPBOARD TRANSPORTATION SIMULATOR (STS). The test load (specimen) was positioned on the STS and securely locked in place using the cam lock at each corner. Using the procedure detailed in the operating instruction, the STS began oscillating at an amplitude of 30 degrees $\pm$ 2 degrees, either side of center and a frequency of 2 cycles-per-minute (30 seconds $\pm$ 2 seconds total roll period). This frequency was observed for apparent defects that could cause a safety hazard. The frequency of oscillation was then increased to 4 cycles-per-minute (15 seconds $\pm$ 1 second roll period). This frequency was then observed for apparent defects that could cause a safety hazard. The frequency of oscillation was then maintained at 4 cycles-per-minute (15 seconds $\pm$ 1 second roll period), and the apparatus operated for two hours. If an inspection of the load does not indicate an impending failure, the frequency of oscillation is further increased to 5 cycles-per-minute (12 seconds $\pm$ 1 second cycle time), and the apparatus operated for four hours. The operation did not necessarily have to be continuous; however, no change or adjustments to the load or load restraints was permitted at any time during the test. After once being set in place, the test load (specimen) was not removed from the apparatus until the test had been completed or was terminated.

PART 4

TEST RESULTS

SECTION 1. STATIC BEAM LOADING

A. ORIGINAL ISSUE RESTRAINT BEAMS.

1. Stress/strain data.
2. Photographs.

B. NEW ISSUE RESTRAINT BEAMS.

1. Stress/strain data.
2. Photographs.

C. ANCRA INTERNATIONAL RESTRAINT BEAMS.

1. Stress/strain data.
2. Photographs.

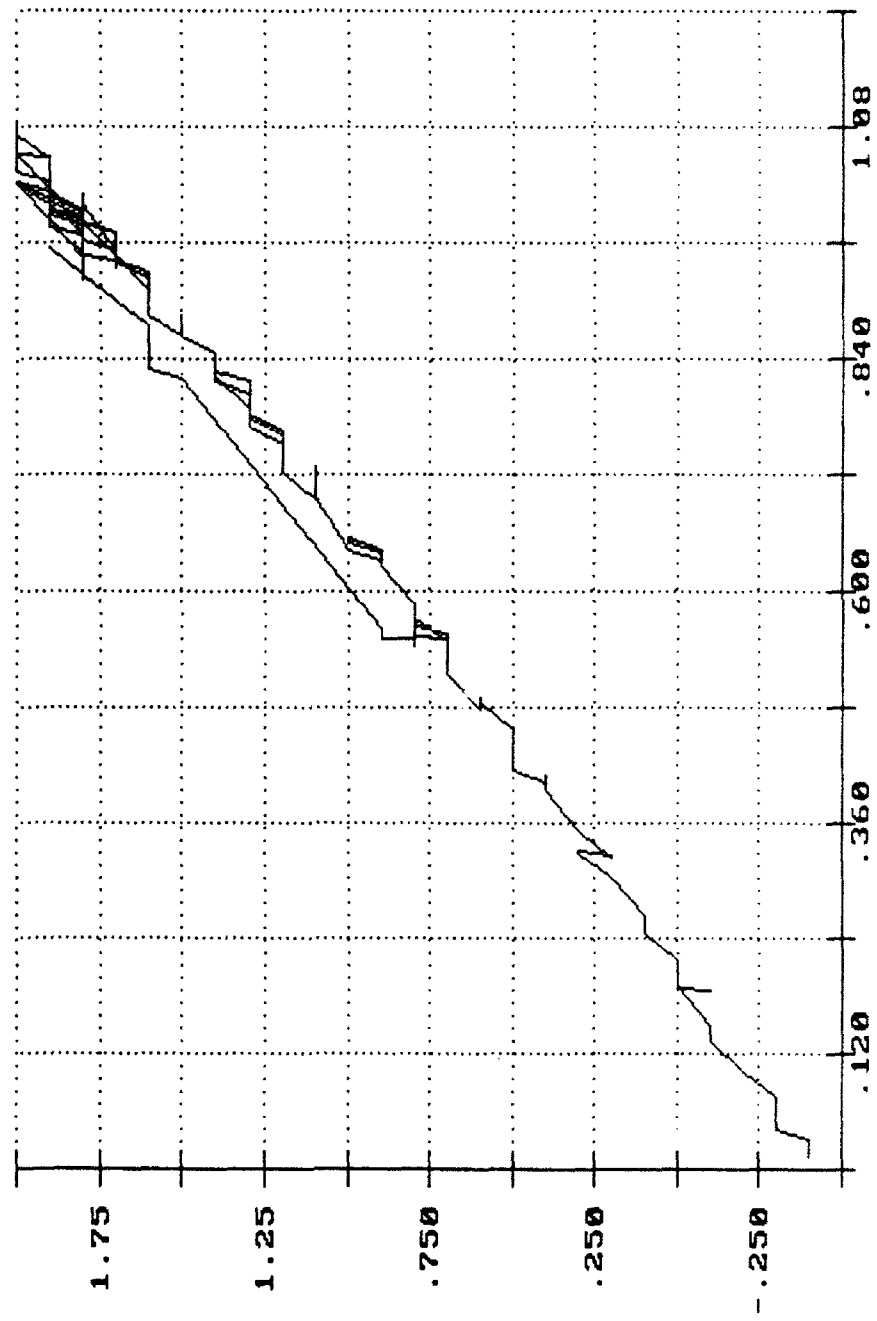
SECTION 1

STATIC BEAM LOADING

A. ORIGINAL ISSUE RESTRAINT BEAMS

STRESS/STRAIN DATA

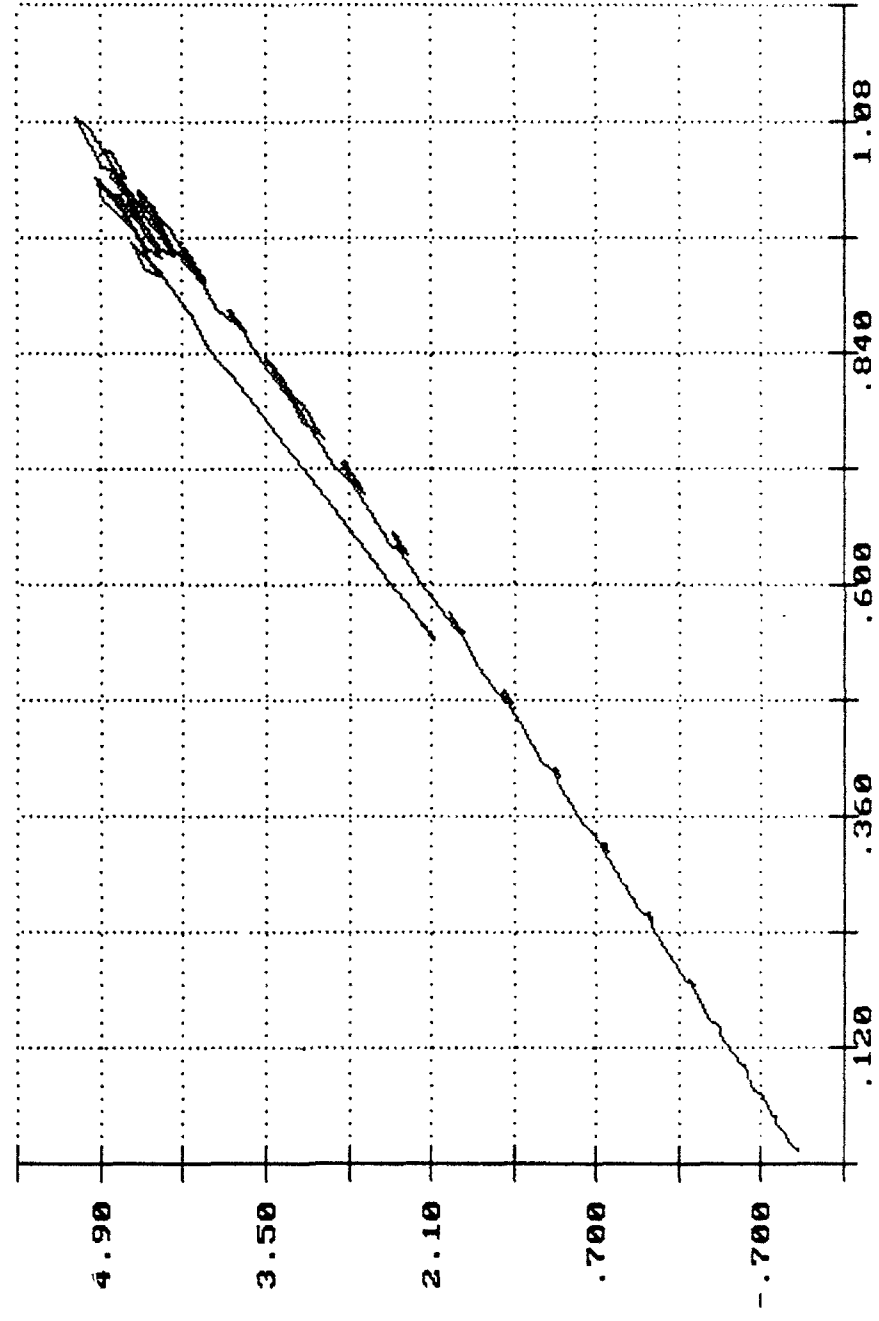
ORIGINAL ISSUE RESTRAINT BEAM
SAMPLE 1



Resultant Strain in Inches / Inch X .0001

Applied Load in Pounds X 10000.0000

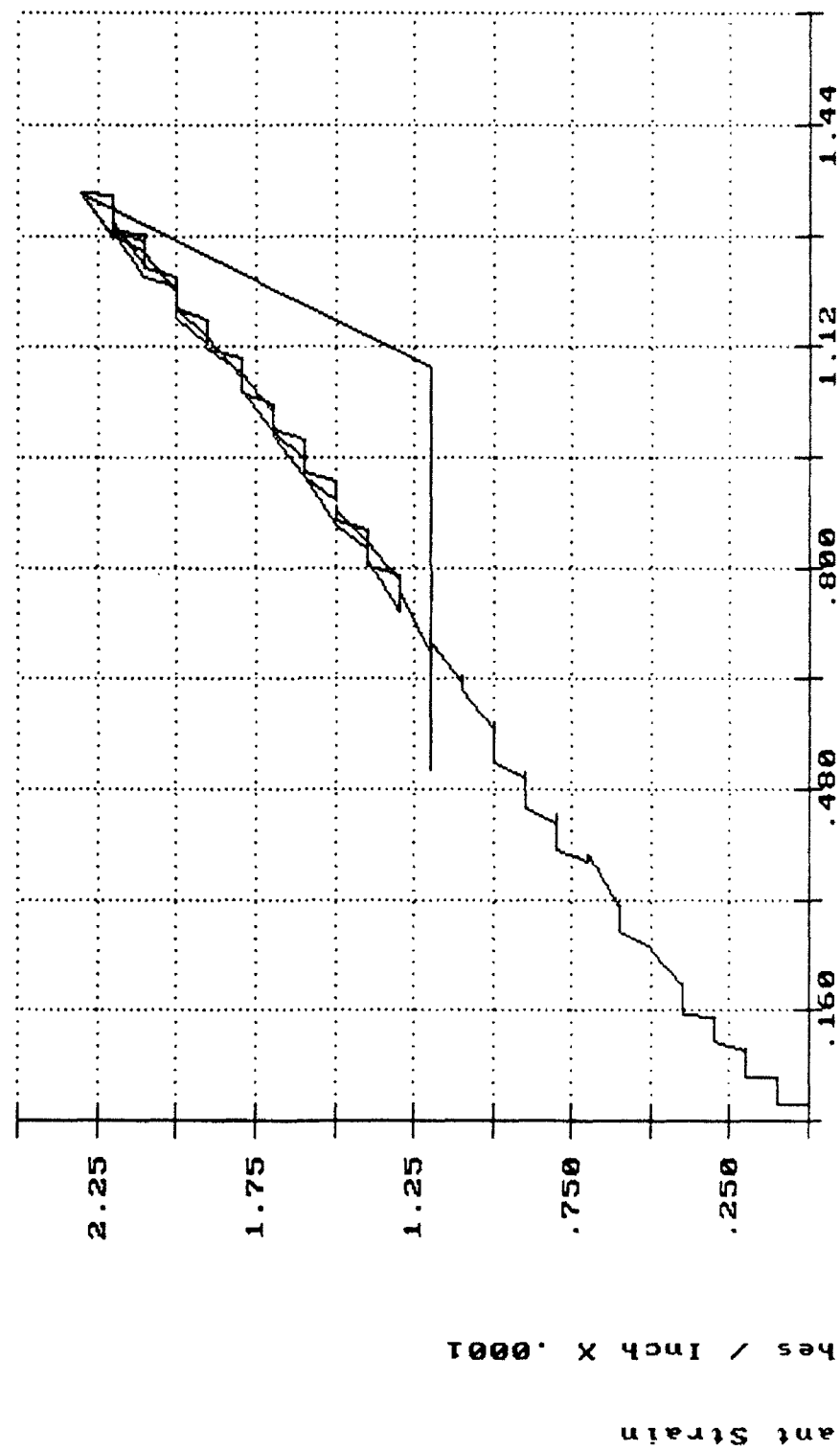
ORIGINAL ISSUE RESTRAINT BEAM
SAMPLE 1



Resultant Stress
in Pounds X 1.0000

Applied Load in Pounds
X 10000.0000

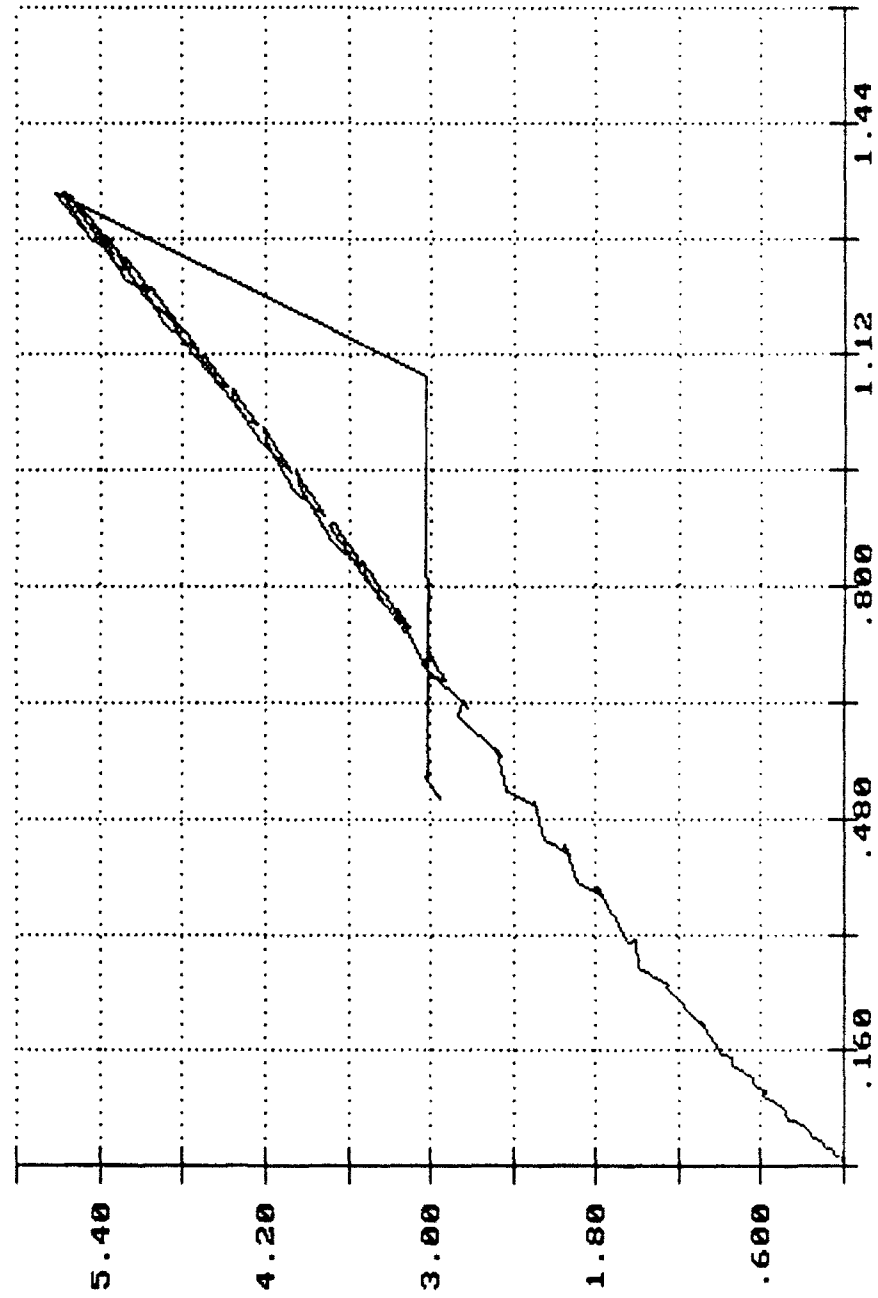
ORIGINAL ISSUE RESTRAINT BEAM
SAMPLE 2



