


TEST REPORT

SHEAR AND TENSION LOADING
OF
RICHMOND INSERTS
1 1/2-INCH TYPE EC-6W
1-INCH TYPE EC-2W

APRIL 19, 1984

Prepared by


S.G. McSee
Civil Engineer

Approved by

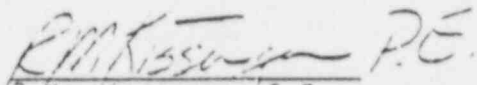

R.M. Kissinger P.E.
Project Civil Engineer

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TEST REPORT

SHEAR AND TENSION LOADING
OF
RICHMOND INSERTS
1 1/2-INCH TYPE EC-6W
AND
1-INCH TYPE EC-2W

1.0 REFERENCES

- A CP-EP-13.0 Test Control
- B CP-EI-13.0-13 1 1/2" and 1" Richmond Insert Shear and Tension Tests

2.0 GENERAL

2.1 DEFINITIONS

Ultimate Load - The load applied to the specimen which caused a physical rupture of the specimen.

Failure Load - The load applied to the specimen beyond which, deflections increased considerably without substantial increase in the applied load.

2.2 PURPOSE AND SCOPE

These tests were performed to determine the characteristics of 1 1/2-Inch Type EC-6W and 1-Inch Type EC-2W Richmond Inserts when installed in concrete representative of that used in the power block structures at CPSES. The test specimens were subjected to shear, tension, and combined shear and tension loadings. The strength, deflections, and type of deformations produced by these loadings were the qualities to be determined.

TEST

2.3 RESPONSIBILITY

The tests were performed under the direction of the CP Project Civil Engineer. Witnesses to the tests were: A TUGCO site Quality Assurance representative and other site engineering personnel.

2.4 TEST APPARATUS

2.4.1 CONCRETE SLAB & EMBEDMENTS

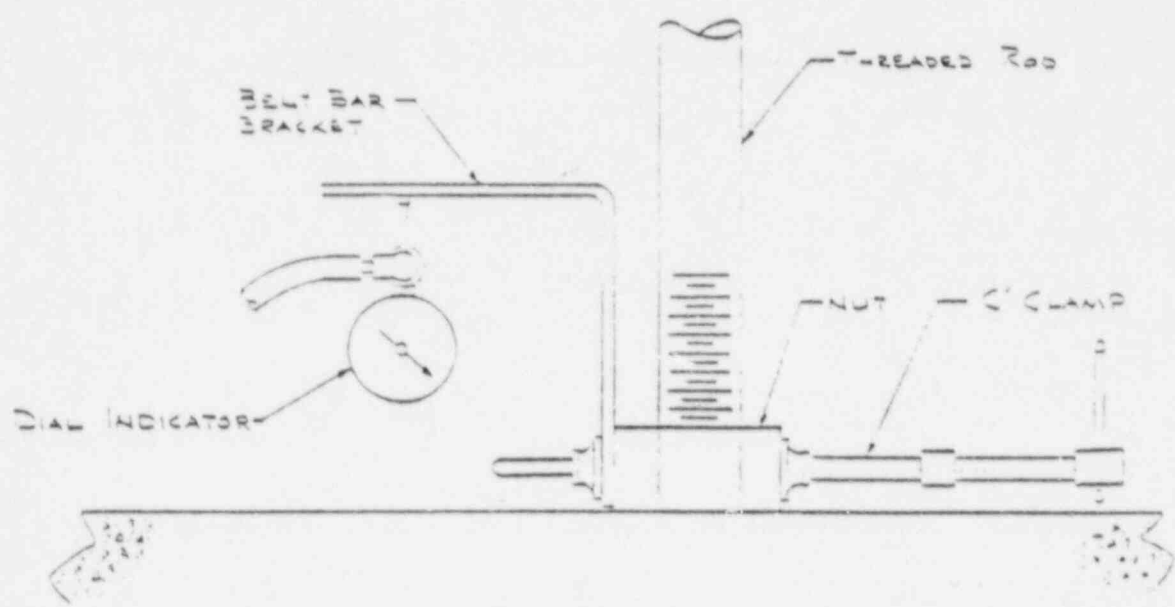
The arrangement and details of the test apparatus are shown on Drawing No. FSC-00464, Sheet 1, 2 and 3, which are included in Appendix 1 to this report. (Note that only MK C-14, C-15, C-16 and Assembly 'C' on Sheet 1 were used in this test.) The insert specimens tested were taken at random from the Constructor's stock on site and therefore, were representative of those installed in the plant structures. They were placed in a concrete slab cast specifically for these tests and which was composed of materials and reinforcement similar to those elements of the plant buildings. The concrete used was based on having a minimum design strength of 4000 pounds per square inch at 28 days. The laboratory test report on the concrete of which this slab is composed is included here in Appendix 1.

2.4.2 SHEAR TEST APPARATUS

An apparatus for applying shear loads to the specimens was designed and built on site. This facility employed a 60-ton capacity, manually operated hydraulic ram whose thrust against a cross head was transmitted by tension rods to a 1 1/2-inch thick shear plate bolted to the insert specimen. The base reaction of the jack was transmitted through a structural steel "bride" to the outer face of the concrete test slab. This arrangement, as shown in Appendix 1, provided a horizontal shear load on the vertically positioned insert without producing secondary or reactive concrete stresses in the vicinity of the specimen. Ram thrust was determined by multiplying the fluid pressure (PSI), as indicated by a calibrated gauge on the pump, by a number equal to the ram piston area in square inches. Deflections were measured by a calibrated dial indicator mounted on a remotely anchored bracket and with its spring loaded probe in contact with a lug welded to the shear plate directly behind the bolt head or threaded rod.

2.4.3 TENSION TEST APPARATUS

An apparatus for applying tension loads to the specimens was also designed and built on site. This facility employed a 60-ton capacity, manually operated hydraulic ram which serves as an end loading on a built-up steel beam. The other end of the beam was bearing against a well-supported round bar which served as a fulcrum and provided the other end reaction of the beam when the jack was operated to load the specimen. A threaded rod protruded through the beam at mid-span, through a nut and bearing plate on the beam with the opposite end threaded into the Richmond Insert. This arrangement caused the load on the rod to be equal to twice the force applied to the jack. Location of the base plates for the reactions of the beam provided clearance from the insert of at least 4 times the overall insert height; i.e., at least 39 1/2 inches for the 1 1/2 inch inserts and 23 inches for the 1 inch inserts. Ram thrust was determined by multiplying the fluid pressure (PSI), as indicated by a calibrated gauge on the pump, by a number equal to the ram piston area in square inches. Deflections were measured by a calibrated dial indicator mounted on a remotely anchored bracket and with its spring loaded probe in contact with a bracket which was securely clamped to the nut on the threaded rod, as shown in the sketch below.



2.4.4 COMBINED SHEAR AND TENSION TEST

The apparatus for the combined shear and tension test utilized the same equipment as that used on the individual shear and tension tests. For the shear portion, the equipment was set up identically to the individual shear test. For the tension portion, the equipment was arranged in a slightly different fashion. The hydraulic ram was not placed under the end of the beam, but instead, on the center of the beam on top. The ram thrust was applied directly to the threaded rod, which passed through the center of the ram, by means of a plate which was placed on top of the ram. The base reaction was resisted by the tension beam, loading which was supported by two wide flange stands at sufficient distance from the insert so as not to induce secondary or reactive concrete stresses in the vicinity of the specimen. This arrangement caused the load on the rod to be equal to the ram thrust. Both rams (one applying tension and one applying shear) were operated by a single hand pump with a calibrated pressure gauge. In this fashion, the shear and tension loads applied to the test specimen would be equal at all times.

3.0 TEST PROCEDURE

In performance of all of the tests, inserts were cleaned of concrete mortar and other trash that would affect bolt thread engagement. A new bolt (A-490) or threaded rod (SA-193 Grade 87) was used for each insert. The fasteners were all tightened "snug tight". The application of all loads was applied by the ram by operation of the manual hydraulic pump. As the load increased from zero (0), indications of fluid pressure (later converted to load) and simultaneous bolt head deflection were read at regular intervals. These intervals were at 400 PSI on the pressure gauge, corresponding to 5300 pounds thrust with the exception of the direct tension tests. On the direct tension test, these intervals were at 200 PSI on the pressure gauge, which also corresponded to 5300 pounds thrust on the specimen due to the configuration used. The load as indicated by these gauge pressures was maintained as constant as possible for a period of two (2) minutes. At the end of this time period, the deflection was again observed and noted. Load application on each specimen was carried out until ultimate failure of the specimen occurred (except specimen no. 1, which was tested in shear). At this point, observations were made of the condition of the specimens and the failure mode.

4.0 RESULTS

4.1 1 1/2-INCH RICHMOND INSERTS

4.1.1 SHEAR TESTS

As can be seen on the test data sheets, the ultimate load applied to the specimens ranged from 90,100 lbs. to 106,000 lbs.. The failure loads ranged from 84,800 lbs. to 106,000 lbs.. All bolts sheared abruptly (except specimen #1; test was halted prior to ultimate failure), with minor spalling of the concrete on the compression side of the Richmond insert. All five (5) specimens were utilizing A-~~307~~⁴⁹⁰ bolts.

<u>SPECIMEN NO.</u>	<u>ULTIMATE LOAD (lbs)</u>	<u>FAILURE LOAD (lbs)</u>
1	90,100	84,800
2	95,400	90,100
3	95,400	90,100
4	106,000	100,700
5	106,000	106,000
Average	98,530	94,340

Using the allowable insert loads given in specification 2323-SS-30 for 1 1/2-inch Richmond Inserts, the factor of safety is determined.

Allowable Shear = 27.0^k

Factor of Safety (F.S.) = $\frac{\text{Average Failure Ld.}}{\text{Design Allowable Ld.}}$

<u>SPECIMEN NO.'s</u>	<u>AVERAGE FAILURE LOAD (k)</u>	<u>FACTOR OF SAFETY</u>
1 thru 5	94.34	$\frac{94.34}{27.0} = 3.49$

4.1.2 TENSION TESTS

The ultimate load applied to the tension test specimens ranged from 87,650 lbs. to 114,150 lbs.. The failure loads ranged from 87,650 lbs. to 108,350 lbs.. The failure mode for specimens 11 and 12 was by stripping the threads between the threaded rod and the Richmond Insert. Specimen 13 failed in the Richmond Insert by a failure of the welds between the axial strut rods to the upper threaded coil. Specimens 14 and 15 failed by concrete shear cone failures. All specimens were utilizing SA-193 Grade B7 threaded material.

<u>SPECIMEN NO.</u>	<u>ULTIMATE LOAD</u>	<u>FAILURE LOAD</u>
11	106,200	103,550
12	114,150	108,350
13	114,150	108,350
14	87,650	87,650
15	100,900	100,900
Average	104,610	101,960

Allowable Tension = 31.3k

Factor of Safety (F.S.) = $\frac{\text{Average Failure Ld.}}{\text{Design Allowable Ld.}}$

<u>SPECIMEN NO.'s</u>	<u>AVERAGE FAILURE LOAD (k)</u>	<u>FACTOR OF SAFETY</u>
11 thru 15	101.96	101.96/31.3 = 3.26

4.1.3 COMBINED SHEAR AND TENSION TESTS

The shear and tension loads applied to the specimens under this loading condition are equal and the ultimate loads ranged from 60,950 lbs. to 68,900 lbs.. The failure loads ranged from 58,300 lbs. to 67,575 lbs.. Specimens 6 through 9 failed by an abrupt shearing of the threaded rod. There was some deformation of the rod in bending at the shear zone (ranging for 20° to 45° bend). Upper insert washer moved from 1/2 inch to 3/4 inch with some concrete spalling on the compression side of the insert. Specimen 10 failed by stripping the threads between the threaded rod and the insert. This failure lifted the upper insert washer from the struts, but the insert remained in place.

<u>SPECIMEN NO.</u>	<u>ULTIMATE LOAD (lbs)</u>	<u>FAILURE LOAD (lbs)</u>
6	68,900	67,575
7	67,575	67,575
8	60,950	58,300
9	61,613	61,613
10	64,925	62,275
Average	64,793	63,468

Allowable Tension = 31.3k

Allowable Shear = 27.0k

Factor of Safety (F.S.)

$$\left(\frac{\text{Average Failure Tension}}{\text{Design Allowable Tension} \times \text{F.S.}} \right)^{4/3} = \left(\frac{\text{Average Failure Shear}}{\text{Design Allowable Shear} \times \text{F.S.}} \right)^{4/3} = 1.0$$

<u>SPECIMEN NO's.</u>	<u>TENSION AND SHEAR AVERAGE FAILURE LOAD (k)</u>	<u>FACTOR OF SAFETY</u>
6 thru 10	63.47	$\left(\frac{63.47}{31.3 \times \text{F.S.}} \right)^{4/3} = \left(\frac{63.47}{27.0 \times \text{F.S.}} \right)^{4/3} = 1.0$ <p>F.S. = 3.63</p>

4.2 1-INCH RICHMOND INSERTS

4.2.1 SHEAR TESTS

From the test data sheets, the ultimate load applied to the specimens ranged from 39,750 lbs. to 60,350 lbs.. The failure loads ranged from 37,100 lbs. to 42,400 lbs.. Specimens 16 thru 19 failed by shear failure of the A-490 bolt. The top portion of the inserts deflected from 1/8 inch to 7/8 inch with some spalling on the compression side of the insert. Specimen 16 showed some rotation of the top of the insert. Specimen 17 and 18 showed no apparent sign of rotation. Specimen 19 failed by breaking the weld between the upper coil and the struts. The bolt then failed in bending after rotating with the upper portion of the coil. Specimen 20 failed by crushing the concrete on the compression side of the insert. The insert then rotated intact and the bolt ultimately failed in bending.

<u>SPECIMEN NO.</u>	<u>ULTIMATE LOAD (lbs)</u>	<u>FAILURE LOAD (lbs)</u>
16	46,375	42,400
17	43,060	37,100
18	50,350	42,400
19	46,375	42,400
20	39,750	37,100
Average	45,182	40,280

Allowable Shear = 11.5k

Factor of Safety (F.S.) = $\frac{\text{Average Failure Ld.}}{\text{Design Allowable Ld.}}$

<u>SPECIMEN NO's.</u>	<u>Average Failure Load (k)</u>	<u>Factor of Safety</u>
16 thru 20	40.28	40.28/11.5 = 3.50

4.2.2 TENSION TESTS

The ultimate load applied to the specimens ranged from 41,270 lbs. to 43,920 lbs.. The failure loads ranged from 39,950 lbs. to 43,920 lbs.. Specimens 26, 28 and 29 failed by concrete shear cone failure. Specimens 27 and 30 failed by Richmond Insert failure. The inserts failed by a failure of the welds between the struts and the lower coil. There was some surface spalling associated with these failures.

<u>SPECIMEN NO.</u>	<u>ULTIMATE LOAD (lbs)</u>	<u>FAILURE LOAD (lbs)</u>
26	42,600	42,600
27	43,920	43,920
28	42,600	39,950
29	42,600	39,950
30	41,270	39,950
Average	42,598	41,276

Allowable Tension = 11.5k

Factor of Safety (F.S.) = $\frac{\text{Average Failure Ld.}}{\text{Design Allowable Ld.}}$

<u>SPECIMEN NO's.</u>	<u>AVERAGE FAILURE LOAD (k)</u>	<u>FACTOR OF SAFETY</u>
25 thru 30	41.276	41.276/11.5 = 3.59

4.2.3 COMBINED SHEAR AND TENSION TESTS

The shear and tension loads applied to the specimens under this loading condition are equal and the ultimate loads ranged from 27,825 lbs. to 30,475 lbs.. The failure loads ranged from 27,825 to 29,150 lbs.. Specimens 21 thru 25 failed abruptly due to shear failure of the threaded rod. All inserts remained intact with only surface spalling of the concrete.

<u>SPECIMEN NO.</u>	<u>ULTIMATE LOAD (lbs)</u>	<u>FAILURE LOAD (lbs)</u>
21	27,325	27,325
22	29,150	29,150
23	30,475	29,150
24	29,150	27,325
25	28,487	27,325
Average	29,017	28,355

Allowable Tension = 11.5k

Allowable Shear = 11.5k

Factor of Safety (F.S.)

$\left(\frac{\text{Average Failure Tension}}{\text{Design Allowable Tension} \times \text{F.S.}}\right)^{4/3} + \left(\frac{\text{Average Failure Shear}}{\text{Design Allowable Shear} \times \text{F.S.}}\right)^{4/3} = 1.0$

<u>SPECIMEN NO's</u>	<u>TENSION AND SHEAR AVERAGE FAILURE LOAD (k)</u>	<u>FACTOR OF SAFETY</u>
21 thru 25	28,355	$\left(\frac{28.36}{11.5 \times \text{F.S.}}\right)^{4/3} + \left(\frac{28.36}{11.5 \times \text{F.S.}}\right)^{4/3} = 1.0$ F.S. = 4.15

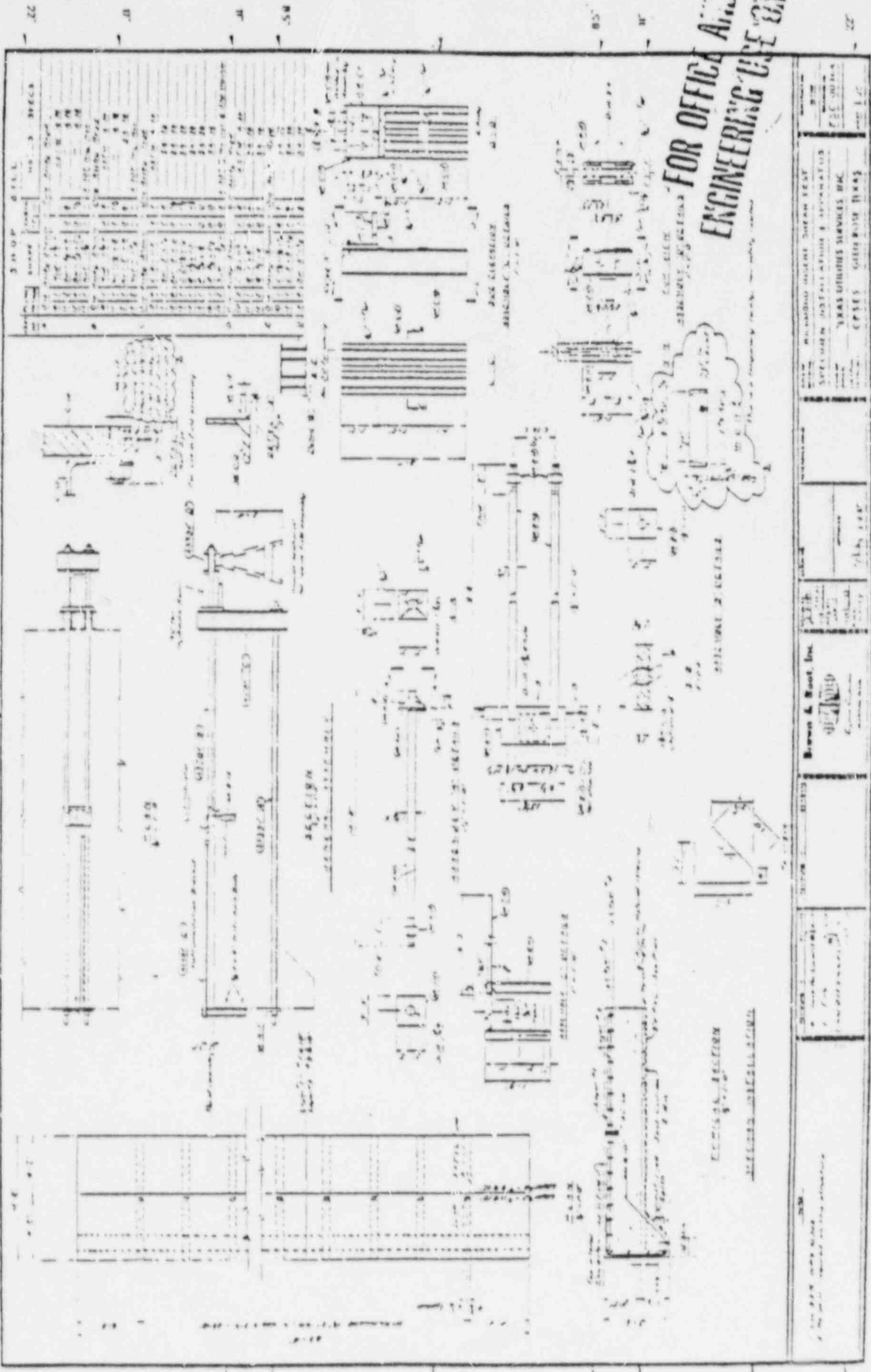
5.0 CONCLUSIONS

These test results show that the performance capabilities of the 1 1/2-inch type EC-6W and the 1-inch type EC-2W Richmond Inserts in shear, tension and combined shear and tension exceed the design allowable by a ratio of more than 3 to 1. These conclusions are valid for the design allowables shown in Specification 2323-SS-30, based on a spacing of the Richmond Inserts such that a full shear cone can develop.

Based on this test, the design allowables for shear, tension and combined shear and tension are acceptable for use without further investigation or additional calculations. Richmond's recommendation of a minimum safety factor of 3 has been complied with.

APPENDIX 1

DRAWING NO. FSC-00464 SHT. 1, 2 & 3



3 1/2 x 4 1/2 IN. SHEET

NO.	DESCRIPTION	QTY.	UNIT
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
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32
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34
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36
37
38
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49
50

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ENGINEERING USE ONLY

STANDARD DRAWING SHEET
SPECIFICATIONS FOR THE
AMERICAN SOCIETY OF MECHANICAL ENGINEERS
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Brown & Root, Inc.
QUINCY, ILL.

SECTION A-A

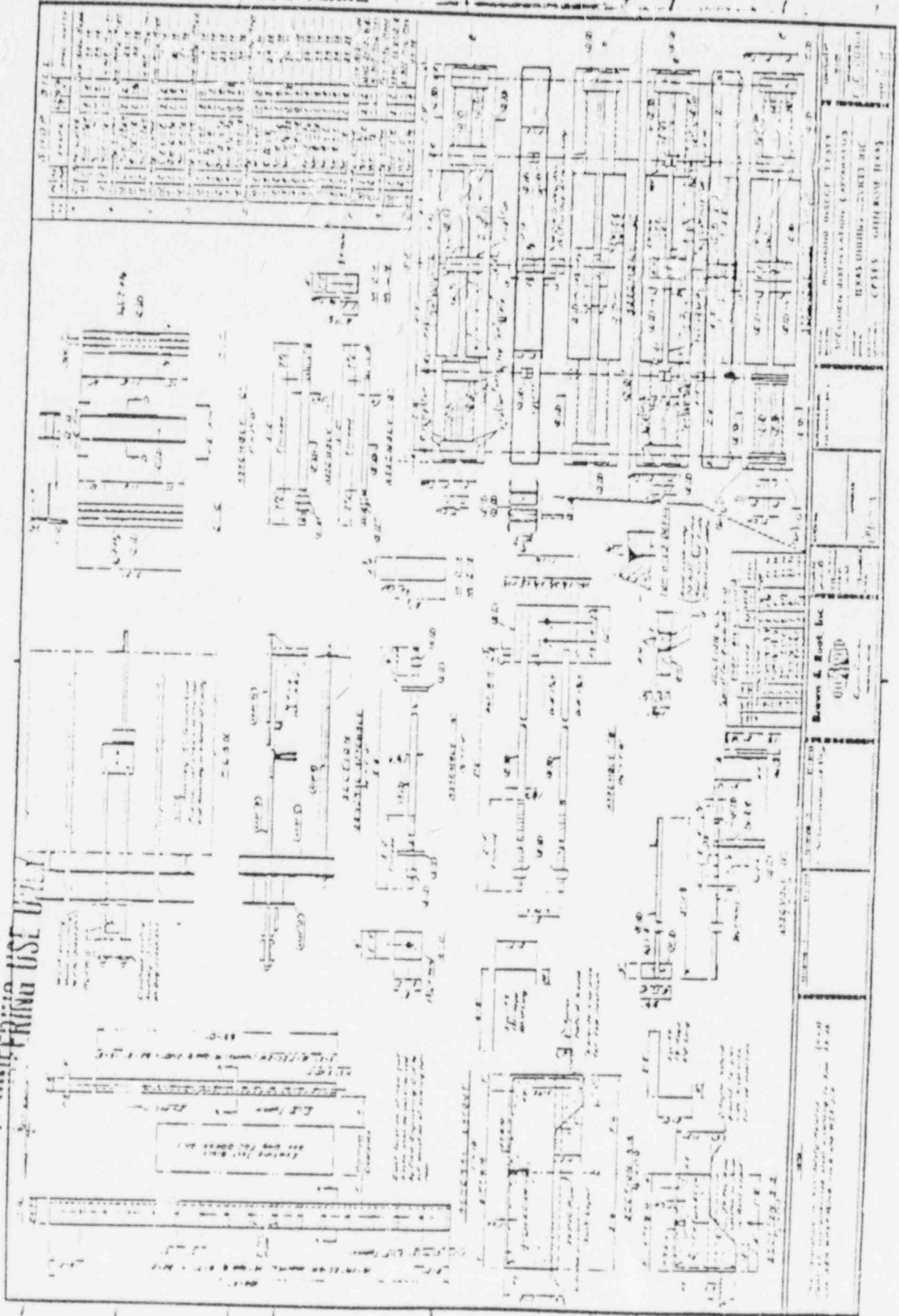
SECTION B-B

SECTION C-C

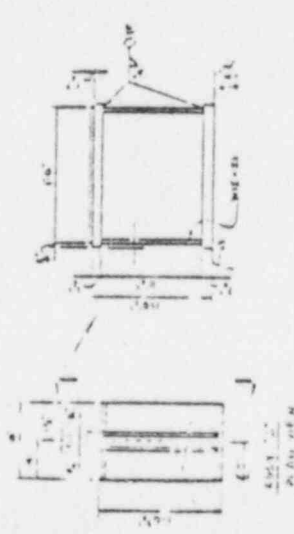
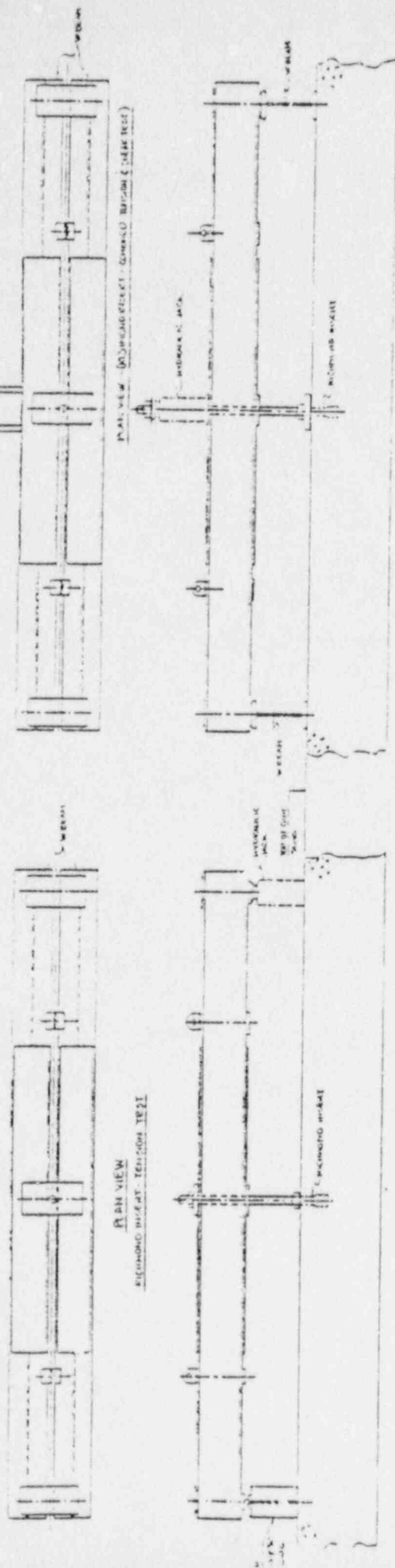
SECTION D-D

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ENGINEERING CO.



1000 1020 1000 1000 1000 1000 1000 1000 1000 1000

<p>DATE: 10/10/2010 DRAWN BY: J. L. BROWN CHECKED BY: J. L. BROWN PROJECT: 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000</p>	<p>PROJECT: 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000</p>	<p>DATE: 10/10/2010 DRAWN BY: J. L. BROWN CHECKED BY: J. L. BROWN PROJECT: 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000</p>	<p>DATE: 10/10/2010 DRAWN BY: J. L. BROWN CHECKED BY: J. L. BROWN PROJECT: 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000</p>
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Brown & Root Inc.

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APPENDIX 2

CONCRETE COMPRESSIVE TEST REPORT

COMANCHE PEAK SES

PORT ON COMPRESSIVE TESTS OF CONCRETE
 PROCEDURE CI-GP-161-41

2-29-84
 POUR NO 017-4834-001
 CYL SET NO 2473
 (TEST BLOCK)

MIX	COMPLETE DATA AS APPLICABLE FROM BATCH "CHECK"	(M) MOIST AGGR	FA	M ₀ FA	SA	M ₀ SA	TOTAL WATER/BATCH	TYPE OF CURING
	CEMENT CU YD	H ₂ O ADDED	H ₂ O/CEMENT RATIO	AIR CU YD	TOTAL AIR	SPECIFIED DESIGN STRENGTH		
	56.9	0	0.333	11.425%	7.3%	4000 PSI	2.8	WET

MATERIALS	BRAND OF CEMENT	TYPE OF CEMENT	BRAND OF AIR ENTRAINING ADMIXTURE	BRAND OF WATER REDUCING ADMIXTURE	MAX SIZE C.A.
	G-H	II	MIBUR	NA	3/8

SOURCE C.A.	SP OR C.A.	SOURCE FA	SP OR FA	FINENESS MODULUS FA
TXI-TIN TOP	2.65	TXI-TIN TOP	2.63	2.71

TYPE OF MIXING	BATCH LOAD	TICKET NO.	SAMPLE TAKEN AT
PLANT 1	3	62989	<input type="checkbox"/> CENTRAL MIXER <input type="checkbox"/> FORMS <input checked="" type="checkbox"/> POINT OF DISCHARGE

METHOD OF PLACING	RAMP	BUCKET	DATE SAMPL'G HOUR	WEATHER	AIR TEMP	CONC. TEMP	SUN
<input type="checkbox"/> BUGGIES <input type="checkbox"/> BELT	<input checked="" type="checkbox"/> CHUTE		2-29-84 1030 PM	CLEAR	46 °F	60 °F	3 1/4

TIME OF MIXING AT CENTRAL PLANT	UNIT WT CU. FT	MIX ID.	SPECIMEN TAKEN BY	SPECIMEN CAST BY	AIR
70 REV	144.36 LBS	132	BIRCHFIELD	RG-00-ZITS	5.0%

CYLINDER ID	AGE	MEASURED DIA IN	AVG DIA IN	DATE CAPPED	CAPPED BY	TIME TESTED	DATE TESTED	MAX LOAD LB	COMPRESSIVE STRENGTH	CAP CHECKED BY	CYLINDER TESTED BY	TYPE OF BREAK
2473A	7	5.980	5.990	3-6-84	DEW	0710	3-7-84	110000	4120	IT	IT	BR
2473B	7	6.021	6.021	3-6-84	DEW	0704	3-7-84	110000	4210	IT	IT	BR
2473C	28	6.000	6.000	3-23-84	DEW	0622	3-28-84	113500	4470	IT	IT	BR
2473D	28	6.000	6.000	3-23-84	DEW	0642	3-28-84	115500	4600	IT	IT	BR
2473E	28	6.001	6.002	3-23-84	DEW	0652	3-28-84	113500	4600	IT	IT	BR
2473F	28	5.991	6.004	3-23-84	DEW	0656	3-28-84	114500	4600	IT	IT	BR
NA												
NA												

DATE & TIME STRIPPED: 3-1-84 9:15 AM
 REMARKS:

CURING CONTROL TEST RESULTS FOR 28 DAY BREAK

LABORATORY CURED CYLINDERS:	FIELD CURED CYLINDERS:
STRENGTH (PSI) <u>5630</u> (C)	STRENGTH (PSI) <u>4230</u> (C)
<u>5696</u> (D)	<u>4920</u> (D)
1 (C)+(D) = (C)+(D) <u>11326</u> *	2 (C)+(D) = 2 * <u>4955</u> *

* NOTE: (1) ABOVE MUST BE EQUAL TO OR GREATER THAN 0.85; OR (2) ABOVE NEED NOT EXCEED THE DESIGN STRENGTH BY MORE THAN 500 PSI EVEN THOUGH THE 0.85 CRITERION IS NOT MET

WIKROMETER OR CALIPERS NO 112-16 1202
 COMPRESSION MACHINE NO 116-1 11073
 CAPPING MOLD NO 1171 11022
 7 DAY PREPARED BY ITC CHECKED BY TPS
 28 DAY PREPARED BY ITC CHECKED BY TPS

BY ENGINEERS (SIGNATURES) (APP. STAMPS)

[Handwritten Signature]
 DATE: 3-1-84

APPENDIX 2

TEST DATA SHEETS

COMANCHE PEAK SES

SHEAR TESTS

RICHMOND ^{EC-614} 1/2-INCH, TYPE INSERT

Reference: CP-EI-13.0-~~13~~ ^{13.25} pcc

Specimen Number: 1 Bolt Spec: A-490 Date: 3 Apr 84
 (First insert @ west end of conc. slab)

DEFLECTION (IN.)		GAUGE PRESSURE (P.S.I.)	JACK * THRUST (Lbs.)	NOTES-FAILURE MODE
INITIAL	AFTER 2-MIN.			
0.003	0.003	500	5300	
.032	.035	800	10600	
.060	.060	1200	15900	
.076	.070	1600	21200	
.095	.098	2000	26500	
.111	.116	2400	31800	
.128	.132	2800	37100	
.144	.150	3200	42400	
.160	.167	3600	47700	
.178	.185	4000	53000	
.190	.200	4400	58300	
.250	.233	4800	63600	
.250	.264	5200	68900	
.277	.297	5600	74200	
.304	.328	6000	79500	Slab deformed.
.380	.429	6400	84800	Crushing of concrete was
.570	1.125	6800	90100	principal failure. No increase in load with increased deflection. Did not load to destructive.
Burned off bolthead for removal. Insert stayed fast in concrete				

* Jack Thrust equal Shear Load on Insert.
 Jack Thrust (Lbs.) = Gauge Pressure (PSI) x 13.25
 Jack:.....Equipment Number RGH 600
 Pressure Gauge: M & TE Number 2355 Due Date: 16 Nov 84
 Dial Gauge:.....M & TE Number 2949 Due Date: 29 June 84

Performed By:

Witnessed By:

J. C. Gilbert 3 Apr 84
 Name Date

Robert P. [Signature] 4-3-84
 QA Representative Date

COMANCHE PEAK SEC
SHEAR TESTS

RICHMOND $\frac{1}{2}$ -INCH, TYPE EC-6W INSERT

Reference: CP-EI-13.0-~~7~~12, 84

Specimen Number: 2
(2nd from west end)


Bolt Spec: A-490

Date: 4 April 84

DEFLECTION (IN.)		GAUGE PRESSURE (P.S.I.)	JACK * THRUST (Lbs.)	NOTES-FAILURE MODE
INITIAL	AFTER 2-MIN.			
.002	0.002	400	5,300	
.021	.022	800	10,600	
.074	.036	1200	15,900	
.040	.051	1600	21,200	
.063	.066	2000	26,500	
.080	.083	2400	31,800	
.096	.102	2800	37,100	
.115	.121	3200	42,400	
.133	.142	3600	47,700	
.157	.166	4000	53,000	
.180	.192	4400	58,300	
.208	.217	4800	63,600	
.237	.247	5200	68,900	
.263	.276	5600	74,200	
.295	.314	6000	79,500	
.338	.370	6400	84,800	
.480	.555	6800	90,100	
.770	1.110	7200	95,400	Bolt sheared abruptly. Concrete

spalled on compression side of insert
approx 1 1/2" deep, running out to zero @ 7" away. Small spalls
6" wide near insert.

* Jack Thrust equal Shear Load on Insert.
Jack Thrust (Lbs.) = Gauge Pressure (PSI) x 13.25"
Jack:.....Equipment Number RCM 606
Pressure Gauge: M & TE Number 27272355 Due Date: 16 Apr 84
Dial Gauge:.....M & TE Number 2944 Due Date: 29 Jun 84


Insert top defl:
ed 7/8"

Performed By:

Witnessed By:

J. C. Hilbert 4 April 84
Name Date

Robert Dietrich 4-4-84
QA Representative Date

COMANCHE PEAK SES

SHEAR TESTS

RICHMOND 1 1/2-INCH, TYPE EC-6W INSERT

Reference: CP-EI-13.0-~~X~~ 19 *per*

Specimen Number: 3

Bolt Spec: A490

Date: 4 April 84

(3rd from West End)

DEFLECTION (IN.)		GAUGE PRESSURE (P.S.I.)	JACK * THRUST (Lbs.)	NOTES-FAILURE MODE
INITIAL	AFTER 2-MIN.			
.000	.000	400	5300	
.002	.002	800	10600	
.003	.003	1200	15900	
.006	.007	1600	21200	
.012	.018	2000	26500	
.032	.036	2400	31800	
.049	.052	2800	37100	
.067	.069	3200	42400	
.078	.083	3600	47700	
.096	.107	4000	53000	
.126	.131	4400	58300	
.144	.154	4800	63600	
.174	.182	5200	68900	
.206	.218	5600	74200	
.242	.259	6000	79500	
.283	.315	6400	84800	
.365	.399	6800	90100	
.520	<u>1.2</u>	7200	95400	Bolt sheared abruptly concrete
Scalloped 1" deep @ insert tapering to zero depth @ 5" out (on compression side of insert). Insert deformed where visible (ins. 12). Insert seemingly intact where still in concrete				

* Jack Thrust equal Shear Load on Insert.

Jack Thrust (Lbs.) = Gauge Pressure (PSI) x 13.25

Jack: Equipment Number RCH 606

Pressure Gauge: M & TE Number 2355

Dial Gauge: M & TE Number 2949

Due Date: 16 Apr 84

Due Date: 29 Apr 84

Insert top deflected abt 9/16"

Performed By:

Witnessed By:

J.P. Giltner 4 April 84
Name Date

Arthur R. ... 4-4-84
QA Representative Date

COMANCHE PEAK SES

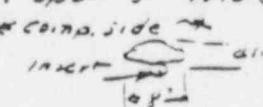
SHEAR TESTS

RICHMOND 1 1/2-INCH, TYPE EC-6W INSERT

Reference: CP-EI-13.0-~~13~~ 13

Specimen Number: 4 Bolt Spec: A-490 Date: 4 April 84
 (4th from West End)

DEFLECTION (IN.)		GAUGE PRESSURE (P.S.I.)	JACK * THRUST (Lbs.)	NOTES-FAILURE MODE
INITIAL	AFTER 2-MIN.			
.0005	.0005	400	5,300	
.003	.003	800	10,600	
.012	.013	1200	15,900	
.024	.026	1600	21,200	
.035	.038	2000	26,500	
.047	.048	2400	31,800	
.058	.059	2800	37,100	
.067	.070	3200	42,400	
.078	.081	3600	47,700	
.089	.092	4000	53,000	
.102	..	4400		accidental opening of valve - good insertion
.107	.109	4800	58,300	
.116	.120	4800	63,600	
.128	.133	5200	68,900	
.142	.146	5600	74,200	
.156	.164	6000	79,500	
.177	.181	6400	84,800	
.292	.303	6800	90,100	
.315	.333	7200	95,400	
.360	.389	7600	100,700	
.552		8000	106,000	Bolt sheared abruptly, concrete spalls

* Jack Thrust equal Shear Load on Insert. 1" deep insert to 0" & 4" out. spall 8" wide
 Jack Thrust (Lbs.) = Gauge Pressure (PSI) x 13.25 * comp. side
 Jack: Equipment Number RCH 606 insert 
 Pressure Gauge: M & TE Number 2355 Due Date: 16 Apr 84
 Dial Gauge: M & TE Number 2929 Due Date: 24 Jun 84

Insert deflected about 1/4"

Performed By: G. C. Gillett 4 April 84
 Name Date

Witnessed By: Andrew Ritzsch 4-4-84
 QA Representative Date

COMANCHE PEAK SES
SHEAR TESTS

RICHMOND 1/2-INCH, TYPE INSERT

Reference: CP-2I-13.0-3/2 p 4

Specimen Number: 5
(5' from West End)

Bolt Spec: A-490

Date: 4 April 84

DEFLECTION (IN.)		GAUGE PRESSURE (P.S.I.)	JACK * THRUST (Lbs.)	NOTES-FAILURE MODE
INITIAL	AFTER 2-MIN.			
0.002	0.002	400	5300	
.004	.005	800	10600	
.013	.015	1200	15900	
.035	.037	1600	21200	
.057	.063	2000	26500	
.090	.094	2400	31800	
.117	.122	2800	37100	
.150	.157	3200	42400	
.176	.183	3600	47700	
.200	.209	4000	53000	
.223	.236	4400	58300	
.248	.261	4800	63600	
.276	.295	5200	68900	
.307	.322	5600	74200	
.338	.356	6000	79500	
.370	.389	6400	84800	
.403	.428	6800	90100	
.447	.479	7200	95400	
.506	.536	7600	100700	
.585		8000	106000	106000 soft sheared abruptly. Concrete socket

1.1" @ Break, 1" deep @ insert to 0" @ 4" out, 6" wide

* Jack Thrust equal Shear Load on Insert.