Applied Load in Pounds
x 10000.0000

Resultant Strain
in inches / inch x .0001

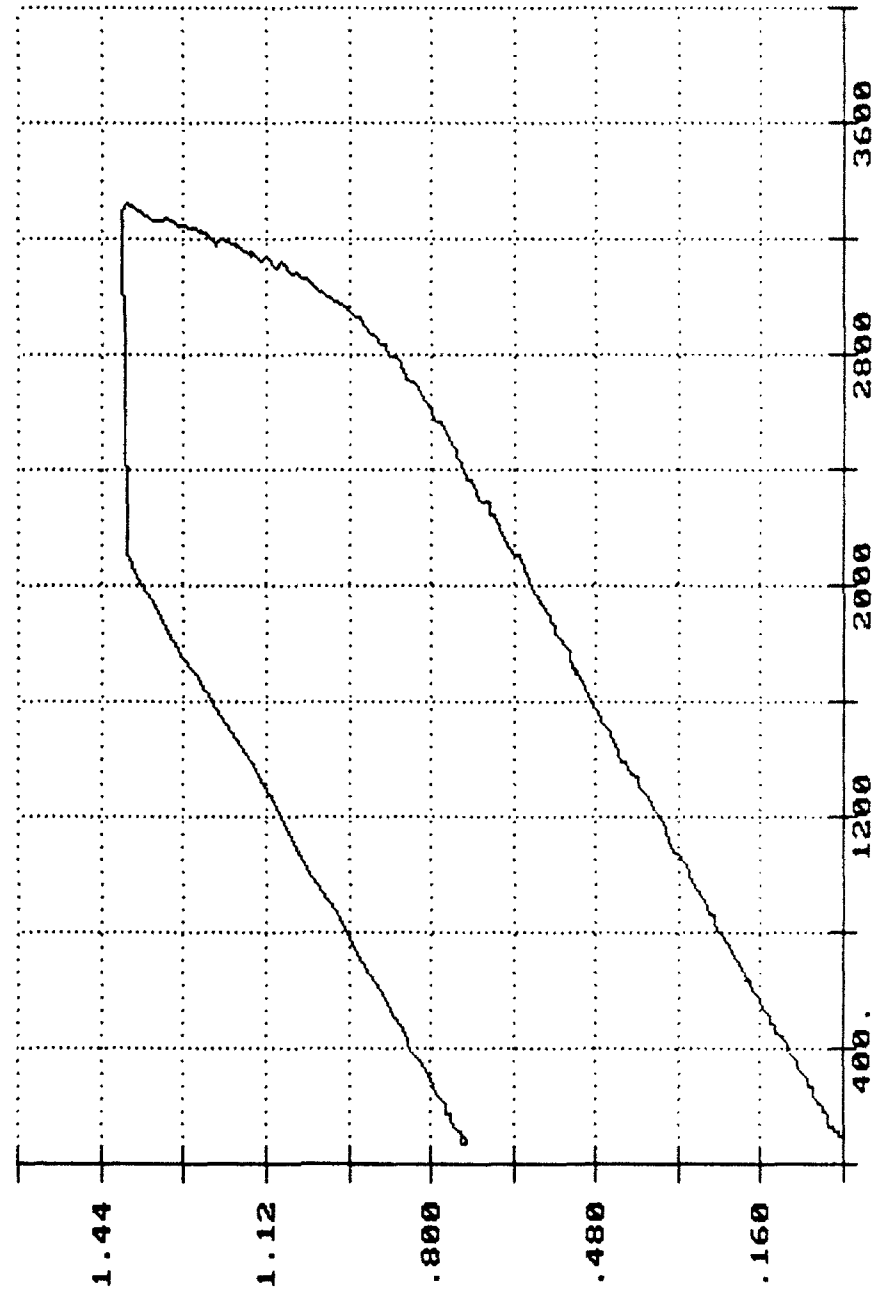
ORIGINAL ISSUE RESTRAINT BEAM
SAMPLE 2



Applied Load in Pounds
X 10000.0000

Resultant Stress
in Pounds X 1.0000

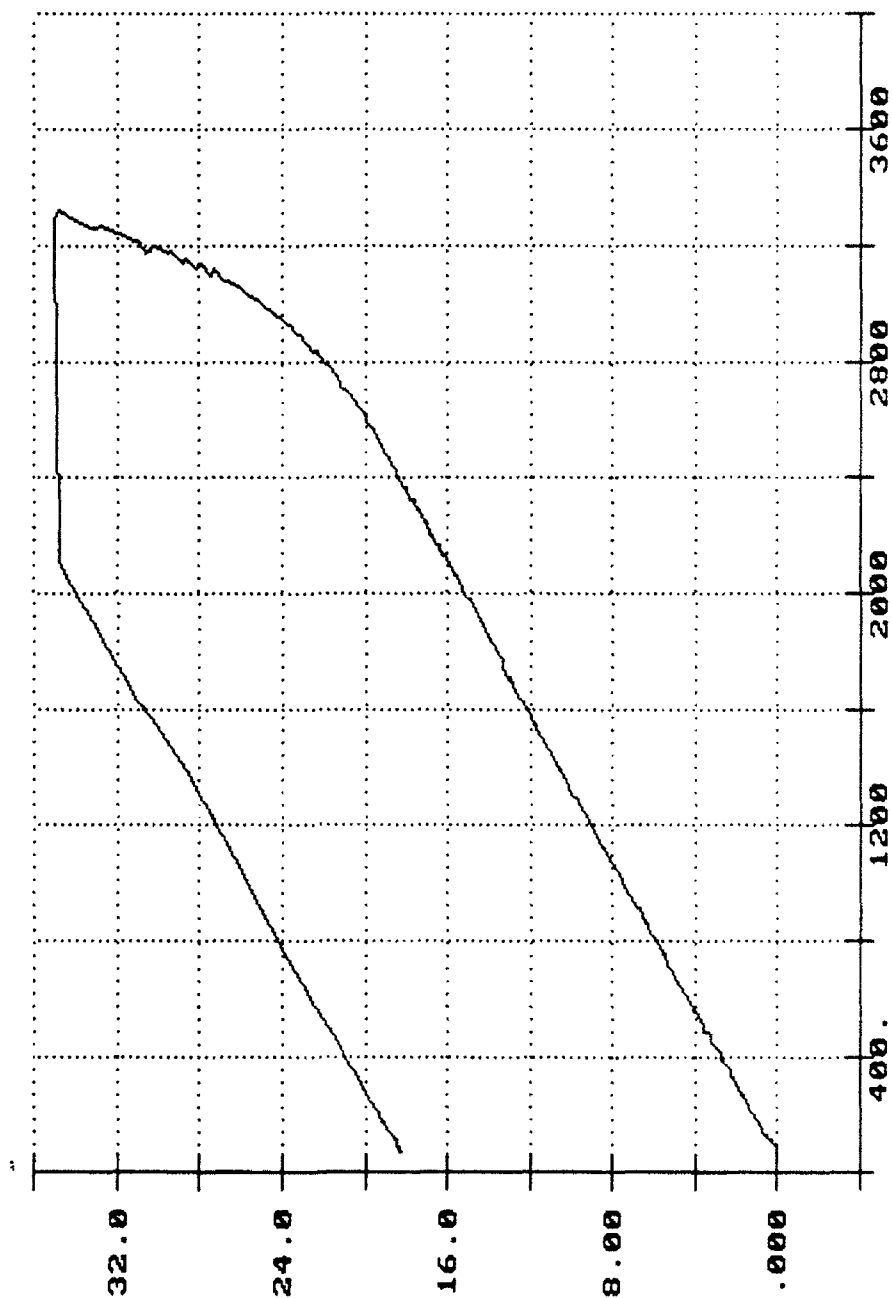
ORIGINAL ISSUE RESTRAINT BEAM
SAMPLE 4



Applied Load in Pounds
X 1.0000

Resultant Strain
in inches / inch x .0010

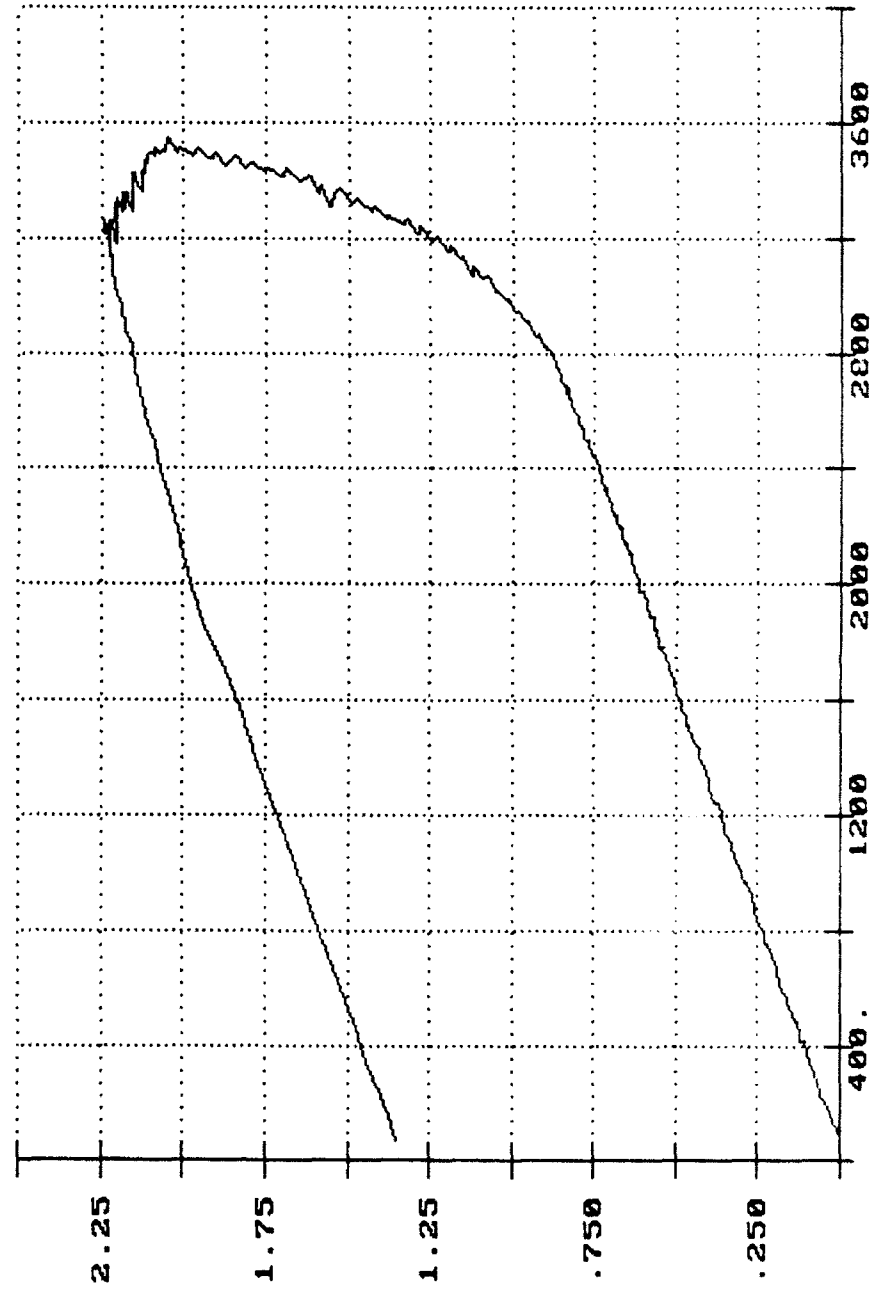
ORIGINAL ISSUE RESTRAINT BEAM
SAMPLE 4



Resultant Stress
in Pounds X 1.0000

Applied Load in Pounds
X 1.0000

ORIGINAL ISSUE RESTRAINT BEAM
SAMPLE 5

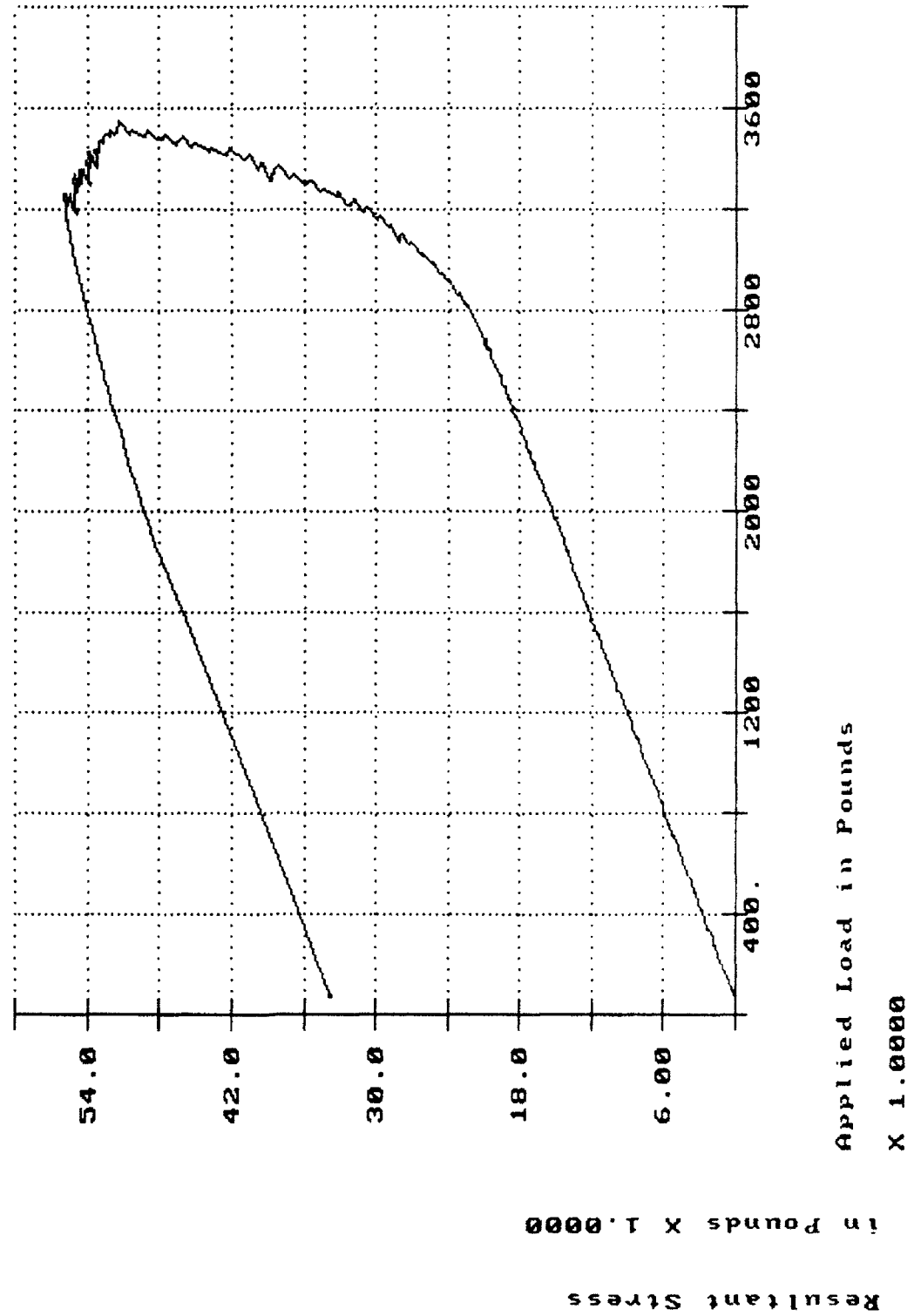


Applied Load in Pounds

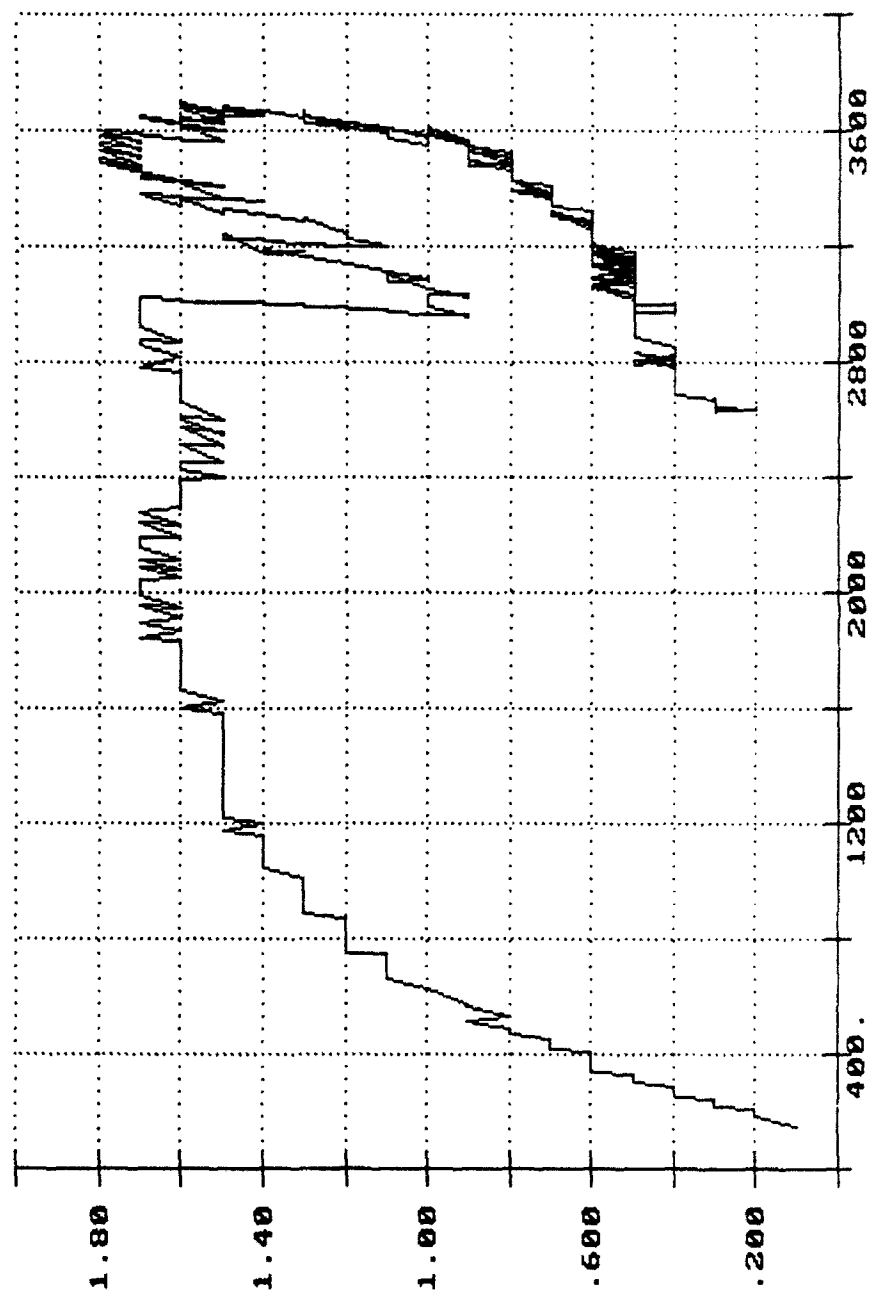
X 1.0000

Resultant Strain
in Inches / Inch X .0010

ORIGINAL ISSUE RESTRAINT BEAM
SAMPLE 5



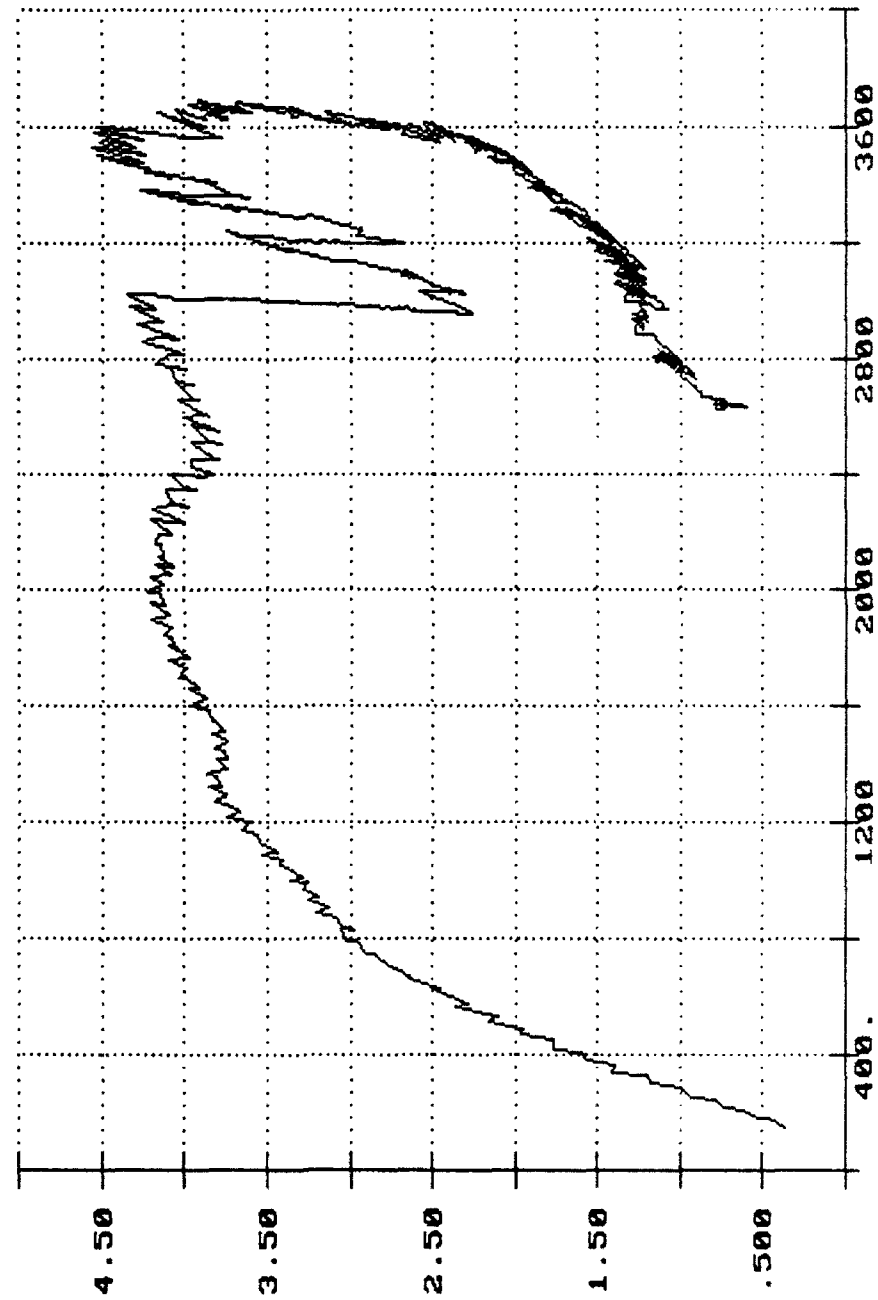
ORIGINAL ISSUE RESTRAINT BEAM
SAMPLE 6



Applied Load in Pounds
X 1.0000

Restraint Strain
in inches / inch x .0001

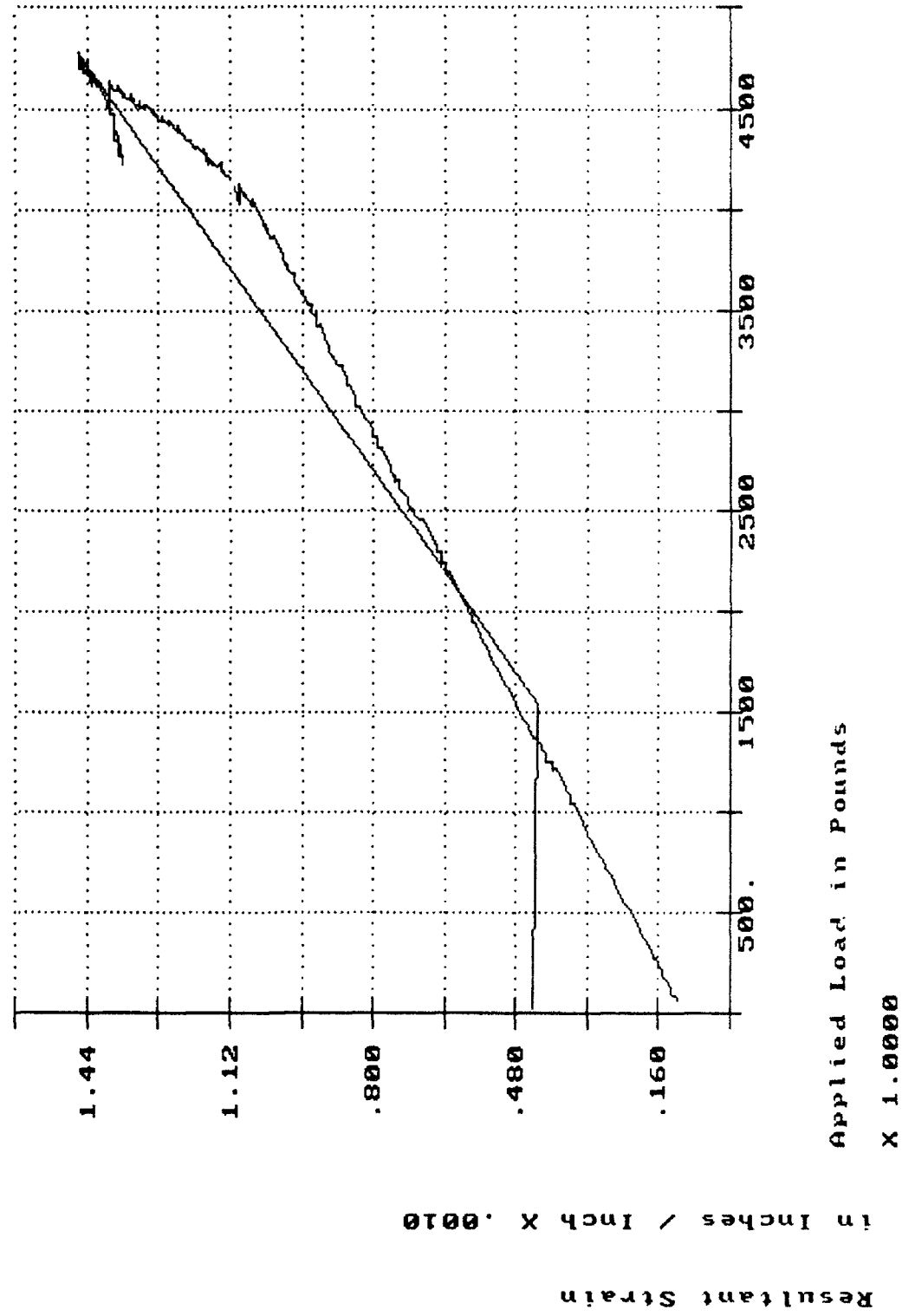
ORIGINAL ISSUE RESTRAINT BEAM
SAMPLE 6



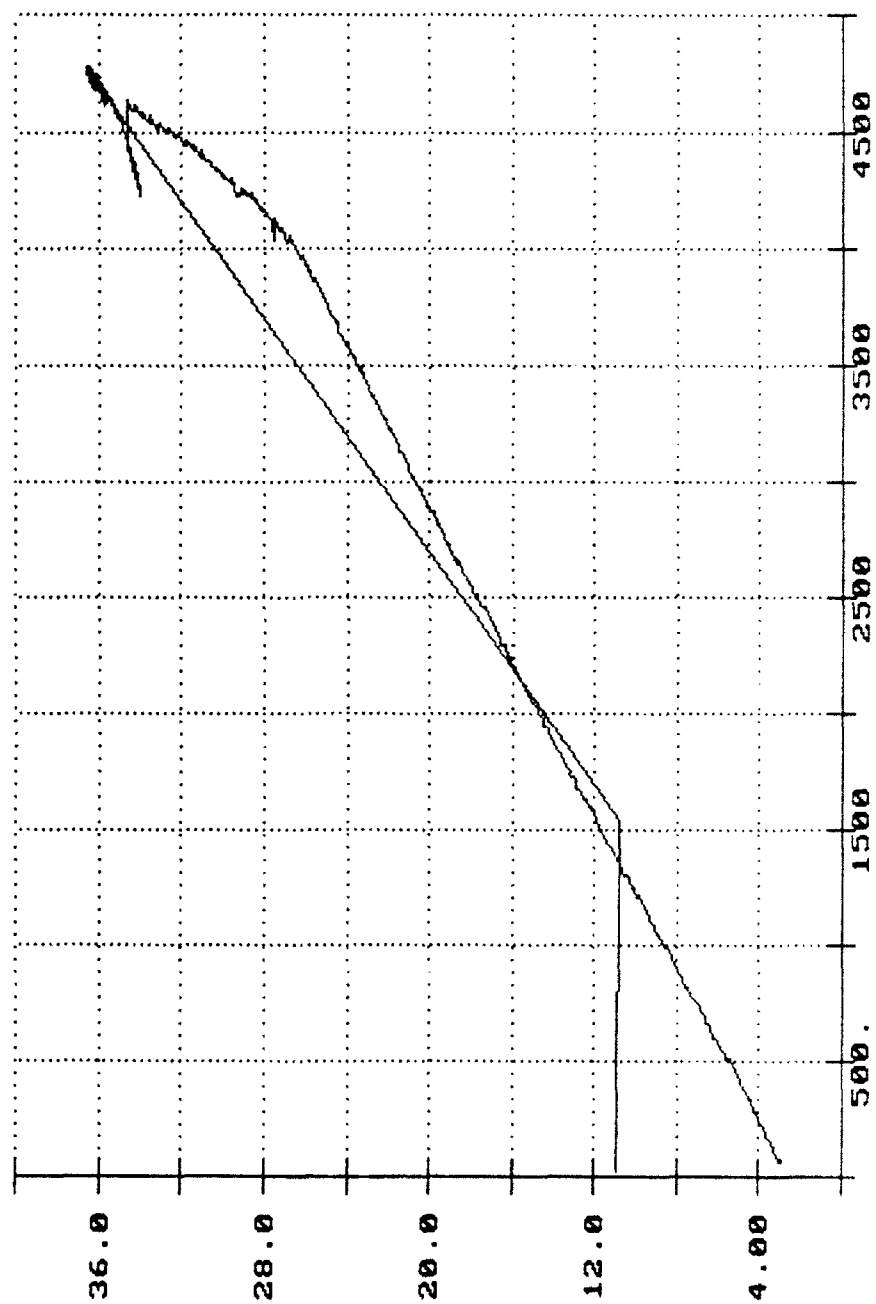
Applied Load in Pounds
X 1.0000

Resultant Stress
in Pounds X 1.0000

ORIGINAL ISSUE RESTRAINT BEAM
SAMPLE 7



ORIGINAL ISSUE RESTRAINT BEAM
SAMPLE 7

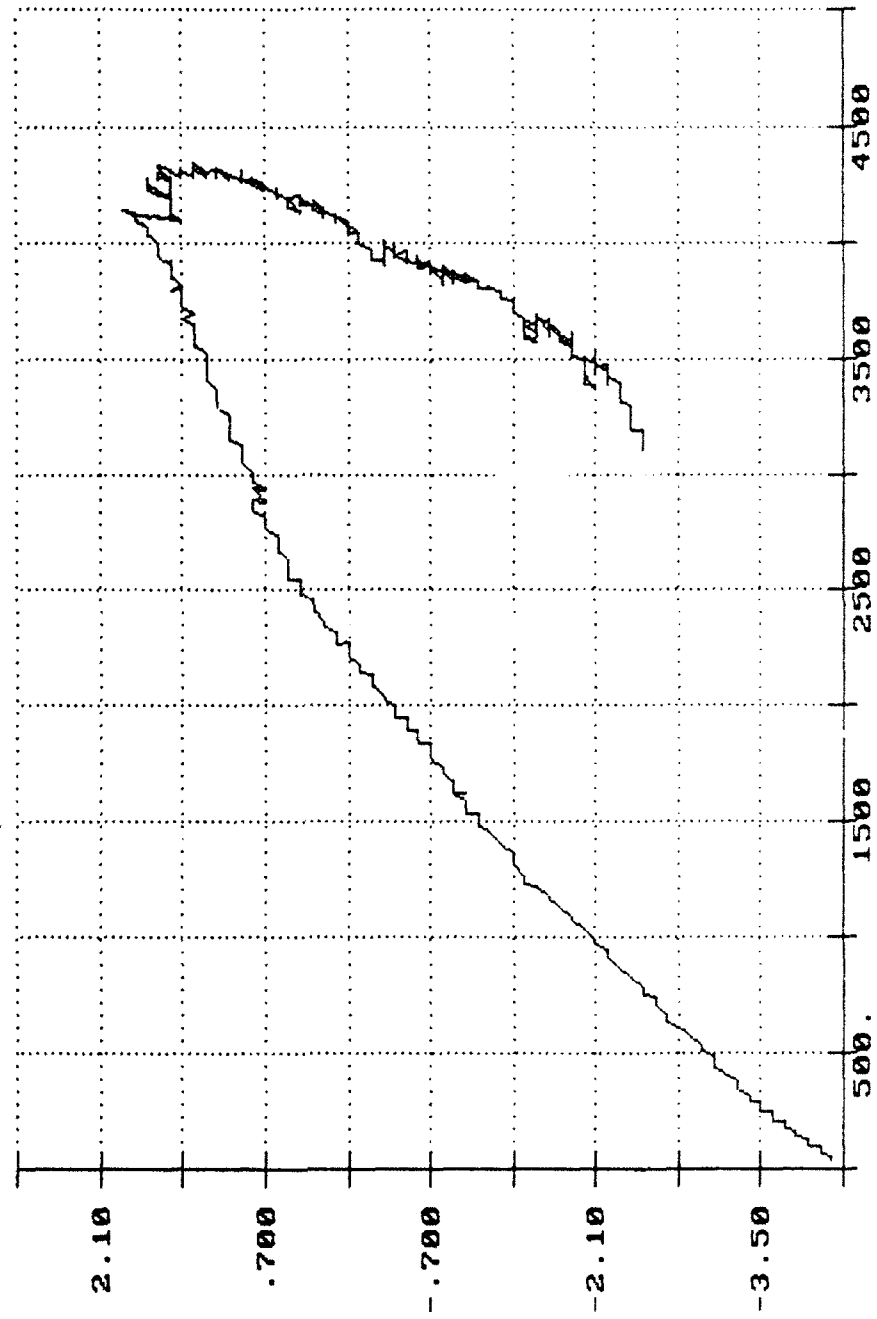


Applied Load in Pounds

X 1.0000

Resultant Stress
in Pounds X 1.0000

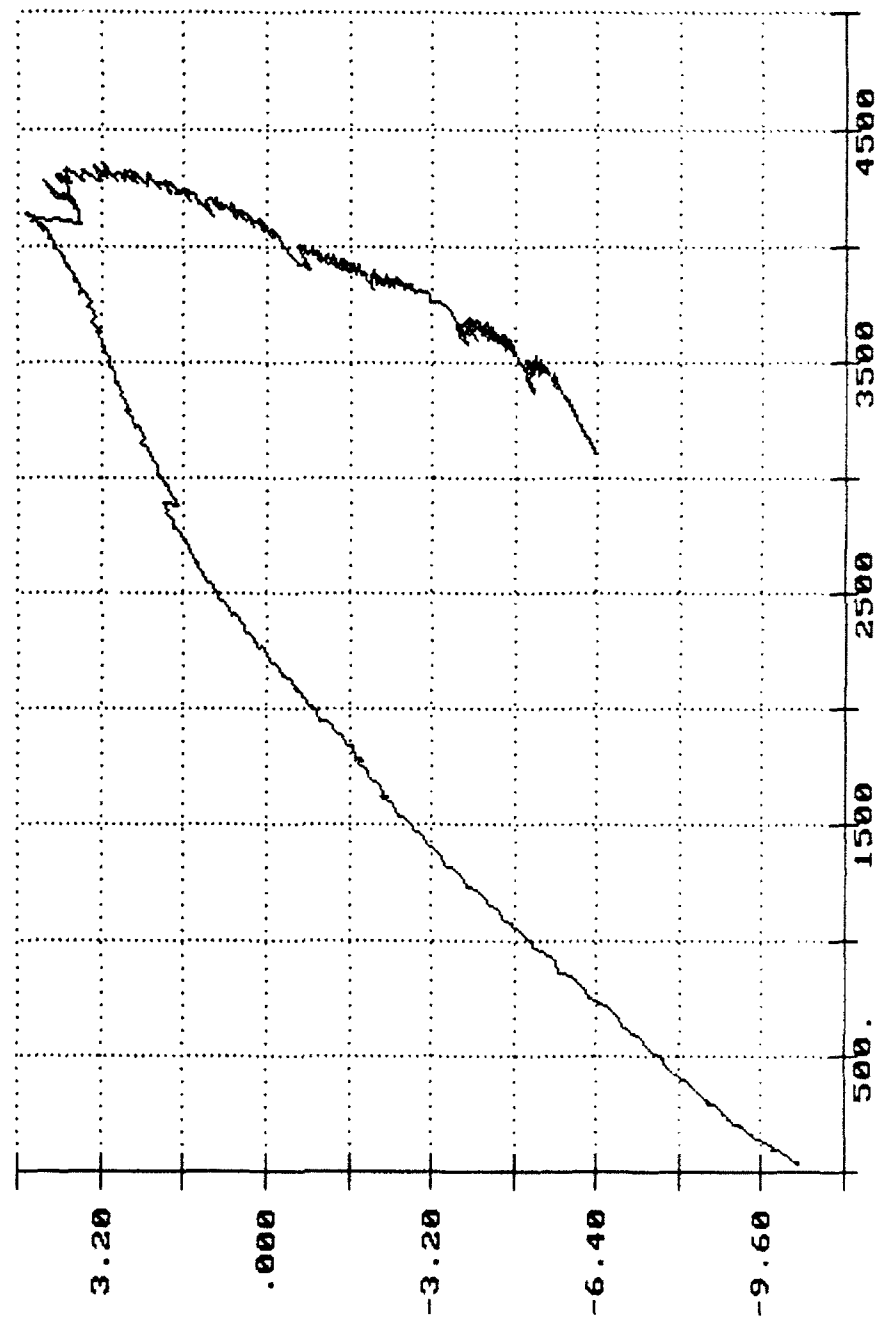
ORIGINAL ISSUE RESTRAINT BEAM
SAMPLE 8



Applied Load in Pounds
X 1.0000

Resultant Strain
in Inches / inch X .0001

ORIGINAL ISSUE RESTRAINT BEAM
SAMPLE 8

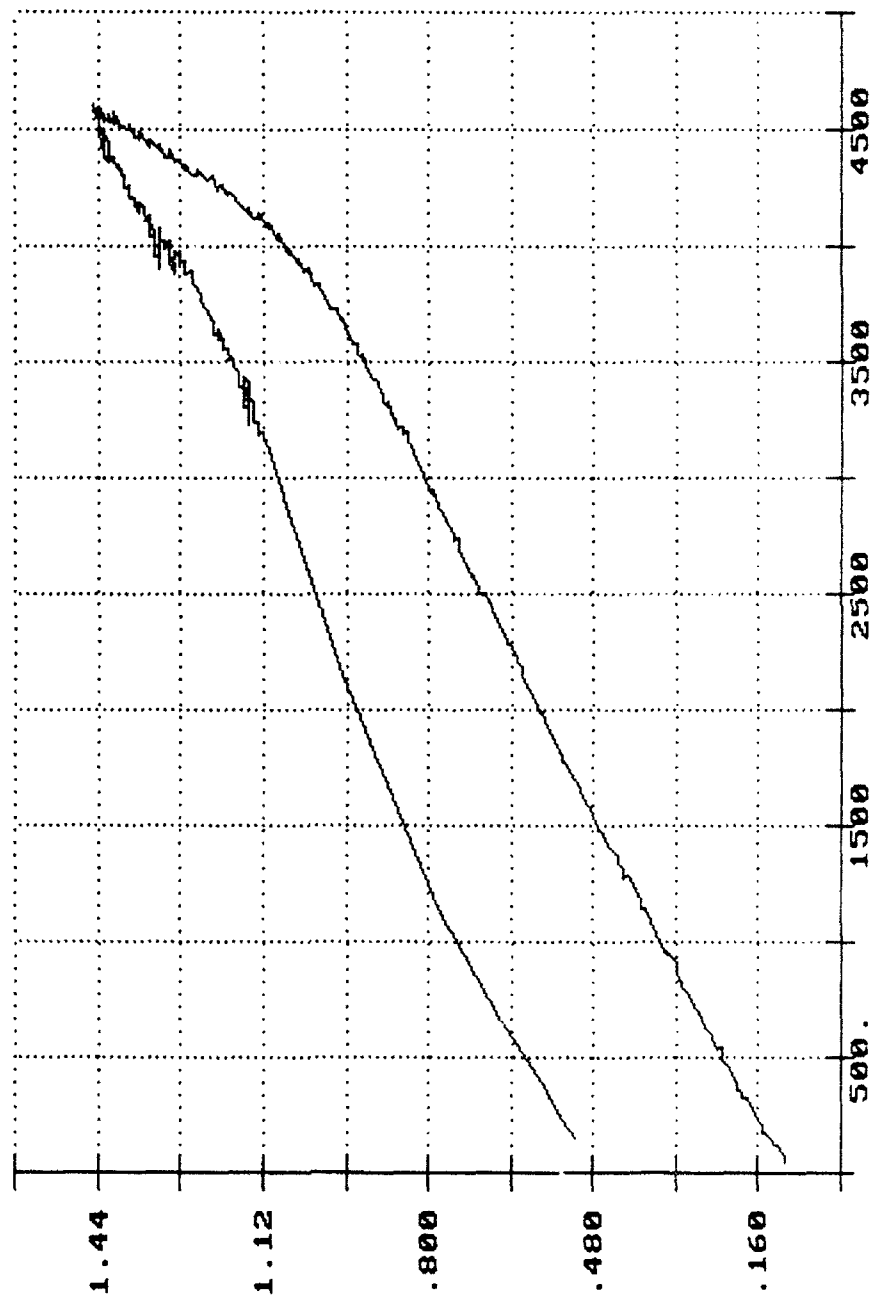


Resultant Stress
in Pounds X 1.0000

Applied Load in Pounds

X 1.0000

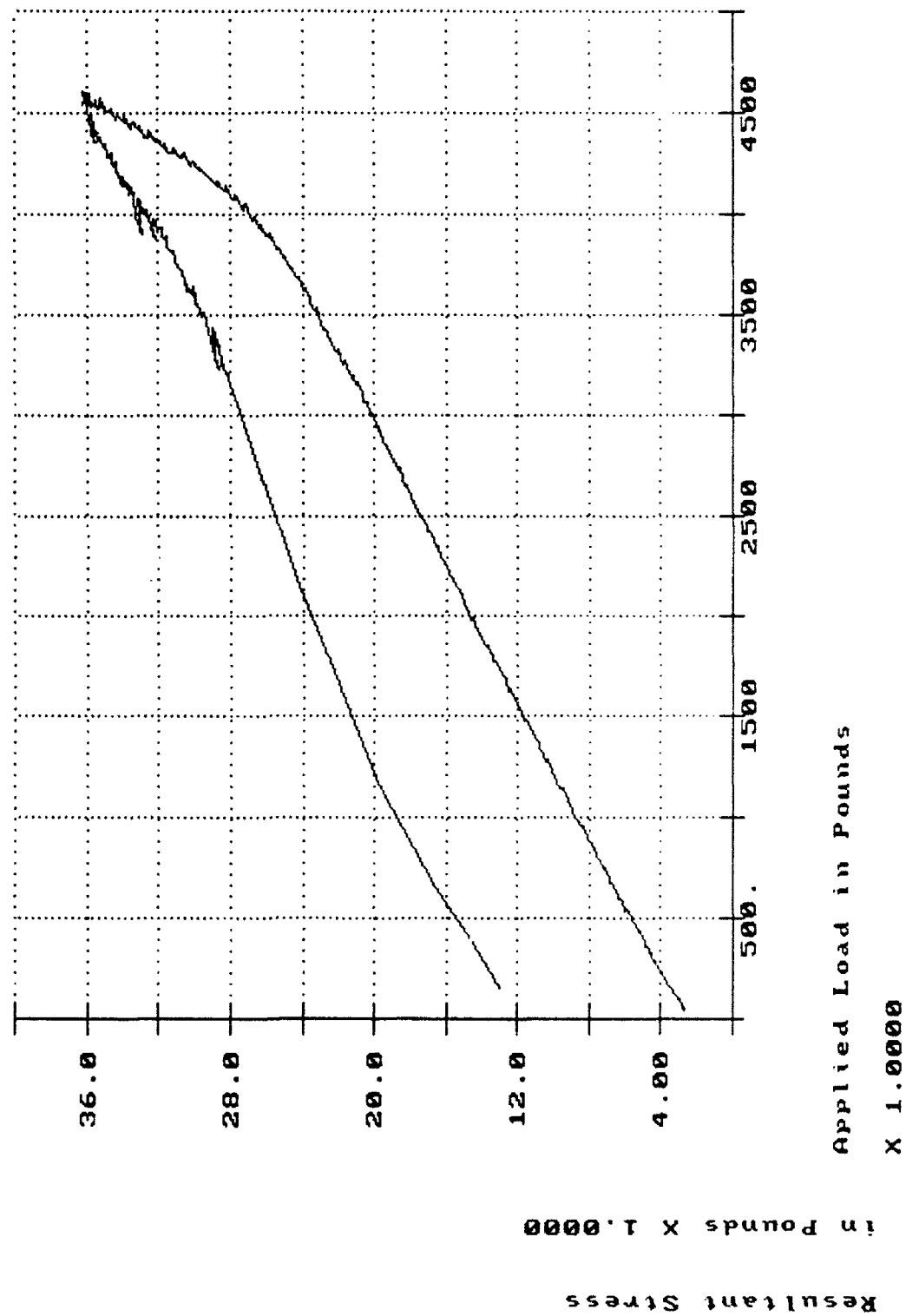
ORIGINAL ISSUE RESTRAINT BEAM
SAMPLE 9



Applied Load in Pounds
X 1.0000

Resultant Strain
in Inches / Inch X .0010

ORIGINAL ISSUE RESTRAINT BEAM
SAMPLE 9

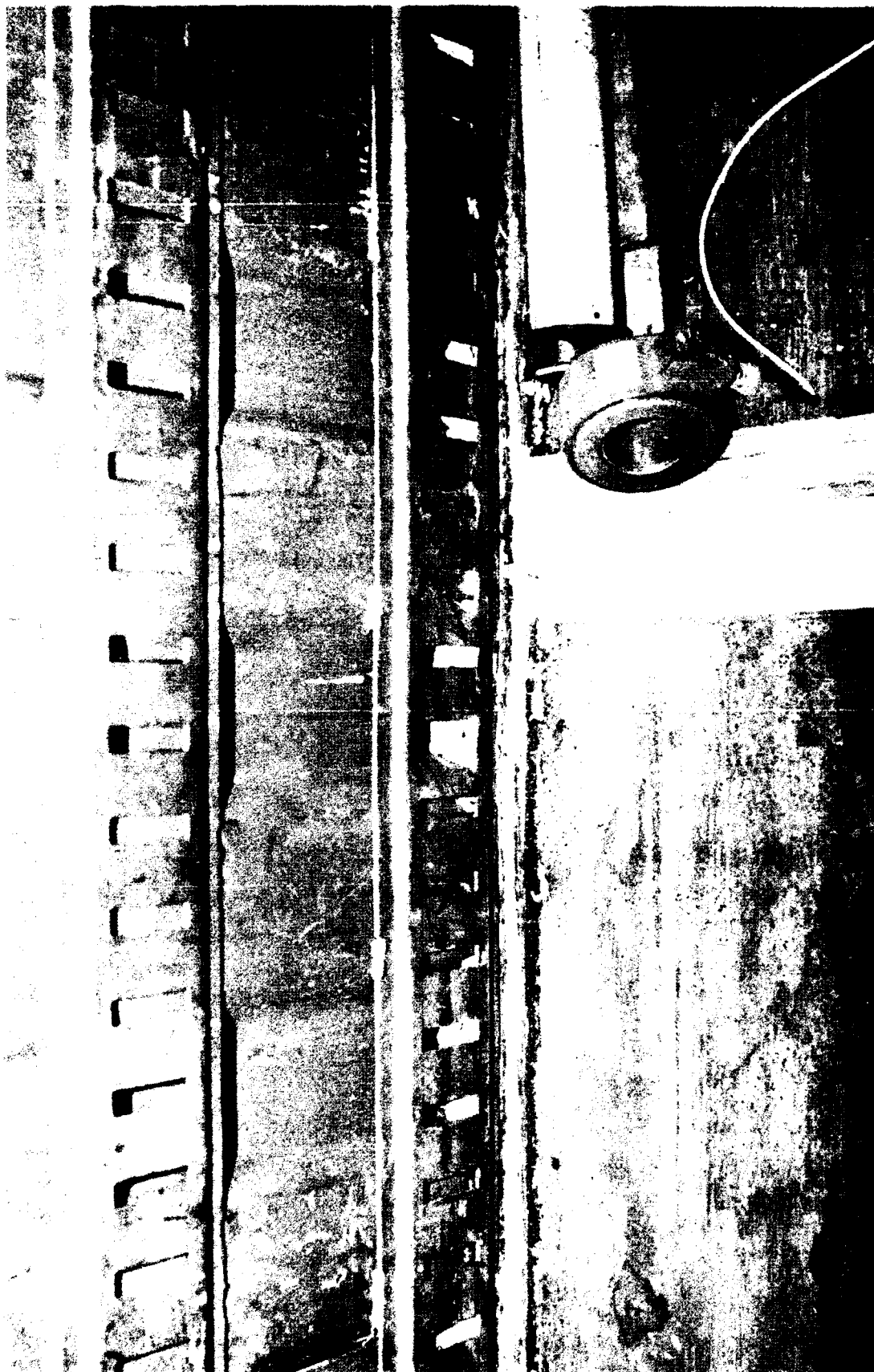


SECTION 1

STATIC BEAM LOADING

ORIGINAL ISSUE RESTRAINT BEAMS

PHOTOGRAPHS



	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL
Photo No. A0317-SPN-90-229-3023. This photo shows the original issue restraint beam, sample no. 2, after end loading. Note deformation of the latch mechanism.	