Jack Thrust (Lbs.) = Gauge Pressure (PSI) x 13.25


Jack:.....Equipment Number RCH 606

Pressure Gauge: M & TE Number 2355

Dial Gauge:.....M & TE Number 2949

Due Date: 16 Apr 84

Due Date: 29 Jun 84

thrust 

Insert top deflected 3/8"

Performed By:

Witnessed By:

L.C. Gilbith 4 Apr 84
Name Date

Adrian Rietzsch 4-4-84
QA Representative Date

COMBINED SHEAR & TENSION TESTS

Reinforced $1\frac{1}{8}$ Inch. Type $\frac{1}{2}$ C. G. W. Insert

Reference: CP-11-11-0-4-17-4-2

Specimen Number: 6 (6 $\frac{1}{2}$ from west)

Invested Load Rod: A-173

Date: 10 April 44

Gauge Press. (PSI)	SHEAR		Gauge Press. (PSI)	2 nd Jack Thrust (lb.)	TENSION		Deflection (Inch) After 2 Min.	Insert Load (lb.)	Net Jack Thrust (lb.)	Deflection (Inch) After 2 Min.	Notes - Failure Mode
	1 st Jack Thrust (lb.)	Deflection (Inch) Inst.			1 st Jack Thrust (lb.)	Net Jack Thrust (lb.)					
700	5300	0.007		5500			0.0015				
800	10600	0.023		10600			0.005				
1200	15700	0.091		15700			0.0095				
1600	21200	0.062		21200			0.018				
2000	26500	0.088		26500			0.037				
2400	31800	0.146		31800			0.026				
2800	37100	0.192	N/A	37100	N/A		0.057				
3200	42400	0.236		42400			0.062				
3600	47700	0.290		47700			0.075				
4000	53000	0.339		53000			0.087				
4350	58319	0.420		58319							
4700	58975	0.510		58975							
4900	58300	0.475		58300							
4950	59625	0.559		59625							
4800	60950	0.58		60950							

Shear Apparatus: Jack - Equipment No: ACG 606
 Pressure Gauge - MBE No: 2335 Due Date: 16 Dec 44
 Dial Gauge - MBE No: 2948 Due Date: 29 Dec 44
 Tension Apparatus: Jack - Equipment No: ACG 603 T
 Pressure Gauge - MBE No: 2094 Due Date: 18 Dec 44
 Dial Gauge - MBE No: 2094 Due Date: 18 Dec 44

1st Jack Thrust = Shear Load on Insert.
 1st Jack Thrust (lb.) = Gauge Pressure (PSI) x 17.25 for Shear Load.
 2nd Jack Thrust (lb.) = Gauge Pressure (PSI) x 17.25 for Tension Load.
 Total Wt. of Tension Load Beam = N/A lb.
 Net-Jack Thrust = Jack Thrust minus 17.2 lb. of Beam = 52.5 lb.
 Insert Load = Net Jack Thrust = 52.5 lb.

Witnessed By: John R. Kelly Date: 4-10-44
 (A Representative) Date

Performed By: J. C. McNeill Date: 4-10-44
 Name Date

COMBINED PEAK SES

COMBINED SHEAR & TENSION TESTS

Rechnoid / 2 - Inch, Type 22 - GAV

Reference: CP (1) 1.0-107 10724

Specimen Number: 6 (P. 2 of 2)

Inserted Load Rod: A-173

Date: 10 April 54

Gauge Press. (PSI)	SHEAR		Gauge Press. (PSI)	Jack Thrust (lb.)	Net Jack Thrust (lb.)	Insert Load (lb.)	TENSION	
	Jack Thrust (lb.)	Deflection (Inch) After 2 Min.					Net Jack Thrust (lb.)	Deflection (Inch) After 2 Min.
7800	63600	0.750	63	600	1/4	1/4	1.64	1.67
1000	66250	0.820	66	250	N/A	N/A	2.86	
1000	67575	0.910	67	575				
5000	68750	1.060	68	920				
5100	67575		N/A	575				

Notes - Failure mode

Abrupt shearing of Net Rod deformation in bending as shear stress coming about water some 1/2 in. from tip.

Shear Apparatus: Jack - Equipment No: FCH 606
 Pressure Gauge - MRE No: 2355
 Dial Gaus, MRE No: 2848
 Tension Apparatus: Jack - Equipment No: ACN 6037
 Pressure Gauge - MRE No: 5000
 Dial Gauge - MRE No: 2084

1 - Jack Thrust = Shear Load on Insert.
 1 - Jack Thrust (lb.) = Gauge Pressure (PSI) x 1.25 for Shear Load.
 2 - Jack Thrust (lb.) = Gauge Pressure (PSI) x 1.25 for Tension Load.
 Total Mt. of Tension Load Beam = N/A lb.
 4 - Jack Thrust - Total Thrust minus 1/2 Mt. of Beam.
 5 - Insert Load = Net Jack Thrust - 2.

Witnessed By: J. C. G. Hall
 Representative
 Date: 4-10-54

Performed By: J. C. G. Hall
 Name
 Date: 4-10-54

COMMERCIAL PEAK 515

COMBINED SHEAR & TENSION TESTS

Rebound $1\frac{1}{2}$ Inch, Type $\frac{1}{2}$ C-CW

Reference: CP-11-10-4-11-2-4

Specimen Number: 7 (7th from west end)

Insert Load Rod: A-113

Date: 11/21/54

Gauge Press. (PSI)	SHEAR		Gauge Press. (PSI)	Jack Thrust (lb.)	Deflection (Inch) After 2 Min.	Deflection (Inch) Init.	Net Jack Thrust (lb.)	Insert Load (lb.)	Deflection (Inch) After 2 Min.
	1*	2*							
400	5,500	5,500	0.000	0.000	0.000	0.000	0.000	0.000	0.000
800	10,600	10,600	0.000	0.000	0.003	0.003	0.003	0.003	0.003
1200	15,900	15,900	0.026	0.026	0.012	0.012	0.012	0.012	0.012
1600	21,200	21,200	0.073	0.073	0.022	0.022	0.022	0.022	0.022
2000	26,500	26,500	0.161	0.161	0.037	0.037	0.037	0.037	0.037
2400	31,800	31,800	0.271	0.271	0.057	0.057	0.057	0.057	0.057
2800	37,100	37,100	0.422	0.422	0.082	0.082	0.082	0.082	0.082
3200	42,400	42,400	0.573	0.573	0.102	0.102	0.102	0.102	0.102
3600	47,700	47,700	0.724	0.724	0.122	0.122	0.122	0.122	0.122
4000	53,000	53,000	0.875	0.875	0.142	0.142	0.142	0.142	0.142
4400	58,300	58,300	1.026	1.026	0.162	0.162	0.162	0.162	0.162
4800	63,600	63,600	1.177	1.177	0.182	0.182	0.182	0.182	0.182
5200	68,900	68,900	1.328	1.328	0.202	0.202	0.202	0.202	0.202
5600	74,200	74,200	1.479	1.479	0.222	0.222	0.222	0.222	0.222
6000	79,500	79,500	1.630	1.630	0.242	0.242	0.242	0.242	0.242
6400	84,800	84,800	1.781	1.781	0.262	0.262	0.262	0.262	0.262
6800	90,100	90,100	1.932	1.932	0.282	0.282	0.282	0.282	0.282
7200	95,400	95,400	2.083	2.083	0.302	0.302	0.302	0.302	0.302
7600	100,700	100,700	2.234	2.234	0.322	0.322	0.322	0.322	0.322
8000	106,000	106,000	2.385	2.385	0.342	0.342	0.342	0.342	0.342
8400	111,300	111,300	2.536	2.536	0.362	0.362	0.362	0.362	0.362
8800	116,600	116,600	2.687	2.687	0.382	0.382	0.382	0.382	0.382
9200	121,900	121,900	2.838	2.838	0.402	0.402	0.402	0.402	0.402
9600	127,200	127,200	2.989	2.989	0.422	0.422	0.422	0.422	0.422
10000	132,500	132,500	3.140	3.140	0.442	0.442	0.442	0.442	0.442
10400	137,800	137,800	3.291	3.291	0.462	0.462	0.462	0.462	0.462
10800	143,100	143,100	3.442	3.442	0.482	0.482	0.482	0.482	0.482
11200	148,400	148,400	3.593	3.593	0.502	0.502	0.502	0.502	0.502
11600	153,700	153,700	3.744	3.744	0.522	0.522	0.522	0.522	0.522
12000	159,000	159,000	3.895	3.895	0.542	0.542	0.542	0.542	0.542
12400	164,300	164,300	4.046	4.046	0.562	0.562	0.562	0.562	0.562
12800	169,600	169,600	4.197	4.197	0.582	0.582	0.582	0.582	0.582
13200	174,900	174,900	4.348	4.348	0.602	0.602	0.602	0.602	0.602
13600	180,200	180,200	4.499	4.499	0.622	0.622	0.622	0.622	0.622
14000	185,500	185,500	4.650	4.650	0.642	0.642	0.642	0.642	0.642
14400	190,800	190,800	4.801	4.801	0.662	0.662	0.662	0.662	0.662
14800	196,100	196,100	4.952	4.952	0.682	0.682	0.682	0.682	0.682
15200	201,400	201,400	5.103	5.103	0.702	0.702	0.702	0.702	0.702
15600	206,700	206,700	5.254	5.254	0.722	0.722	0.722	0.722	0.722
16000	212,000	212,000	5.405	5.405	0.742	0.742	0.742	0.742	0.742
16400	217,300	217,300	5.556	5.556	0.762	0.762	0.762	0.762	0.762
16800	222,600	222,600	5.707	5.707	0.782	0.782	0.782	0.782	0.782
17200	227,900	227,900	5.858	5.858	0.802	0.802	0.802	0.802	0.802
17600	233,200	233,200	6.009	6.009	0.822	0.822	0.822	0.822	0.822
18000	238,500	238,500	6.160	6.160	0.842	0.842	0.842	0.842	0.842
18400	243,800	243,800	6.311	6.311	0.862	0.862	0.862	0.862	0.862
18800	249,100	249,100	6.462	6.462	0.882	0.882	0.882	0.882	0.882
19200	254,400	254,400	6.613	6.613	0.902	0.902	0.902	0.902	0.902
19600	259,700	259,700	6.764	6.764	0.922	0.922	0.922	0.922	0.922
20000	265,000	265,000	6.915	6.915	0.942	0.942	0.942	0.942	0.942
20400	270,300	270,300	7.066	7.066	0.962	0.962	0.962	0.962	0.962
20800	275,600	275,600	7.217	7.217	0.982	0.982	0.982	0.982	0.982
21200	280,900	280,900	7.368	7.368	1.002	1.002	1.002	1.002	1.002
21600	286,200	286,200	7.519	7.519	1.022	1.022	1.022	1.022	1.022
22000	291,500	291,500	7.670	7.670	1.042	1.042	1.042	1.042	1.042
22400	296,800	296,800	7.821	7.821	1.062	1.062	1.062	1.062	1.062
22800	302,100	302,100	7.972	7.972	1.082	1.082	1.082	1.082	1.082
23200	307,400	307,400	8.123	8.123	1.102	1.102	1.102	1.102	1.102
23600	312,700	312,700	8.274	8.274	1.122	1.122	1.122	1.122	1.122
24000	318,000	318,000	8.425	8.425	1.142	1.142	1.142	1.142	1.142
24400	323,300	323,300	8.576	8.576	1.162	1.162	1.162	1.162	1.162
24800	328,600	328,600	8.727	8.727	1.182	1.182	1.182	1.182	1.182
25200	333,900	333,900	8.878	8.878	1.202	1.202	1.202	1.202	1.202
25600	339,200	339,200	9.029	9.029	1.222	1.222	1.222	1.222	1.222
26000	344,500	344,500	9.180	9.180	1.242	1.242	1.242	1.242	1.242
26400	349,800	349,800	9.331	9.331	1.262	1.262	1.262	1.262	1.262
26800	355,100	355,100	9.482	9.482	1.282	1.282	1.282	1.282	1.282
27200	360,400	360,400	9.633	9.633	1.302	1.302	1.302	1.302	1.302
27600	365,700	365,700	9.784	9.784	1.322	1.322	1.322	1.322	1.322
28000	371,000	371,000	9.935	9.935	1.342	1.342	1.342	1.342	1.342
28400	376,300	376,300	10.086	10.086	1.362	1.362	1.362	1.362	1.362
28800	381,600	381,600	10.237	10.237	1.382	1.382	1.382	1.382	1.382
29200	386,900	386,900	10.388	10.388	1.402	1.402	1.402	1.402	1.402
29600	392,200	392,200	10.539	10.539	1.422	1.422	1.422	1.422	1.422
30000	397,500	397,500	10.690	10.690	1.442	1.442	1.442	1.442	1.442
30400	402,800	402,800	10.841	10.841	1.462	1.462	1.462	1.462	1.462
30800	408,100	408,100	10.992	10.992	1.482	1.482	1.482	1.482	1.482
31200	413,400	413,400	11.143	11.143	1.502	1.502	1.502	1.502	1.502
31600	418,700	418,700	11.294	11.294	1.522	1.522	1.522	1.522	1.522
32000	424,000	424,000	11.445	11.445	1.542	1.542	1.542	1.542	1.542
32400	429,300	429,300	11.596	11.596	1.562	1.562	1.562	1.562	1.562
32800	434,600	434,600	11.747	11.747	1.582	1.582	1.582	1.582	1.582
33200	439,900	439,900	11.898	11.898	1.602	1.602	1.602	1.602	1.602
33600	445,200	445,200	12.049	12.049	1.622	1.622	1.622	1.622	1.622
34000	450,500	450,500	12.200	12.200	1.642	1.642	1.642	1.642	1.642
34400	455,800	455,800	12.351	12.351	1.662	1.662	1.662	1.662	1.662
34800	461,100	461,100	12.502	12.502	1.682	1.682	1.682	1.682	1.682
35200	466,400	466,400	12.653	12.653	1.702	1.702	1.702	1.702	1.702
35600	471,700	471,700	12.804	12.804	1.722	1.722	1.722	1.722	1.722
36000	477,000	477,000	12.955	12.955	1.742	1.742	1.742	1.742	1.742
36400	482,300	482,300	13.106	13.106	1.762	1.762	1.762	1.762	1.762
36800	487,600	487,600	13.257	13.257	1.782	1.782	1.782	1.782	1.782
37200	492,900	492,900	13.408	13.408	1.802	1.802	1.802	1.802	1.802
37600	498,200	498,200	13.559	13.559	1.822	1.822	1.822	1.822	1.822
38000	503,500	503,500	13.710	13.710	1.842	1.842	1.842	1.842	1.842
38400	508,800	508,800	13.861	13.861	1.862	1.862	1.862	1.862	1.862
38800	514,100	514,100	14.012	14.012	1.882	1.882	1.882	1.882	1.882
39200	519,400	519,400	14.163	14.163	1.902				

COMBINE PLAK SES
COMBINED SHEAR & TENSION TESTS
Richmond 1/2 - Inch, Type Invert
Reference: CP 111.0-9-1334

Specimen Number: 8 (8th from next end) Inverted Load Rod: A-173 Date: 11 April 1954

SHEAR		DEFLECTION (Inch)		Gauge Press. (PSI)		Jack Thrust (lb.)		Net Jack Thrust (lb.)		Insert Load (lb.)		Deflection (Inch) After 2 Min.		Notes - Failure Mode
Gauge Press. (PSI)	Jack Thrust (lb.)	Init.	After	Init.	After	Init.	After	Init.	After	Init.	After	Init.	After	
1200	5200	0.000	0.000	5300								0.000	0.000	Did not attempt to prevent slippage & time of failure about 30° @ shear joint. Washer of insert moved horizontally 1/2" @ shear broke & weld from washer. Concrete washer failed to settle 5" out on conc. side of insert.
800	10600	0.021	0.021	10600								0.001	0.001	
1200	15900	0.046	0.047	15700								0.005	0.005	
1600	21200	0.062	0.068	21200								0.009	0.009	
2000	26500	0.081	0.088	25300								0.014	0.014	
2400	31800	0.100	0.108	31800								0.019	0.019	
2800	37100	0.120	0.130	37100								0.024	0.024	
3200	42400	0.140	0.152	42400								0.029	0.029	
3600	47700	0.160	0.174	47700								0.034	0.034	
4000	53000	0.180	0.196	53000								0.039	0.039	
4400	58300	0.200	0.218	58300								0.044	0.044	
4800	63600	0.220	0.240	63600								0.049	0.049	
5200	68900	0.240	0.264	68900								0.054	0.054	
5600	74200	0.260	0.288	74200								0.059	0.059	
6000	79500	0.280	0.312	79500								0.064	0.064	
6400	84800	0.300	0.336	84800								0.069	0.069	
6800	90100	0.320	0.360	90100								0.074	0.074	
7200	95400	0.340	0.384	95400								0.079	0.079	
7600	100700	0.360	0.408	100700								0.084	0.084	
8000	106000	0.380	0.432	106000								0.089	0.089	
8400	111300	0.400	0.456	111300								0.094	0.094	
8800	116600	0.420	0.480	116600								0.099	0.099	
9200	121900	0.440	0.504	121900								0.104	0.104	
9600	127200	0.460	0.528	127200								0.109	0.109	
10000	132500	0.480	0.552	132500								0.114	0.114	
10400	137800	0.500	0.576	137800								0.119	0.119	
10800	143100	0.520	0.600	143100								0.124	0.124	
11200	148400	0.540	0.624	148400								0.129	0.129	
11600	153700	0.560	0.648	153700								0.134	0.134	
12000	159000	0.580	0.672	159000								0.139	0.139	
12400	164300	0.600	0.696	164300								0.144	0.144	
12800	169600	0.620	0.720	169600								0.149	0.149	
13200	174900	0.640	0.744	174900								0.154	0.154	
13600	180200	0.660	0.768	180200								0.159	0.159	
14000	185500	0.680	0.792	185500								0.164	0.164	
14400	190800	0.700	0.816	190800								0.169	0.169	
14800	196100	0.720	0.840	196100								0.174	0.174	
15200	201400	0.740	0.864	201400								0.179	0.179	
15600	206700	0.760	0.888	206700								0.184	0.184	
16000	212000	0.780	0.912	212000								0.189	0.189	
16400	217300	0.800	0.936	217300								0.194	0.194	
16800	222600	0.820	0.960	222600								0.199	0.199	
17200	227900	0.840	0.984	227900								0.204	0.204	
17600	233200	0.860	1.008	233200								0.209	0.209	
18000	238500	0.880	1.032	238500								0.214	0.214	
18400	243800	0.900	1.056	243800								0.219	0.219	
18800	249100	0.920	1.080	249100								0.224	0.224	
19200	254400	0.940	1.104	254400								0.229	0.229	
19600	259700	0.960	1.128	259700								0.234	0.234	
20000	265000	0.980	1.152	265000								0.239	0.239	
20400	270300	1.000	1.176	270300								0.244	0.244	
20800	275600	1.020	1.200	275600								0.249	0.249	
21200	280900	1.040	1.224	280900								0.254	0.254	
21600	286200	1.060	1.248	286200								0.259	0.259	
22000	291500	1.080	1.272	291500								0.264	0.264	
22400	296800	1.100	1.296	296800								0.269	0.269	
22800	302100	1.120	1.320	302100								0.274	0.274	
23200	307400	1.140	1.344	307400								0.279	0.279	
23600	312700	1.160	1.368	312700								0.284	0.284	
24000	318000	1.180	1.392	318000								0.289	0.289	
24400	323300	1.200	1.416	323300								0.294	0.294	
24800	328600	1.220	1.440	328600								0.299	0.299	
25200	333900	1.240	1.464	333900								0.304	0.304	
25600	339200	1.260	1.488	339200								0.309	0.309	
26000	344500	1.280	1.512	344500								0.314	0.314	
26400	349800	1.300	1.536	349800								0.319	0.319	
26800	355100	1.320	1.560	355100								0.324	0.324	
27200	360400	1.340	1.584	360400								0.329	0.329	
27600	365700	1.360	1.608	365700								0.334	0.334	
28000	371000	1.380	1.632	371000								0.339	0.339	
28400	376300	1.400	1.656	376300								0.344	0.344	
28800	381600	1.420	1.680	381600								0.349	0.349	
29200	386900	1.440	1.704	386900								0.354	0.354	
29600	392200	1.460	1.728	392200								0.359	0.359	
30000	397500	1.480	1.752	397500								0.364	0.364	
30400	402800	1.500	1.776	402800								0.369	0.369	
30800	408100	1.520	1.800	408100								0.374	0.374	
31200	413400	1.540	1.824	413400								0.379	0.379	
31600	418700	1.560	1.848	418700								0.384	0.384	
32000	424000	1.580	1.872	424000								0.389	0.389	
32400	429300	1.600	1.896	429300								0.394	0.394	
32800	434600	1.620	1.920	434600								0.399	0.399	
33200	439900	1.640	1.944	439900								0.404	0.404	
33600	445200	1.660	1.968	445200								0.409	0.409	
34000	450500	1.680	1.992	450500								0.414	0.414	
34400	455800	1.700	2.016	455800								0.419	0.419	
34800	461100	1.720	2.040	461100								0.424	0.424	
35200	466400	1.740	2.064	466400								0.429	0.429	
35600	471700	1.760	2.088	471700								0.434	0.434	
36000	477000	1.780	2.112	477000								0.439	0.439	
36400	482300	1.800	2.136	482300								0.444	0.444	
36800	487600	1.820	2.160	487600								0.449	0.449	
37200	492900	1.840	2.184	492900								0.454	0.454	
37600	498200	1.860	2.208	498200								0.459	0.459	
38000	503500	1.880	2.232	503500								0.464	0.464	
38400	508800	1.900	2.256	508800								0.469	0.469	
38800	514100	1.920	2.280	514100								0.474	0.474	
39200	519400	1.940	2.304	519400								0.479	0.479	
39600	524700	1.960	2.328											