	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL
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Photo No. A0317-SPN-90-229-3025. This photo shows the original issue restraint beam, sample no. 3, before end loading. The hydraulic cylinder was extended until belt rail failure.



U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. A0317-SPN-90-229-3031. This photo shows the original issue restraint beam, sample no. 4, after point loading. The hydraulic cylinder was extended until permanent deformation of the restraint beam occurred.



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Photo No. A0317-SPN-90-229-3033. This photo shows the original issue restraint beam, sample no. 5, after point loading. The hydraulic cylinder was extended until permanent deformation of the restraint beam occurred. This sample pulled out of the belt rail.



	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL
Photo No. A0317-SPN-90-229-3035. This photo shows the original issue restraint beam, sample no. 5, after point loading. This sample pulled out of the belt rail.	



U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. A0317-SPN-90-229-3034. This photo is a closeup of the belt rail where sample no. 5 pulled out. Note damage to the lower part of the interlock from the restraint bar hook.



U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL
Photo No. A0317-SPN-90-229-3037. This photo shows the original issue restraint beam, sample no. 6, after applying a point load.



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Photo No. A0317-SPN-90-229-3040. This photo shows the original issue restraint beam, sample no. 7, with a load applied.



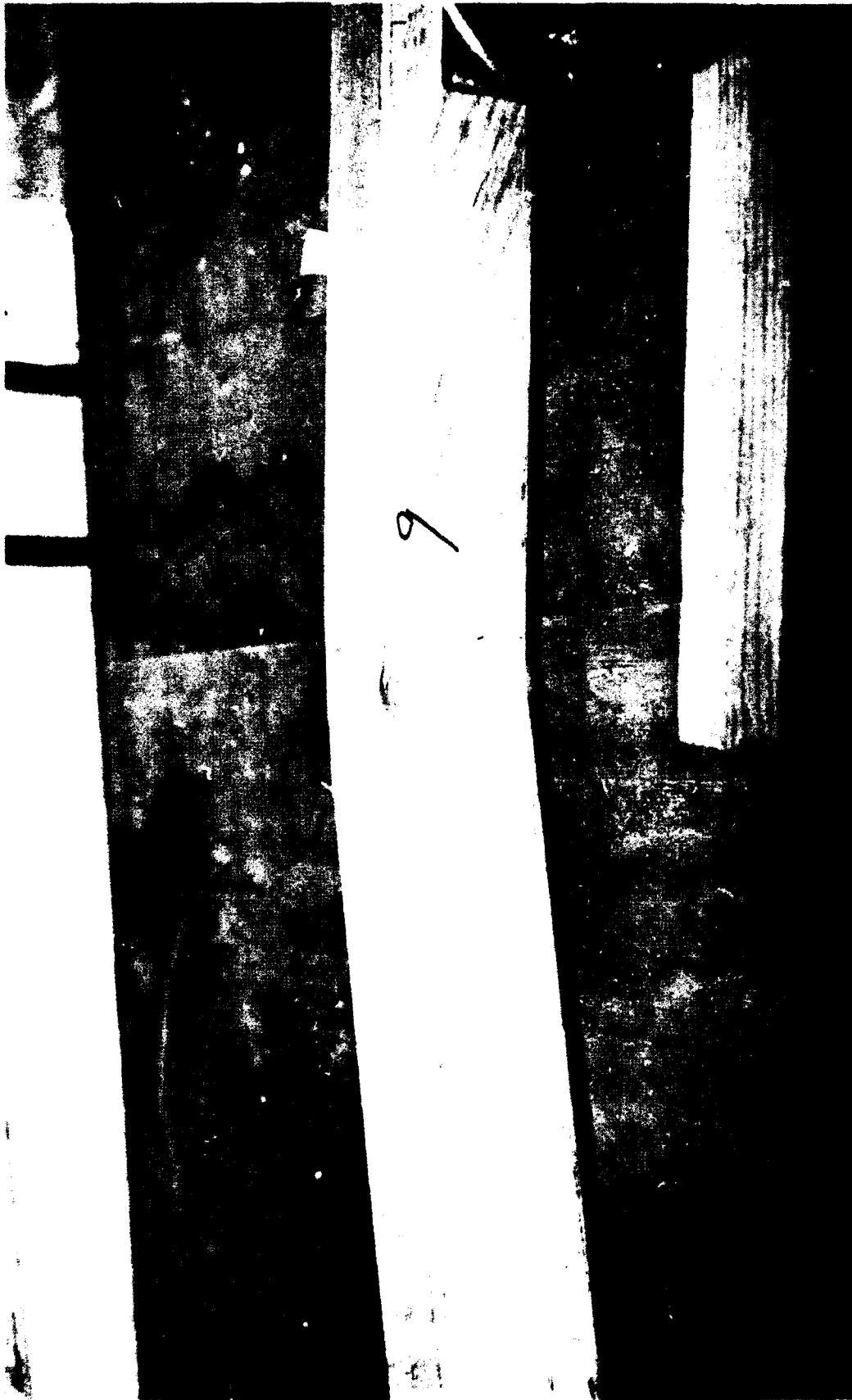
	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
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Photo No. A0317-SPN-90-229-3044. This photo shows the original issue restraint beam, sample no. 7, after the loading test. This photo shows where the restraint beam clamp disengaged from the belt rail.



U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. A0317-SPN-90-229-3074. This photo shows the original issue restraint beam, sample no. 8, with a test load and resultant damage.



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Photo No. A0317-SPN-90-229-3076. This photo shows the original issue restraint beam, sample no. 9, with a test load and resultant damage.

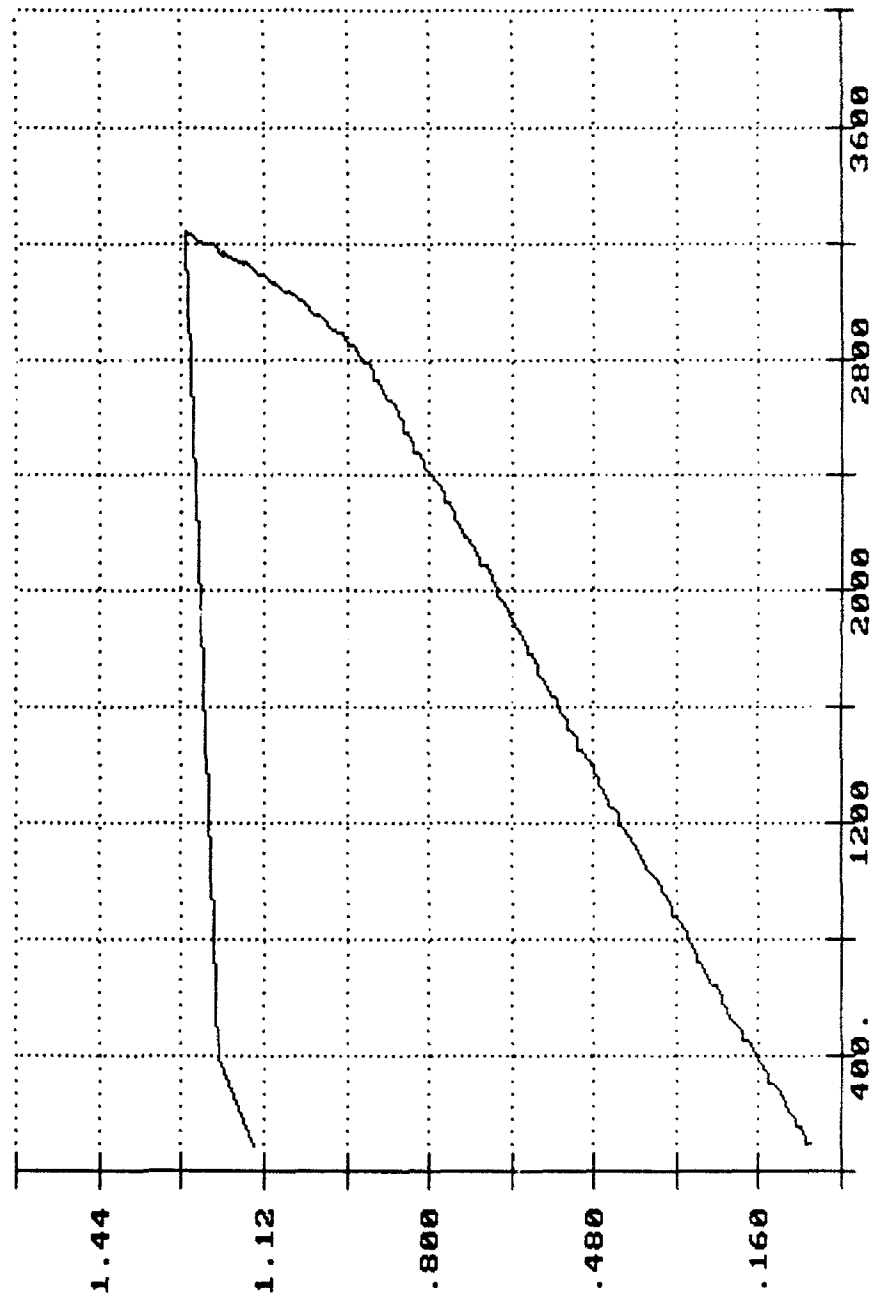
SECTION 1

STATIC BEAM LOADING

B. NEW ISSUE RESTRAINT BEAMS

STRESS/STRAIN DATA

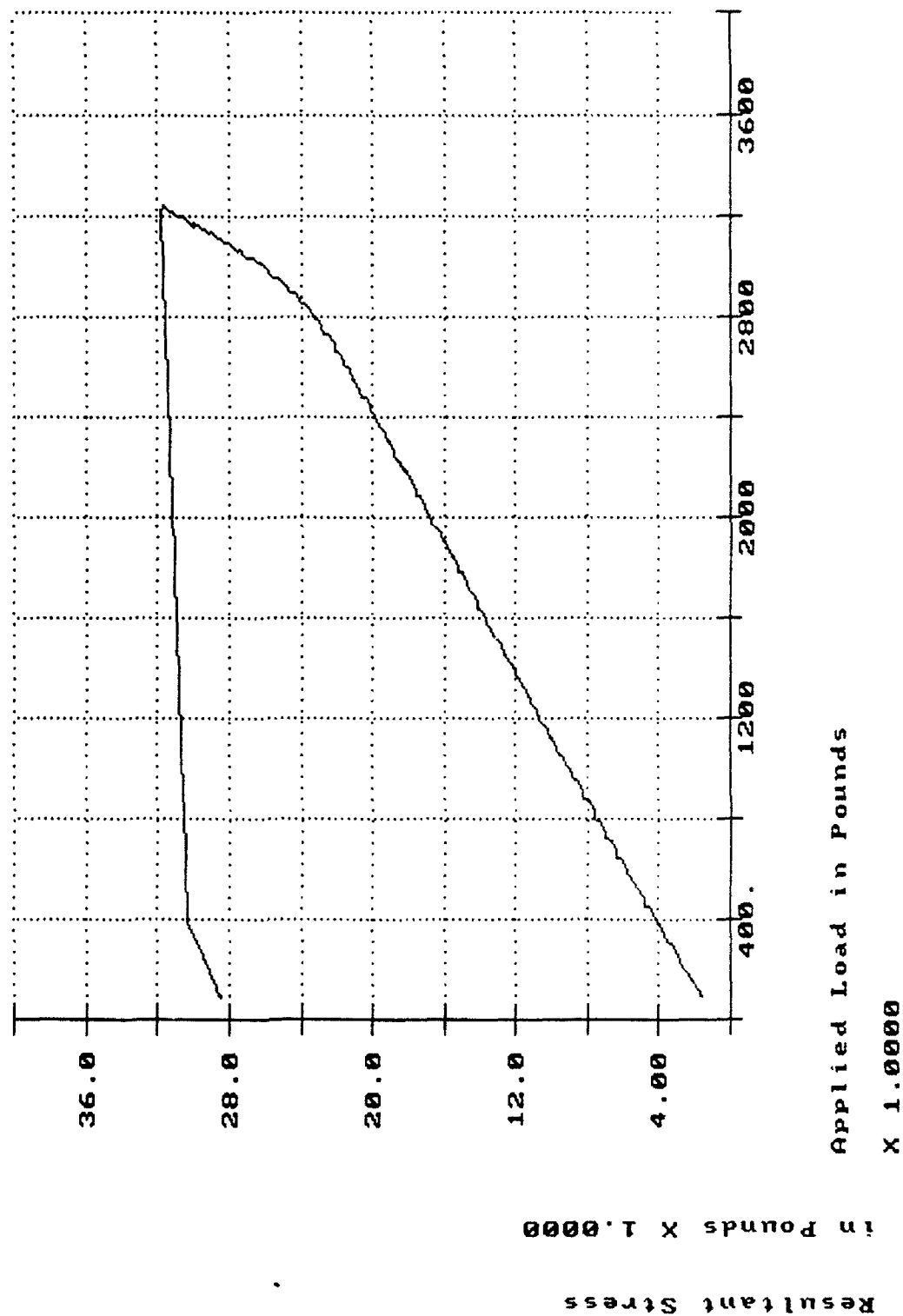
NEW ISSUE RESTRAINT BEAM
SPREAD LOAD
SAMPLE 11



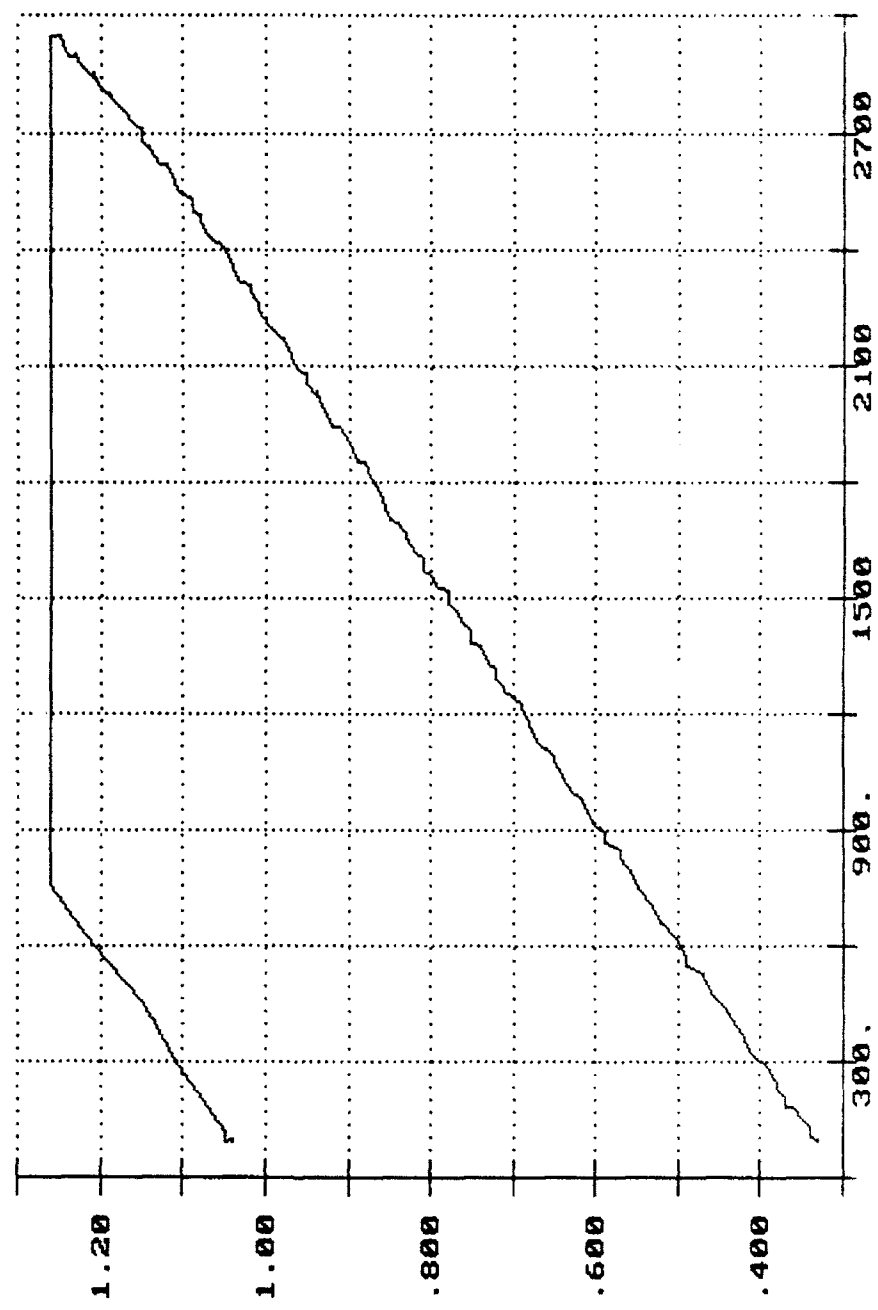
Restraint Strain
in Inches / Inch X .0010

Applied Load in Pounds
X 1.0000

NEW ISSUE RESTRAINT BEAM
SPREAD LOAD
SAMPLE 11



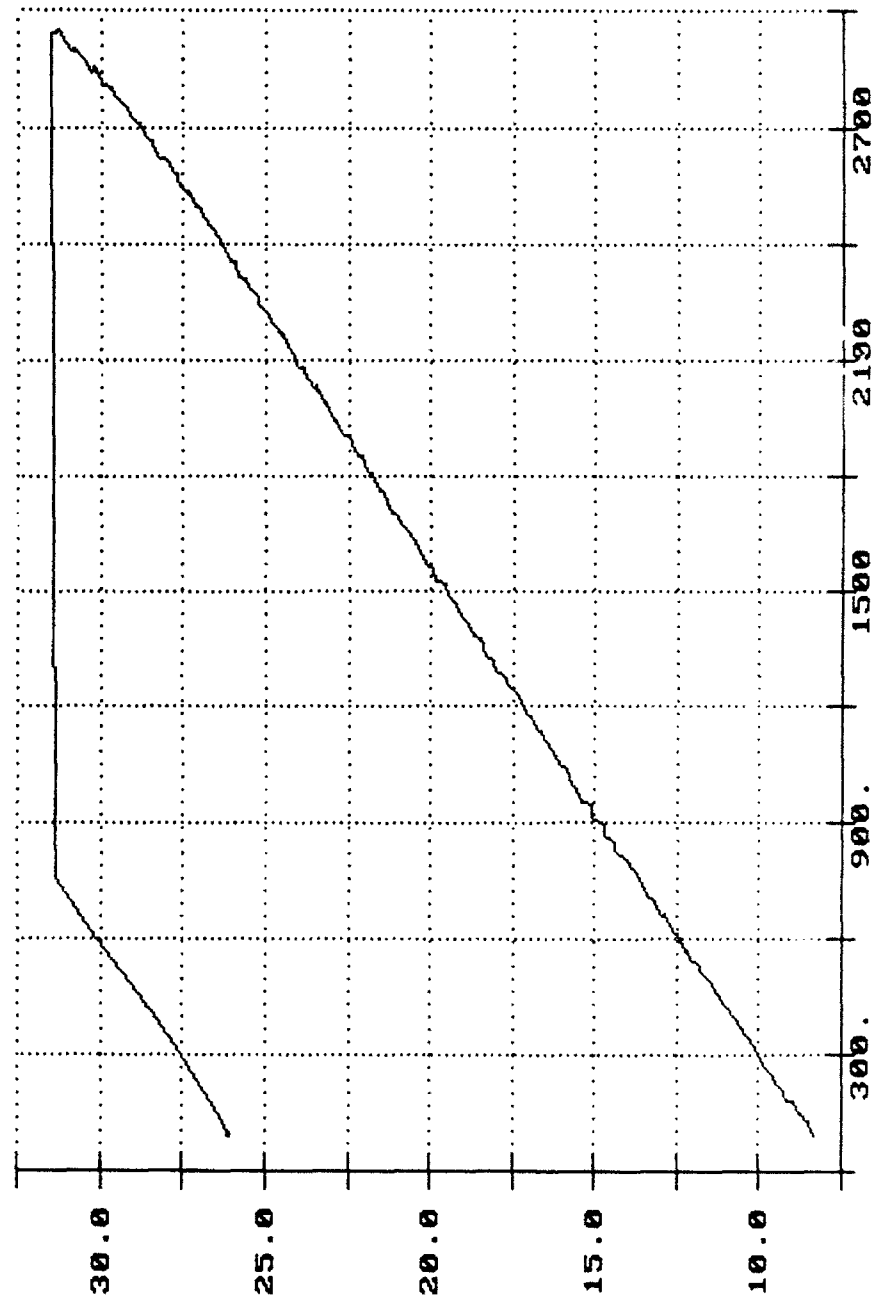
NEW ISSUE RESTRAINT BEAM
SPREAD LOAD
SAMPLE 12



Applied Load in Pounds
X 1.0000

Resultant Strain
in Inches / Inch X .0010

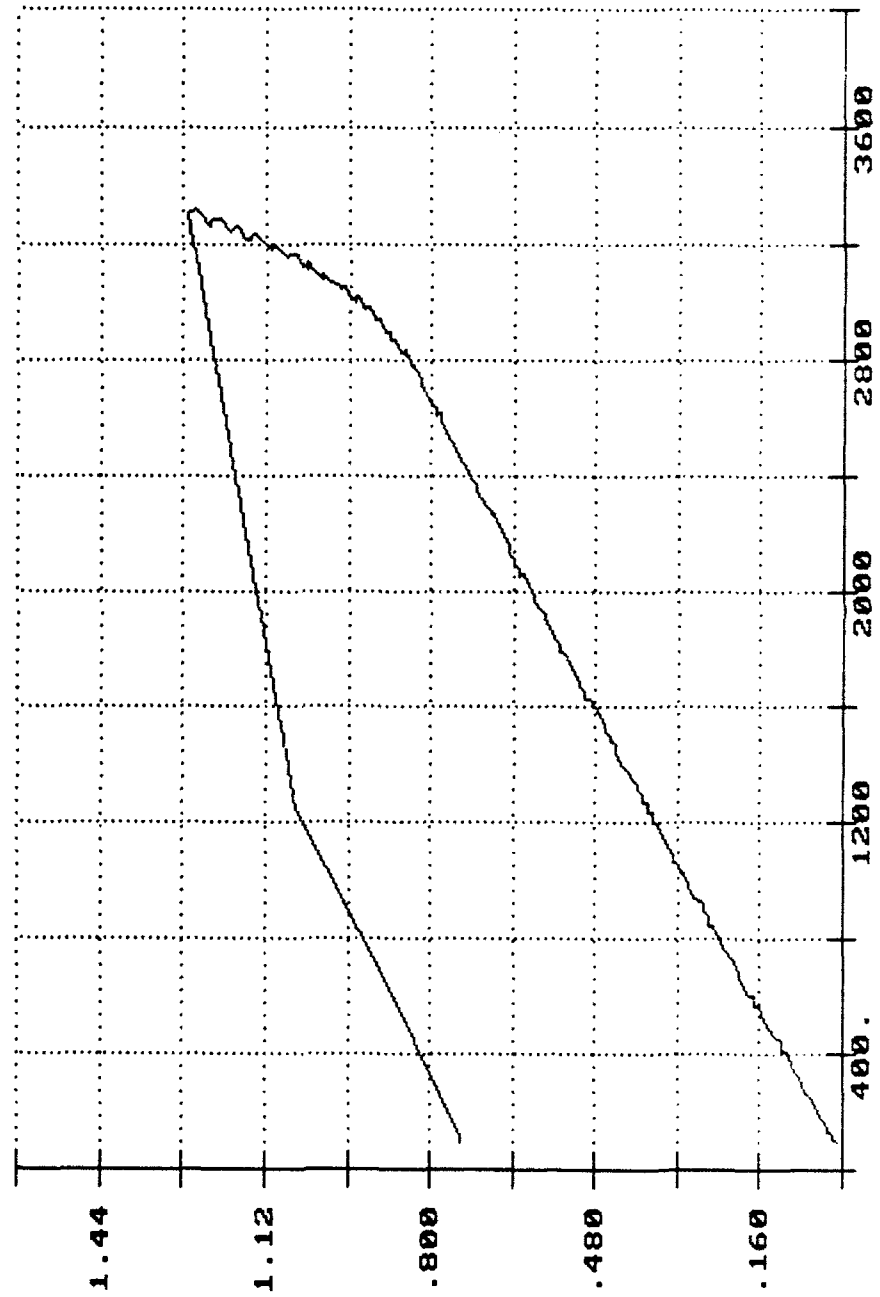
NEW ISSUE RESTRAINT BEAM
SPREAD LOAD
SAMPLE 12



Resultant Stress
in Pounds X 1.0000

Applied Load in Pounds
X 1.0000

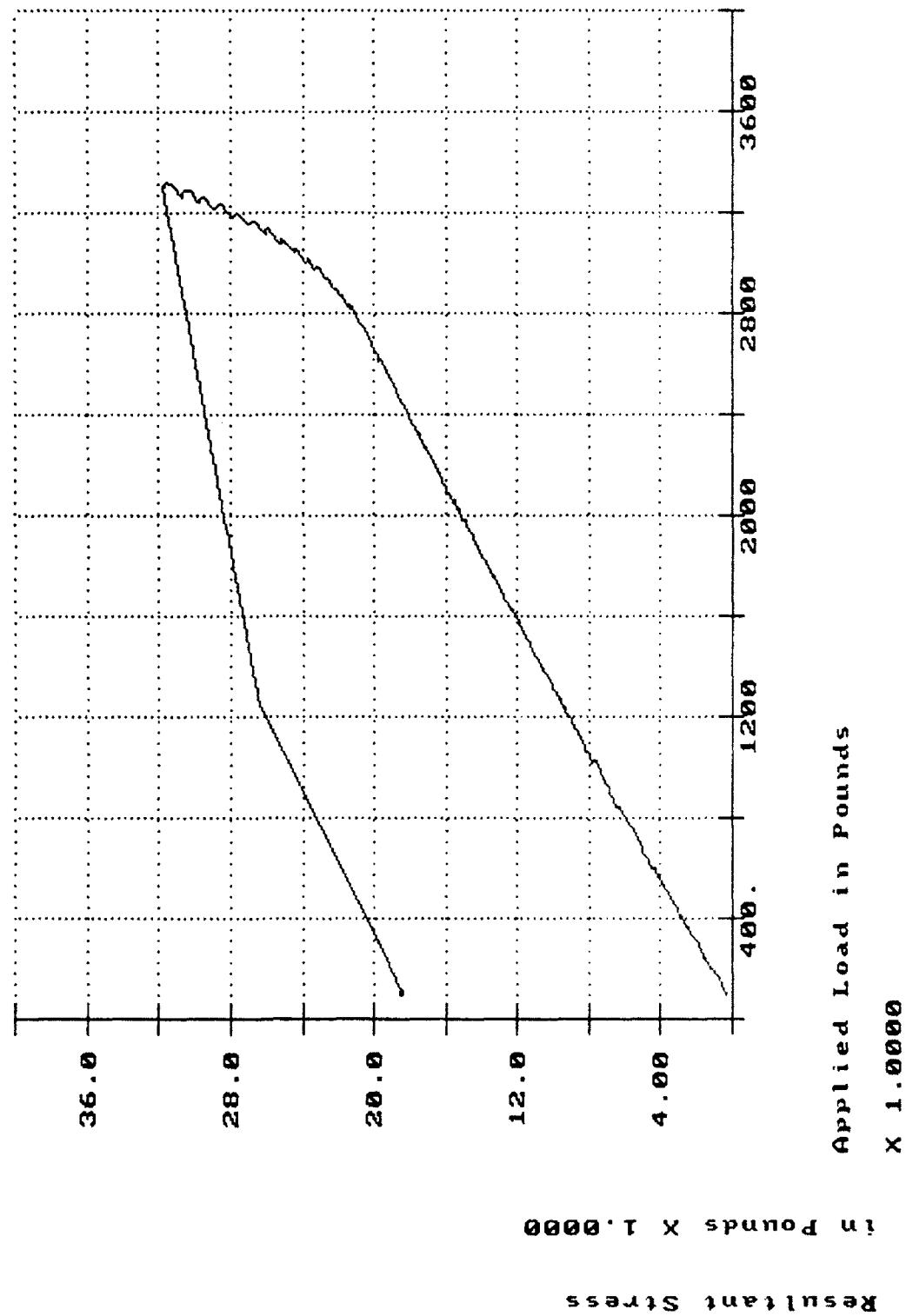
NEW ISSUE RESTRAINT BEAM
SPREAD LOAD
SAMPLE 13



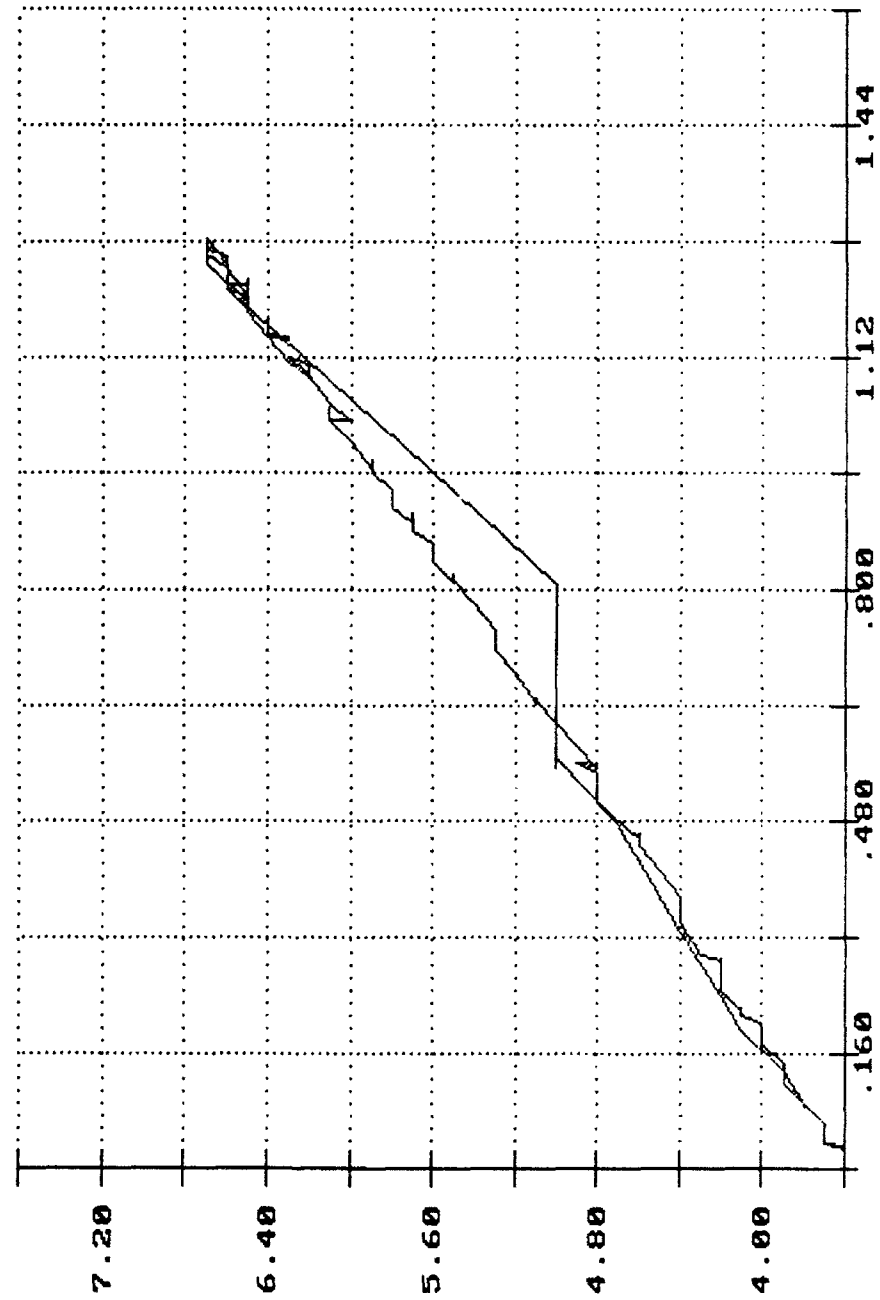
Resultant Strain
in Inches / Inch x .0010