COMMERCIAL PEAK SLS

CORRECTED SHEAR & TENSION TESTS

Richmond $\frac{1}{2}$ - Inch, Type $\frac{1}{2}$ - 90° Insert

Reference: CP-11-13-0-4-13, 2-8

Date: 1 April 54

Specimen Number: 10 (10th from west end)

Insert Load Rod: A-113

Diameter	SHEAR		TENSION		Deflection (Inch) After 2 Min.	Insert Load (lb.)	Net Jack Thrust (lb.)	Jack Thrust (lb.)	Gauge Press. (PSI)	Notes - Fatigue Mode
	1 - Jack Thrust (lb.)	Deflection (Inch) Init.	2 - Jack Thrust (lb.)	Net Jack Thrust (lb.)						
400	5,300	0.000	5,300		0.000					
400	10,600	0.004	10,600		0.000					
400	15,900	0.055	15,900		0.001					
400	21,200	0.065	21,200		0.001					
400	26,500	0.065	26,500		0.077					
400	31,800	0.067	31,800		0.072					
400	37,100	0.082	37,100		0.072					
400	42,400	0.107	42,400		0.100					
400	47,700	0.128	47,700		0.120					
400	53,000	0.159	53,000		0.120					
400	58,300	0.189	58,300		0.120					
400	63,600	0.216	63,600		0.120					
400	68,900	0.270	68,900		0.133					
400	74,200	0.310	74,200		0.155					
400	79,500	0.315	79,500		0.230					
400	84,800	0.570	84,800		0.245					
400	90,100	0.600	90,100		0.230					
400	95,400	0.600	95,400		0.230					
400	100,700	0.625	100,700		0.245					

Reset Tension dial due to its fouling to zero

Threads stripped. Lifted insert washer loose from stub. Insert remained in place.

Shear Apparatus: Jack - Equipment No: NCH 606
 Pressure Gauge-MBE No: 2332 Due Date: 6-21-54
 Dial Gauge-MBE No: 2438 Due Date: 24-6-54
 Tension Apparatus: Jack-Equipment No: NCH 6037
 Pressure Gauge-MBE No: 2427 Due Date: 12-2-54
 Dial Gauge-MBE No: 2097 Due Date: 12-2-54

1* Jack Thrust = Shear Load on Insert.
 1* Jack Thrust (lb.) = Gauge Pressure (PSI) x 13.25 for Shear Load.
 2* Jack Thrust (lb.) = Gauge Pressure (PSI) x 13.25 for Tension Load.
 Total Wt. of Tension Load Beam = N/A lb.
 Net-Jack Thrust = Total Thrust Minus 1/2 Wt. of Beam.
 Insert Load = Net Jack Thrust x 2.

Witnessed By: J.C. Hibbard Date: 9-11-54

Performed By: J.C. Hibbard Name: J.C. Hibbard Date: 4-11-54

COMANCHE TESTIES

TENSION TESTS

RICHMOND 1 1/2-INCH, TYPE EC-6N INSERT

Reference: CP-21-13.0-~~13~~13, ex

Specimen Number: 11

Load Rod Spec: A-193

Date: 5 Apr 84

(11ft from west, 5th from east)

GAUGE PRESS. (P.S.I.)	JACK THRUST (Lb.)	NET JACK THRUST (Lb.)	INSERT LOAD (Lb.)	DEFLECTION (IN.)		NOTES-FAILURE MODE
				INIT.	AFTER 2-MIN.	
200	2650	1425	2350	0.000	0.000	
400	5300	4075	8150	0.000	0.000	
600	7950	6725	13450	0.000	0.000	
800	10600	9375	18750	0.001	0.001	
1000	13250	12025	24050	0.003	0.0035	
1200	15900	14675	29350	0.005	0.006	
1400	18550	17325	34650	0.007	0.011	
1600	21200	19975	39950	0.013	0.015	
1800	23850	22625	43250	0.0155	0.017	
2000	26500	25275	50550	0.0195	0.020	
2200	29150	27925	55850	0.022	0.023	
2400	31800	30575	61150	0.027	0.028	
2600	34450	33225	66450	0.032	0.035	
2800	37100	35875	71750	0.073	0.073	
3000	39750	38525	77050	0.094	0.099	
3200	42400	41175	82350	0.103	0.1055	
3400	45050	43825	87650	0.109	0.111	
3600	47700	46475	92950	0.123	0.123	
3800	50350	49125	98250	0.138	0.148	
4000	52000	51775	103550	0.190	0.214	
5100	54325 54325	53100	106,200			Abrupt failure of threads (insert and rod). Thread engagement was "full". Threads on beam rod & insert were stripped. Concrete spalled to about 12" depth in 15" over concrete only. Embed not exposed.

Abrupt failure of threads (insert and rod). Thread engagement was "full". Threads on beam rod & insert were stripped. Concrete spalled to about 12" depth in 15" over concrete only. Embed not exposed.

* Jack Thrust (Lb.) = Gauge Pressure (PSI) x 13.25 [By dynamometer No. M & TE # 1432 due Apr. 17, '84]
 Total Weight of Load Beam = 2450
 ** Net Jack Thrust = Total Thrust Minus 1/2 Weight of Beam. (1/2 Wt. of bin. = 1225)
 *** Insert Load = Net Jack Thrust x 2.
 Jack: Equipment Number RCM 606
 Pressure Gauge: M & TE Number 2355 Due Date: 16 Apr 84
 Dial Gauge: M & TE Number 2949 Due Date: 29 Jun 84
 Performed By: J.C. Hilbert 5 apr 84
 Witnessed By: Andrew Petryk 4-5-84
 Name Date QA Representative Date

COMANCHE PEI SES
TENSION TESTS

RICHMOND $\frac{1}{2}$ -INCH, TYPE EC-6W INSERT

Reference: CP-EI-13.0-~~5~~ 13.04

Specimen Number: 12 Load Rod Spec: A-193 Date: 5 April 84
(12 from West, 22 from East)

GAUGE PRESS. (P.S.I.)	* JACK THRUST (Lb.)	** NET JACK THRUST (Lb.)	*** INSERT LOAD (Lb.)	DEFLECTION (IN.)		NOTES-FAILURE MODE
				INIT.	AFTER 2-MIN.	
200	2650	1425	2850	0.000	0.000	
400	5300	4075	8150	0.000	0.000	
600	7950	6725	13450	0.000	0.000	
800	10600	9375	18750	0.0015	0.002	
1000	13250	12025	24050	0.0035	0.0055	
1200	15900	14675	29350	0.007	0.008	
1400	18550	17325	34650	0.009	0.010	
1600	21200	19975	39950	0.0115	0.012	
1800	23850	22625	45250	0.014	0.0145	
2000	26500	25275	50550	0.017	0.0175	
2200	29150	27925	55850	0.0195	0.020	
2400	31800	30575	61150	0.022	0.0225	
2600	34450	33225	66450	0.0245	0.0265	
2800	37100	35875	71750	0.028	0.0295	
3000	39750	38525	77050	0.032	0.034	
3200	42400	41175	82350	0.036	0.037	
3400	45050	43825	87650	0.040	0.043	
3600	47700	46475	92950	0.048	0.051	
3800	50350	49125	98250	0.057	0.0625	
4000	53000	51775	103550	0.070	0.075	
4200	55650	54425	108850	0.084	0.092	
4400	58300	57075	114150	0.120		Failure by stripped threads, Rod to insert. Thread engagement was "full" stripped length was 3". Concrete surface spalled in 18" dia. area. Spalling apparently result of impact when threads stripped. This failure was abrupt. Max. depth of surface spall was 1". Did not expose rebar.

* Jack Thrust (Lb.) = Gauge Pressure (PSI) x 13.25
Total Weight of Load Beam = 2450

** Net Jack Thrust = Total Thrust Minus 1/2 Weight of Beam. ($\frac{1}{2}$ WT. = 1225#)

*** Insert Load = Net Jack Thrust x 2.

Jack:.....Equipment Number RCH 606

Pressure Gauge: M & TE Number 2355 Due Date: 16 Apr 84

Dial Gauge: M & TE Number 2940 Due Date: 29 Jun 84

Performed By:

J. C. Whitel 5 Apr 84
Name Date

Witnessed By:

Andrew Pietryk 4-5-84
QA Representative Date

COMANCHE PEEL TEST
TENSION TESTS

RICHMOND $\frac{1}{2}$ -INCH, TYPE EC-6W INSERT

Reference: CP-EI-13.0 ~~13.0~~ 13.25

Specimen Number: 13 Load Rod Spec: A-193 Date: 5 Apr '84
(13th from west 32nd from East)

GAUGE PRESS. (P.S.I.)	* JACK THRUST (Lb.)	** NET JACK THRUST (Lb.)	*** INSERT LOAD (Lb.)	DEFLECTION (IN.)		NOTES-FAILURE MODE
				INIT.	AFTER 2-MIN.	
200	2650	1425	2850	0.000	0.000	
400	5300	4075	8150	0.000	0.000	
600	7950	6725	13450	0.000	0.000	
800	10600	9375	18750	0.000	0.000	
1000	13250	12025	24050	0.001	0.001	
1200	15900	14675	29350	.001	.001	
1400	18550	17325	34650	.0015	.0015	
1600	21200	19975	39950	.003	.004	
1800	23850	22625	43250	.0045	.0045	
2000	26500	25275	47550	.0055	.007	
2200	29150	27925	51850	.0075	.008	
2400	31800	30575	61150	.009	.010	
2600	34450	33225	64450	.011	.012	
2800	37100	35875	71750	.0135	.015	
3000	39750	38525	77050	.0175	.0185	
3200	42400	41175	82350	.021	.023	
3400	45050	43825	87650	.0255	.0285	
3600	47700	46475	92950	.033	.0385	
3800	50350	49125	98250	.045	.051	
4000	53000	51775	103550	.059	.063	
4200	55650	54425	108850	.074	.080	
4400	58300	57075	114150			Concrete failed

On surface in area some 18" x 18"
structural failure that allowed this was
failure of the weld connecting the
axial strut rods to the threaded coil
This permitted surface spalling of the
concrete. However there was no discern-
ible sign of a cone failure in the concrete.
Concrete visible to repair depth looked intact
and there was no sound like a void when
tapped with a metal object.

- * Jack Thrust (Lb.) = Gauge Pressure (PSI) x 13.25
Total Weight of Load Beam = 2450
- ** Net Jack Thrust = Total Thrust Minus 1/2 Weight of Beam. ($\frac{1}{2}$ Wt. = 1225#)
- *** Insert Load = Net Jack Thrust x 2.
- Jack: Equipment Number PC4 606
- Pressure Gauge: M & TE Number 2355 Due Date: 16 Apr '84
- Dial Gauge: M & TE Number 2949 Due Date: 29 Jun '84

Performed By: C. P. White Date: 5 Apr 84

Witnessed By: Andrew R. ... Date: 4.5.84
IA Representative Date

COMANCHE PEAK SES
TENSION TESTS

RICHMOND 1 1/2-INCH, TYPE EC-6W INSERT

Reference: CP-EI-13.0-~~13~~ 13, 2, 4

Specimen Number: 14

Load Rod Spec: A-193

Date: 5 Apr 84

(14th from West End, 2nd from East)

GAUGE PRESS. (P.S.I.)	JACK THRUST (Lb.)	NET JACK THRUST (Lb.)	INSERT LOAD (Lb.)	DEFLECTION (IN.)		NOTES-FAILURE MODE
				INIT.	AFTER 2-MIN.	
200	2650	1425	2850	0.000	0.000	
400	5300	4075	8150	0.001	0.001	
600	7950	6725	13450	.0015	.0015	
800	10600	9375	18750	.002	.002	
1000	13250	12025	24050	.004	.004	
1200	15900	14675	29350	.004	.0065	
1400	18550	17325	34650	.008	.0065	
1600	21200	19975	39950	.0095	.0095	
1800	23850	22625	45250	.010	.010	
2000	26500	25275	50550	.010	.010	
2200	29150	27925	55850	.010	.010	
2400	31800	30575	61150	.012	.012	
2600	34450	33225	66450	.0135	.012	
2800	37100	35875	71750	.016	.0165	
3000	39750	38525	77050	.018	.019	
3200	42400	41175	82350	.020	.024	
3400	45050	43825	87650	.028	.055	Concrete failed
3600						shear cone type failure. Depth of cone equal full depth of insert. Top of cone limited in size by rebar. (2 10" dia.) After initial failure, rebar lifted cover concrete, fracturing in area about 3' x 5' the long dimension. Compressive strength to the direction of upper layer of rebar.

* Jack Thrust (Lb.) = Gauge Pressure (PSI) x 13.25
Total Weight of Load Beam = 2450

** Net Jack Thrust = Total Thrust Minus 1/2 Weight of Beam. (1/2 wt = 1225#)

*** Insert Load = Net Jack Thrust x 2.
Jack: Equipment Number PC14 606

Pressure Gauge: M & TE Number 2355 Due Date: 10 Apr '84

Dial Gauge: M & TE Number 2944 Due Date: 29 Jun '84

Performed By: J.C. Roberts 5 Apr 84

Witnessed By: Andrew R. Smith 4.5.84

COMANCHE PEAK SES
TENSION TESTS

RICHMOND $\frac{1}{2}$ - INCH, TYPE EC-6W INSERT

Reference: CP-EI-13.0 \Rightarrow 13.25

Specimen Number: 15
(15th from West end - 14 on East End)

Load Rod Spec: A-193

Date: 4 April 84

GAUGE PRESS. (P.S.I.)	* JACK THRUST (Lb.)	** NET JACK THRUST (Lb.)	*** INSERT LOAD (Lb.)	DEFLECTION (IN.)		NOTES-FAILURE MODE
				INIT.	AFTER 2-MIN.	
200	2650	1425	2850	0.000	0.000	
400	5300	4075	8150	0.000	0.000	
600	7950	6725	13450	0.001	0.001	
800	10400	9375	18750	0.003	0.003	
1000	12250	12025	24050	0.004	0.006	
1200	15900	14675	29350	.008	.008	
1400	18550	17325	34650	.009	.010	
1600	21200	19975	39950	.010	.012	
1800	23850	22625	45250	.013	.015	
2000	26500	25275	50550	.017	.0175	
2200	29150	27925	55850	.021	.024	
2400	31800	30575	61150	.026	.027	
2600	34450	33225	66450	.028	.031	
2800	37100	35875	71750	.034	.036	
3000	39750	38525	77050	.038	.040	
3200	42400	41175	82350	.041	.042	
3400	45050	43825	87650	.049	.053	
3600	47700	46475	92950	.058	.065	
3800	50350	49125	98250	.069	.081	
3900	51,675	50,450	100,900	.70		Concrete failed,

shear cone type, limited ~~in~~ in area by rebar pattern. Concrete ~~in~~ groove rebar spalled in oval 3' x 4'. Cone below cone. Cone about 10" dia at top. depth = 10.00"
~~in~~ dimension top of conc. to office in vertical rods of insert, (Avt. 6")

* Jack Thrust (Lb.) = Gauge Pressure (PSI) x $\frac{13.25}{1}$ (By dynamometer No. M & TG 1432 due Apr 17, '84)
Total Weight of Load Beam = 2450 Lb. (-2 = 1225) ---
** Net Jack Thrust = Total Thrust Minus 1/2 Weight of Beam.
*** Insert Load = Net Jack Thrust x 2.

Jack: Equipment Number RCH 656

Pressure Gauge: M & TE Number 2355 Due Date: 16 Apr 84

Dial Gauge: M & TE Number 2943 Due Date: 29 Jun 84

Performed By: J. C. Litchell 4 Apr 84
Witnessed By: Andrew Butzick 4-4-84
Date Date

COMANCHE PEAK SES
SHEAR TESTS

RICHMOND / -INCH, TYPE EC-2W INSERT

Reference: CP-EI-13.0-~~X~~12, 84

Specimen Number: 16
(1st on West end)

Bolt Spec: A-192 490 Date: 6 April 84

DEFLECTION (IN.)		GAUGE PRESSURE (P.S.I.)	JACK * THRUST (Lbs.)	NOTES-FAILURE MODE
INITIAL	AFTER 2-MIN.			
0.000	0.000	400	5300	
.001	.001	800	10,600	
.0195	.021	1200	15,900	
.042	.044	1600	21,200	
.062	.0655	2000	26,500	
.085	.091	2400	31,800	
.112	.12	2800	37,100	
.152	.170	3200	42,400	
.22		3500 3500	46,375	Failure of bolt in shear.

Insert top deflected 7/8" by crushing of upper portion of concrete. Within this yield pattern, the top of insert rotated a few degrees.

* Jack Thrust equal Shear Load on Insert.
 Jack Thrust (Lbs.) = Gauge Pressure (PSI) x 13.25
 Jack:.....Equipment Number RCH 606
 Pressure Gauge: M & TE Number 2355 Due Date: 16 Apr '84
 Dial Gauge:.....M & TE Number 2949 Due Date: 29 Jun 80

Performed By:

Witnessed By:

J. C. G. Smith, 6 April 84
Name Date

Andrew R. Smith 4-6-84
QA Representative Date

COMANCHE PEAK SES
SHEAR TESTS

RICHMOND 1 -INCH, TYPE EC-21W INSERT

Reference: CP-21-13.0-~~X~~13904

Specimen Number: 17
(2nd fr West End)

F Spec: A-490 sec 4 Date: 6 Apr '84
Bolt

DEFLECTION (IN.)		JACK THRUST	GAUGE THRUST	NOTES-FAILURE MODE
INITIAL	AFTER 2-MIN.	THRUST (Lbs)	Pressure (PSI)	
0.000	0.000	5300	400	
.020	.020	10,600	800	
.037	.039	15,900	1200	
.060	.0645	21,200	1600	
.087	.093	26,500	2000	
.127	.129	31,800	2800	
.166	.186	37,100	2800	
.313	.332	42,400	3200	
.	.	43,060	3250	Failure by bolt shear
Insert deflected horizontally 3/8", being permitted by crushing failure of concrete. No apparent rotation of top of insert.				

* Jack Thrust equal Shear Load on Insert.
 Jack Thrust (Lbs.) = Gauge Pressure (PSI) x 13.25
 Jack:.....Equipment Number PCM 606
 Pressure Gauge: M & TE Number 2355 Due Date: 16 Apr '84
 Dial Gauge:.....M & TE Number 2949 Due Date: 29 Jun '84

Performed By: J C. Gilbert 6 Apr '84
 Name Date

Witnessed By: A. L. ... 4-6-84
 QA Representative Date

COMANCHE PEAK SES
SHEAR TESTS

RICHMOND 1 -INCH, TYPE EC-2W INSERT

Reference: CP-2I-13.0-~~X~~¹³₄

Specimen Number: 18

Bolt Spec: A-490

Date: 6 Apr 84

(3rd from west end)

DEFLECTION (IN.)		GAUGE PRESSURE (P.S.I.)	JACK * THRUST (Lbs.)	NOTES-FAILURE MODE
INITIAL	AFTER 2-MIN.			
0.000	0.000	400	5 300	
.003	.004	800	10 600	
.023	.0245	1200	15 900	
.042	.045	1600	21 200	
.060	.063	2000	26 500	
.080	.085	2400	31 800	
.104	.109	2800	37 100	
.136	.148	3200	42 400	
.200	.332	3600	47 700	
.460		3800	50 350	Failure by bolt shear insert too deflected about 1/8" no apparent rotation of insert Top of concrete crushed (spalls) about 2" in front of insert The insert washer sheared off from the struts, thus the 1/8" deflection was after this shear failure. Coils & struts did not move.

* Jack Thrust equal Shear Load on Insert.
Jack Thrust (Lbs.) = Gauge Pressure (PSI) x 13.25
Jack:.....Equipment Number RCH 606
Pressure Gauge: M & TE Number 2355
Dial Gauge:.....M & TE Number 2949

Due Date: 16 Apr 84
Due Date: 29 Jun 84

Performed By:

Witnessed By:

J.C. Gilbert 6 Apr 84
Name Date

Richard Reitzel 4-6-84
QA Representative Date

COMANCHE PEAK SES
SHEAR TESTS

RICHMOND / -INCH, TYPE EC-2W INSERT

Reference: CP-EI-13.0-X¹³ ~~104~~

Specimen Number: 19
(4th from west end)

Bolt Spec: A-490

Date: 9 Apr '84

DEFLECTION (IN.)		GAUGE PRESSURE (P.S.I.)	JACK * THRUST (Lbs.)	NOTES-FAILURE MODE
INITIAL	AFTER 2-MIN.			
0.004	0.0035	400	5300	
.036	.036	800	10600	
.050	.0605	1200	15900	
.080	.081	1600	21200	
.098	.099	2000	26500	
.122	.127	2400	31800	
.147	.155	2800	37100	
.190	.2225	3200	42400	
		3500		
.270		3500	46375	Insert failed by breaking weld between upper coil and struts. Bolt failed after rotating with the encased upper coil thru several degrees. The bolt failed in bending with a lesser load than the 46375 lb.

* Jack Thrust equal Shear Load on Insert.

Jack Thrust (Lbs.) = Gauge Pressure (PSI) x 13.25

Jack:.....Equipment Number RC14 606

Pressure Gauge: M & TE Number 2355

Dial Gauge:.....M & TE Number 2949

Due Date: 16 Apr '84

Due Date: 29 JUN '84

Performed By:

Witnessed By:

J. C. Gilbert 9 Apr '84
Name Date

Robert Ritzke 4-9-84
QA Representative Date

COMANCHE PEAK SES
SHEAR TESTS

RICHMOND 1-INCH, TYPE EC-2W INSERT

Reference: CP-2I-13.0 ~~13904~~

Specimen Number: 20 Bolt Spec: A-490 Date: 9 Apr 84
(5th from West End)

DEFLECTION (IN.)		GAUGE PRESSURE (P.S.I.)	JACK * THRUST (Lbs.)	NOTES-FAILURE MODE
INITIAL	AFTER 2-MIN.			
0.002	0.007	500		} Slack not out of apparatus
0.004	0.006	500		
0.008	0.007	500		
		500		
0.003	0.003	900	5300	
.025	.032	800	10600	
.046	.046	1200	15900	
.063	.064	1600	21300	
.085	.087	2000	26500	
.115	.122	2400	31800	
.154	.173	2800	37100	
.270		3200 3000	39750	Concrete crushed, insert remained intact but upper portion rotated thru a few degrees. Deflection of upper part of insert (washer) 3/8". Bolt broke in bending at lower load than the max 39750. Rotation caused conc spill to lift on tension side 1 1/2" approx - slipping to form 10" crack. Spill total 12" dia (I)

* Jack Thrust equal Shear Load on Insert.
Jack Thrust (Lbs.) = Gauge Pressure (PSI) x 13.25
Jack:.....Equipment Number RCH 606
Pressure Gauge: M & TE Number 2355
Dial Gauge:.....M & TE Number 2949

Due Date: 16 Apr '84
Due Date: 29 Jun '84

Performed By:

Witnessed By:

J C Gilbreth 9 Apr '84
Name Date

Alan Ristich 4.9.84
QA Representative Date

COMBINGE PEAK SES
 COMBINED SHEAR & TENSION TESTS
 Richmond / -Inch, Type ^{25C} Insert
 Reference: CP 11-13.0-9/13/44

Specimen Number: 21 (6th from West) Inserted Load Rod: A-193 Date: 9 Apr 44

SHEAR		TENSION		Deflection (Inch)	Insert Load (lb.)	Net Jack Thrust (lb.)	2* Jack Thrust (lb.)	Gauge Press. (PSI)	Failure Mode
1* Jack Thrust (lb.)	Deflection (Inch) After 2 Min.	Init.	After 2 Min.						
400	0.000	0.000	0.020				5,300		
800	0.001	0.000	0.000				10,600		
1200	0.005	0.020	0.025				15,900		
1600	0.013	0.040	0.050				21,200		
2000	0.030	0.111	0.130				26,100		
2400	0.400	0.15	0.130				27,825		
					N/A	N/A			

Sound of a wet breaking. ~~with~~ ^{rod} inserted @ 200 = 900 - 4925. ^{Insert washer drilled & laterally 1/4".} Some bonding of rod but fractured surface indicated a shear break. Top of insert rotated thru
 Concrete cracked all around @ about 12" dia. 1/2" deep @ insert per depth & edge

Shear Apparatus: Jack---Equipment No: NCH 606
 Pressure Gauge-NRE No: 2355 Due Date: 4-30-44
 Dial Gauge-NRE No: 2922 Due Date: 29-6-44
 Tension Apparatus: Jack Equipment No: NCH 6037
 Pressure Gauge-NRE No: 2002 Due Date:
 Dial Gauge-NRE No: 2450 Due Date: 10/1/44

1* Jack Thrust = Shear Load on Insert.
 1* Jack Thrust (lb.) = Gauge Pressure (PSI) x (7.25" for Shear Load.
 2* Jack Thrust (lb.) = Gauge Pressure (PSI) x (7.25" for Tension Load.
 Total Wt. of Tension Load Beam = 21.2
~~Net Jack Thrust~~ = Total Thrust - Beam Wt.
 Insert Load = Net Jack Thrust

Performed By: J. C. Hill Date: 9 Apr 44
 Witnessed by: J. L. Hill Date: 4-7-44
 Representative

COMBINED PEAK SES
 COMBINED SHEAR & TENSION TESTS
 Richmond / - Inch, Type ^{3/4"} Insert
 Reference: CP U-11.0 # 12,000

Specimen Number: 22 (7" dia = 45.3T) Date: 9 April 54

Gauge Press. (PSI)	SHEAR		TENSION		Deflection (Inch) After 2 Min.	Notes - Failure Mode
	1- Jack Thrust (lb.)	2- Jack Thrust (lb.)	1- Jack Thrust (lb.)	2- Jack Thrust (lb.)		
400	5300	5300	5300	5300	0.001	
800	10600	10600	10600	10600	0.019	
1200	15900	15900	15900	15900	0.053	
1600	21200	21200	21200	21200	0.055	
2000	26500	26500	26500	26500	0.115	
2200	29100	29100	29100	29100	0.16	
1800	25850	25850	N/A	N/A		
1500	19875	19875	N/A	N/A		

Went broke - Shear main. Cause unknown
 And sheared near top of slotted & shear
 line. This occurs, 20" when broke.
 Concrete spalled approx 15" diameter,
 being 12" on center side of 3" on comp. (Main
 shear bar) side 2" deep & insert
 failed. Concrete intact.

Shear Apparatus: Jack - Equipment No: RCN 606
 Pressure Gauge-MBE No: 2953 Due Date: 16 Apr 54
 Dial Gauge-MBE No: 2887 Due Date: 29 Jul 54
 Tension Apparatus: Jack - Equipment No: RCN 6037
 Pressure Gauge-MBE No: Same Due Date:
 Dial Gauge-MBE No: 2072 Due Date: 29 Jul 54

1- Jack Thrust = Shear Load on Insert.
 1- Jack Thrust (lb.) = Gauge Pressure (PSI) x 12.25 for Shear Load.
 2- Jack Thrust (lb.) = Gauge Pressure (PSI) x 12.25 for Tension Load.
 Total Wt. of Tension Load Beam = N/A
 1- Jack Thrust = Total Thrust - Weight of Beam
 Insert Load = Net Jack Thrust = 19875

Performed By: J. C. H. [Signature] Date: 8 Apr 54
 Witnessed By: A. [Signature] Date: 9 Apr 54
 QA Representative

CURVICHIE PEAK SES
COMBINED JEAR & TENSION TESTS
 Richmond / - Inch. Type Insert
 Reference: CP-11-11.0 9.04

Specimen Number: 23 (6" from west end)
 Inserted Load Rod: A-193
 No. 6610 of 2 spec. 84

Gauge Press. (PSI)	SHEAR		Gauge Press. (PSI)	2.* Jack Thrust (lb.)	Net Jack Thrust (lb.)	TENSION	Deflection (Inch)	
	1.* Jack Thrust (lb.)	After 2-Min.					Init.	After 2-Min.
400	5300	.002		5300			.0005	.0005
800	10600	.035		10600			.009	.010
1200	15900	.122		15900			.034	.041
1600	21200	.245		21200			.075	.084
2000	26500	.350		26500			.140	.158
2200	29500	.430		29500			.20	
2300	30975	.630	N/A	30415	N/A	N/A		

Notes - Failure Mode
 Deflection increased rapidly. At pt failure by shear of rod. Insert washer moved horizontally 1/8". No buckling of insert. Rod rotated some 30° above breaks of insert. This permitted by crushing of concrete and probably deformation of threaded coil. Rod failure was by shear after considerable deformation.

Shear Apparatus: Jack - Equipment No: SCN 600
 Pressure Gauge - RHE No: 2735 Due Date: 6 Apr 84
 Dial Gauge - RHE No: 2782 Due Date: 27 Oct 84
 Tension Apparatus: Jack Equipment No: SCN 600T
 Pressure Gauge - RHE No: 2735E Due Date: 6 Apr 84
 Dial Gauge - RHE No: 2092 Due Date: 10 Oct 84

Witnessed By: Adverse Date: 4-10-84
 Representative

1.* Jack Thrust = Shear Load on Insert.
 1.* Jack Thrust (lb.) = Gauge Pressure (PSI) x 12.25 for Shear Load.
 2.* Jack Thrust (lb.) = Gauge Pressure (PSI) x 12.25 for Tension Load.
 Total Wt. of Tension Load Beam = 4 1/2 lb.
 3.* Net Jack Thrust = Total Thrust - Wt. of Beam.
 4.* Insert Load = Net Jack Thrust.

Performed By: G. C. White Date: 10 Apr 84
 Name

COMBINED SHEAR & TENSION TESTS
 Richmond / - Inch. Type EC-24
 Reference: CP-11-13.0 9-29-59

CORVATH PEAK SES

Specimen Number: 24 (9th from west end)

Inserted Load Rod: A-183

Date: 10 April 64

Gauge Press. (PSI)	SHEAR		TENSION		Gauge Press. (PSI)	Jack Thrust (lb.)	Net Jack Thrust (lb.)	Insert Load (lb.)	Deflection (Inch)		Notes - Failure Mode
	1- Jack Thrust (lb.)	2- Jack Thrust (lb.)	Init.	After 2 Min.							
400	5,300	5,500	0.001	0.002	0.002	9,002					
800	14,600	10,600	0.008	0.065	0.065						
1200	15,200	15,900	0.050	0.27	0.27						
1600	21,200	21,200	0.153	0.62	0.62						
2000	26,500	26,500	0.325	1.35	1.35						
2400	31,800	27,025	0.400	1.7	1.7						
2800	34,800	27,025	0.500	2.0	2.0						
2200	28,150	24,150	0.540	2.27	2.27						
2000	24,150	24,500	0.700	2.27	2.27						

1- Jack Thrust = Shear Load on Insert.
 1- Jack Thrust (lb.) = Gauge Pressure (PSI) x 18.25 for Shear Load.
 2- Jack Thrust (lb.) = Gauge Pressure (PSI) x 18.25 for Tension Load.
 Total Wt. of Tension Load Beam = 4.3 lb.
 Net Jack Thrust = Total Thrust - 4.3 lb.
 Insert Load = Net Jack Thrust - 2.5 lb.

Shear Apparatus: Jack - Equipment No: RCH-206
 Pressure Gauge-MBE No: 2355 Due Date: 6-30-64
 Dial Gauge-MBE No: 2949 Due Date: 6-30-64
 Tension Apparatus: Jack - Equipment No: RCH-2037
 Pressure Gauge-MBE No: 2094 Due Date: 6-30-64
 Dial Gauge-MBE No: 2094 Due Date: 6-30-64

Witnessed By: John C. S. [Signature] 4-10-64
 Representative Date

Performed By: J. C. S. [Signature] 10 April 64
 Date

Notes - Failure Mode: Rapid yielding began.
 Break. Abrupt shear failure of rod. Some 1/2" horizontal deflection of top of insert permitted by rotation crushing of concrete and debonding of upper coil of insert. Concrete spalled 2" deep. 2" of insert seen to have tilted 5" (1" insert lateral movement).

COMBINED PEAK SES
COMBINED SHEAR & TENSION TESTS
Richmond / - Inch, Type $\frac{1}{2}$ - 210 Insert
Reference: CP-11-11.0-9-26

Specimen Number: 25 (1009 from Wood's) Inverted Load Rod: A-123
Date: 10 April 54

SHEAR		TENSION		Insert Load (lb.)	Deflection (Inch) After 2 Min.	Notes - Failure Mode
Gauge Press. (PSI)	Jack Thrust (lb.)	Net Jack Thrust (lb.)	Net Jack Thrust (lb.)			
900	5,300	5,300	5,300		0.005	
800	10,600	10,600	10,600		0.026	
1200	15,900	15,900	15,900		0.115	
1600	21,200	21,200	21,200		0.229	
2000	26,500	26,500	26,500		0.307	
2100	27,825	27,825	27,825		0.370	
2150	29,987	29,987	29,987	N/A	0.400	

Shear Apparatus: Jack - Equipment No. ACH 606
 Pressure Gauge - HMI No. 2355 Due Date: 16 Apr 54
 Dial Gauge - HMI No. 2727 Due Date: 27 Apr 54
 Tension Apparatus: Jack - Equipment No. ACH 608T
 Pressure Gauge - HMI No. 2727 Due Date: 27 Apr 54
 Dial Gauge - HMI No. 2727 Due Date: 27 Apr 54

1* Jack Thrust = Shear Load on Insert.
 1* Jack Thrust (lb.) = Gauge Pressure (PSI) x 10.25 for Shear Load.
 2* Jack Thrust (lb.) = Gauge Pressure (PSI) x 17.22 for Tension Load.
 Total Wt. of Tension Load Beam = N/A lb.
 Net Jack Thrust = Total Thrust - Wt. of Beam.
 Net Insert Load = Net Jack Thrust - 2.

Witnessed By: [Signature] Date: 4-2-54
 Representative: [Signature] Date: 4-2-54

Performed By: [Signature] Date: 10 April 54

Insert collected (54-10)

CONCRETE PEAK STRESS
TENSION TESTS

RICHMOND 1 - INCH, TYPE EC-2W INSERT

Reference: CP-EI-13.0-~~5~~ 13.14

Specimen Number: 26 Load Rod Spec: A-193 Date: 6 Apr '84
~~11th~~ 11th from west end, 5th from east

GAUGE PRESS. (P.S.I.)	* JACK THRUST (Lb.)	** NET JACK THRUST (Lb.)	*** INSERT LOAD (Lb.)	DEFLECTION (IN.)		NOTES-FAILURE MODE
				INIT.	AFTER 2-MIN.	
200	2650	1225	2850	0.060	0.020	
400	5300	4075	8150	.003	.003	
600	7950	6725	13450	.007	.0075	
800	10600	9375	18750	.012	.0125	
1000	13250	12025	24050	.0175	.019	
1200	15900	14375	29350	.037	.038	
1400	18550	17325	34650	.070	.070	
1600	21200	19975	39950	.098	.105	
1700	22525	21300	42600	.134		Failure.
<p>Insert remained intact. Shear cone type failure of concrete. Insert was located near center between E-W & N-S rebar. Cone was restricted somewhat by 4-bars 2-each way. Some lifting force on bars caused concrete to spall 3-ft ea. side of insert. Shear cone depth = full height of insert less 1/4" @ bottom.</p>						

- * Jack Thrust (Lb.) = Gauge Pressure (PSI) x 13.25
- Total Weight of Load Beam = 2450
- ** Net Jack Thrust = Total Thrust Minus 1/2 Weight of Beam. ($\frac{1}{2}$ WT. = 1225-16)
- *** Insert Load = Net Jack Thrust x 2.
- Jack: Equipment Number ACH 606

Pressure Gauge: M & TE Number 2355 Due Date: 16 Apr '84
 Dial Gauge: M & TE Number 2944 Due Date: 29 Jun '84

Performed By: C. B. Little Date: 6 Apr '84
 Witnessed By: R. L. ... Date: 5.1.84
 Name Date DA Representative Date

COMANCHE PC SES
TENSION TESTS

RICHMOND / -INCH, TYPE 2C-2W INSERT

Reference: CP-EI-13.0-13.211

Specimen Number: 27

Load Rod Spec: A-193

Date: 6 Apr '84

12" from West End, 4" from east

GAUGE PRESS. (P.S.I.)	* JACK THRUST (Lb.)	** NET JACK THRUST (Lb.)	*** INSERT LOAD (Lb.)	DEFLECTION (IN.)		NOTES-FAILURE MODE
				INIT.	AFTER 2-MIN.	
200	2650	1225	2650	0.000	0.000	
400	5300	4075	8150	.000	.000	
600	7950	6725	13450	.000	.000	
800	10600	9375	18750	.0005	.0005	
1000	13250	12025	24050	.0065	.0075	
1200	15900	14675	29350	.0165	.0175	
1400	18550	17325	34650	.050	.056	
1600	21200	19975	39950	.082000	.092	
1750	23188	21960	43920	.146		Failure

Failure occurred by failure of the insert. Weld between lower coil and vertical struts broke. Threaded, upper, coil came out and carried the two struts with. Concrete spalled an oval area about 1.5' x 2.25' max depth 2" @ insert. Exposed one rebar located 3" o.c. from insert. Rebar not disturbed. Only concrete cover removed.