Applied Load in Pounds
x 1.0000

NEW ISSUE RESTRAINT BEAM
SPREAD LOAD
SAMPLE 13



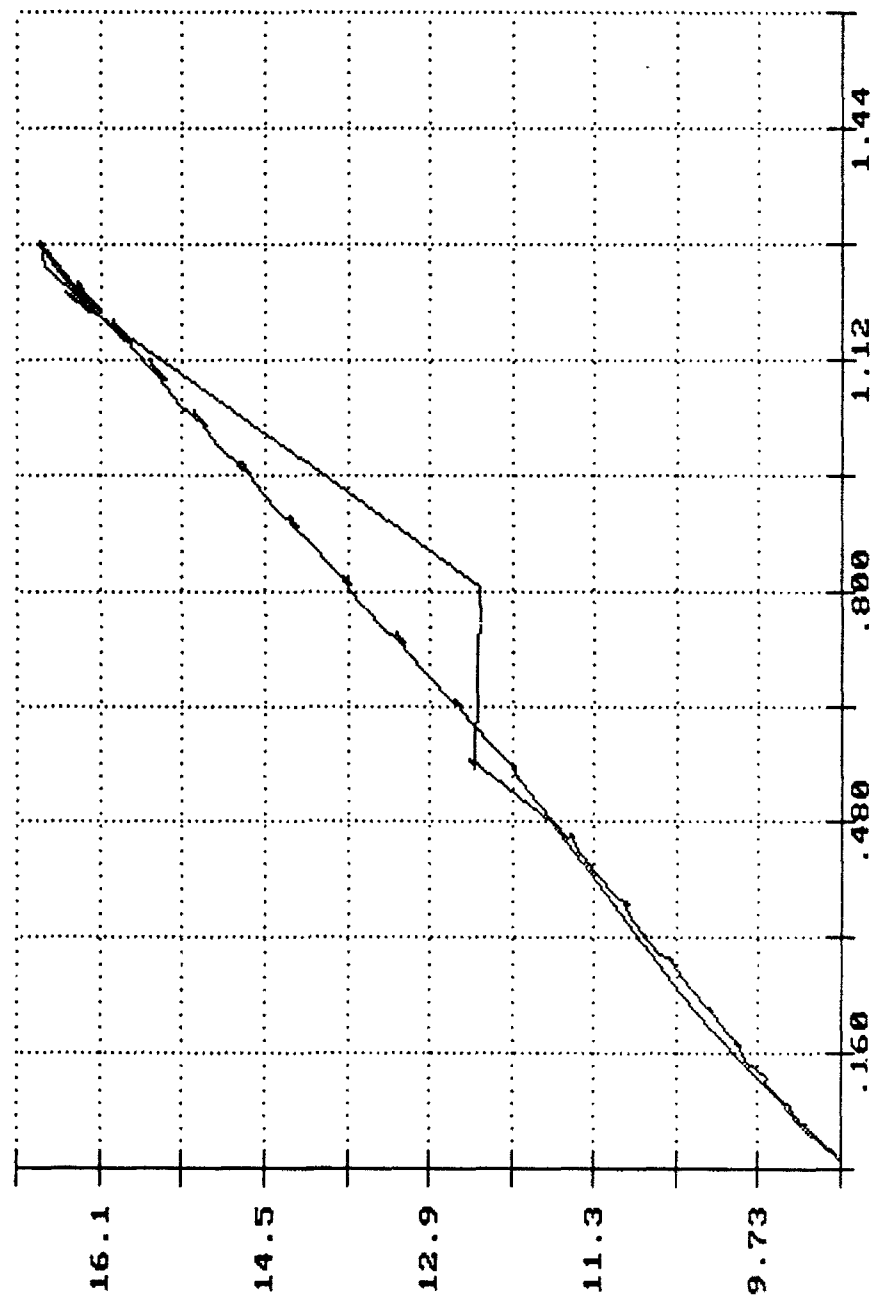
NEW ISSUE RESTRAINT BEAM
POINT LOAD
SAMPLE 14



Applied Load in Pounds
X 10000.0000

Resultant Strain
in Inches / Inch X .0001

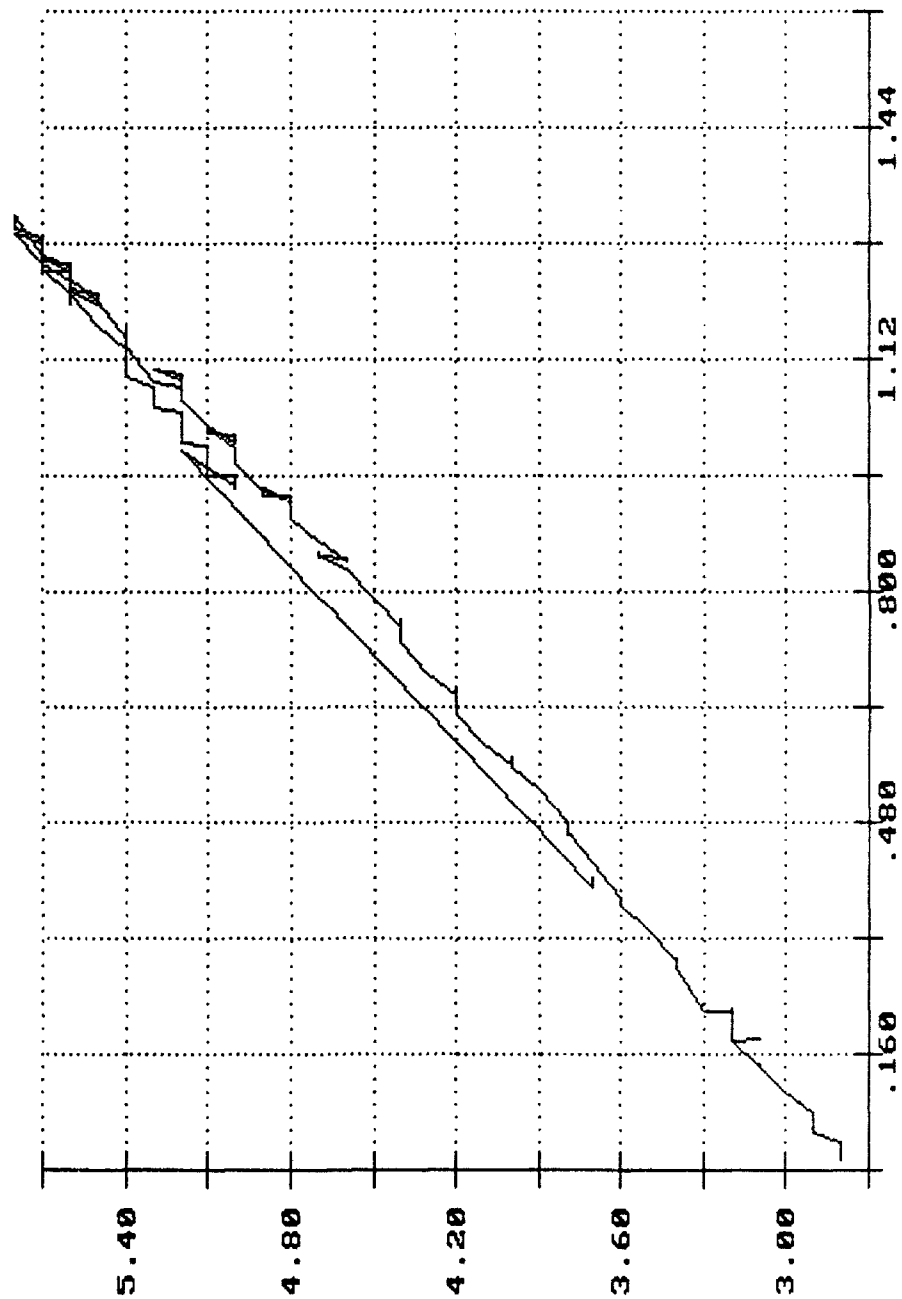
NEW ISSUE RESTRAINT BEAM
POINT LOAD
SAMPLE 14



Resultant Stress
in Pounds X 1.0000

Applied Load in Pounds
X 10000.0000

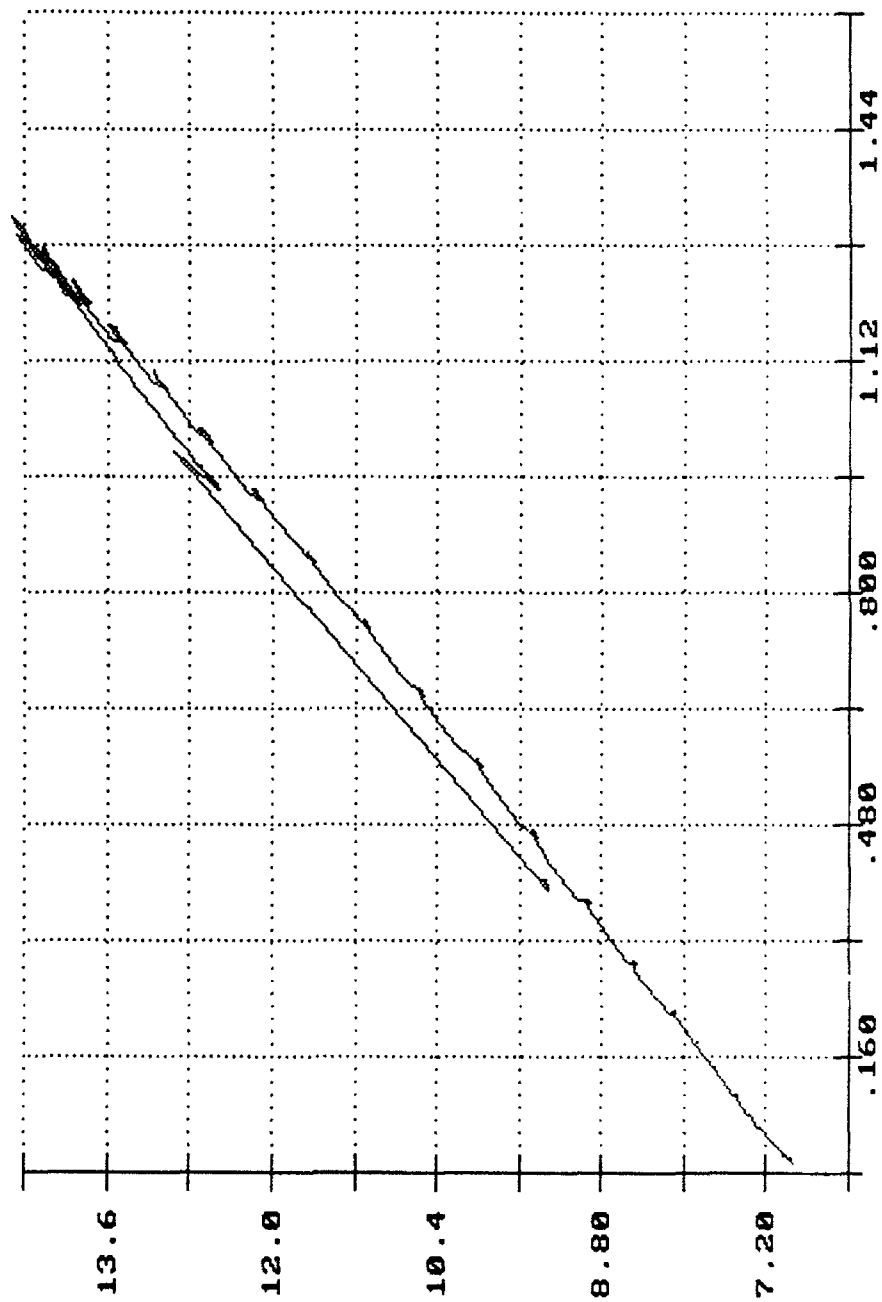
NEW ISSUE RESTRAINT BEAM
POINT LOAD
SAMPLE 15



Resultant Strain
in Inches / Inch X .0001

Applied Load in Pounds
X 10000.0000

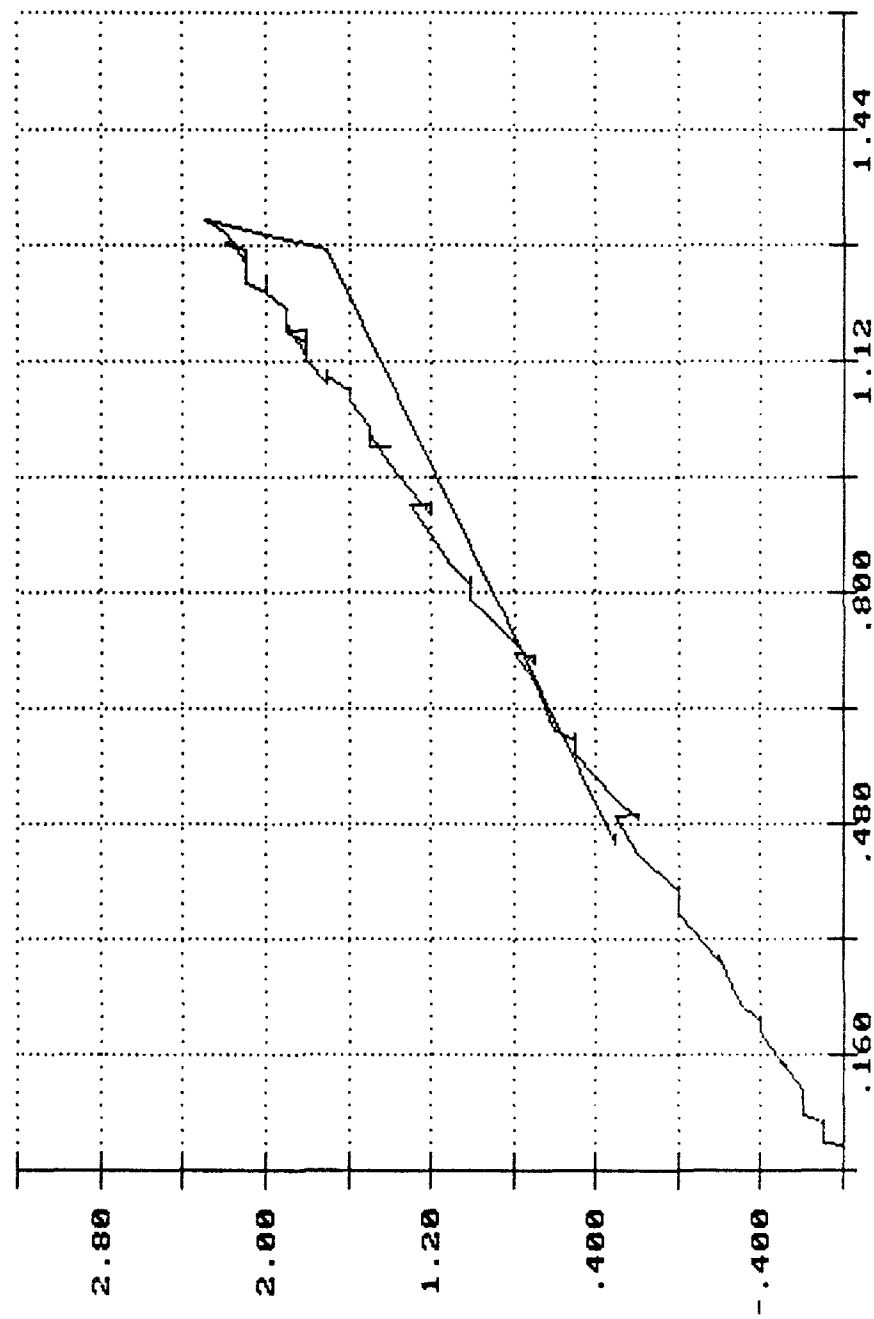
NEW ISSUE RESTRAINT BEAM
POINT LOAD
SAMPLE 15



Resultant Stress
in Pounds X 1.0000

Applied Load in Pounds
X 10000.0000

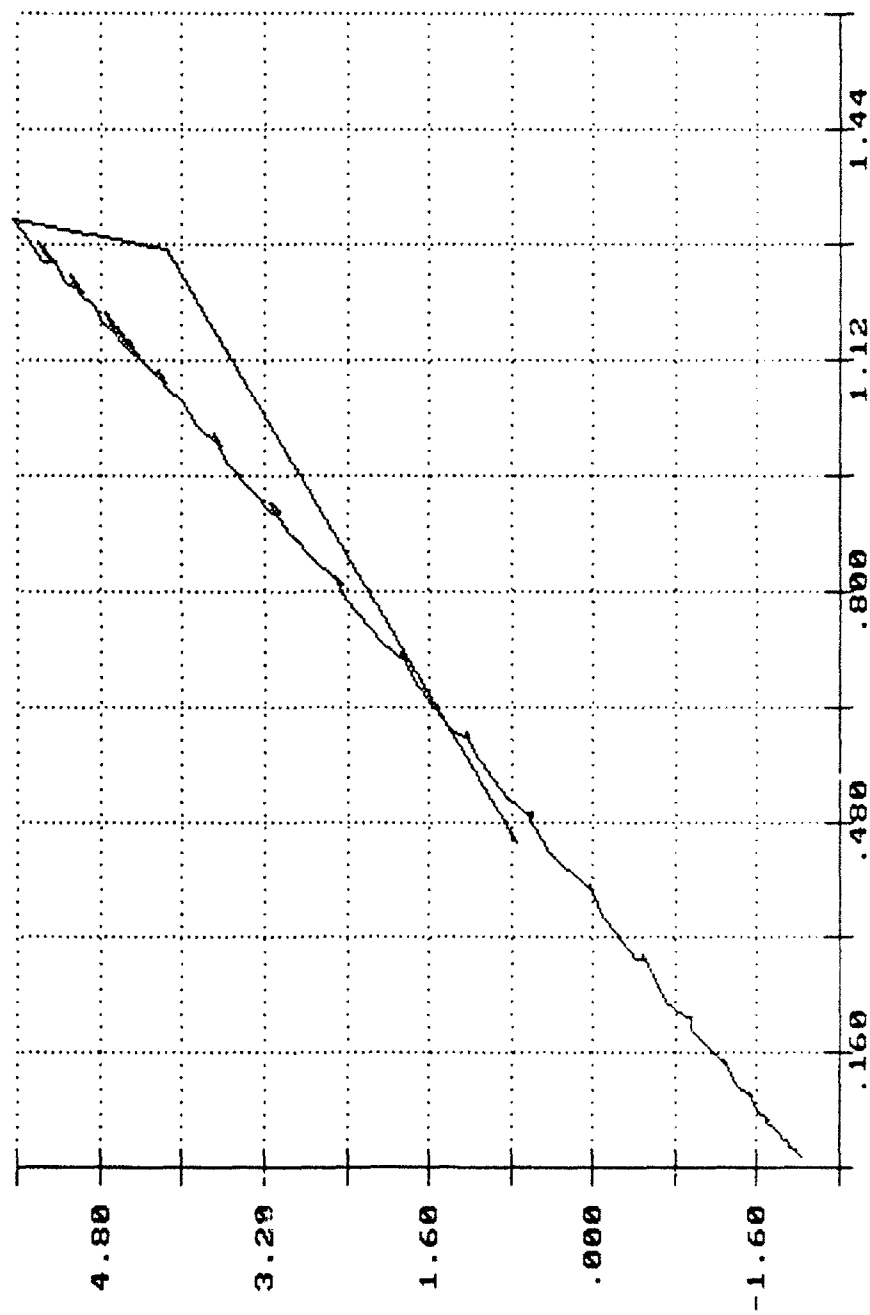
NEW ISSUE RESTRAINT BEAM
POINT LOAD
SAMPLE 16



Restraint Strain
in Inches / Inch X .0001

Applied Load in Pounds
X 10000.0000

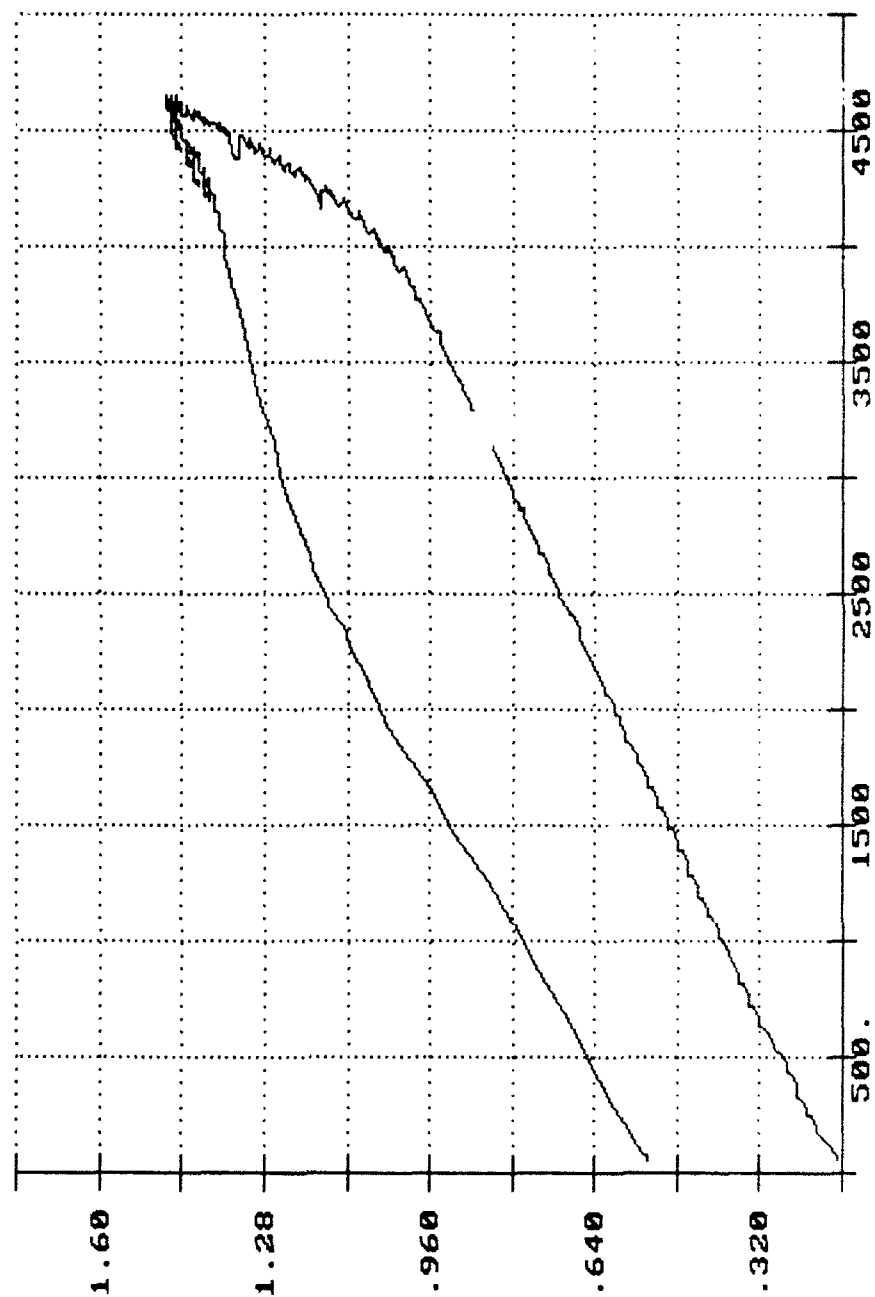
NEW ISSUE RESTRAINT BEAM
POINT LOAD
SAMPLE 16



Resultant Stress
in Pounds X 1.0000

Applied Load in Pounds
X 10000.0000

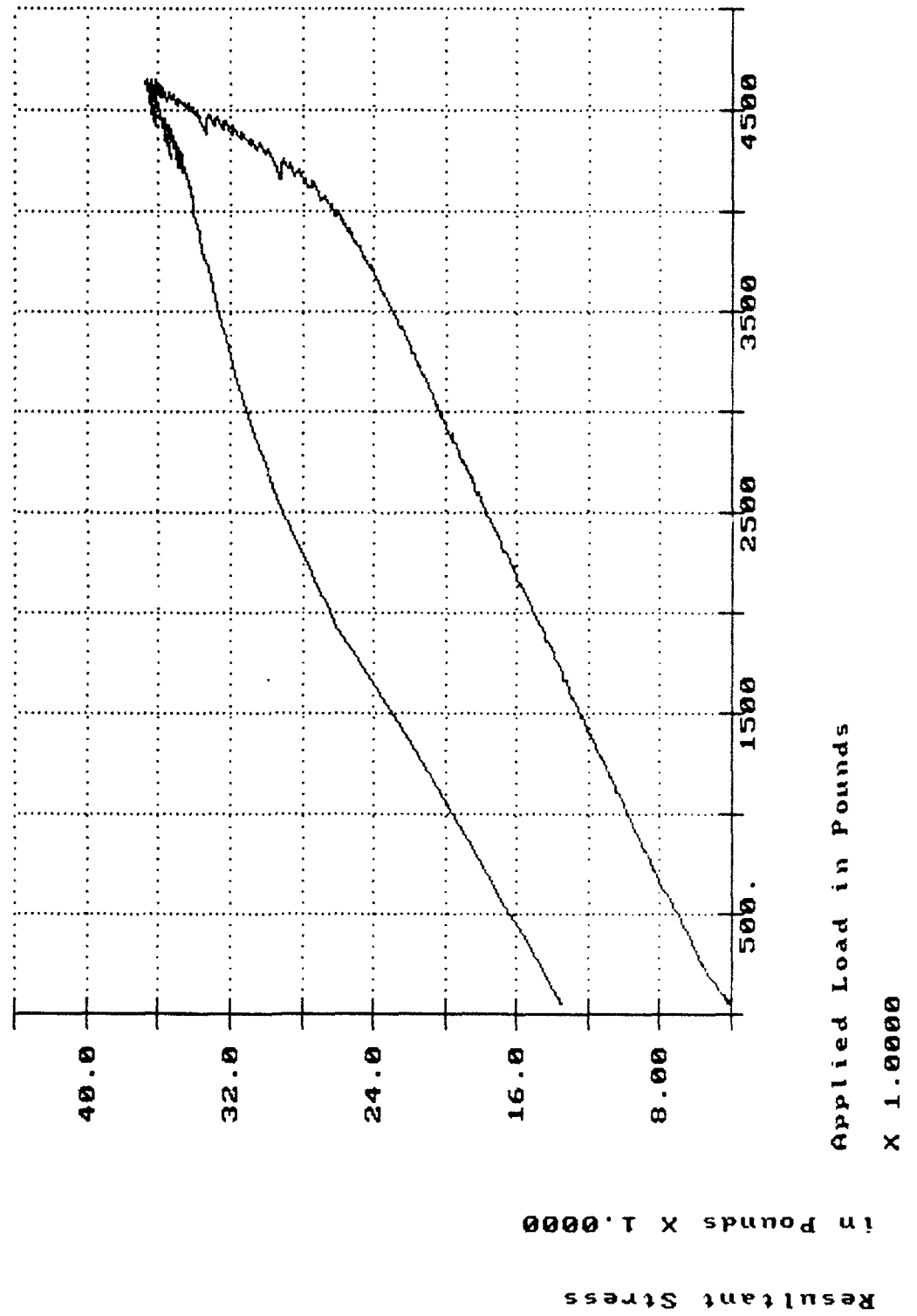
NEW ISSUE RESTRAINT BEAM
END LOAD
SAMPLE 17



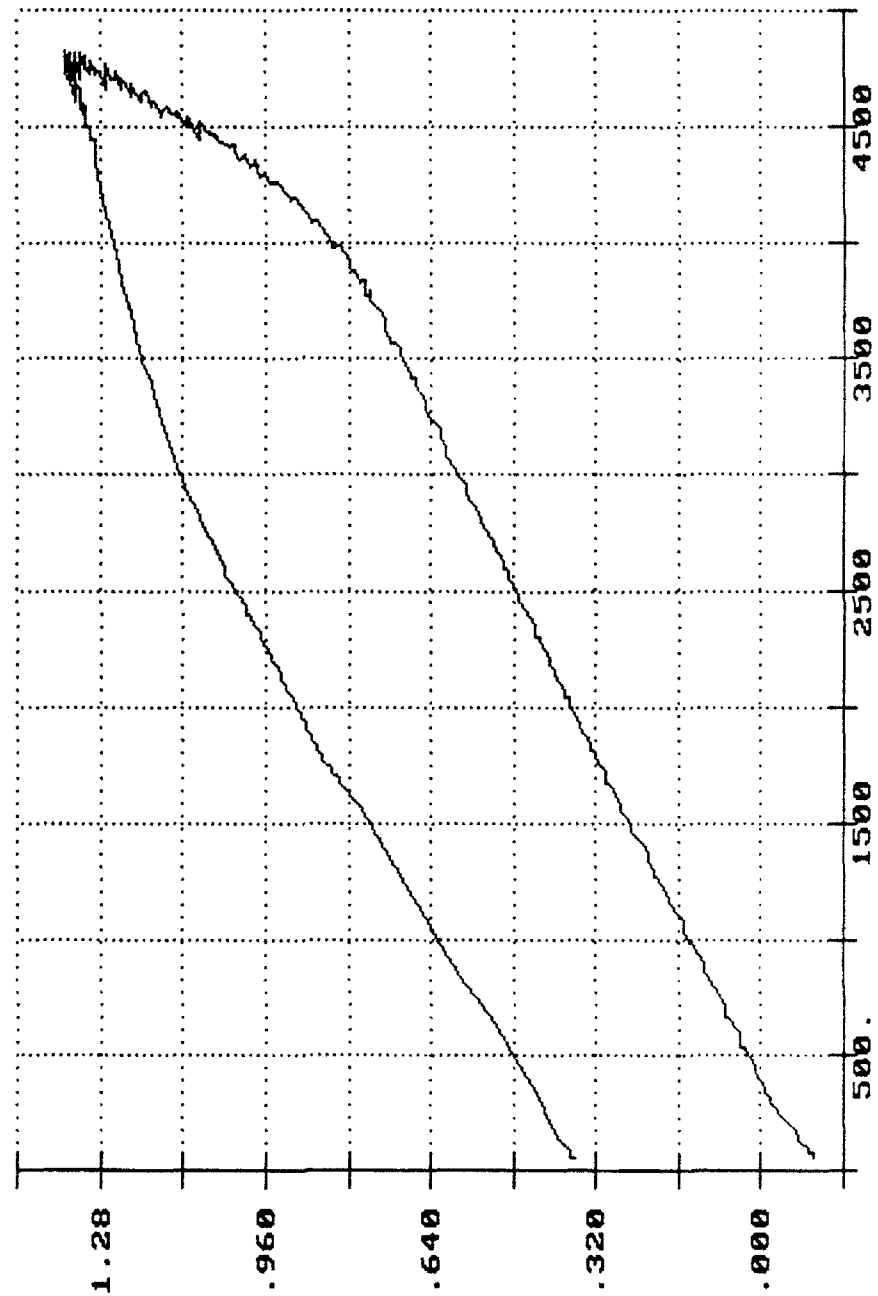
Applied Load in Pounds
X 1.0000

Resultant Strain
in Inches / Inch X .0010

NEW ISSUE RESTRAINT BEAM
END LOAD
SAMPLE 17



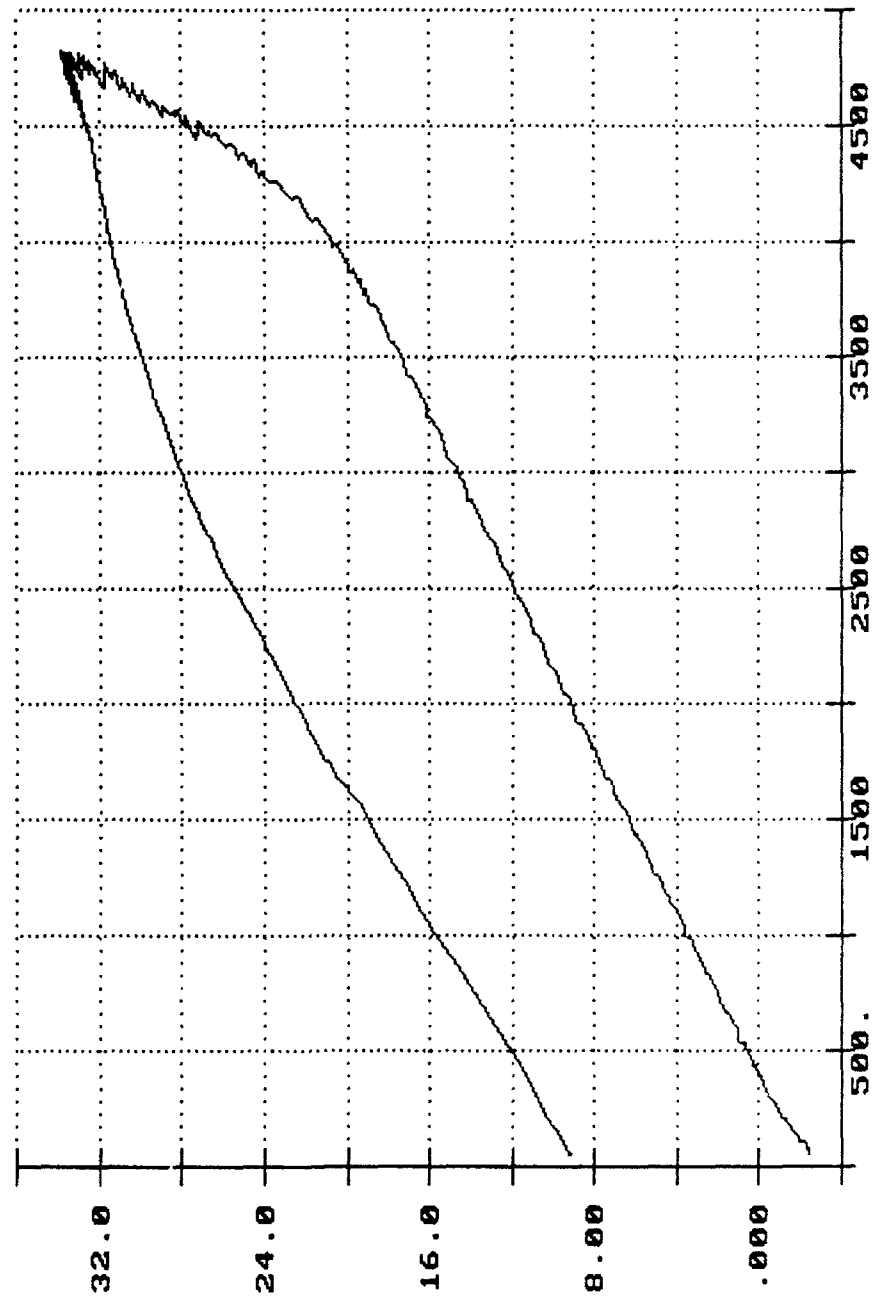
NEW ISSUE RESTRAINT BEAM
END LOAD
SAMPLE 18



Resultant Strain
in Inches / inch X .0010

Applied Load in Pounds
X 1.0000

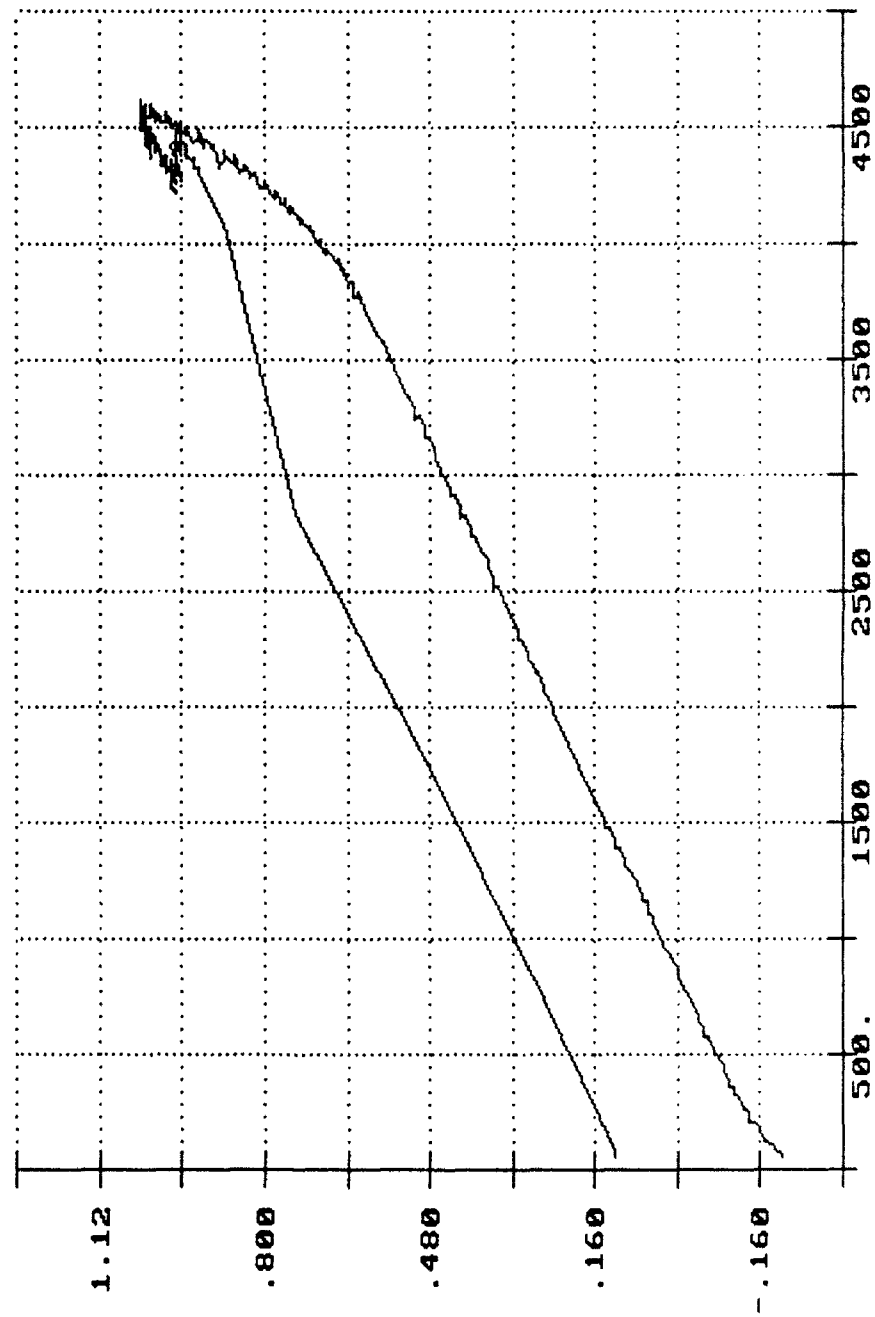
NEW ISSUE RESTRAINT BEAM
END LOAD
SAMPLE 18



Resultant Stress
in Pounds X 1.0000

Applied Load in Pounds
X 1.0000

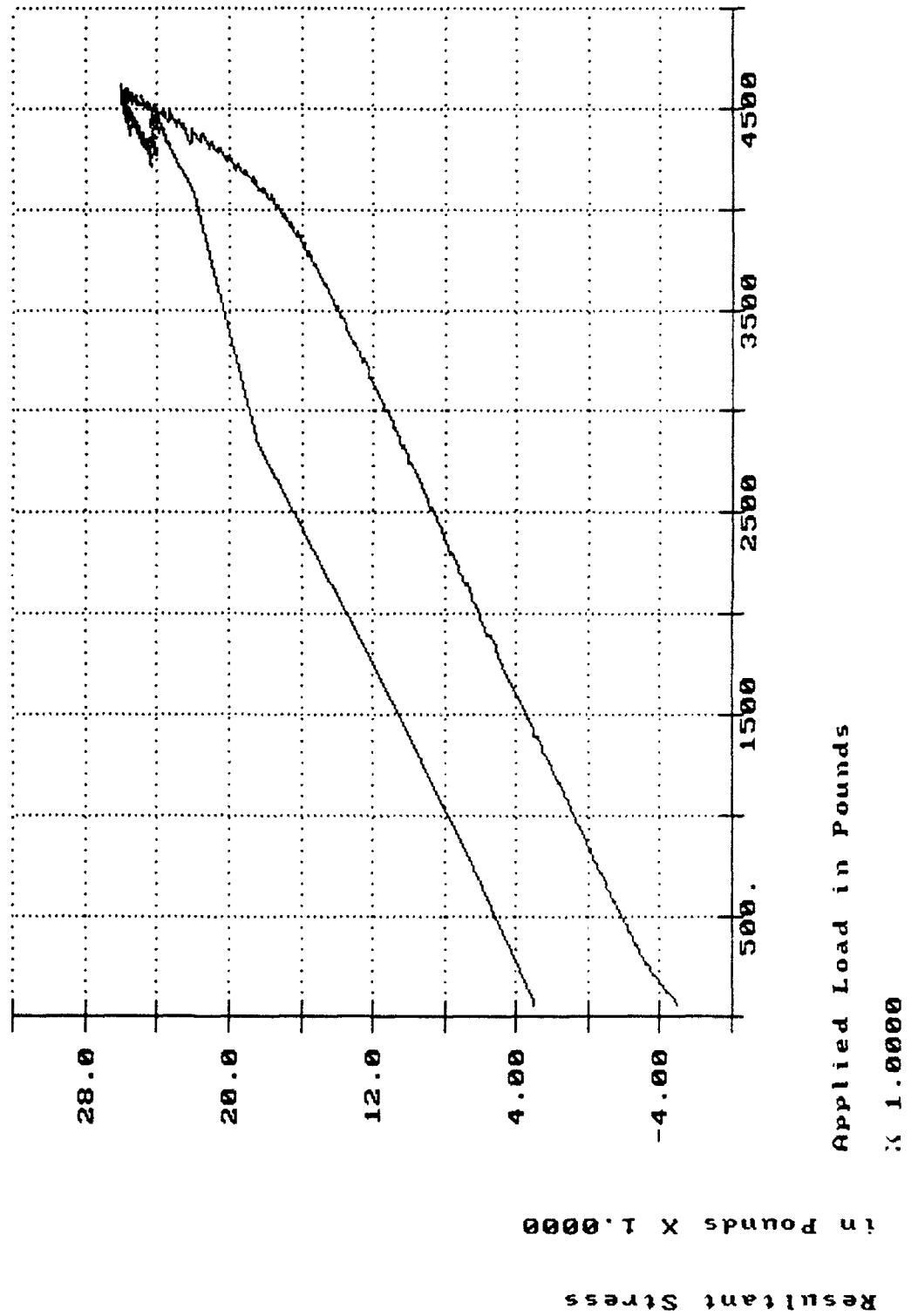
NEW ISSUE RESTRAINT BEAM
END LOAD
SAMPLE 19



Resultant Strain
in Inches / Inch X .0010

Applied Load in Pounds
X 1.0000

NEW ISSUE RESTRAINT BEAM
END LOAD
SAMPLE 19



SECTION 1

STATIC BEAM LOADING

NEW ISSUE RESTRAINT BEAMS

PHOTOGRAPHS

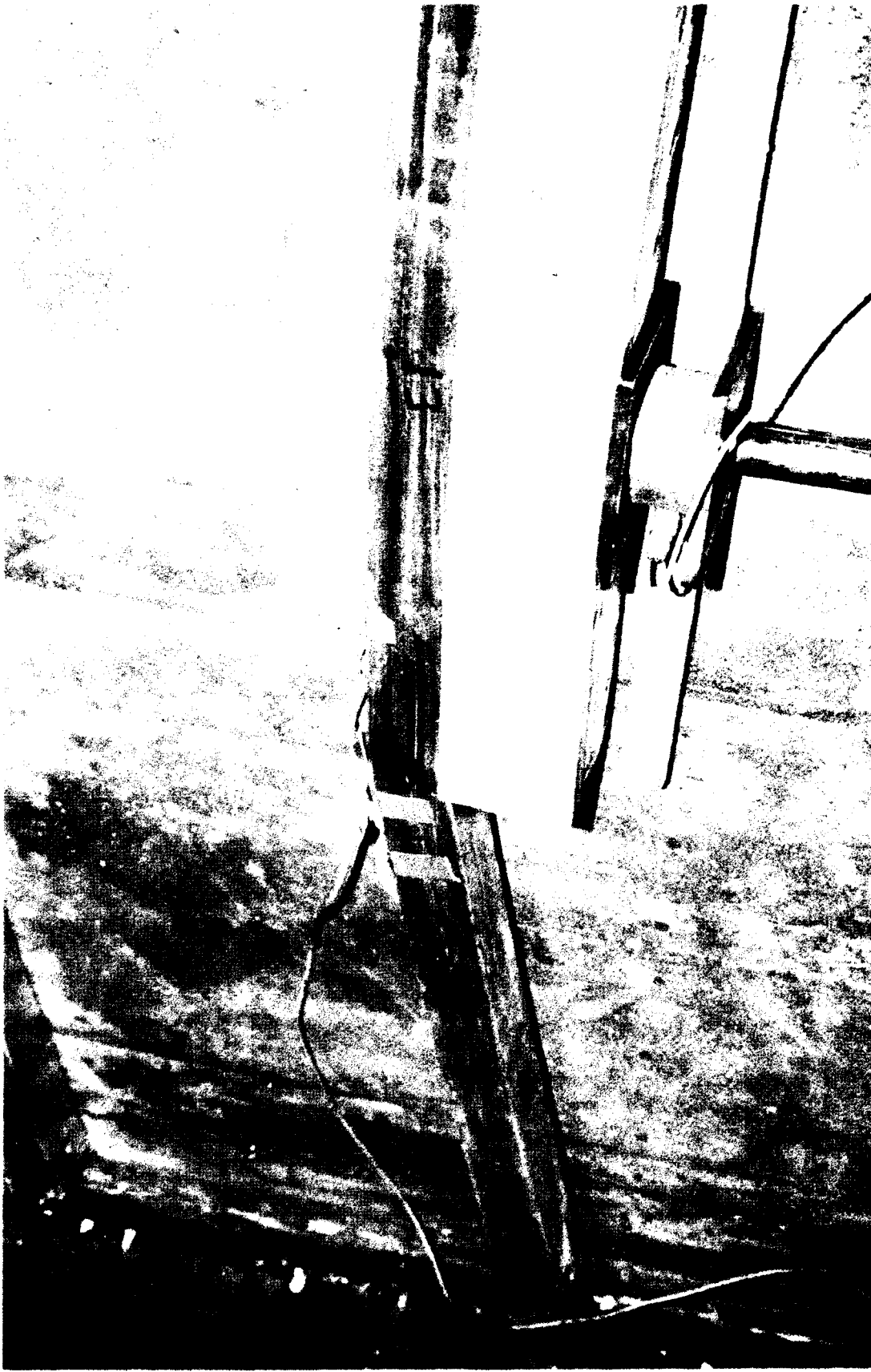


U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

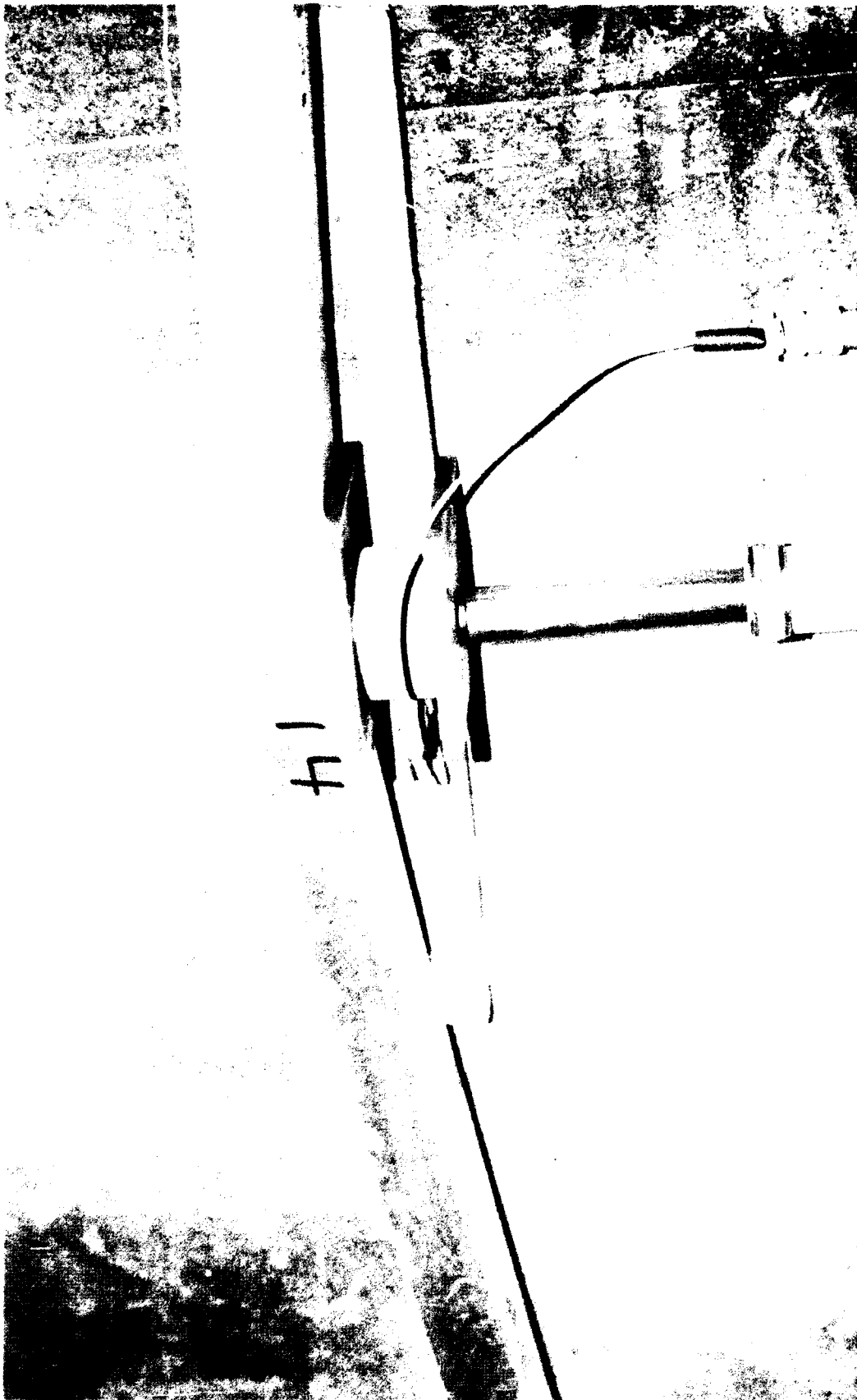
Photo No. A0317-SPN-90-229-3067. This photo shows test sample no. 11 after load testing.



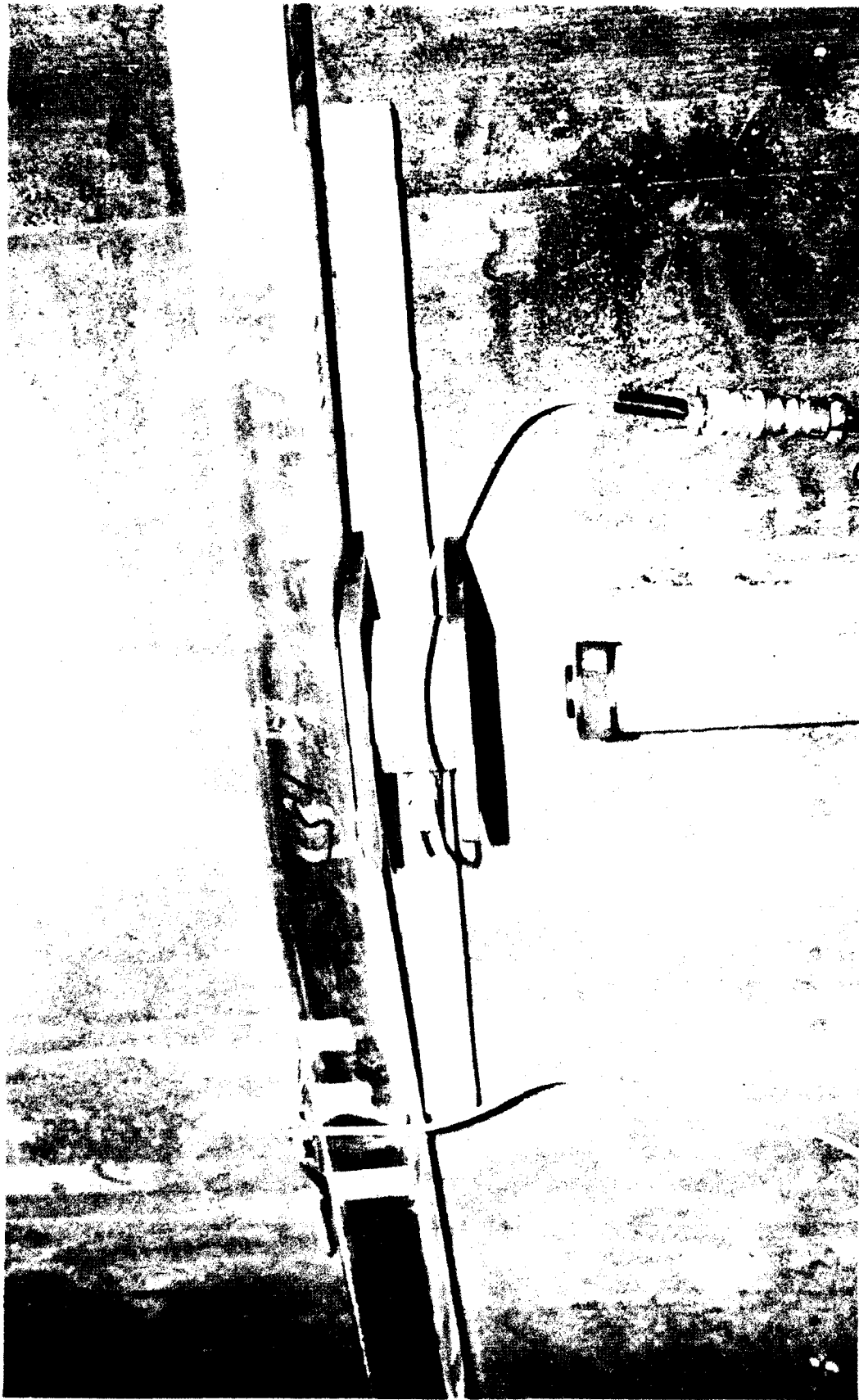
	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL
Photo No. A0317-SPN-90-229-3064. This photo shows test sample no. 12 after load testing. Note buckling damage perpendicular to the length of the beam.	



U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	Photo No. A0317-SPN-90-229-3058. This photo shows test sample no. 13 fully loaded. Loading force on the beams increased to a repeated level before failure. After this point, additional load caused increased bending and beam set.
--	--

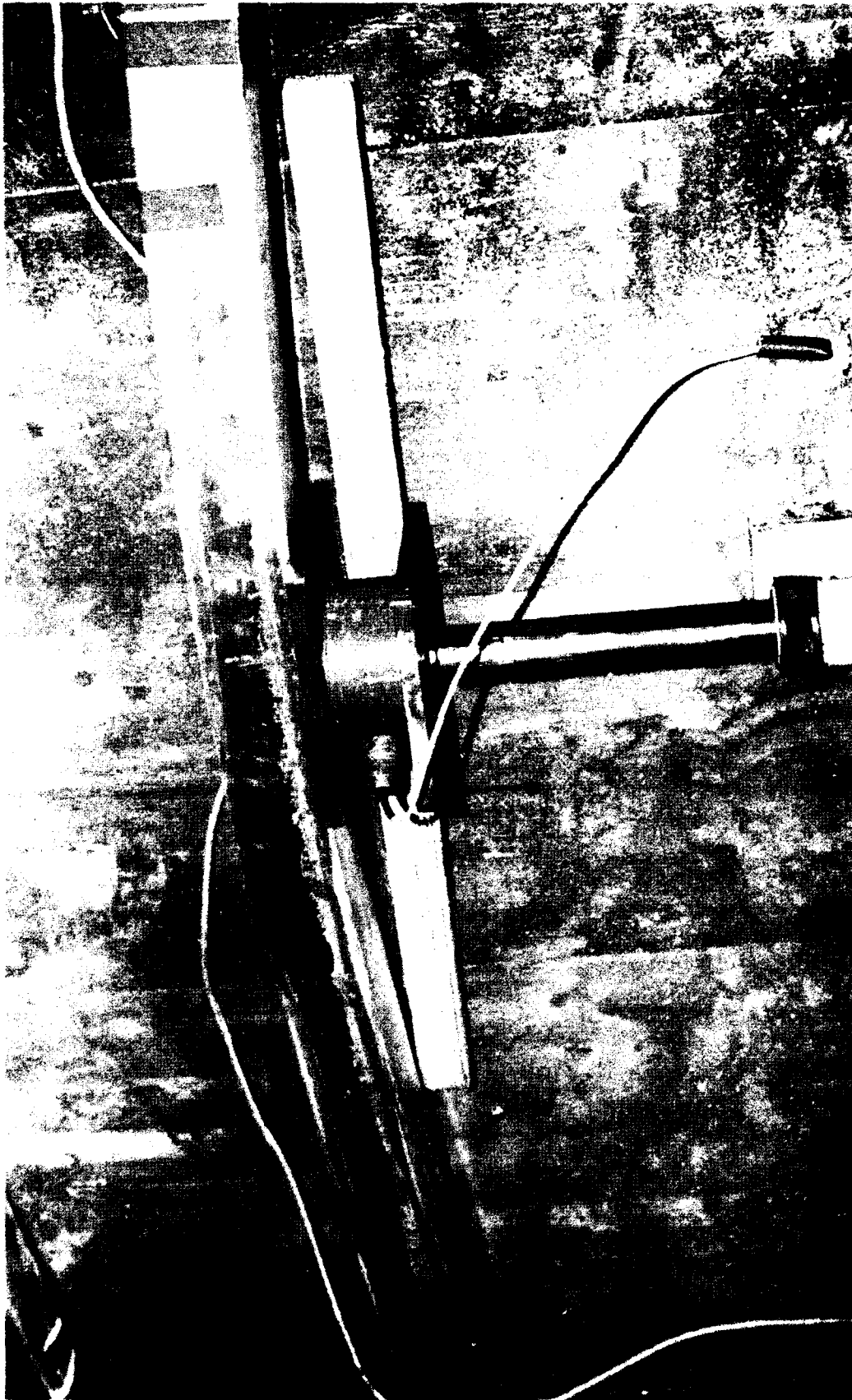


	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL
Photo No. A0317-SPN-90-229-3059. This photo shows test sample no. 14 fully loaded. Loading force on the beams increased to a repeated level before failure. After this point, additional load caused increased bending and beam set.	



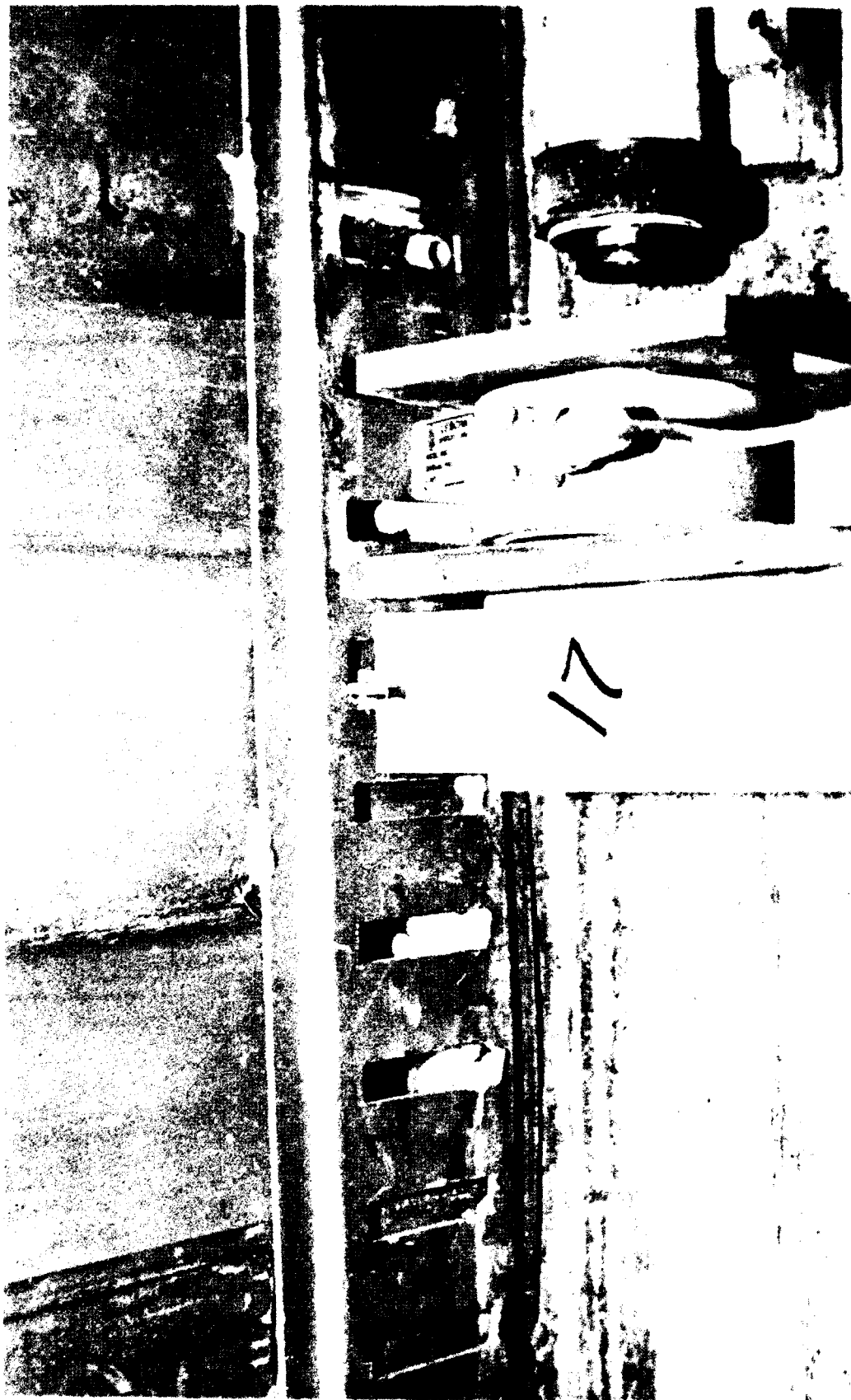
U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. A0317-SPN-90-229-3060. This photo shows test sample no. 15 fully loaded. Loading force on the beams increased to a repeated level before failure. After this point, additional load caused increased bending and beam set.



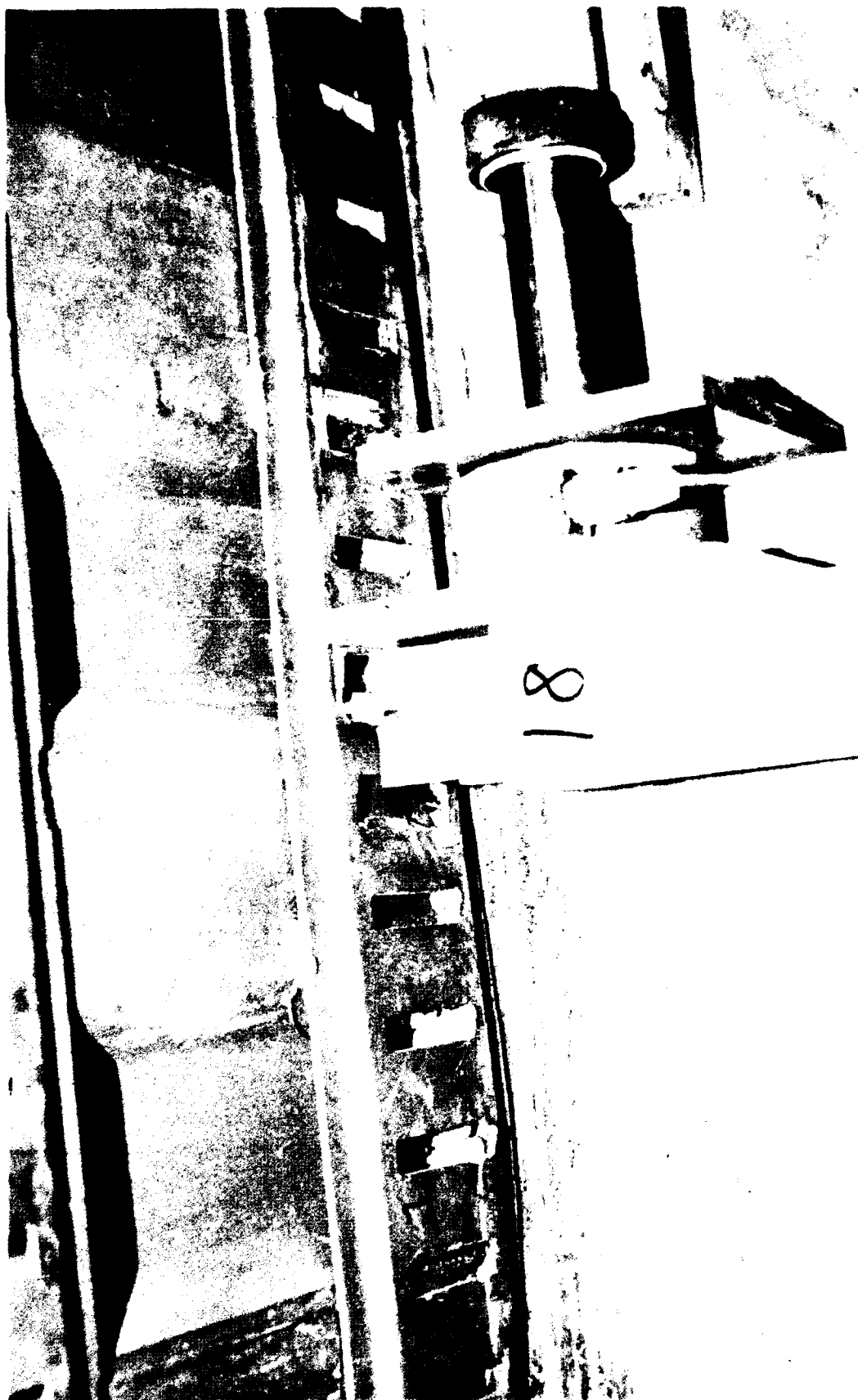
	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL
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Photo No. A0317-SPN-90-229-3061. This photo shows test sample no. 16 fully loaded. Loading force on the beams increased to a repeated level before failure. After this point, additional load caused increased bending and beam set.