* Jack Thrust (Lb.) = Gauge Pressure (PSI) x 13.25

Total Weight of Load Beam = 2450

** Net Jack Thrust = Total Thrust Minus 1/2 Weight of Beam. ($\frac{1}{2}$ Wt. = 1225)

*** Insert Load = Net Jack Thrust x 2.

Jack: Equipment Number RCH 606

Pressure Gauge: M & TE Number 2355 Due Date: 16 Apr '84

Dial Gauge: M & TE Number 2949 Due Date: 29 Jun '84

Performed By:

Witnessed By:

J. C. Silbath 6 Apr '84
Name Date

Richard [Signature] 4-6-84
QA Representative Date

COMANCHE PEAK
TENSION TESTS

RICHMOND 1-INCH, TYPE FC-2W INSERT

Reference: CP-61-13.0-13 PCM

Specimen Number: 28
(3/4 from east end)

Load Rod Spec: A-193

Date: 10 April '84

GAUGE PRESS. P.S.I.)	* JACK THRUST (Lb.)	** NET JACK THRUST (Lb.)	*** INSERT LOAD (Lb.)	DEFLECTION (IN.)		NOTES-FAILURE MODE
				INIT.	AFTER 2-MIN.	
200	2650	1425	2850	0.000	0.000	
400	5300	4075	8150	.000	.000	
600	7950	6725	13450	.000	.000	
800	10600	9375	18750	.002	.002	
1000	13250	12025	24050	.004	.005	
1200	15900	14675	29350	.009	.010	
1400	18550	17325	34650	.015	.029	
1500 1550	20538	19313	38424	.055	-	
1600	21200	19975	39950	.067	.082	
1700 1800 1900 2000 2100	22,525	21300	42600	.15		Concrete shear cone failure. Insert and rod remained intact. Cone height equal insert height. Size of cone top limited by rebar width mast. Rebars lifted with cone and lifted area 4.5 x 3.5'. Rebars @ 9" o.c. E.W.

* Jack Thrust (Lb.) = Gauge Pressure (PSI) x 13.25

Total Weight of Load Beam = 2450

** Net Jack Thrust = Total Thrust Minus 1/2 Weight of Beam. ($\frac{1}{2}$ Wt. = 1225 Lb)

*** Insert Load = Net Jack Thrust x 2.

Jack: ... Equipment Number RCH 606

Pressure Gauge: M & TE Number 2355

Due Date: 16 Apr '84

Dial Gauge: M & TE Number 2049

Due Date: 18 Jun '84

Performed By:

Witnessed By:

D. C. Gilbert 4-10-84
Name Date

John Petrol 4-10-84
QA Representative Date

COMANCHE PEAK SES
TENSION TESTS

EC-2W
RICHMOND / -INCH, TYPE INSERT

Reference: CP-EI-13.0 ¹³ ₂₂₄

Specimen Number: 29 Load Rod Spec: A-193 Date: 6 April '84
(2nd from East, 14th fr. West)

GAUGE PRESS. (P.S.I.)	JACK THRUST (Lb.)	NET JACK THRUST (Lb.)	INSERT LOAD (Lb.)	DEFLECTION (IN.)		NOTES-FAILURE MODE
				INIT.	AFTER 2-MIN.	
200	2450	1225	2355	0.000	0.000	
400	5300	4075	8150	.005	.005	
600	7750	6725	13430	.009	.009	
800	10600	9375	18750	.0145	.015	
1000	13250	12025	24050	.021	.022	
1200	15900	14675	29350	.033	.027	
1400	18550	17325	34650	.101	.104	
1600	21200	19975	39950	.135	.1455	
1700	22525	21300	42600			concrete failed by the load on insert lifting the repair mat. An area some 3.5' x 6.0' failed in this manner then insert pulled out taking a small cone with it. Top rebar was placed in contact with insert, thus contributing to the cause of this large area concrete failure.

- * Jack Thrust (Lb.) = Gauge Pressure (PSI) x 13.25
- Total Weight of Load Beam = 2450
- ** Net Jack Thrust = Total Thrust Minus 1/2 Weight of Beam. ($\frac{1}{2}$ WT. = 1225)
- *** Insert Load = Net Jack Thrust x 2.

Jack: Equipment Number PCH 606

Pressure Gauge: M & TE Number 2355 Due Date: 16 Apr '84

Dial Gauge: M & TE Number 2949 Due Date: 29 Apr '84

Performed By:

Witnessed By:

C. P. Lubett 6 April 84
Date Date

Andrew Pictorial 4-2-84
QA Representative Date

COMANCHE PEAK SES
TENSION TESTS

RICHMOND / -INCH, TYPE EC-2W INSERT

Reference: CP-EI-13.0-F224

Specimen Number: 30

Load Rod Spec: A-93

Date: 5 April '84

(1st on east end)

GAUGE PRESS. (P.S.I.)	* JACK THRUST (Lb.)	** NET JACK THRUST (Lb.)	*** INSERT LOAD (Lb.)	DEFLECTION (IN.)		NOTES-FAILURE MODE
				INIT.	AFTER 2-MIN.	
500 400				0.000 0.000	0.000 0.000	
500				0.000	0.000	
500	2650	1225	2850	0.000	0.000	
600	5360	4075	8150	0.010	.000	
600	7950	5225	13450	.001	.001	
800	10600	4375	18750	.005	.006	
1000	13250	12025	24050	.019	.021	
1200	15900	14675	29350	.047	.049	
1400	18550	17325	34650	0.106	.109	
1600	21200	19975	39950	.153	.174	
1800 1850	21860	20635	41270	.250		Load Peaked Out
						Insert failed by breaking area between lower coil and vertical struts. Upper (threaded coil) came out w/rod, also struts came out. Top concrete spalled over 18" diam. Surface spall only. Lower 12" dia exposed by removal of cover. Bar not deformed. Concrete

* Jack Thrust (Lb.) = Gauge Pressure (PSI) x 15.25

Total Weight of Load Beam = 2450

** Net Jack Thrust = Total Thrust Minus 1/2 Weight of Beam. (1/2 WT. = 1225)

*** Insert Load = Net Jack Thrust x 2.

Jack:.....Equipment Number RCH 606

Pressure Gauge: M & TE Number 2355

Due Date: 16 Apr '84

Dial Gauge: M & TE Number 2920

Due Date: 29 Jun '84

Performed By:

Witnessed By:

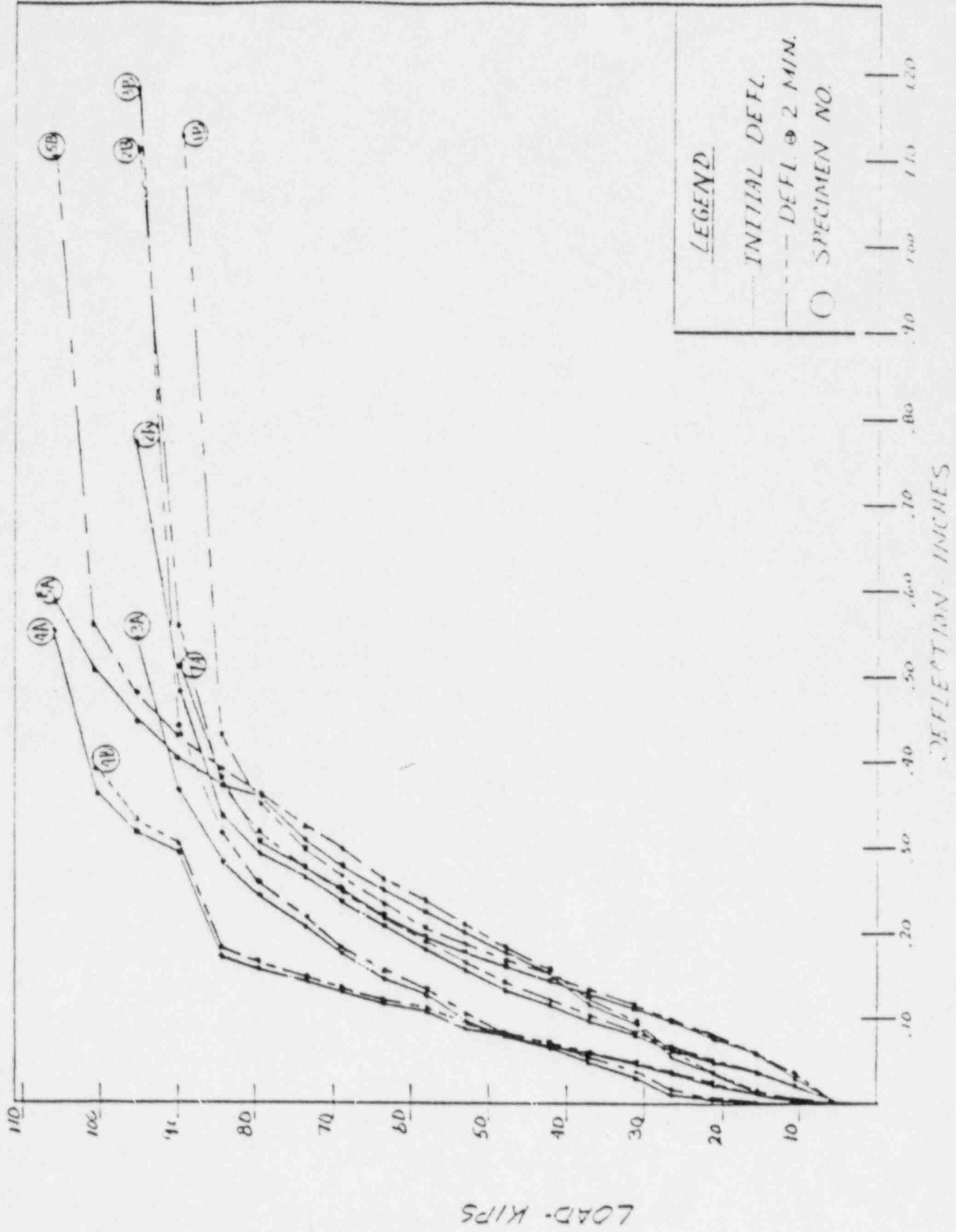
J. C. Whitford 5 Apr 84

Andrew Petryak 4-5-84

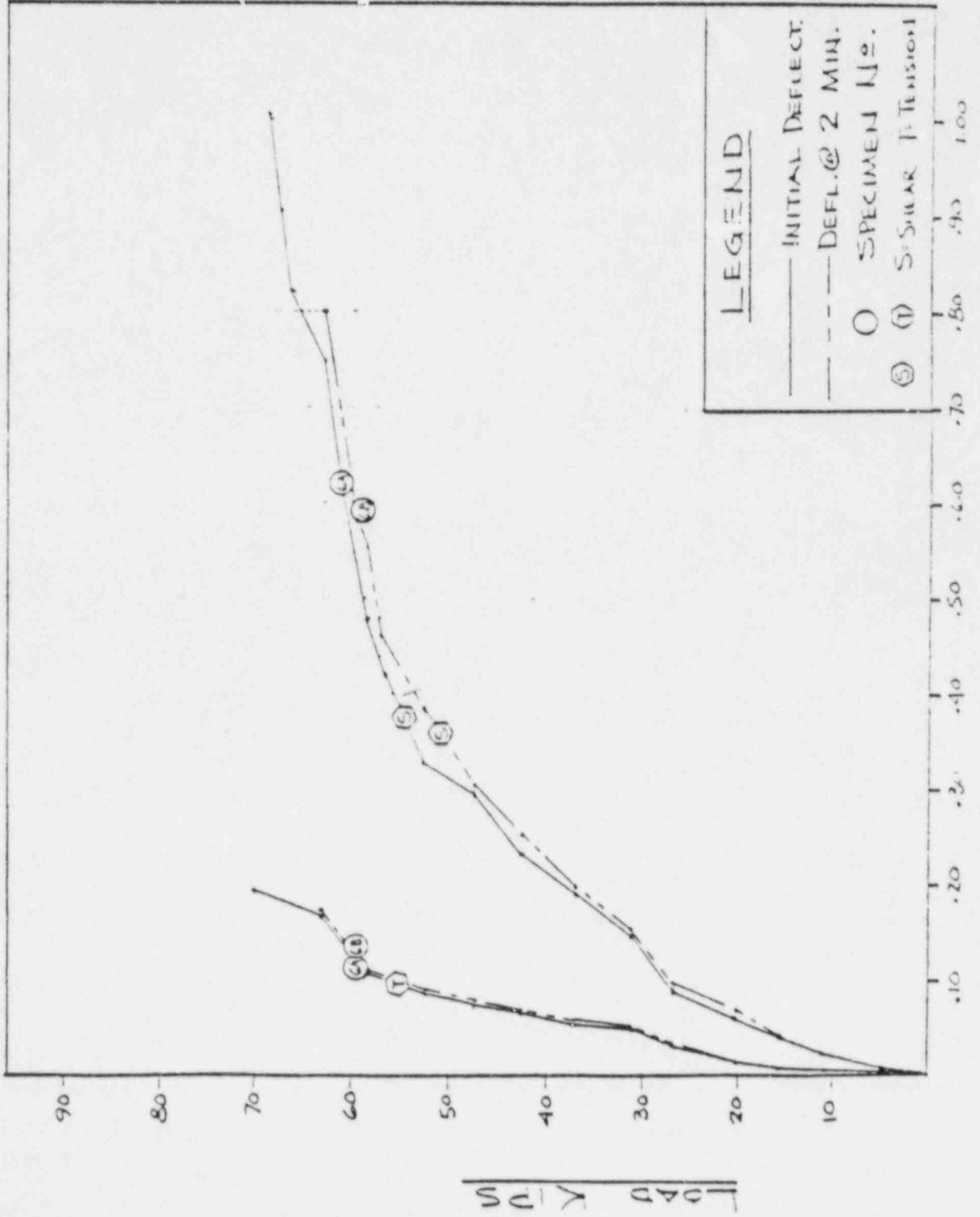
APPENDIX 3

LOAD-DEFLECTION CURVES

LOAD-DEFLECTION CURVES 1/2-INCH TYPE EC-6W, SHEAR TEST

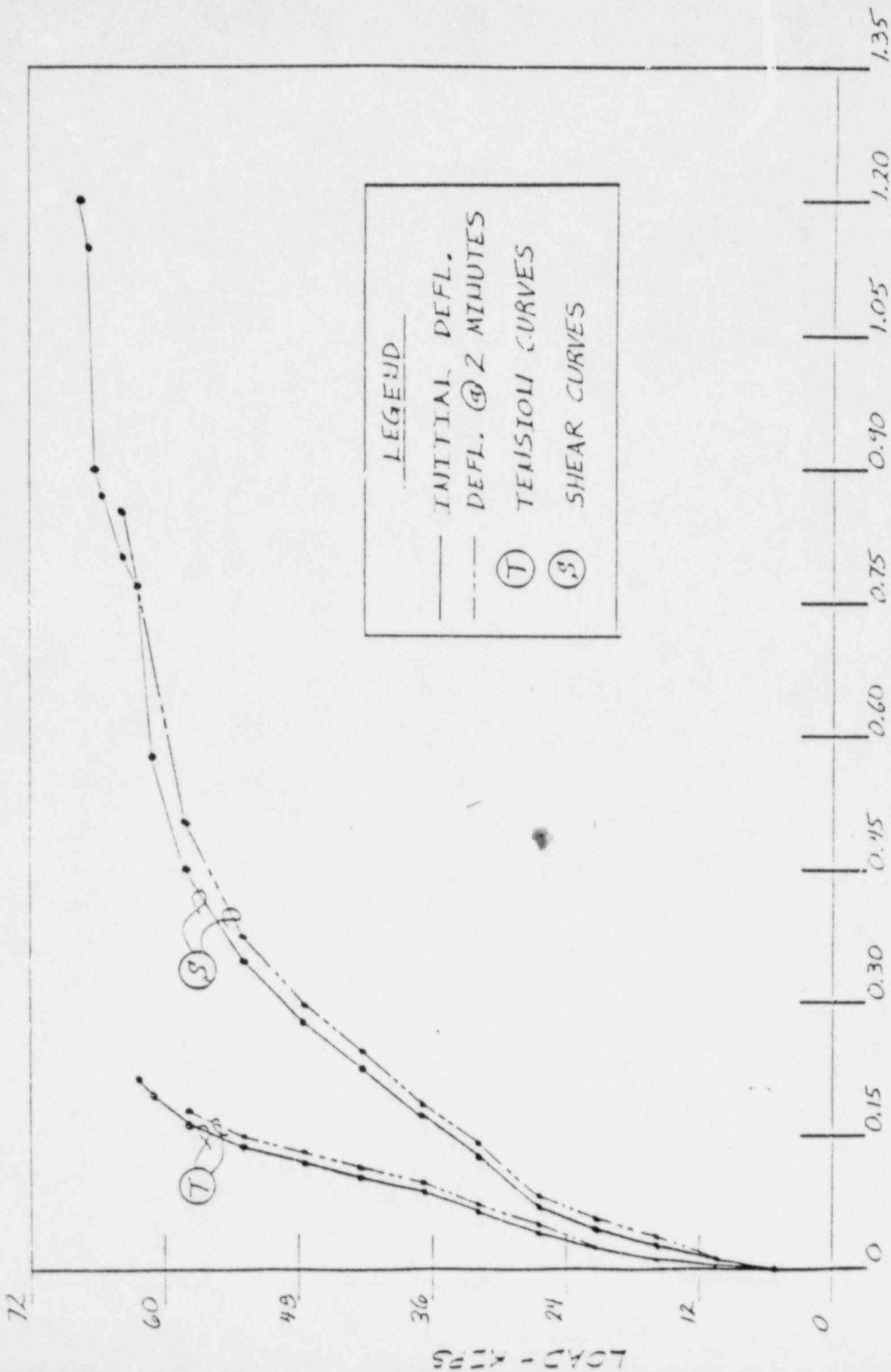


COMBINED SHEAR & TENSION TEST CHART
 RICHMOND 1 1/2 INCH, TYPE EC-6W INSERT
 SPECIMAN No. 6



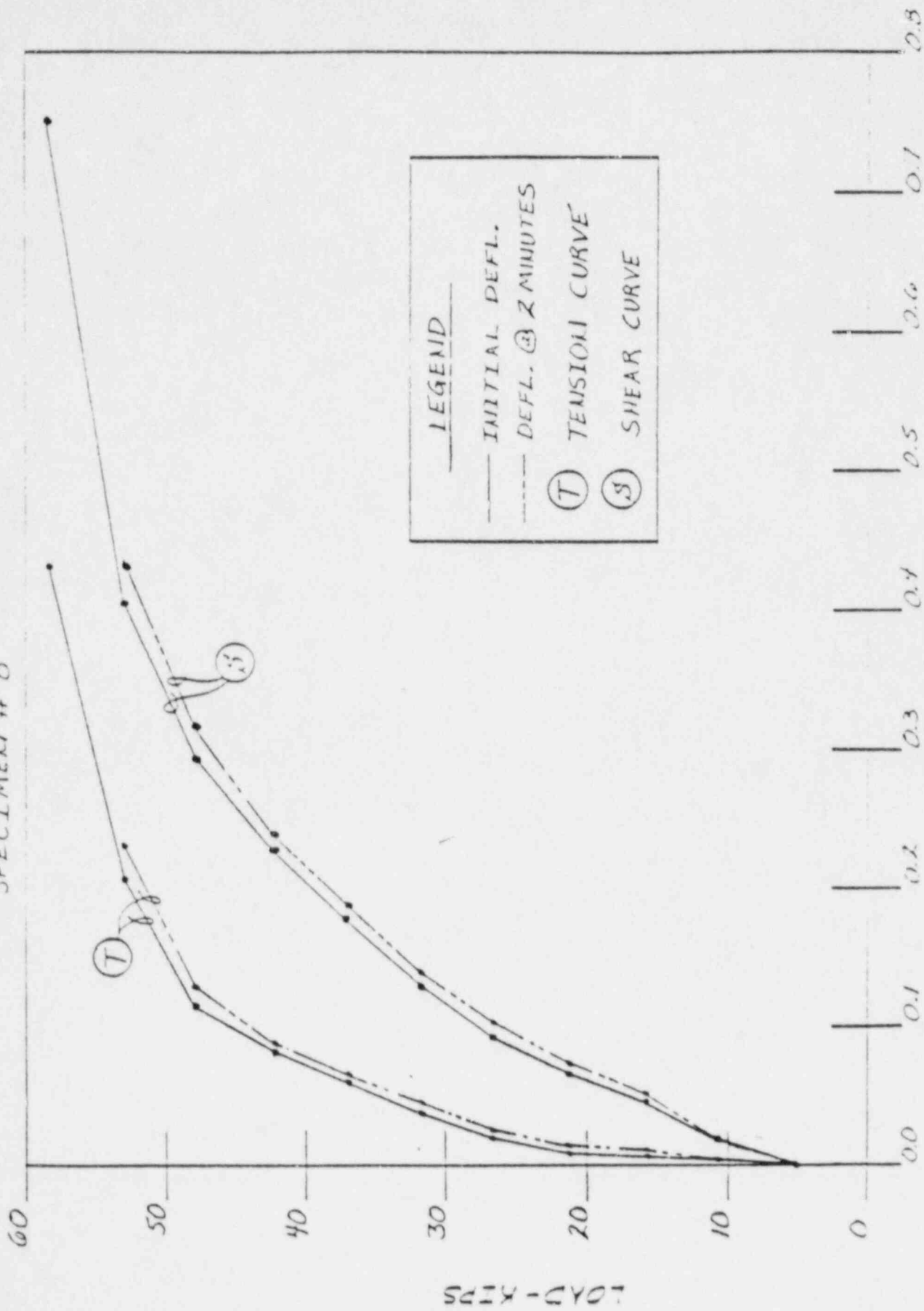
Vertical Scale: 10, 20, 30, 40, 50, 60, 70, 80, 90