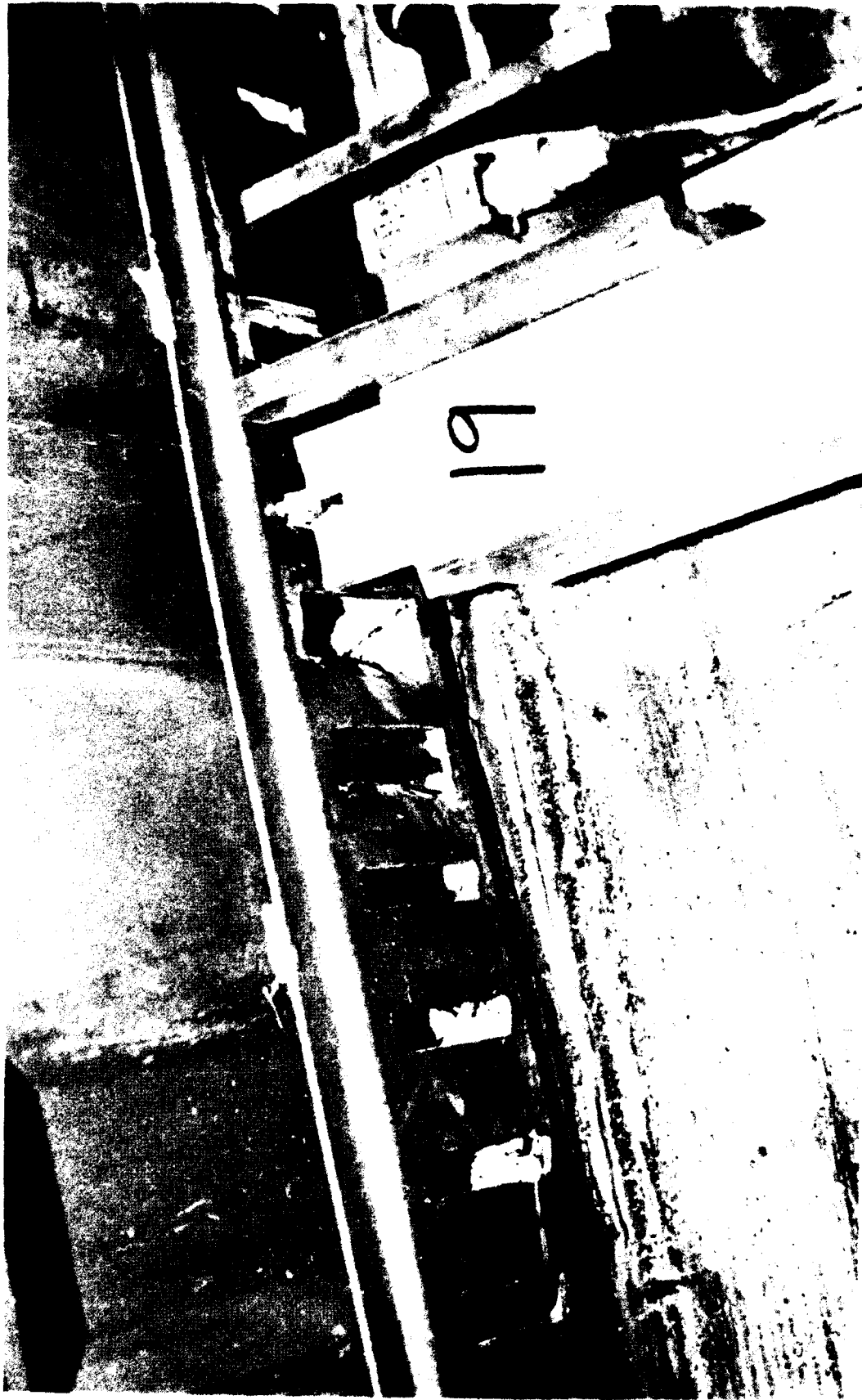


U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. A0317-SPN-90-229-3046. This photo shows test sample no. 17. Loading force on the beam was increased until the belt rail cog failed.



	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL
Photo No. A0317-SPN-90-229-3047. This photo shows test sample no. 18. Loading force on the beam was increased until the belt rail cog failed.	



U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. A0317-SPN-90-229-3049. This photo shows test sample no. 19 fully loaded. Loading force on the beam was increased until the belt rail cog failed. Note offset in the latch assembly.