1 1/2 INCH, TYPE LC-6W
SPECIMEN # 7



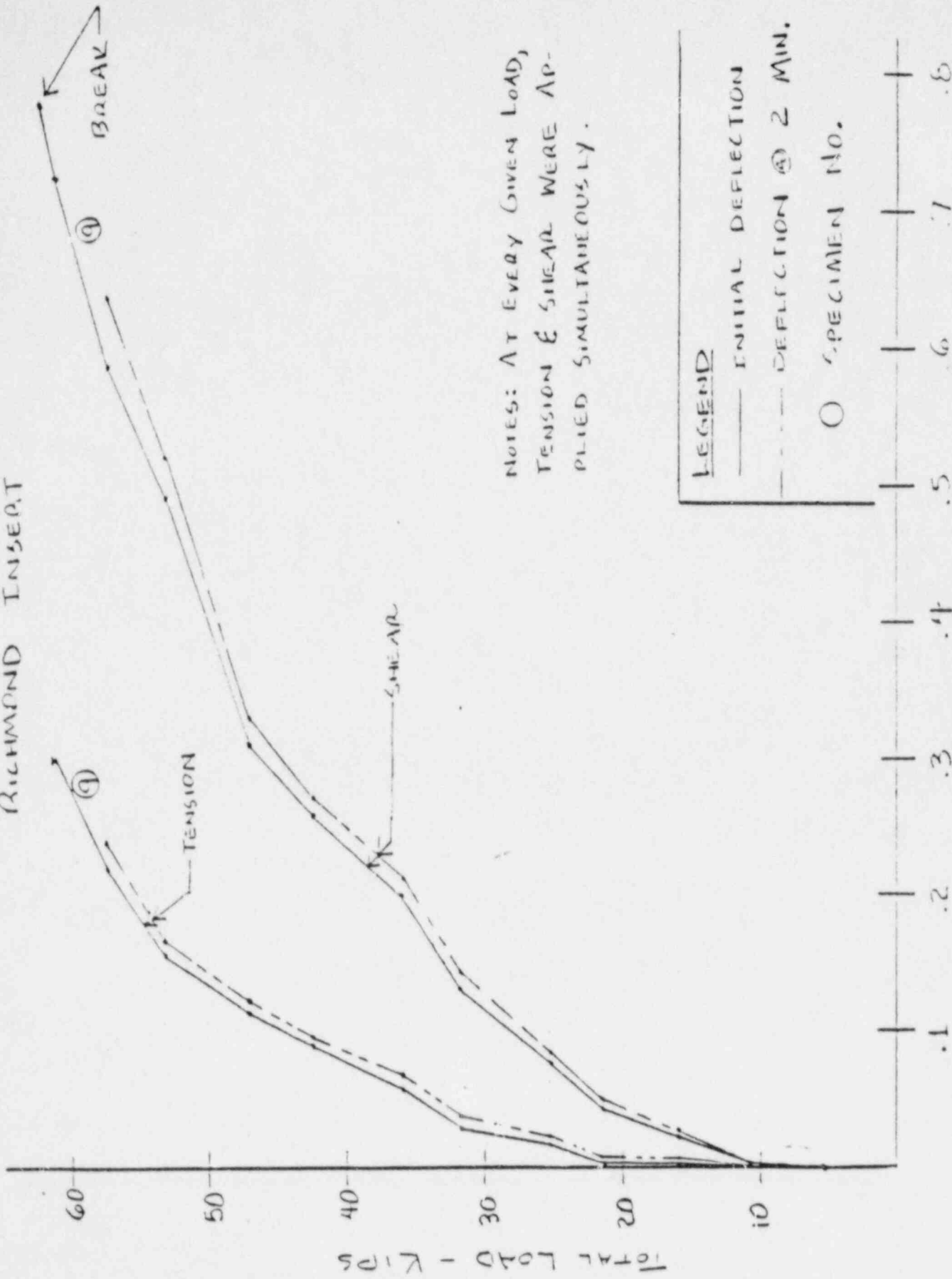
DEFLECTION - INCHES

COMBINED SHEAR & TENSION TEST CURVES
 1½ INCH, TYPE EC-6W
 SPECIMEN # B



DEFLECTION - INCHES

LOAD DEFLECTION CURVES FOR 1 1/2" TYPE EC-6W RICHMOND INSERT



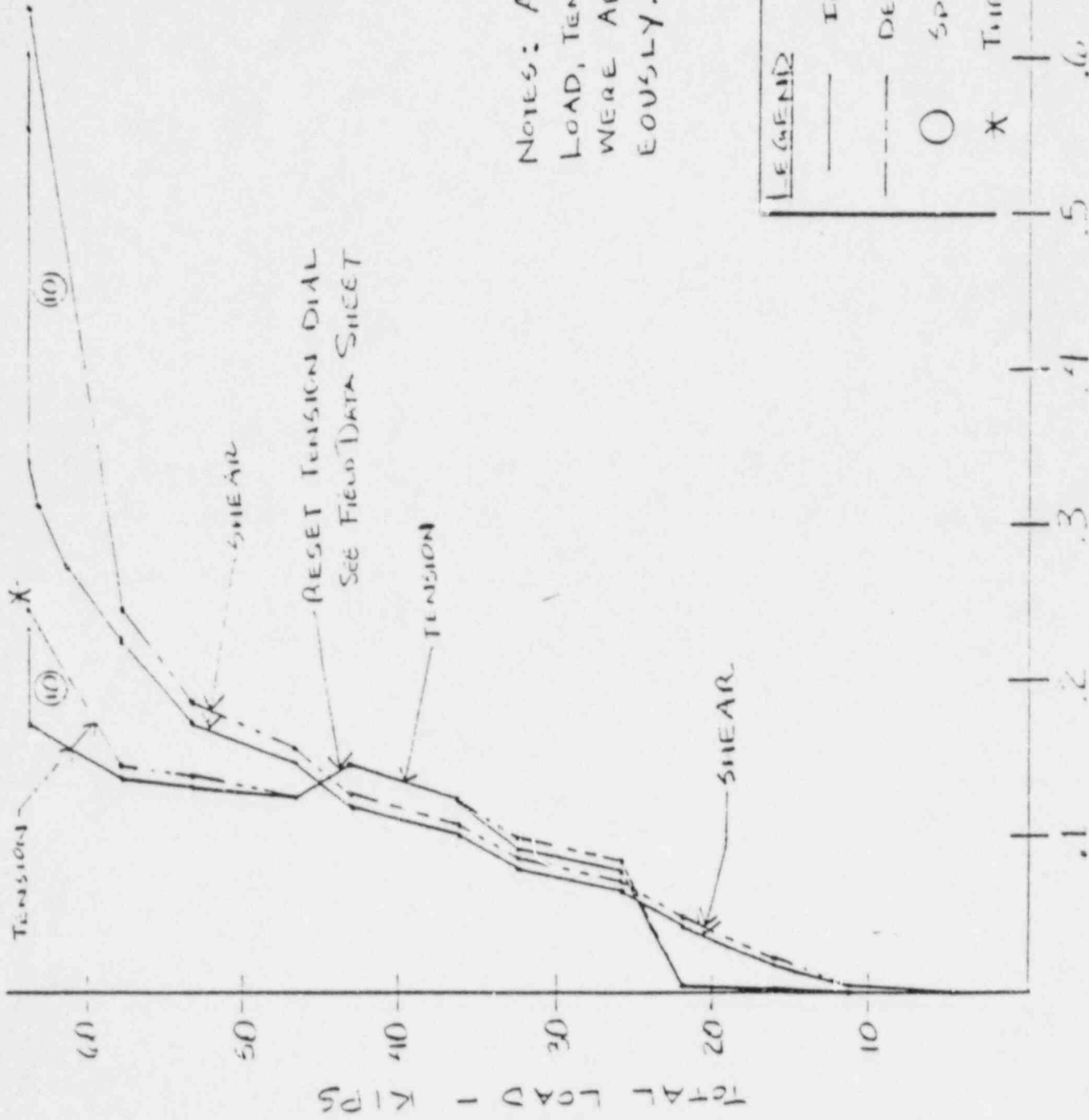
NOTES: AT EVERY GIVEN LOAD,
TENSION & SHEAR WERE AP-
PLIED SIMULTANEOUSLY.

LEGEND

- INITIAL DEFLECTION
- - - DEFLECTION @ 2 MIN.
- SPECIMEN NO.

DEFLECTION - INCHES

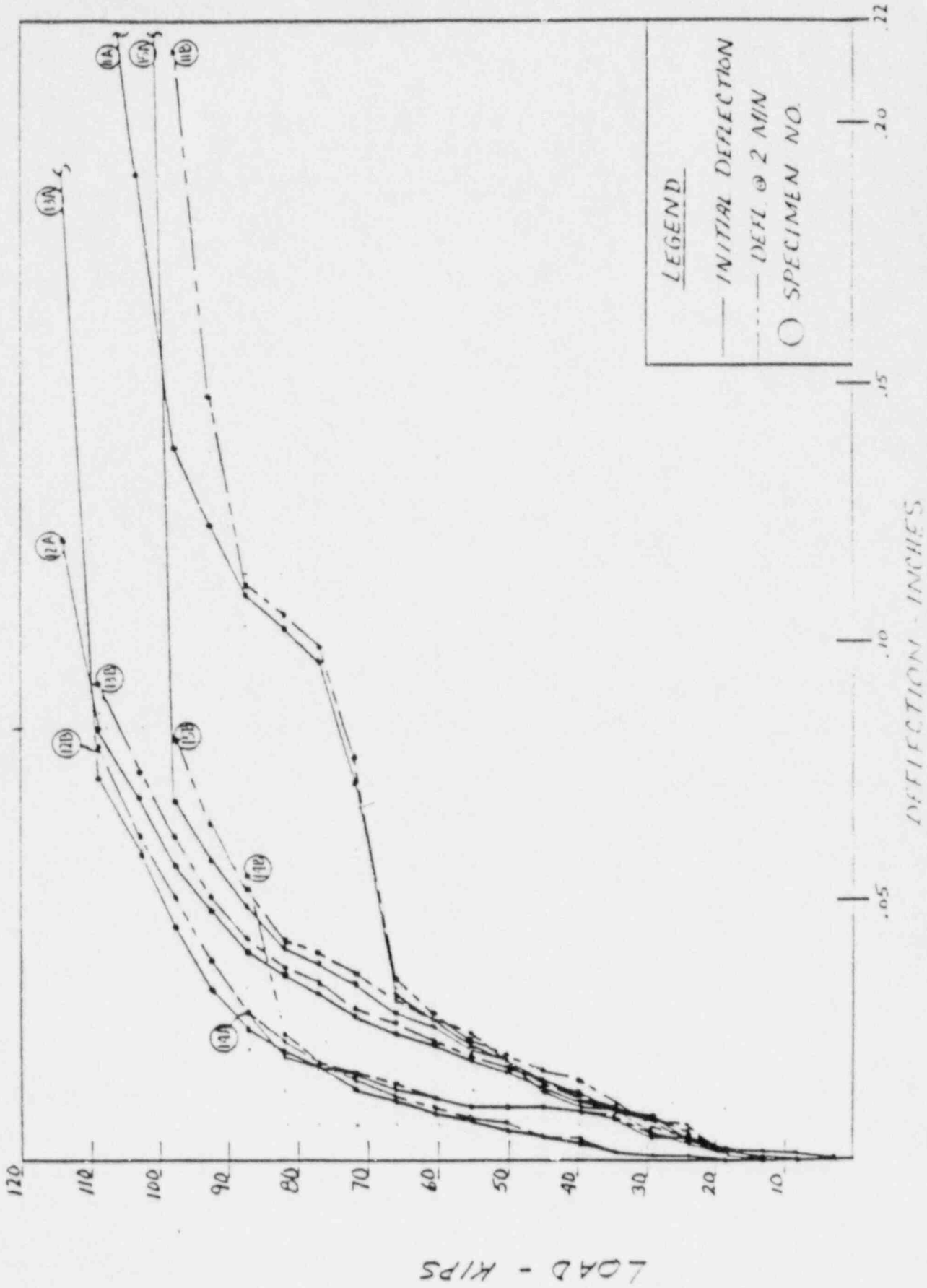
LOAD-DEFLECTION CURVES FOR 1/2" Ø 1770-160000
RICHMOND INSERT



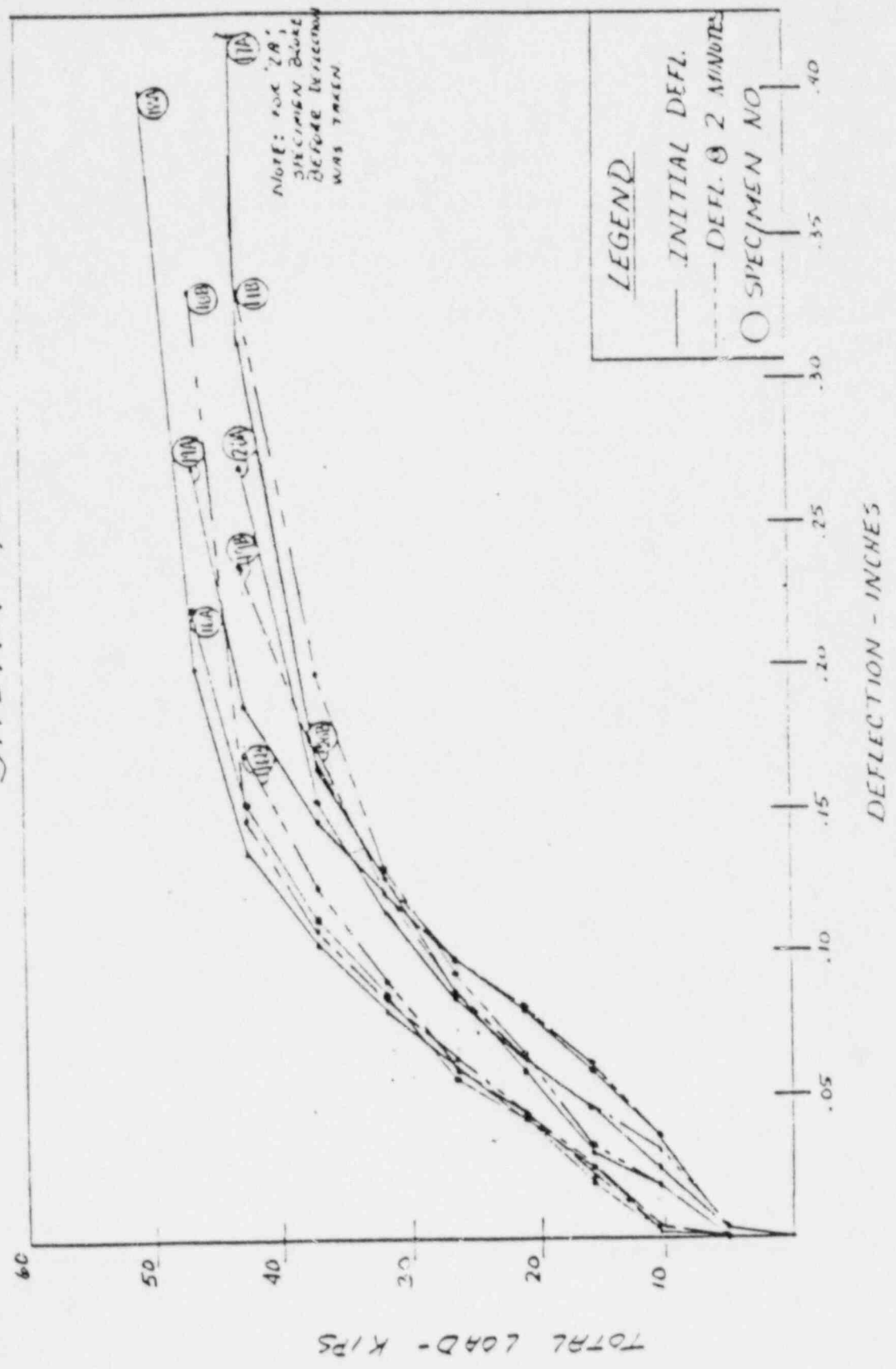
NOTES: AT EVERY GIVEN
LOAD, TENSION & SHEAR
WERE APPLIED SIMULTANEOUSLY.