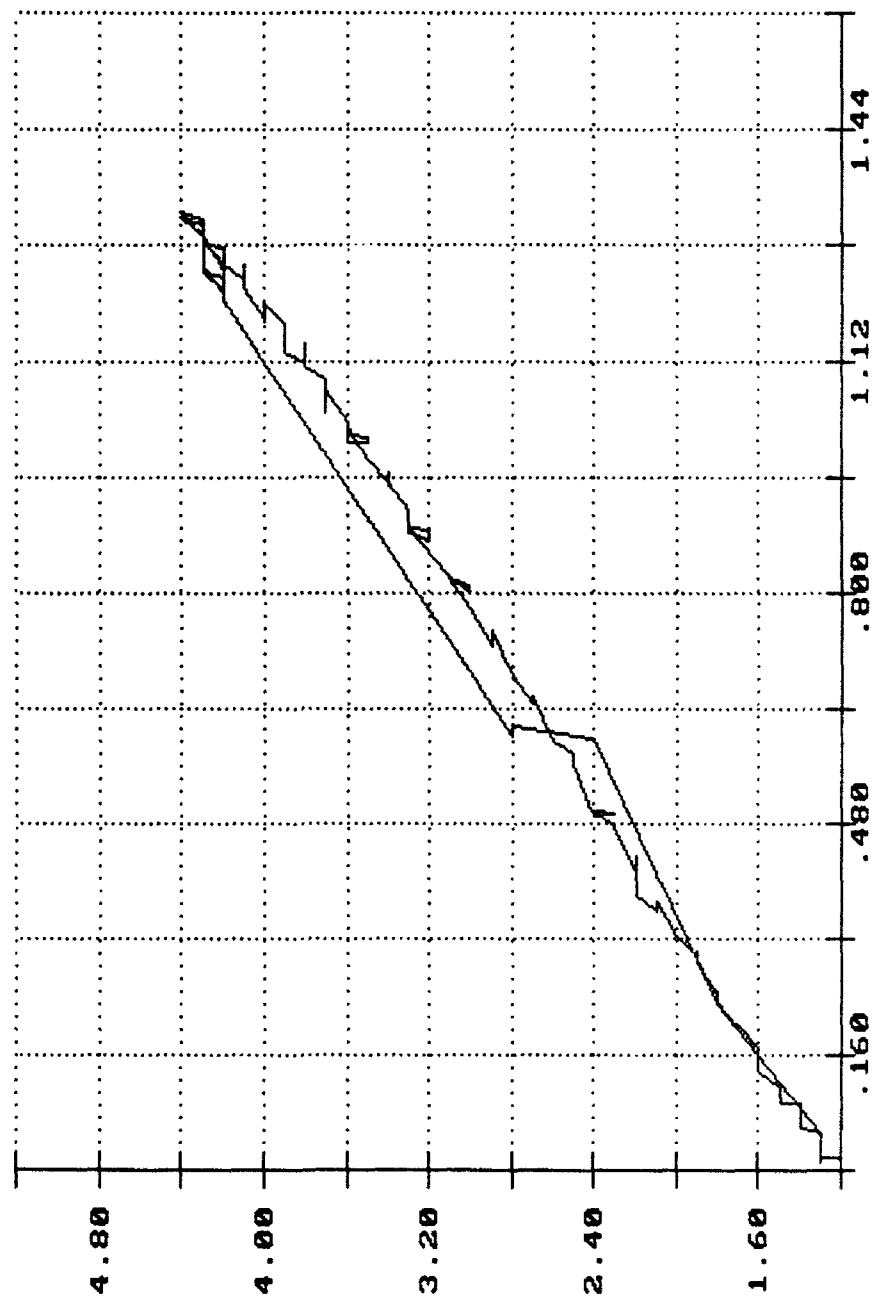
SECTION 1

STATIC BEAM LOADING

C. ANCRA INTERNATIONAL RESTRAINT BEAMS

STRESS/STRAIN DATA

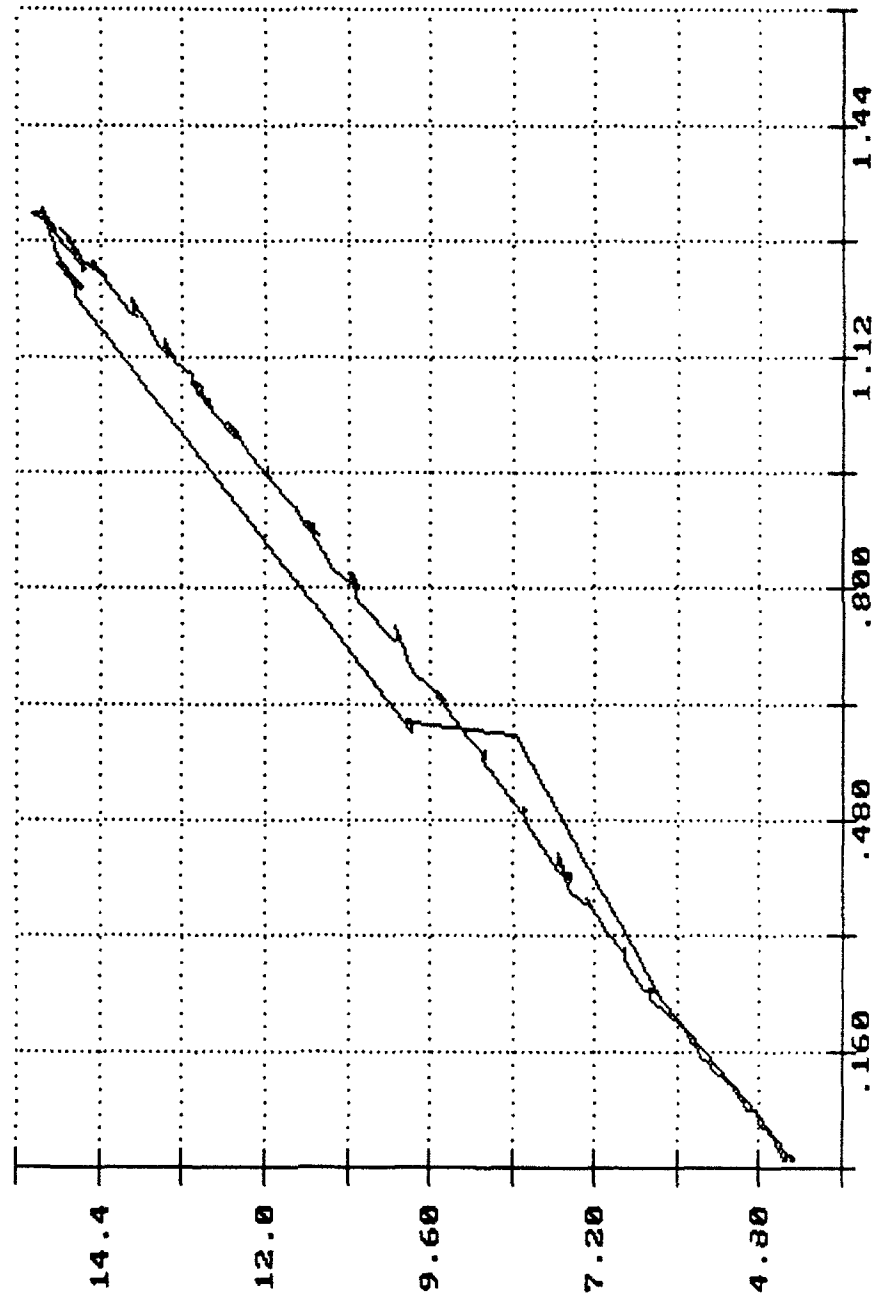
ANCRA BEAM END LOADING
SAMPLE 31



Resultant Strain
in Inches / Inch X .0001

Applied Load in Pounds
X 10000.0000

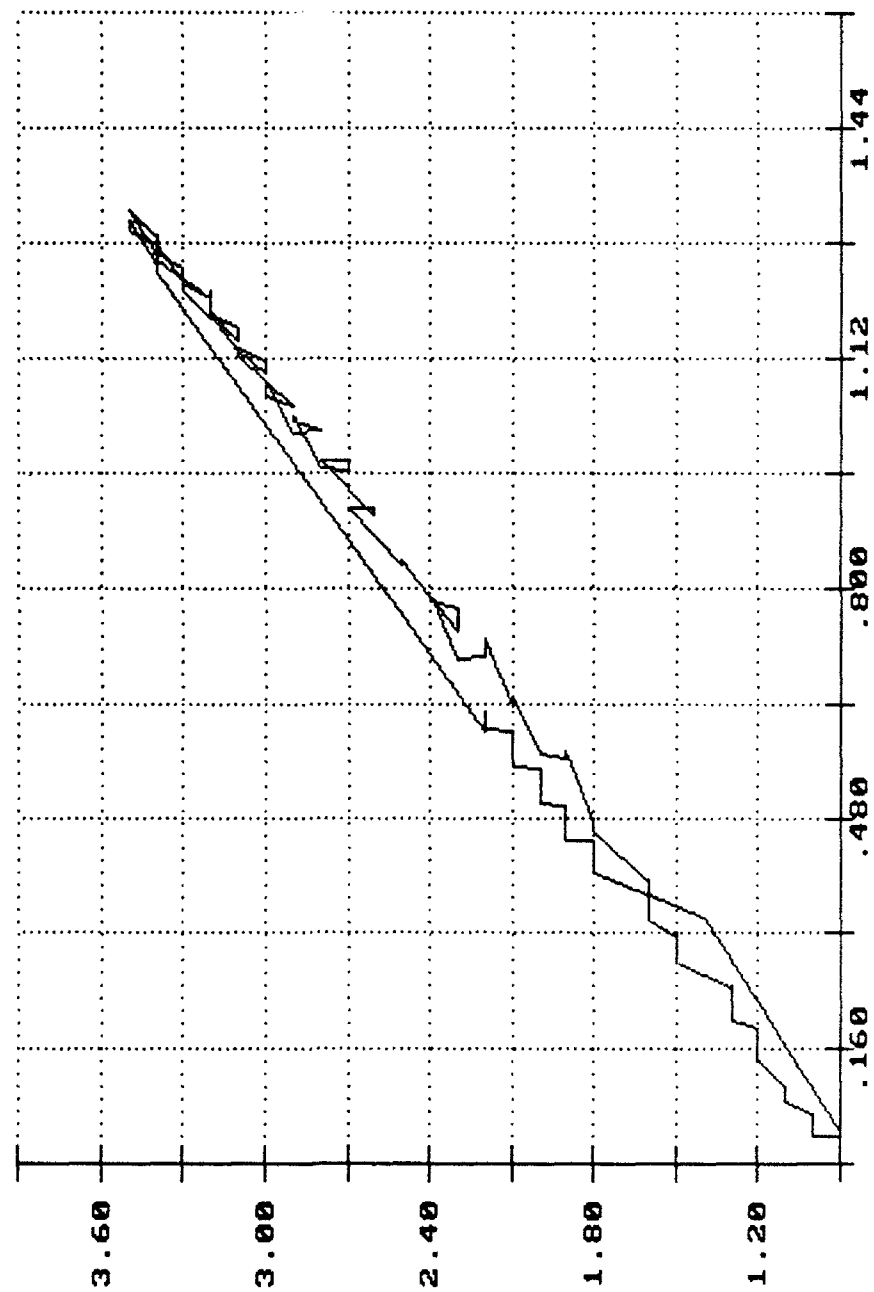
ANCRA BEAM END LOADING
SAMPLE 31



Resultant Stress
in Pounds X 1.0000

Applied Load in Pounds
X 10000.0000

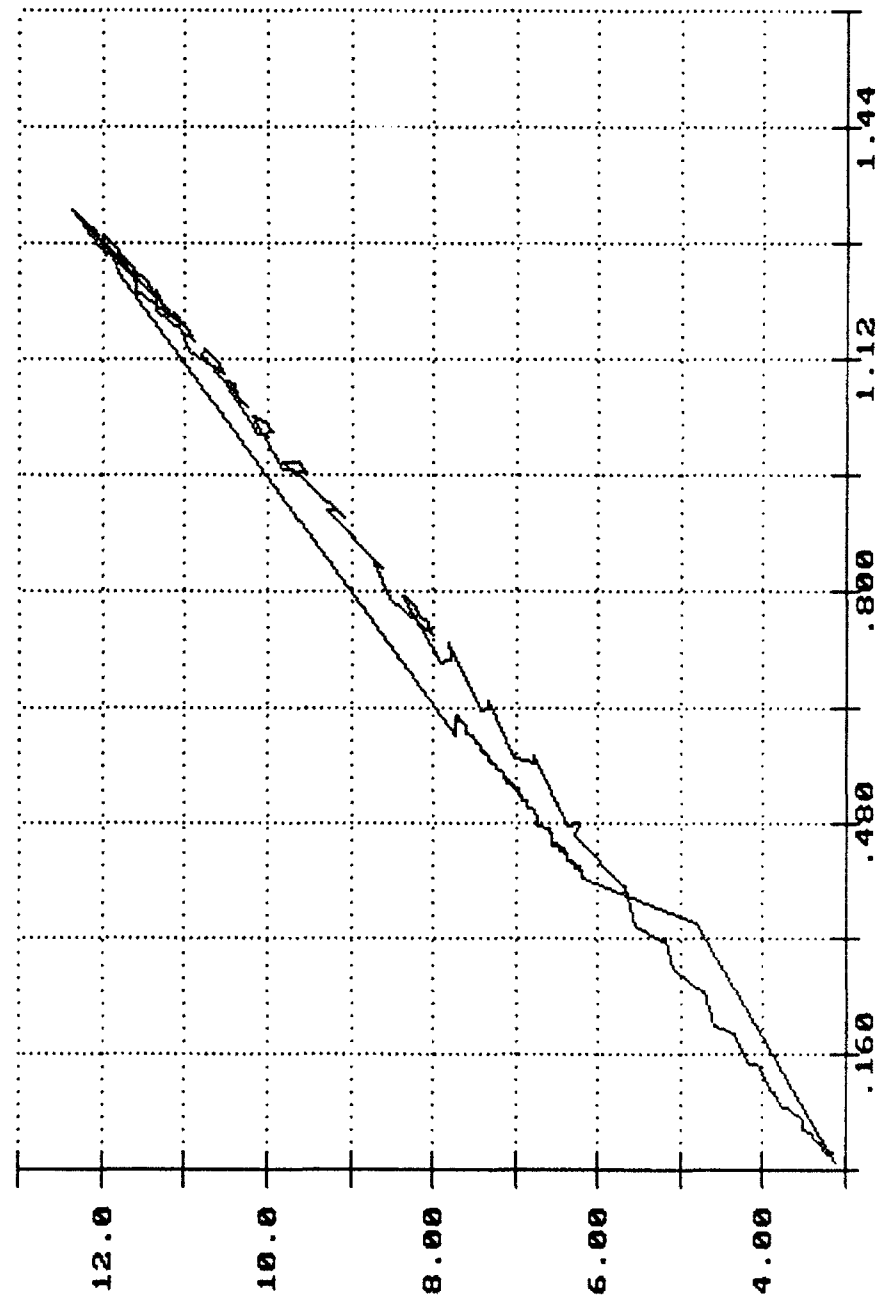
ANCRA BEAM END LOADING
SAMPLE 32



Resultant Strain
in Inches / Inch X .0001

Applied Load in Pounds
X 10000.0000

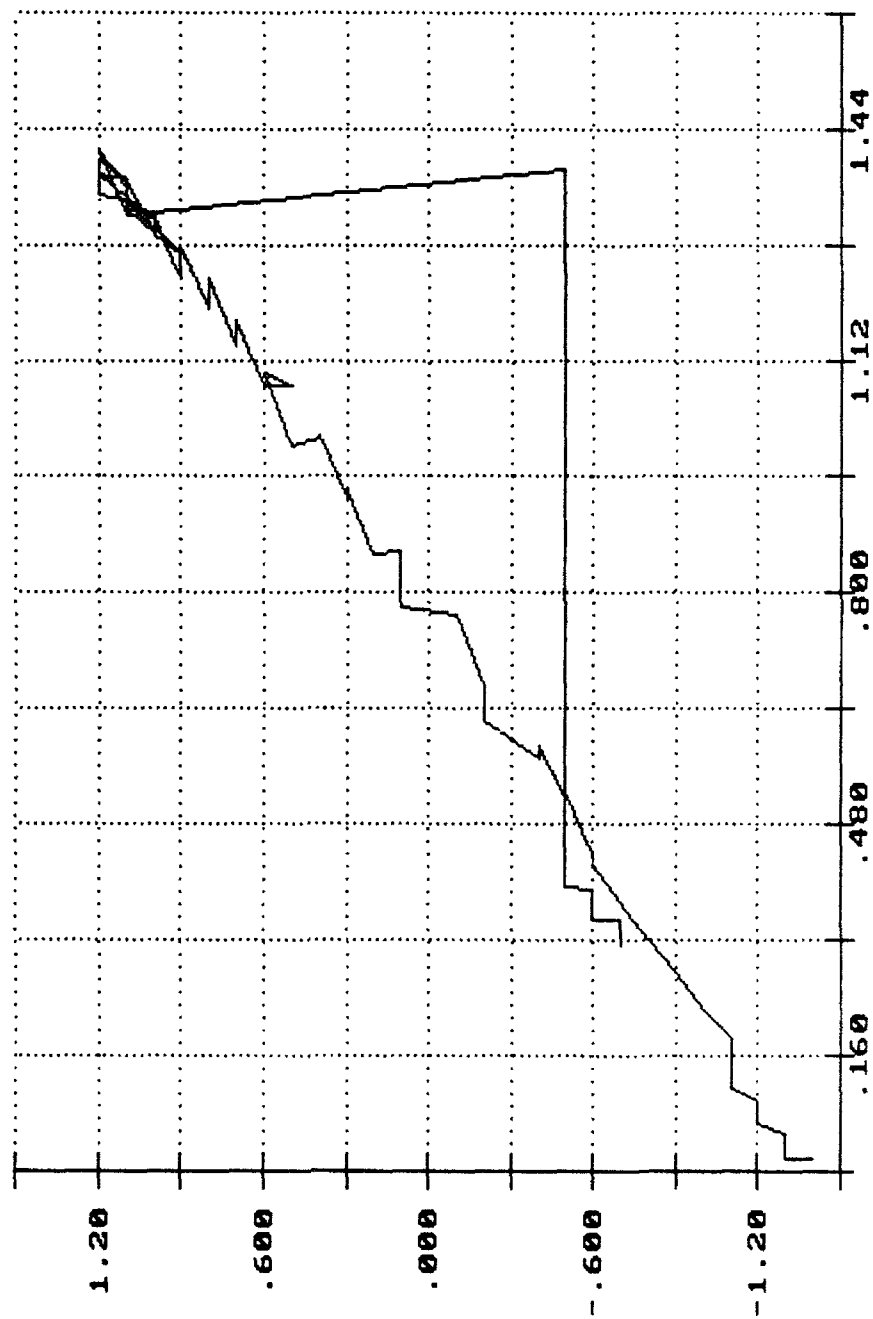
ANCRA BEAM END LOADING SAMPLE 32



Resultant Stress
in Pounds X 1.0000

Applied Load in Pounds
X 10000.0000

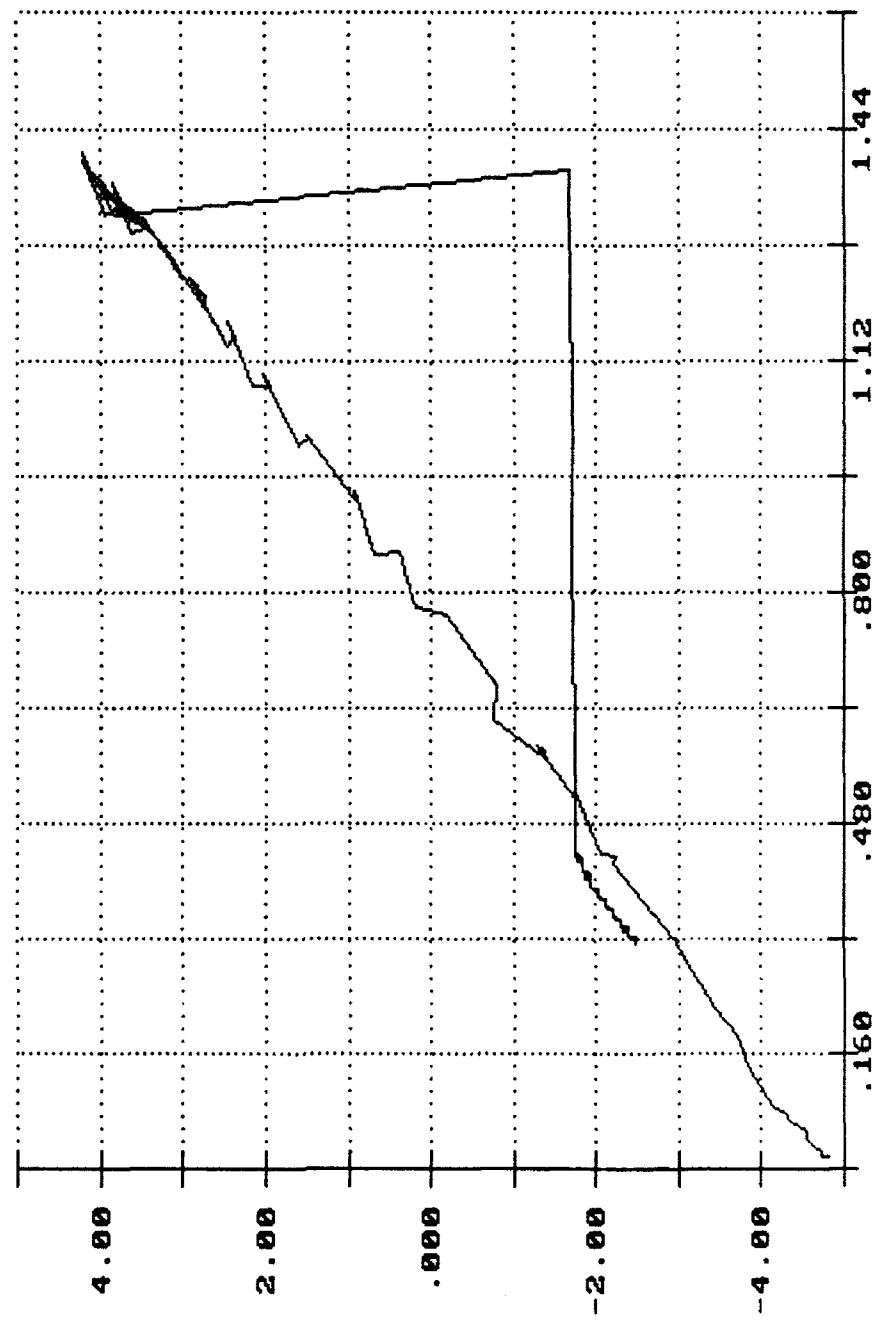
ANCRA BEAM END LOADING SAMPLE 33



Applied Load in Pounds
X 10000.0000

Resultant Strain
in inches / inch x .0001

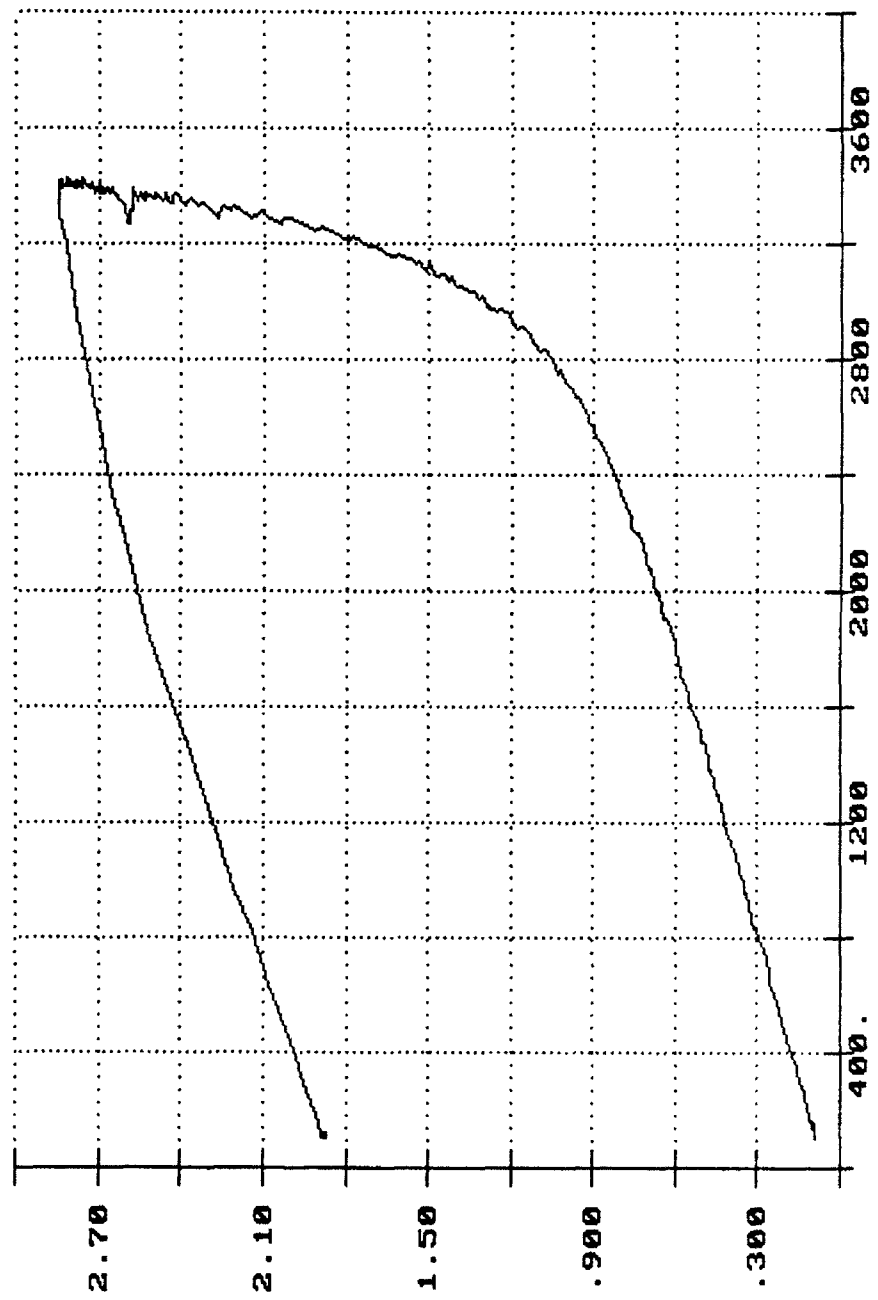
ANCRA BEAM END LOADING SAMPLE 33



Resultant Stress
in Pounds X 1.0000

Applied Load in Pounds
X 10000.0000

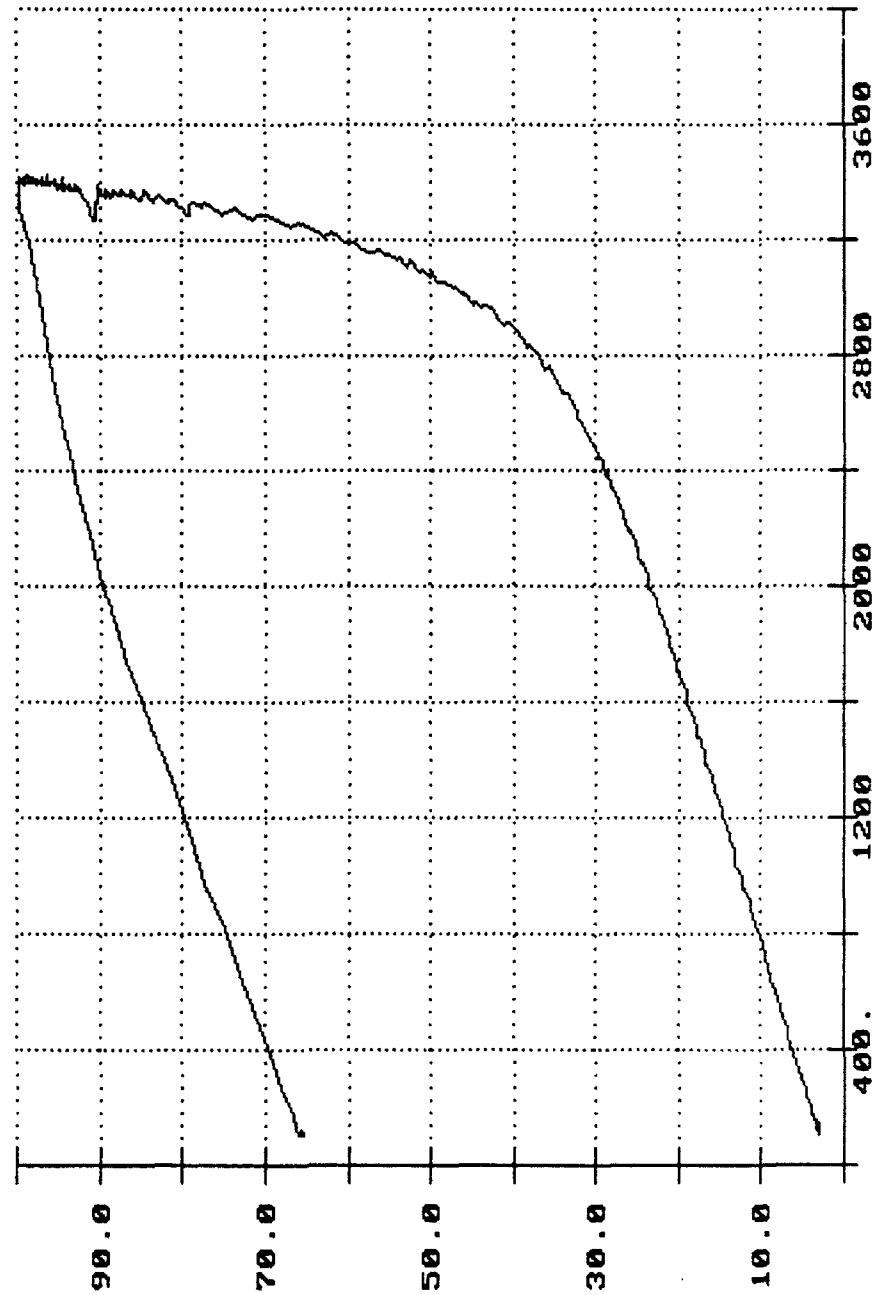
ANCRA BEAM POINT LOADING
SAMPLE 34



Applied Load in Pounds
X 1.0000

Resultant Strain
in Inches / Inch X .0010

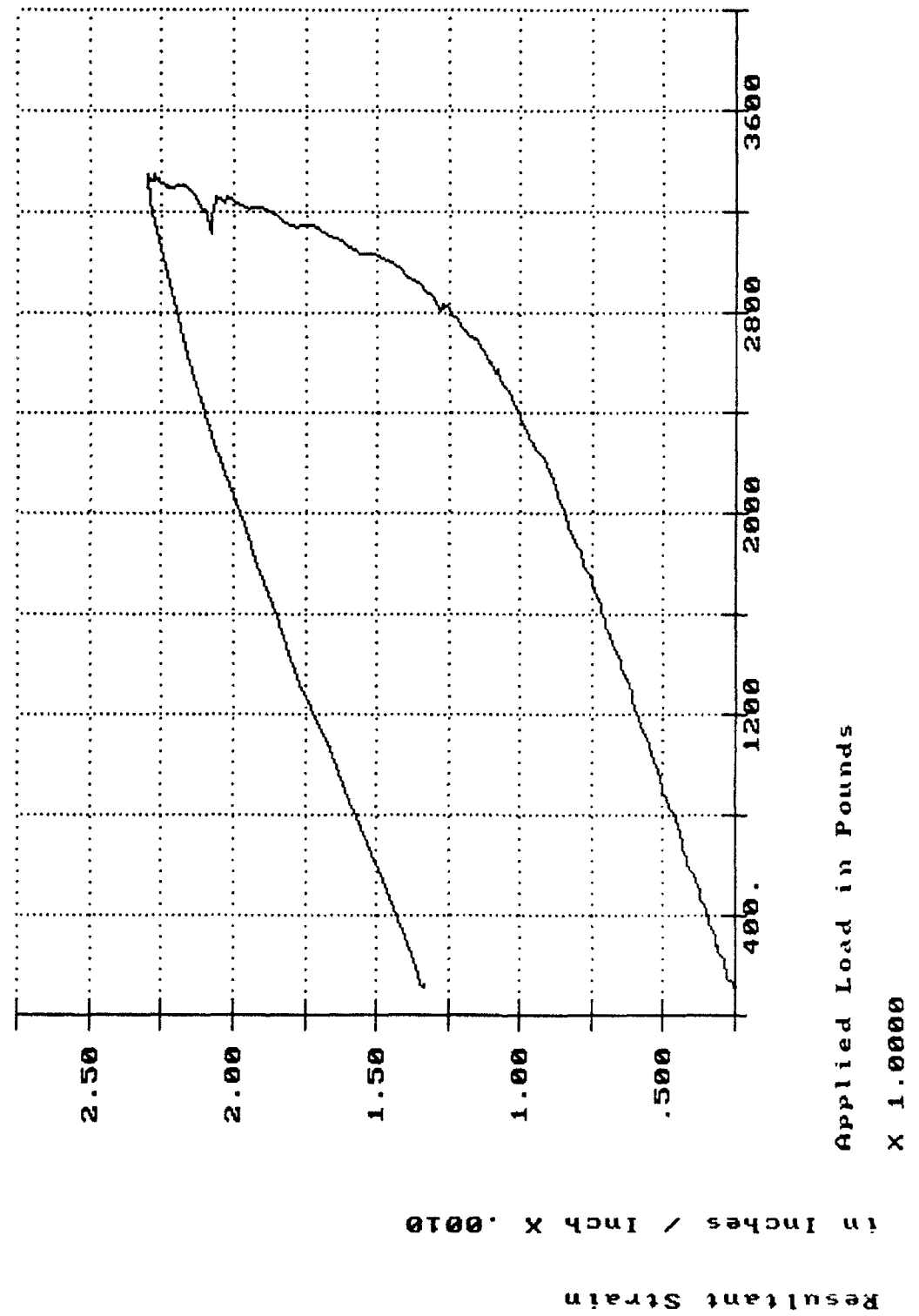
ANCRA BEAM POINT LOADING SAMPLE 34



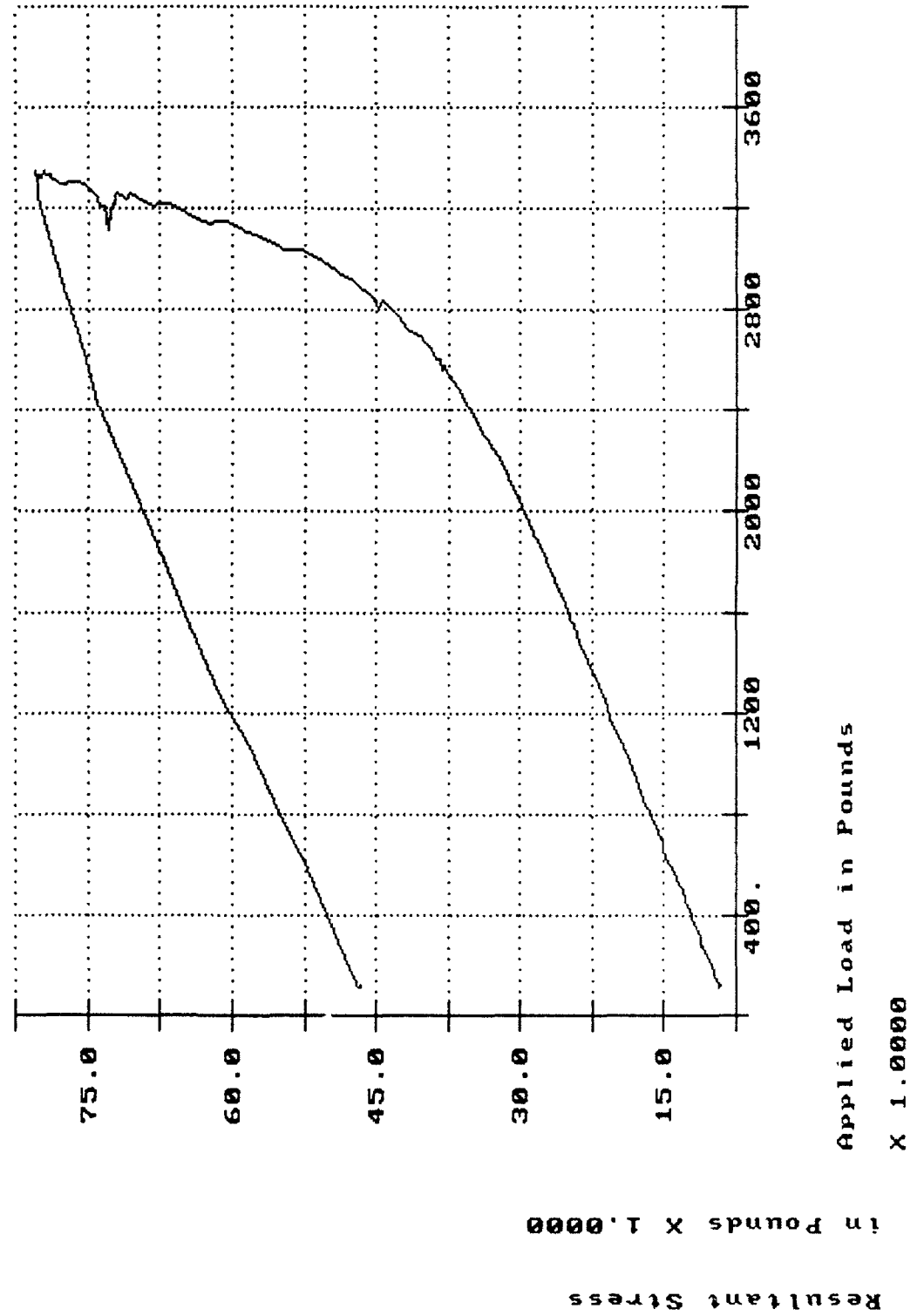
Resultant Stress
in Pounds X 1.0000

Applied Load in Pounds
X 1.0000

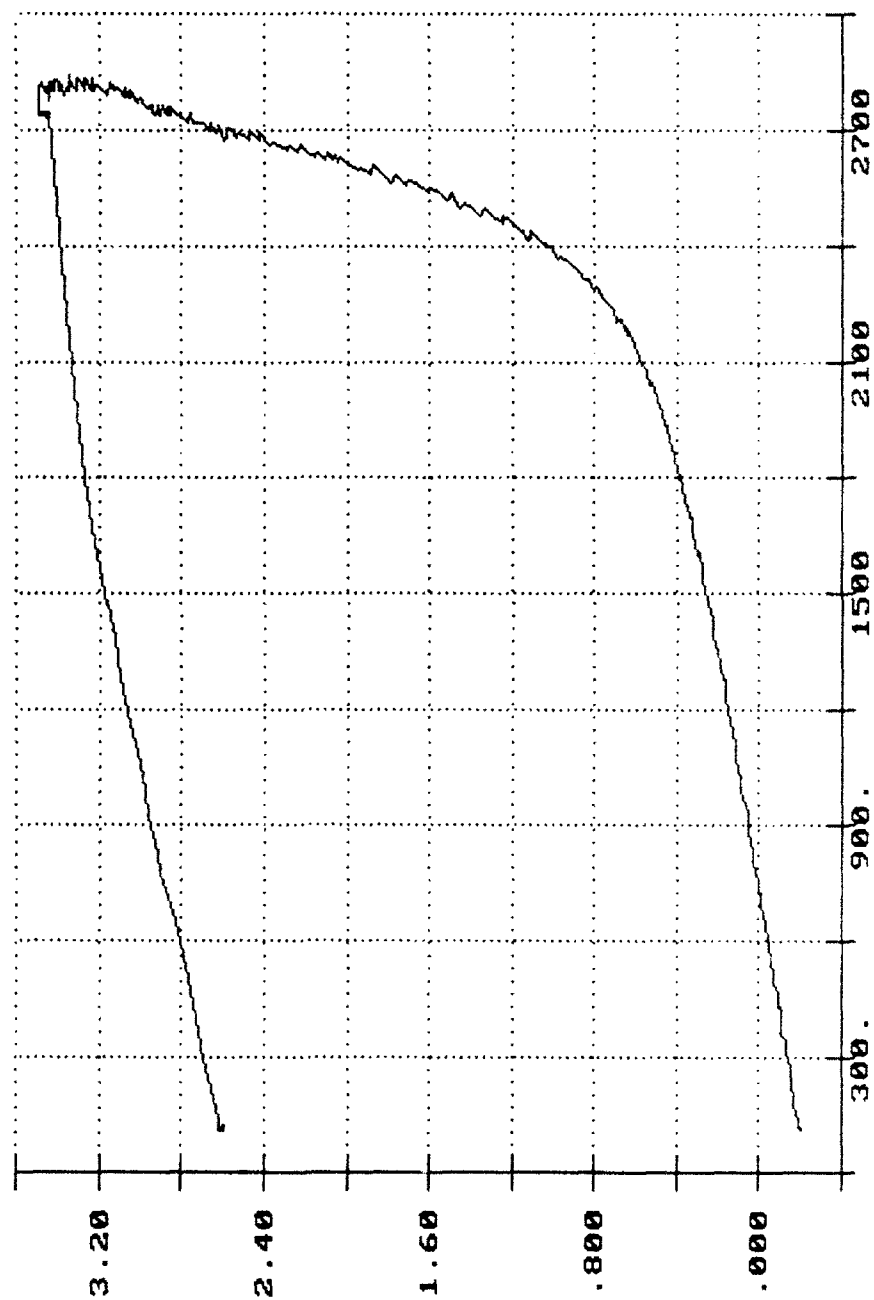
ANCRA BEAM POINT LOADING
SAMPLE 35



ANCRA BEAM POINT LOADING SAMPLE 35



ANCRA BEAM POINT LOADING SAMPLE 36

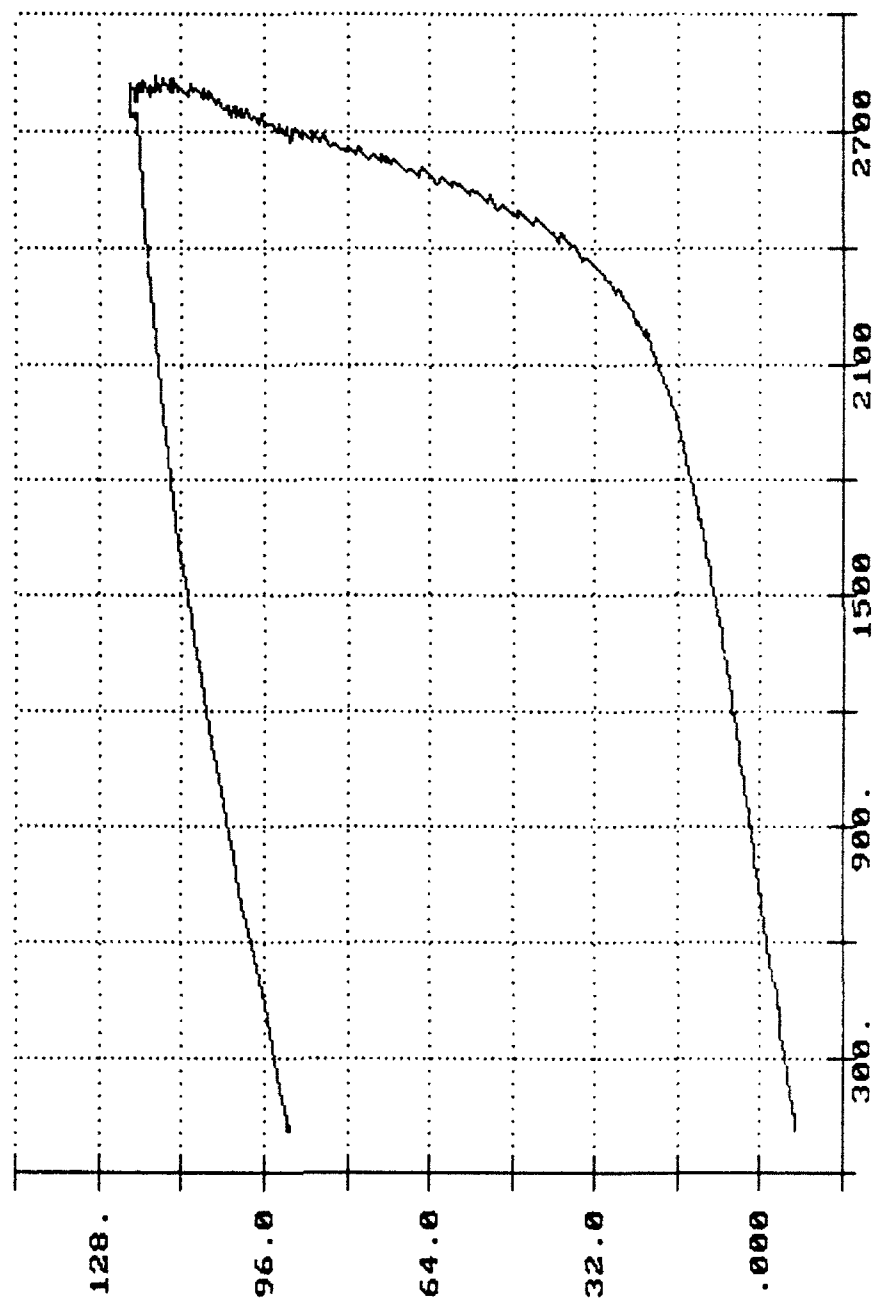


Resultant Strain
in Inches / inch X .0010

Applied Load in Pounds

X 1.0000

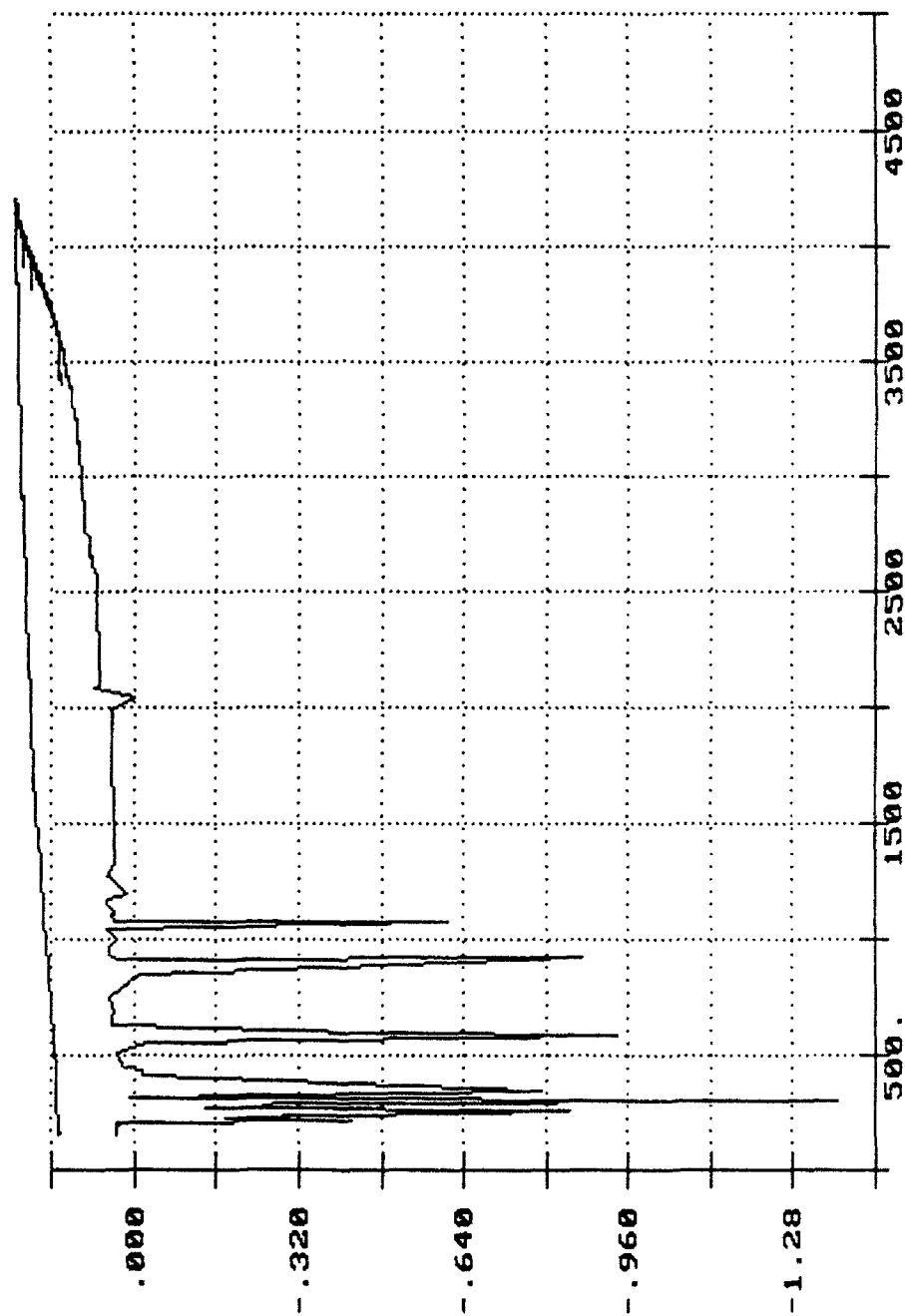
ANCRA BEAM POINT LOADING SAMPLE 36



Resultant Stress
in Pounds X 1.0000

Applied Load in Pounds
X 1.0000

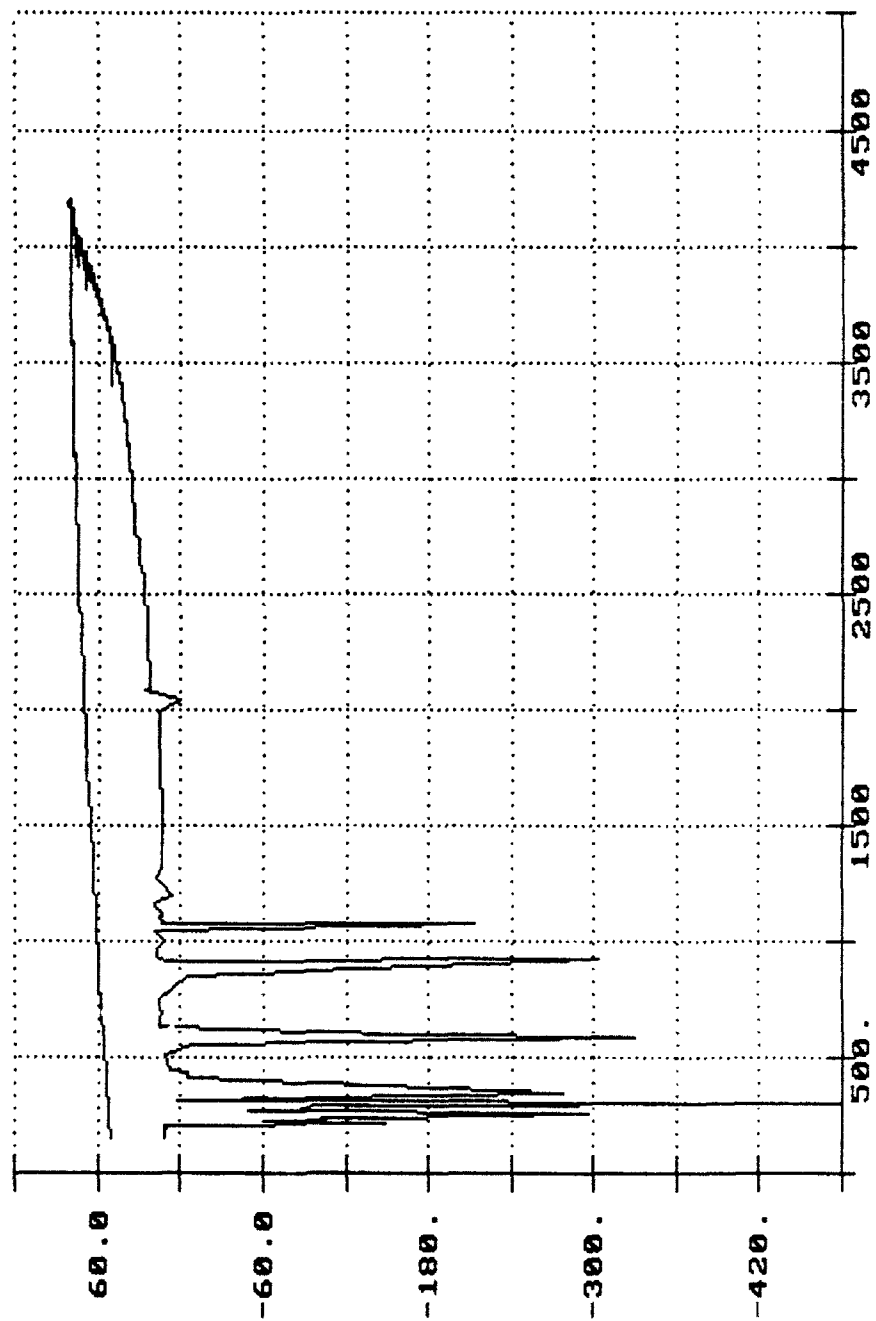
ANCRA BEAM SPREAD LOADING SAMPLE 37



Resultant Strain
in Inches / Inch X .0100

Applied Load in Pounds
X 1.0000

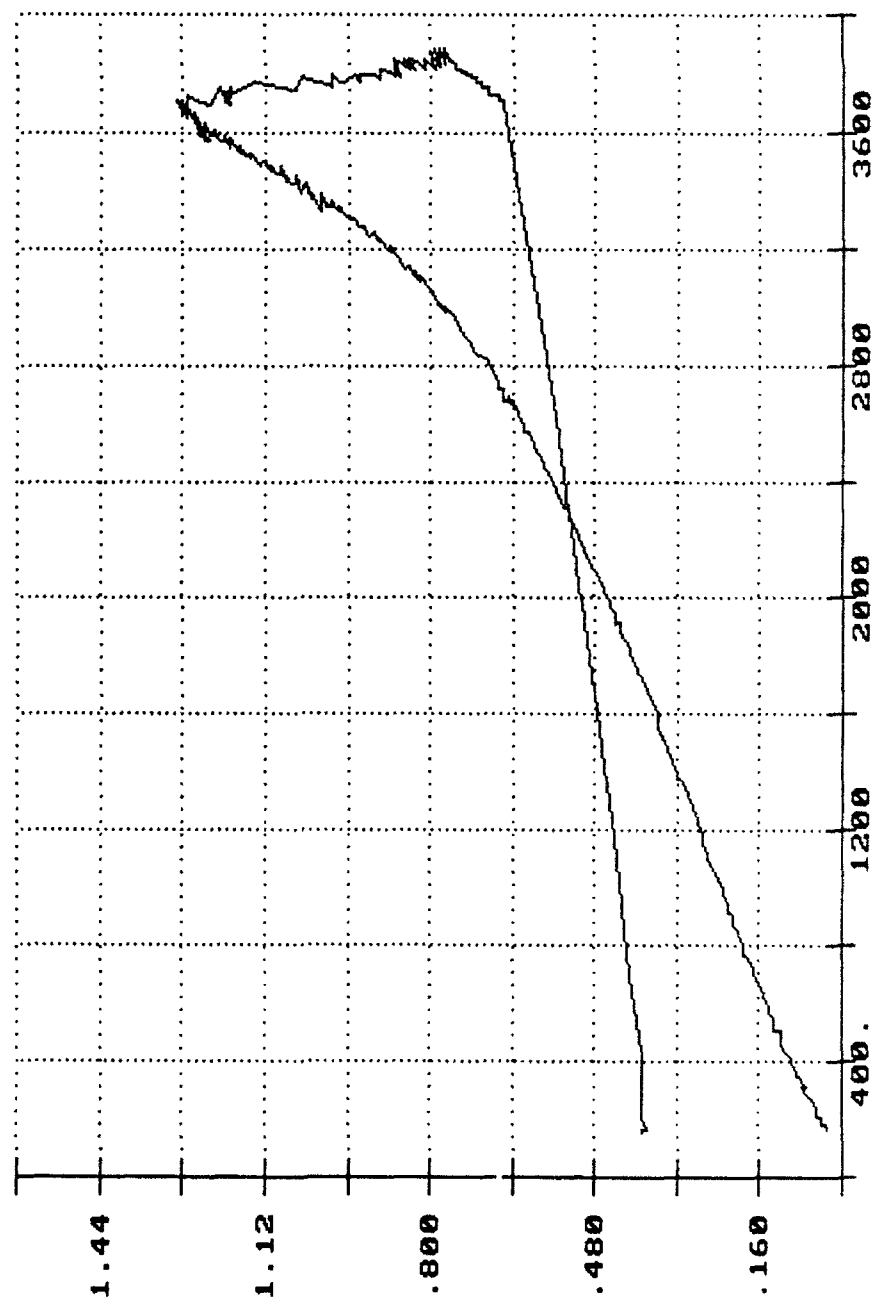
ANCRA BEAM SPREAD LOADING SAMPLE 37



Resultant Stress
in Pounds X 1.0000

Applied Load in Pounds
X 1.0000

ANCRA BEAM SPREAD LOADING
SAMPLE 39

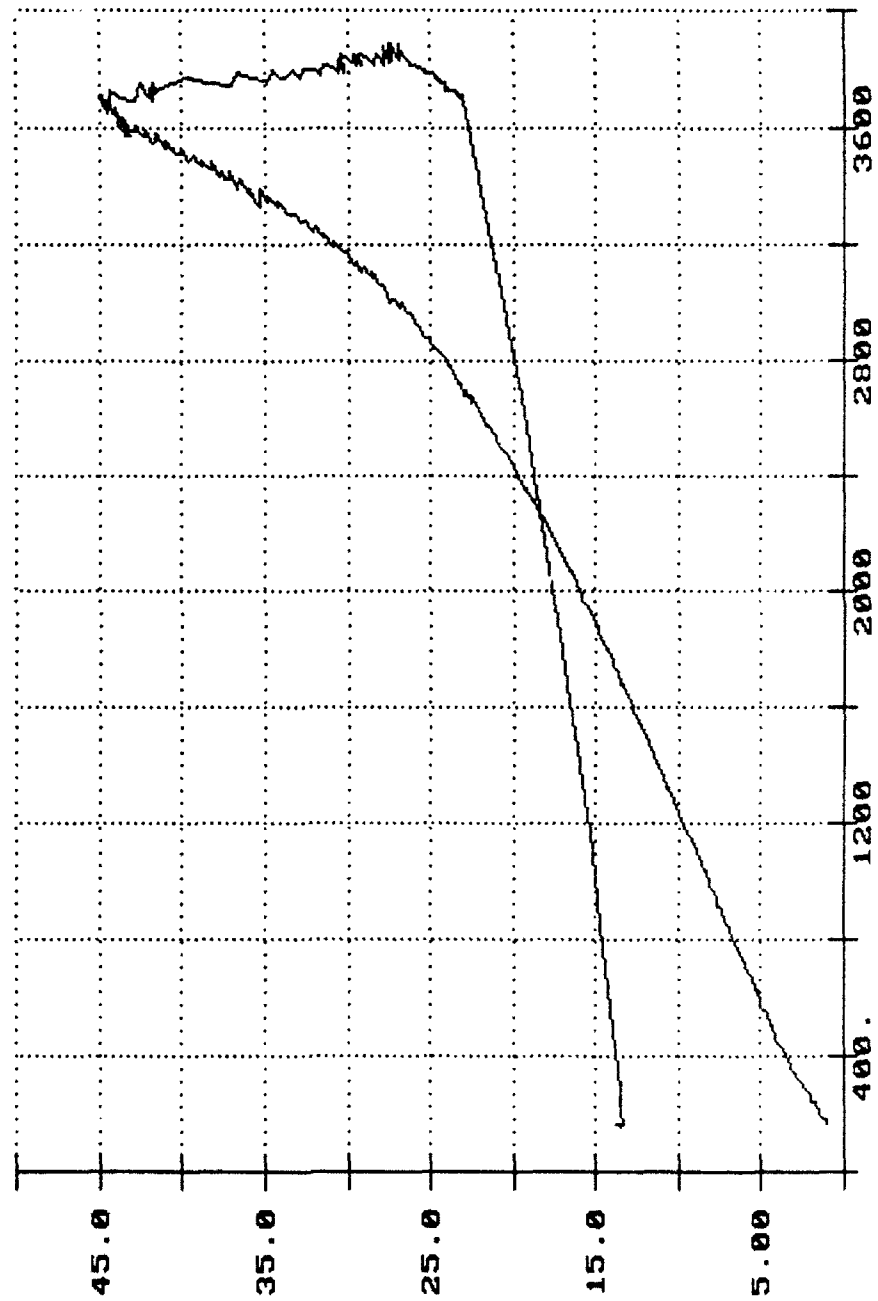


Applied Load in Pounds

X 1.0000

Resultant Strain
in Inches / Inch X .0010

ANCRA BEAM SPREAD LOADING
SAMPLE 39



Applied Load in Pounds

X 1.0000

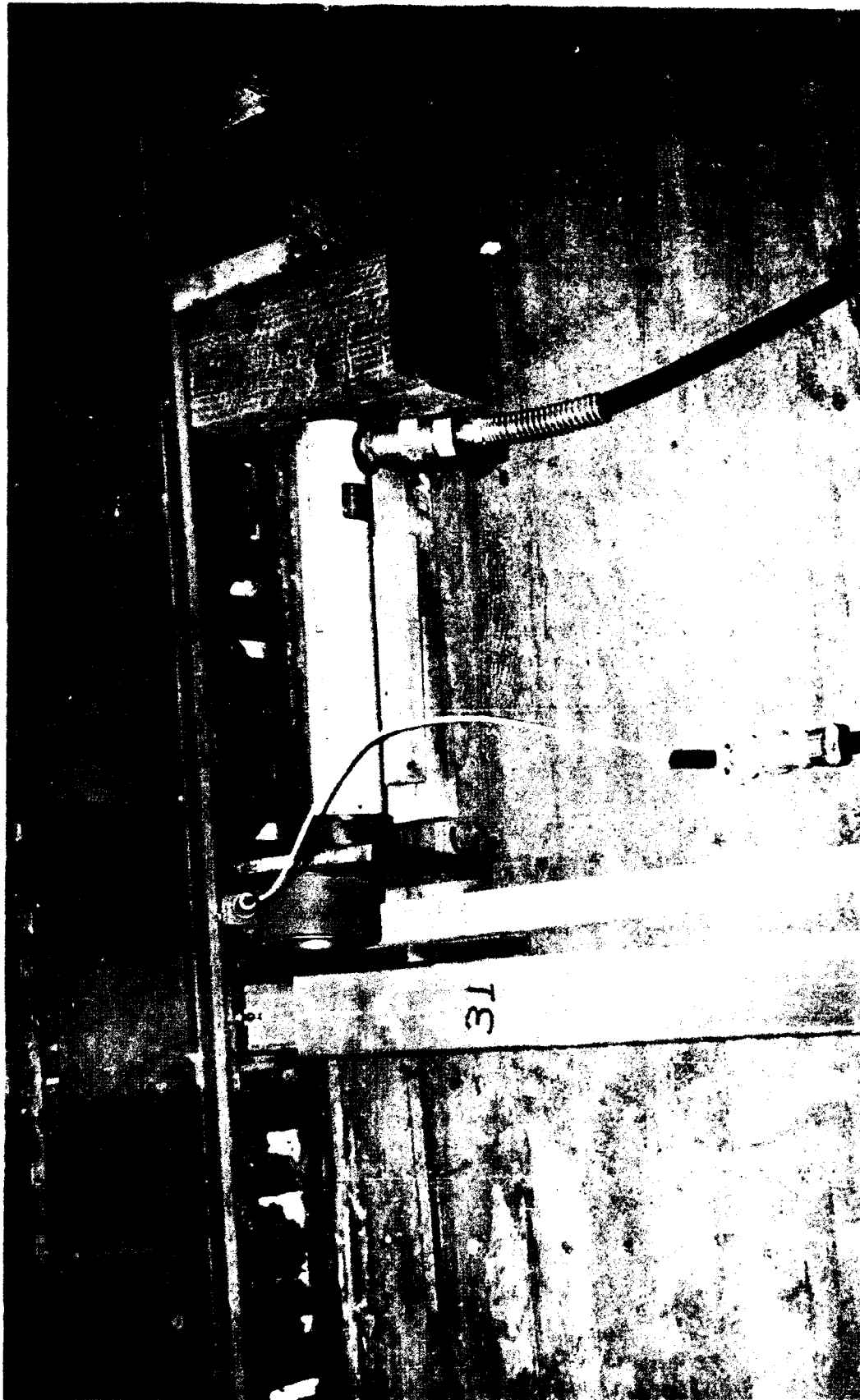
Resultant Stress
in Pounds X 1.0000

SECTION 1

STATIC BEAM LOADING

ANCRA INTERNATIONAL RESTRAINT BEAMS

PHOTOGRAPHS



U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL
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Photo No. SPN-90-229-3083: This photo shows an ANCRA International restraint beam, sample no. 31, prior to performing an end load test.



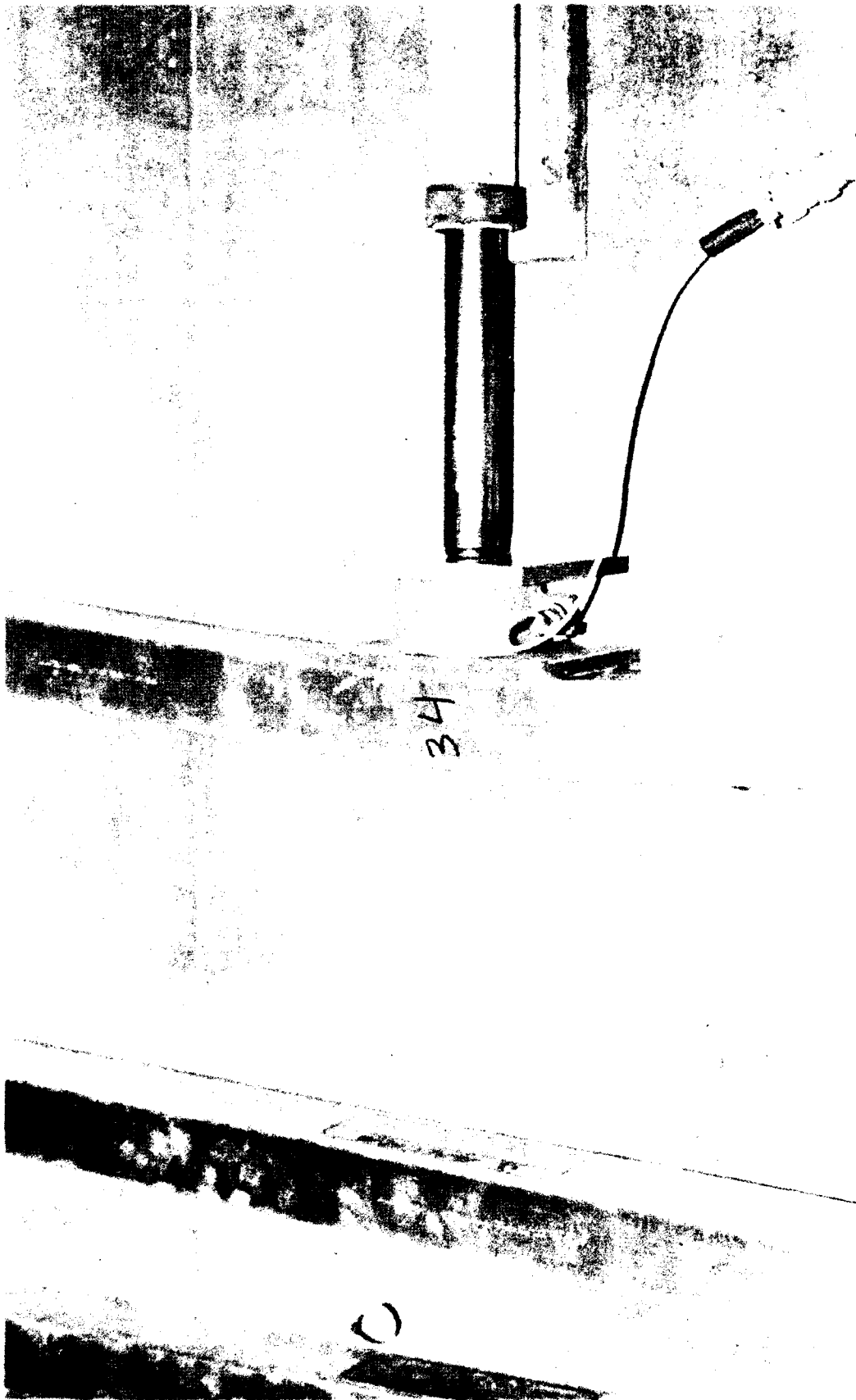
U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. SPN-90-229-3086: This photo shows an ANCRA International restraint beam, sample no. 32, with an end load applied to a force just below failure.



	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL
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Photo No. SPN-90-229-3087: This photo shows an ANCRA International restraint beam, sample no. 33, with an end load applied to a force just below failure.



U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. SPN-90-229-3089: This photo shows an ANCRA International restraint beam, sample no. 34, with a point load applied. Failure occurred when the center of the beam started deforming by caving in toward the center line of the beam.



U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. PN-90-229-3097: This photo shows an ANCRA International restraint beam, sample no. 37, after testing with a spread load. The spread load is modeled with the three 2-by 6-inch boards cut to approximately one-third the length of the beam. Failure occurred at the point where the beam ends in contact with the beam.



	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
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Photo No. SPN-90-229-3103: This photo shows an ANCRA International restraint beam, sample no. 38, after testing with a spread load. The spread load is modeled with the three 2-by 6-inch boards cut to approximately one-third the length of the beam. Failure occurred at the point where the beam ends in contact with the beam. Note beam deflection.



	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
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Photo No. SPN-90-229-3107: This photo shows an ANCRA International restraint beam, sample no. 39, after testing with a spread load. The spread load is modeled with the three 2-by 6-inch boards cut to approximately one-third the length of the beam. Failure occurred at the point where the beam ends in contact with the beam. Note beam deflection in relation to the belt rail engagement. This photo shows the left side of the loaded beam.



U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. SPN-90-229-3105: This photo shows an ANCRA International restraint beam, sample no. 39, after testing with a spread load. The spread load is modeled with the three 2-by 6-inch boards cut to approximately one-third the length of the beam. Failure occurred at the point where the beam ends in contact with the beam. Note bow at beam center. End points of the wooden beam act as pivots.

SECTION 2

TRANSPORTABILITY TESTS

D. ORIGINAL ISSUE AND ANCRA INTERNATIONAL RESTRAINT BEAMS

RAIL TEST DATA

TEST NO.: 1

DATE: 30 April 1990

TEST SPECIMEN: Two MILVANS, one with standard issue restraint beams and the second with ANCRA Internatioanl restraint beams and both loaded with inert 155mm projectiles.

TEST TOFC NO.: TTX 601063

LT. WT.: 66,200 POUNDS

LOAD NO.: 1

LADING & DUNNAGE

WT.: 39,295 POUNDS

MILVAN: USA 0105344

WT.: 5,785 POUNDS

CHASSIS NO.: 5394

WT.: 5,120 POUNDS

LOAD NO.: 2

LADING & DUNNAGE

WT.: 39,255 POUNDS

MILVAN: USA A0094574

WT.: 5,900 POUNDS

CHASSIS NO.: 5394

WT.: 4,390 POUNDS

TOTAL SPECIMEN

WT.: 165,945 POUNDS

BUFFER CARS (5 CARS)

WT.: 250,000 POUNDS

		REMARKS				
<u>IMPACT NO.</u>	<u>END STRUCK</u>	<u>VELOCITY</u> <u>(MPH)</u>	<u>LOAD 1</u>		<u>LOAD 2</u>	
			<u>LEFT</u> <u>(INCH)</u>	<u>RIGHT</u> <u>(INCH)</u>	<u>LEFT</u> <u>(INCH)</u>	<u>RIGHT</u> <u>(INCH)</u>
1	Rear	4.55	-1/4	-1/8	-1/8	-1/8
2	Rear	6.67	-1/8	0	0	-3/8
3	Rear	8.52	0	+3/8	0	-1/8
4	Forward	8.52	+7/8	+1/2	+1/8	+5/8

Notes: 1. End struck - Rearward end of container (door end) faces direction of impact. Forward end of container is the towed end.

2. Load 1 container has standard issue restraint beams.

3. Load 2 container has ANCRA International restraint beams.

4. Load displacements shown are measured from a fixed reference point on the second belt rail from the container floor.

ROAD TEST DATA

TEST NO.: 2

Date: 30 April 1990

TEST SPECIMEN No.: 1, Standard Issue Restraint Beams and 155mm Projectiles.

PASS 1-A OVER FIRST SERIES OF TIES	0.10 MIN	5.68 MPH
------------------------------------	----------	----------

PASS 1-B OVER SECOND SERIES OF TIES	0.11 MIN	5.16 MPH
-------------------------------------	----------	----------

REMARKS: No load shift.

PASS 2-A OVER FIRST SERIES OF TIES	0.9 MIN	6.3 MPH
------------------------------------	---------	---------

PASS 2-B OVER SECOND SERIES OF TIES	0.1 MIN	5.68 MPH
-------------------------------------	---------	----------

REMARKS: Beams between pallets inside load bowed up approximately 1/2-inch.

30-MILE ROAD TEST: No change.

PASS 3-A OVER FIRST SERIES OF TIES	.11 MIN	5.16 MPH
------------------------------------	---------	----------

PASS 3-B OVER SECOND SERIES OF TIES	.12 MIN	4.73 MPH
-------------------------------------	---------	----------

REMARKS: No movement or damage.

PASS 4-A OVER FIRST SERIES OF TIES	.11 MIN	5.16 MPH
------------------------------------	---------	----------

PASS 4-B OVER SECOND SERIES OF TIES	.10 MIN	5.68 MPH
-------------------------------------	---------	----------

REMARKS: No movement or damage.

WASHBOARD COURSE: No movement or damage.

SHIPBOARD TRANSPORTATION SIMULATOR (STS): No movement or damage.

ROAD TEST DATA

TEST NO.: 3

DATE: 30 April 1990

TEST SPECIMEN No.: 2, ANCRA International Restraint Beams and 155mm Projectiles.

PASS 1-A OVER FIRST SERIES OF TIES	0.11 MIN	5.16 MPH
------------------------------------	----------	----------

PASS 1-B OVER SECOND SERIES OF TIES	0.10 MIN	5.68 MPH
-------------------------------------	----------	----------

REMARKS: No load shift.

PASS 2-A OVER FIRST SERIES OF TIES	.10 MIN	5.68 MPH
------------------------------------	---------	----------

PASS 2-B OVER SECOND SERIES OF TIES	.10 MIN	5.68 MPH
-------------------------------------	---------	----------

REMARKS: No load shift.

30-MILE ROAD TEST: No load shift or damage.

PASS 3-A OVER FIRST SERIES OF TIES	.11 MIN	5.16 MPH
------------------------------------	---------	----------

PASS 3-B OVER SECOND SERIES OF TIES	.10 MIN	5.68 MPH
-------------------------------------	---------	----------

REMARKS: No load shift or damage.

PASS 4-A OVER FIRST SERIES OF TIES	.11 MIN	5.16 MPH
------------------------------------	---------	----------

PASS 4-B OVER SECOND SERIES OF TIES	.11 MIN	5.16 MPH
-------------------------------------	---------	----------

REMARKS: No load shift or damage.

WASHBOARD COURSE: No load shift or damage.

SHIPBOARD TRANSPORTATION SIMULATOR: No movement or damage.

RAIL IMPACT TEST DATA

TEST NO.: 4

DATE: 30 April 1990

TEST SPECIMEN: Two MILVANS, one with standard issue restraint beams and the second with ANCRA International restraint beams both loaded with inert 105mm boxed ammunition.

TEST TOFC NO.: TTX 601063

LT. WT.: 66,200 POUNDS

LOAD NO.: 1 (ANCRA International restrain beams)

LADING & DUNNAGE

WT.: 40,200 POUNDS

MILVAN: USA 0094574

WT.: 5,900 POUNDS

CHASSIS NO.: 4268

WT.: 5,120 POUNDS

LOAD NO.: 2 (Standard issue restraint beams)

LADING & DUNNAGE

WT.: 39,615 POUNDS

MILVAN: USA 0105344

WT.: 5,785 POUNDS

CHASSIS: 5394

WT.: 4,390 POUNDS

TOTAL SPECIMEN

WT.: 167,210 POUNDS

BUFFER CARS (5 CARS)

WT.: 250,000 POUNDS

<u>IMPACT NO.</u>	<u>END STRUCK</u>	<u>VELOCITY</u> <u>(MPH)</u>	<u>REMARKS</u>	
			<u>LOAD 1</u> <u>LOAD DISPLACEMENT</u>	<u>LOAD 2</u>
1	Rear	4.63	-1 1/4"	-3/4"
2	Rear	6.67	-1/4"	0
3	Rear	8.52	-1/4"	0
4	Forward	8.33	+1/4"	+1/4"

Notes: 1. End struck - Rearward end of container (door end) faces direction of impact. Forward end of container is the towed end.

2. Load 1 container has ANCRA International restraint beams.

3. Load 2 container has standard issue restraint beams.

4. Load displacements shown were measured from a fixed reference point on the container floor at the rear. Displacements shown were incremental from impact-to-impact.

ROAD TEST DATA

TEST NO.: 5

DATE: 3 May 1990

TEST SPECIMEN: MILVAN, USA A0094574, Chassis 4268, loaded with inert 105mm boxed ammunition restrained with ANCRA International restraint beams.

PASS 1-A OVER FIRST SERIES OF TIES	.11 MIN	5.16 MPH
------------------------------------	---------	----------

PASS 1-B OVER SECOND SERIES OF TIES	.09 MIN	6.31 MPH
-------------------------------------	---------	----------

REMARKS: Fourth restraint bar from floor disengage left belt rail.

PASS 2-A OVER FIRST SERIES OF TIES	.10 MIN	5.68 MPH
------------------------------------	---------	----------

PASS 2-B OVER SECOND SERIES OF TIES	.11 MIN	5.16 MPH
-------------------------------------	---------	----------

REMARKS: No damage.

30-MILE ROAD TEST: No damage.

PASS 3-A OVER FIRST SERIES OF TIES	.10 MIN	5.68 MPH
------------------------------------	---------	----------

PASS 3-B OVER SECOND SERIES OF TIES	.11 MIN	5.16 MPH
-------------------------------------	---------	----------

REMARKS: No damage.

PASS 4-A OVER FIRST SERIES OF TIES	.09 MIN	6.31 MPH
------------------------------------	---------	----------

PASS 4-B OVER SECOND SERIES OF TIES	.09 MIN	6.31 MPH
-------------------------------------	---------	----------

REMARKS: No damage.

WASHBOARD COURSE: No damage. Disengage restraint bar did not change position through the test.

SHIPBOARD TRANSPORTATION SIMULATOR (STS): No damage.

ROAD TEST DATA

TEST NO. 6

DATE: 3 May 1990

TEST SPECIMEN: MILVAN, USA 0105344, Chassis 5394, loaded with inert 105mm boxed ammunition restrained with standard beams.

PASS 1-A OVER FIRST SERIES OF TIES	.10 MIN	5.68 MPH
------------------------------------	---------	----------

PASS 1-B OVER SECOND SERIES OF TIES	.09 MIN	6.31 MPH
-------------------------------------	---------	----------

REMARKS: No damage.

PASS 2-A OVER FIRST SERIES OF TIES	.11 MIN	5.16 MPH
------------------------------------	---------	----------

PASS 2-B OVER SECOND SERIES OF TIES	.10 MIN	5.68 MPH
-------------------------------------	---------	----------

REMARKS: No damage.

30-MILE ROAD TEST: No damage.

PASS 3-A OVER FIRST SERIES OF TIES	.09 MIN	6.31 MPH
------------------------------------	---------	----------

PASS 3-B OVER SECOND SERIES OF TIES	.10 MIN	5.68 MPH
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REMARKS: No damage.

PASS 4-A OVER FIRST SERIES OF TIES	.10 MIN	5.68 MPH
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PASS 4-B OVER SECOND SERIES OF TIES	.11 MIN	5.16 MPH
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REMARKS: No damage.

WASHBOARD COURSE: No damage.

SHIPBOARD TRANSPORTATION SIMULATOR (STS): No damage.

TRANSPORTABILITY TESTS

ORIGINAL ISSUE AND ANCRA INTERNATIONAL RESTRAINT BEAMS

PHOTOGRAPHS



	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
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Photo No. A0317-SPN-90-230-3112. This photo shows two MILVANs loaded with inert 155MM ammunition being restrained by standard issue restraint beams and ANCRA International restraint beams. The TOFC is shown approaching the anvil cars.



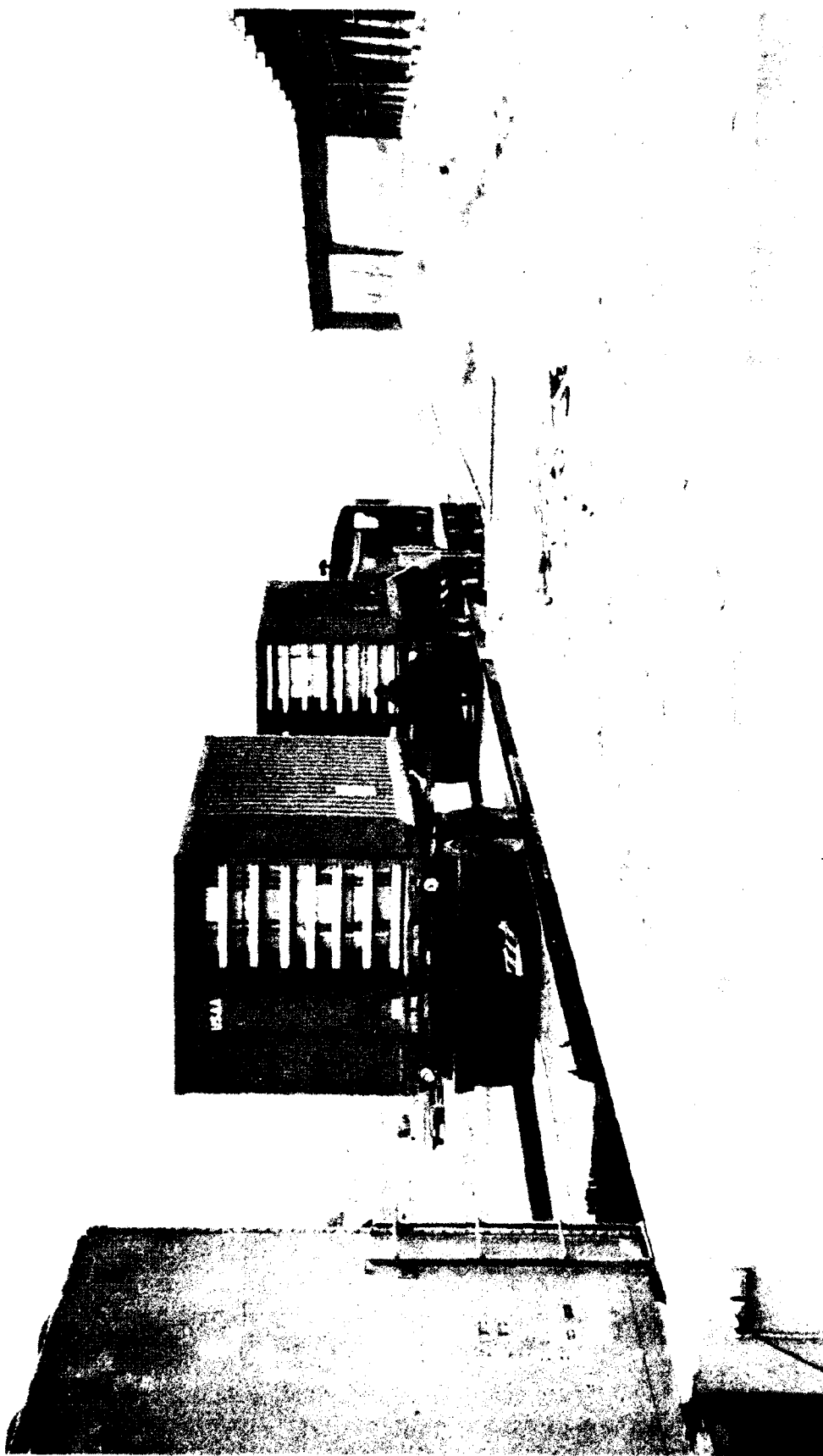
U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. A0317-SPN-90-230-3123. This photo shows a MILVAN loaded with inert 155MM ammunition being restrained by ANCRA International beams after rail impact. Note the bow in the top bar. This was probably caused from frictional forces between the tie block and the shim board behind the restraint beam.



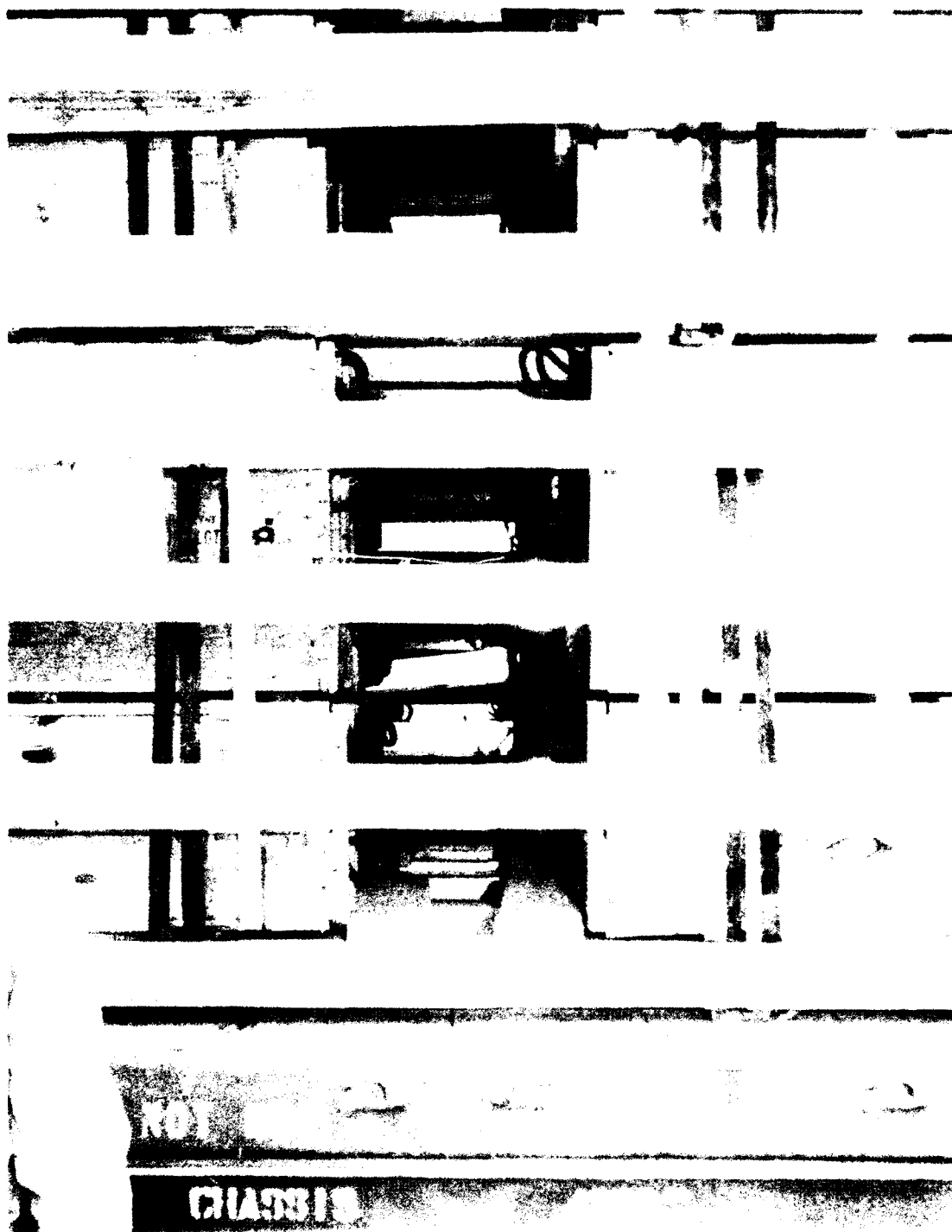
	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL
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Photo No. A0317-SPN-90-230-3092. This photo shows a MILVAN loaded with inert 155MM ammunition being restrained by ANCRA International beams after rail impact. Note the bow in the restraint beams as compared to the plywood fillers.
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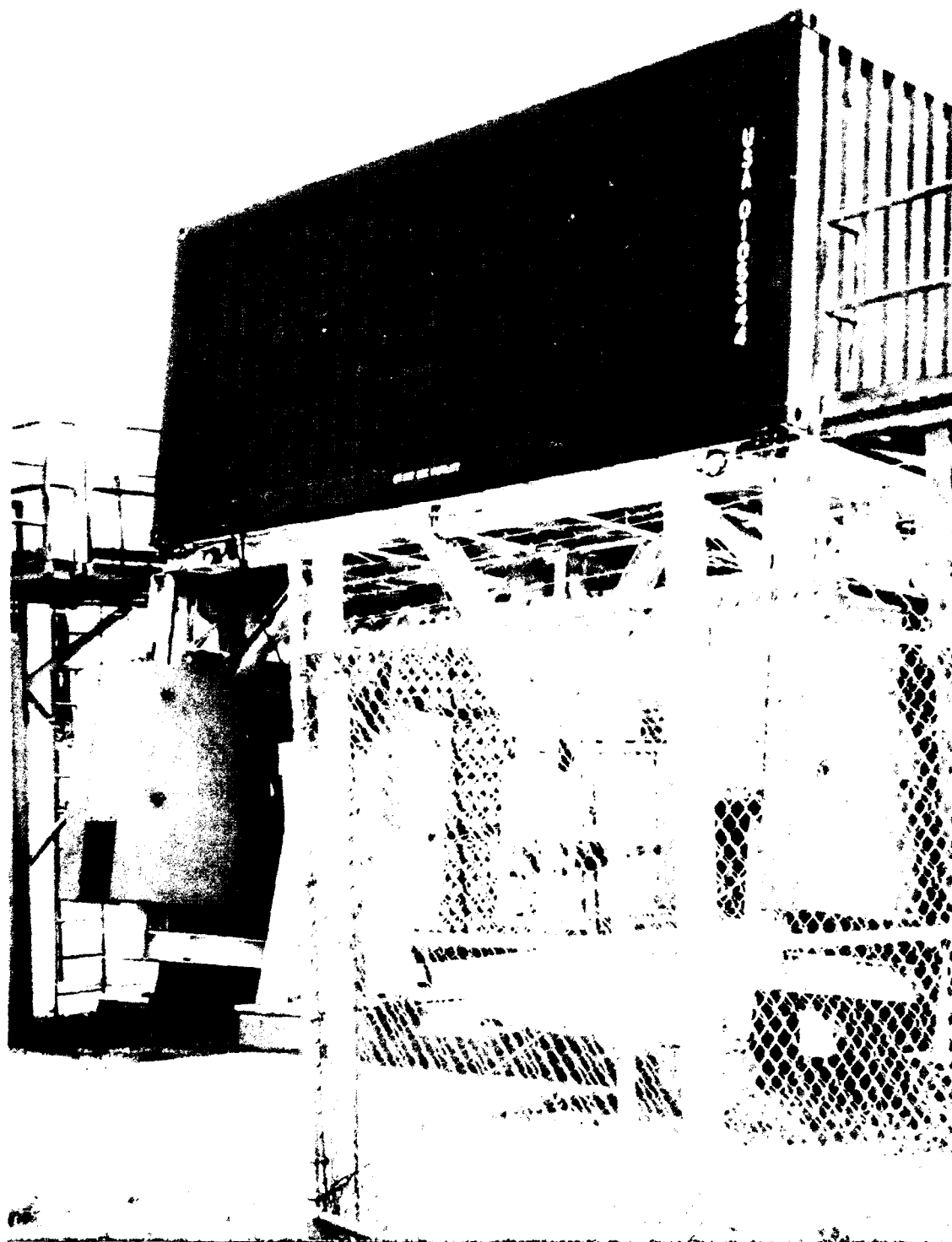
U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. A0317-SPN-90-230-3146. This photo shows two MILVANs loaded with inert boxed ammunition being tested for compatibility in the rail mode of transportation. One MILVAN has standard issue restraint beams, the other MILVAN has ANCRA International restraint beams.



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Photo No. A0317-SPN-90-230-3158. This photo shows the inside of the MILVAN restrained with ANCRA International restraint beams. Note one restraint beam is disengaged from the belt rail. Even though the one beam disengaged, no damage to the test load was experienced.



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Photo No. A0317-SPN-90-230-3118. This photo shows one of the test MILVANs on the Shipboard Transportation Simulator (STS).		
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