DEFLECTION - INCHES

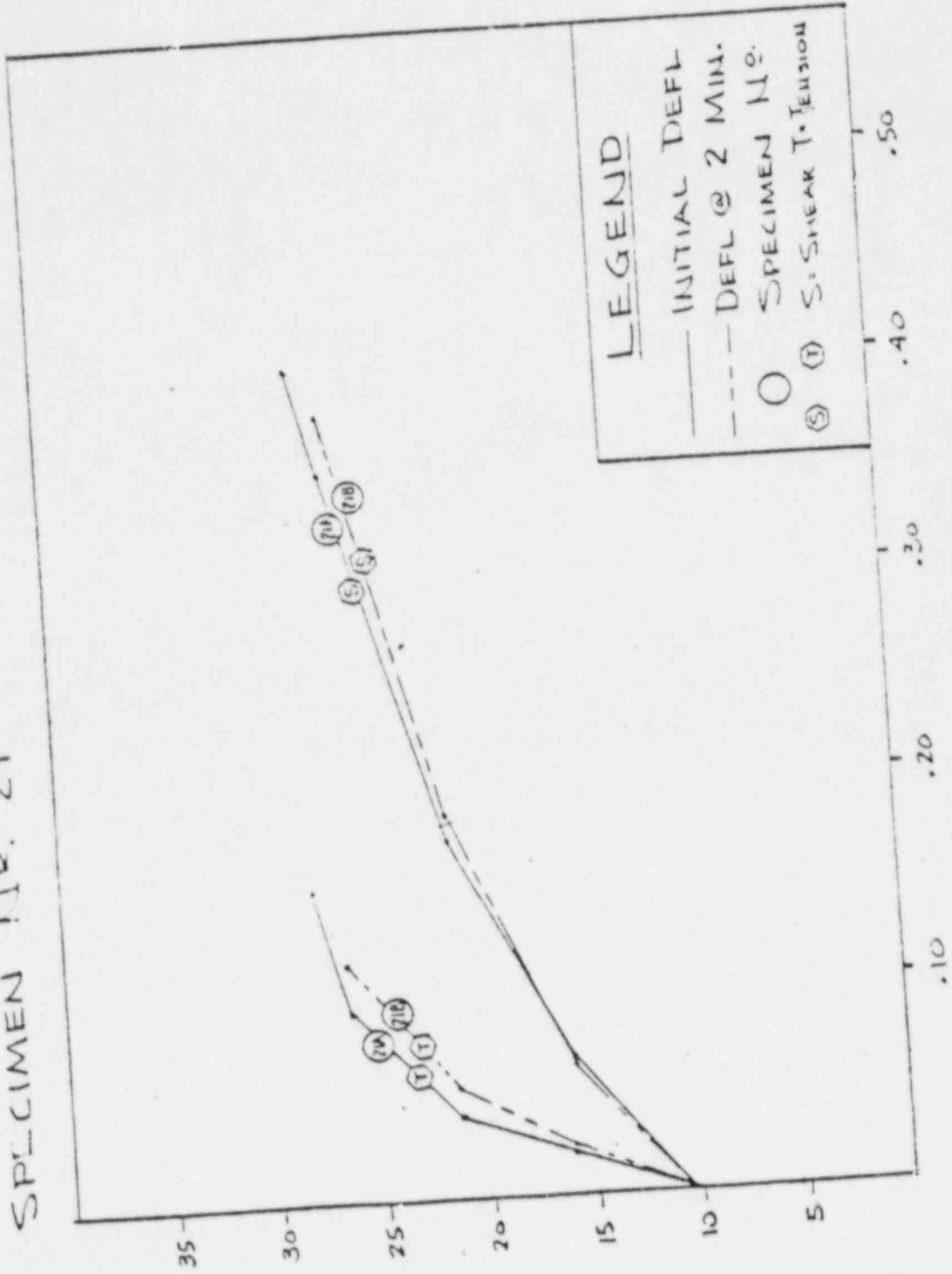
LOAD-DEFLECTION CURVES 1/2-INCH TYPE EC-6W, TENSION TEST



LOAD-DEFLECTION CURVES 1-INCH TYPE EC-2W SHEAR TEST



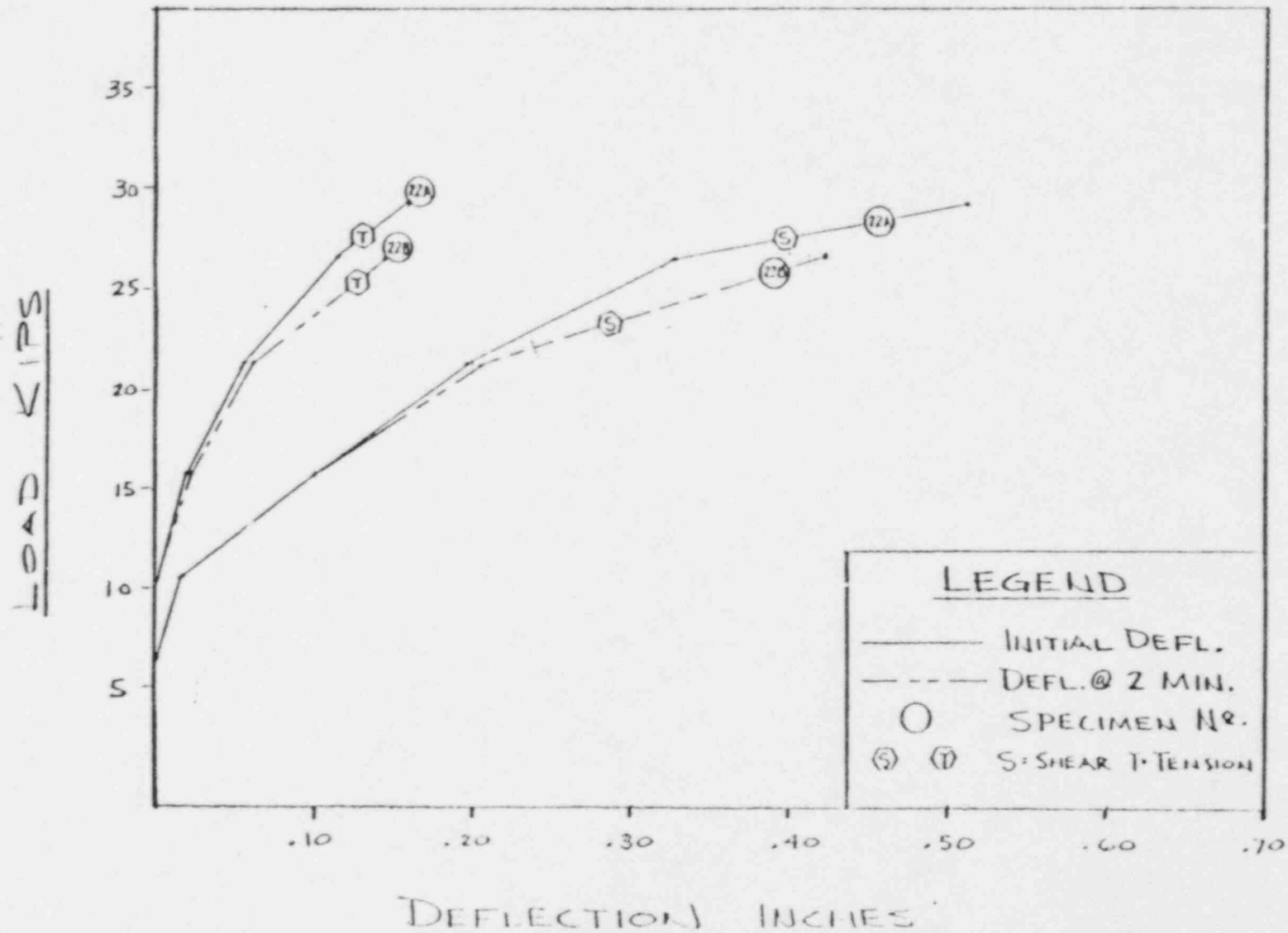
COMBINED SHEAR & TENSION CHART
 RICHMOND 1 INCH, TYPE EC-ZW INSERT
 SPECIMEN No. 21



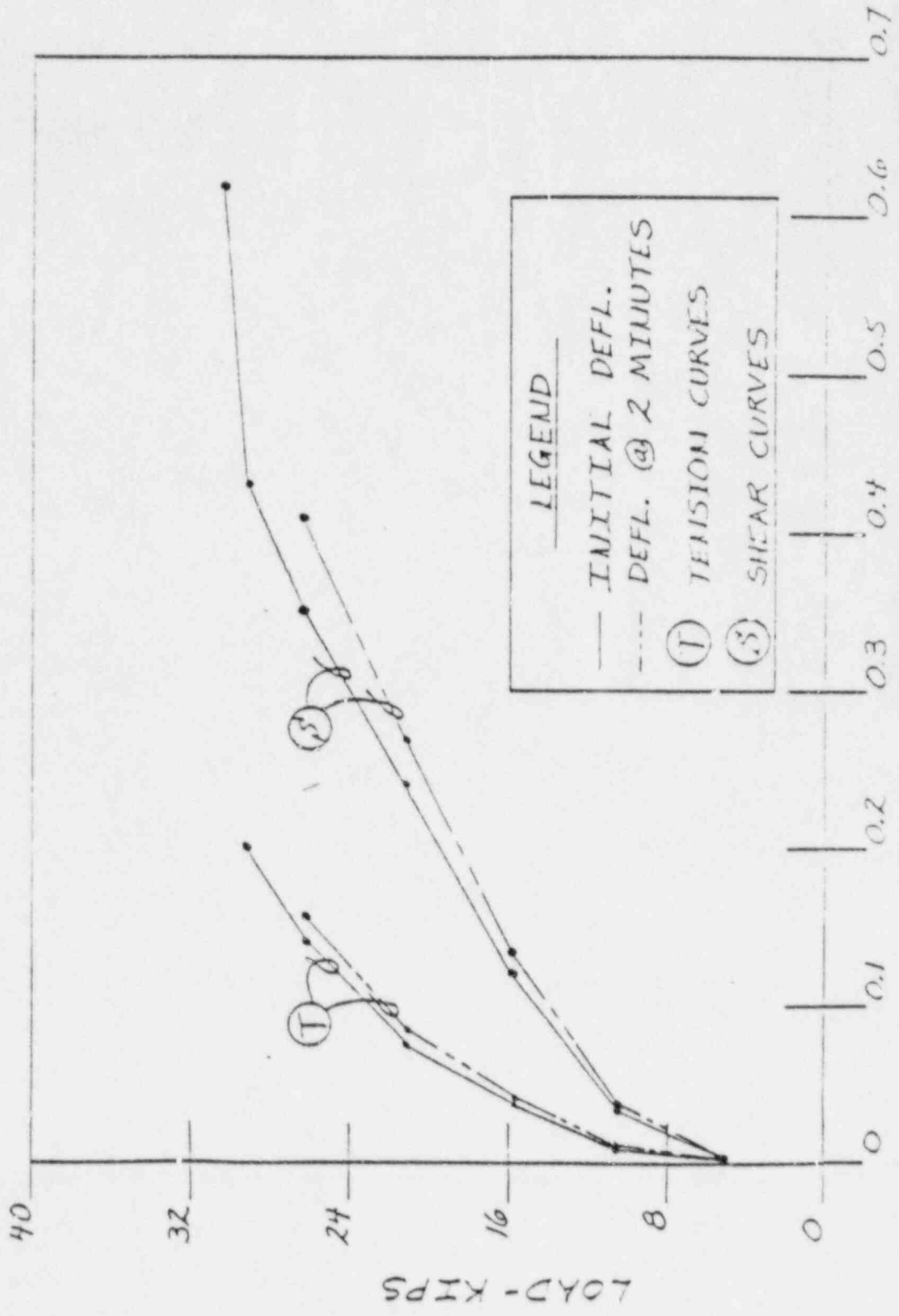
LOAD

DEFLECTION INCHES

COMBINED SHEAR & TENSION CHART
 RICHMOND 1 INCH, TYPE EC-2W INSERT
 SPECIMAN N^o. 22

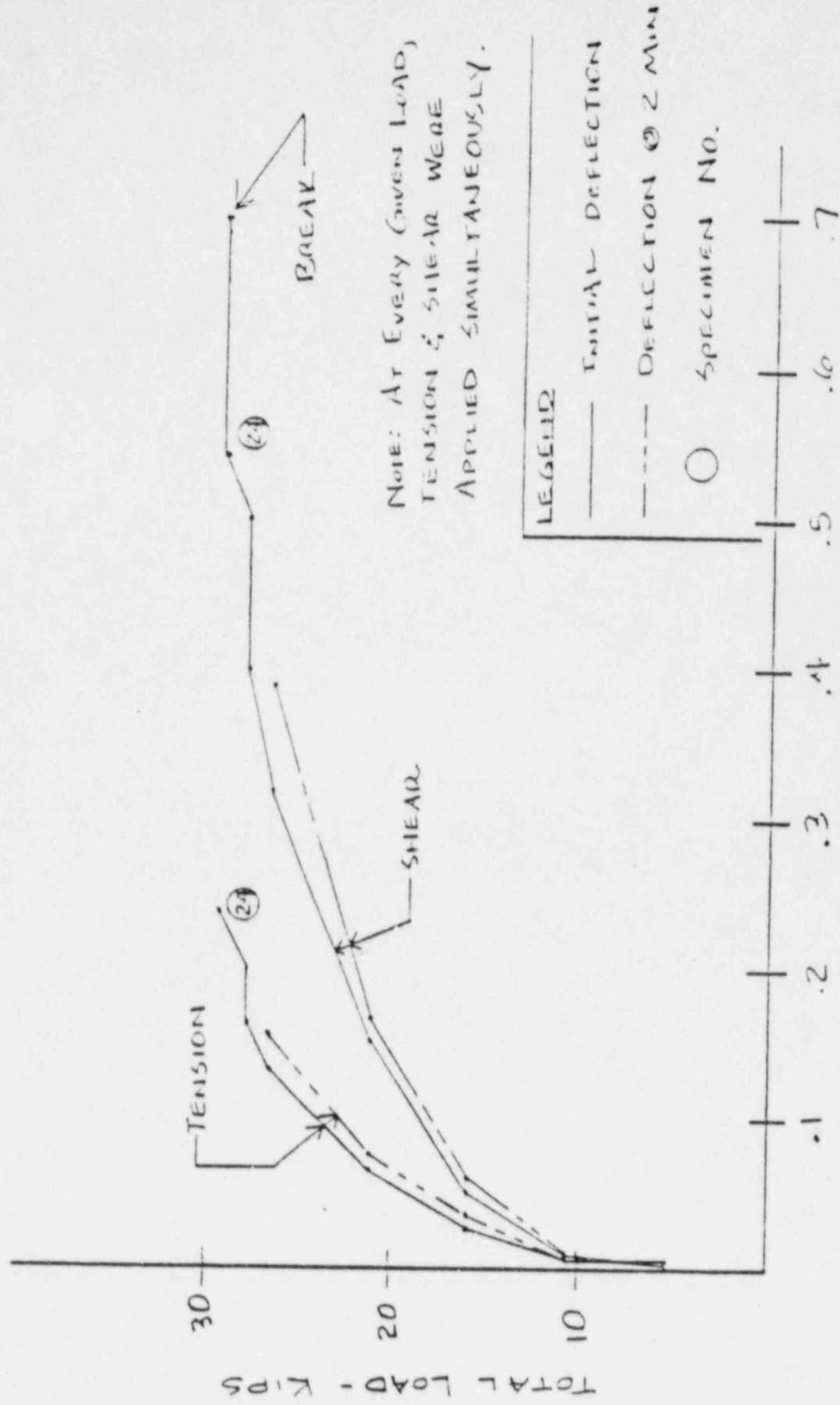


COMBINED SHEAR & TENSION TEST CURVES
 1 INCH, TYPE EC-2W
 SPECIMEN #23



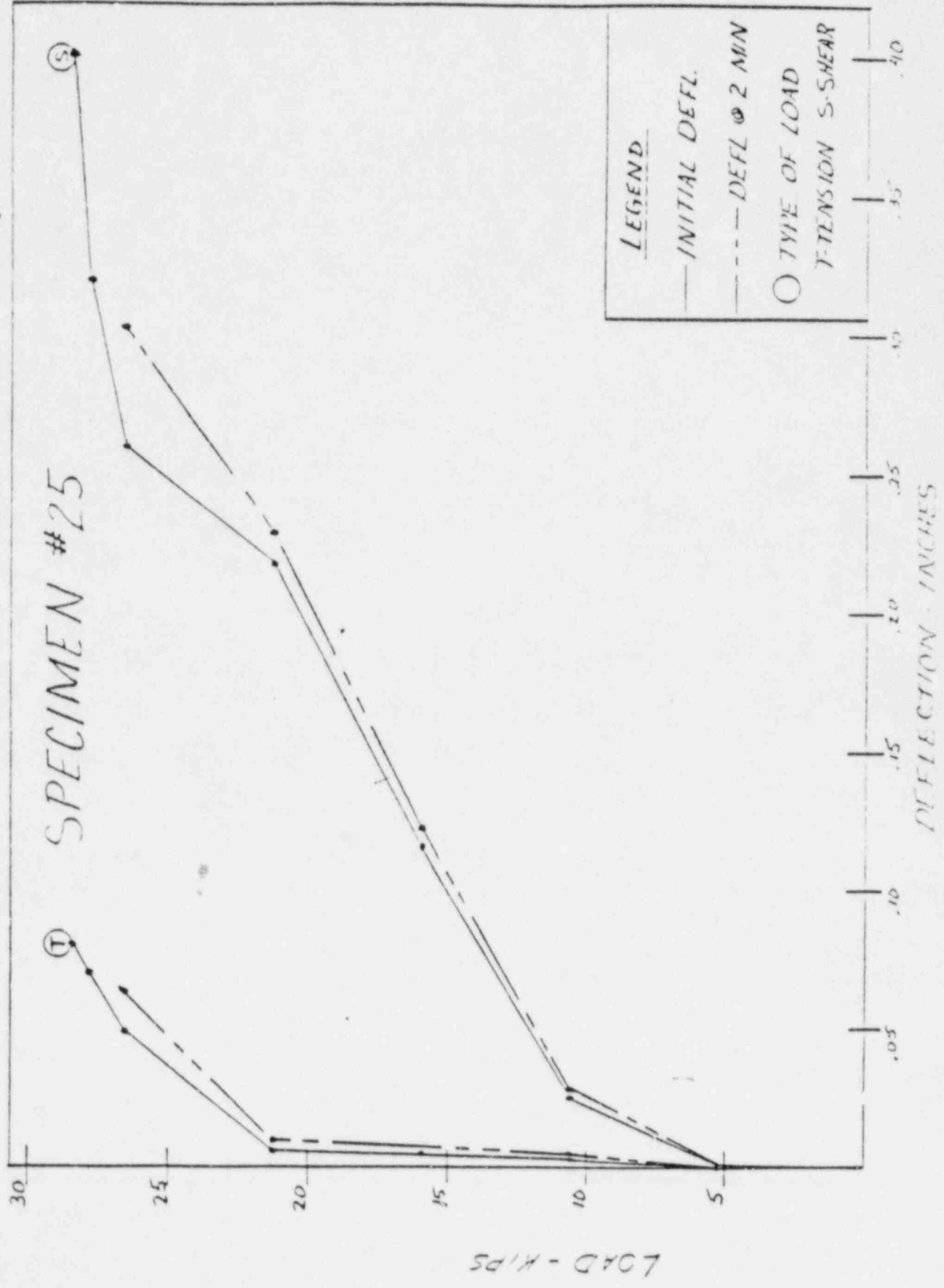
DEFLECTION - INCHES

LOAD DEFLECTION CURVES FOR 1" ϕ TYPE EC-2W RICHMOND INSERT



LOAD-DEFLECTION CURVE
 1-INCH TYPE EC-2W
 COMBINED SHEAR AND TENSION

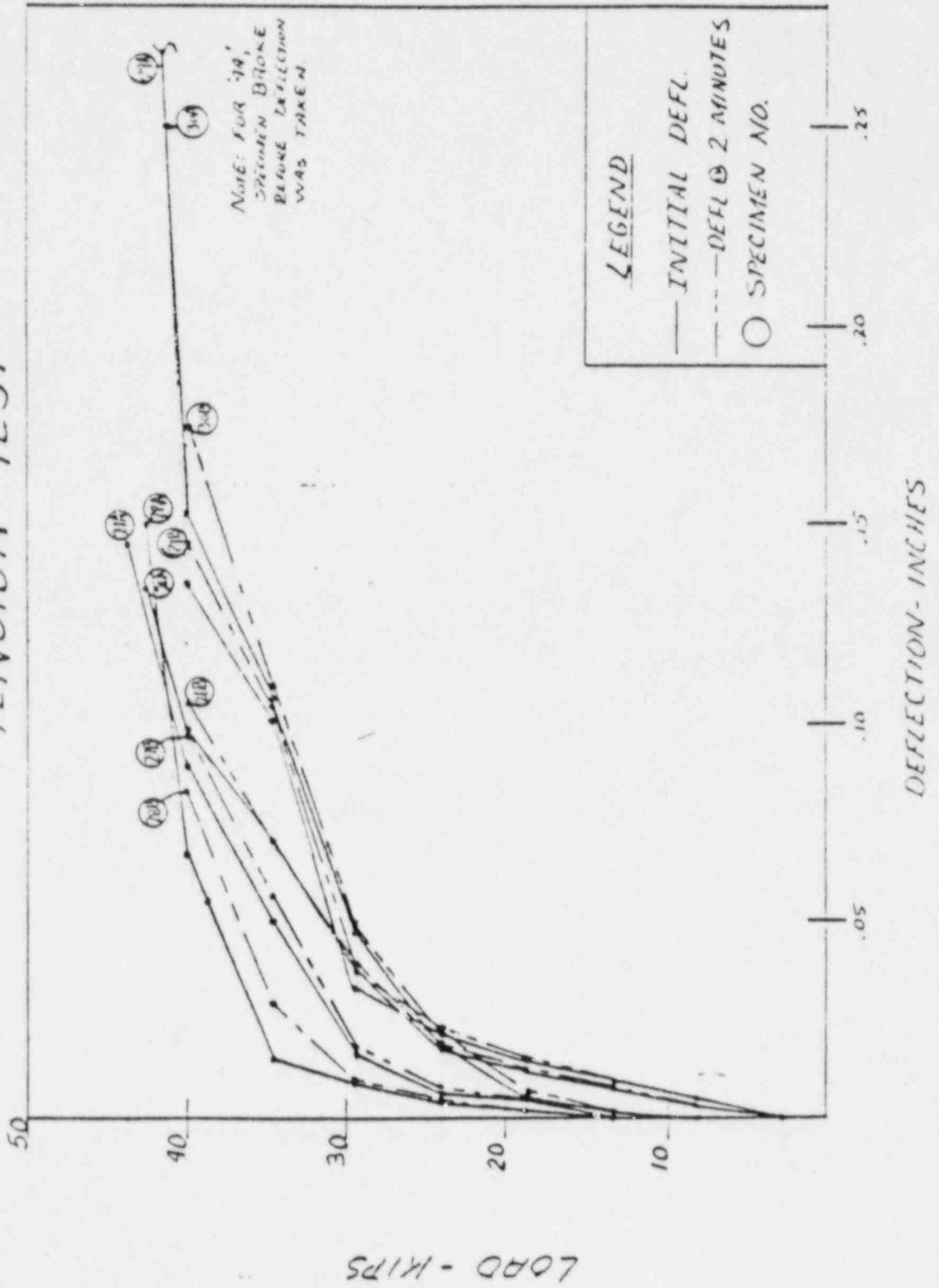
SPECIMEN #25



LEGEND

- INITIAL DEFL.
- - - DEFL @ 2 MIN
- TYPE OF LOAD
T-TENSION S-SHEAR

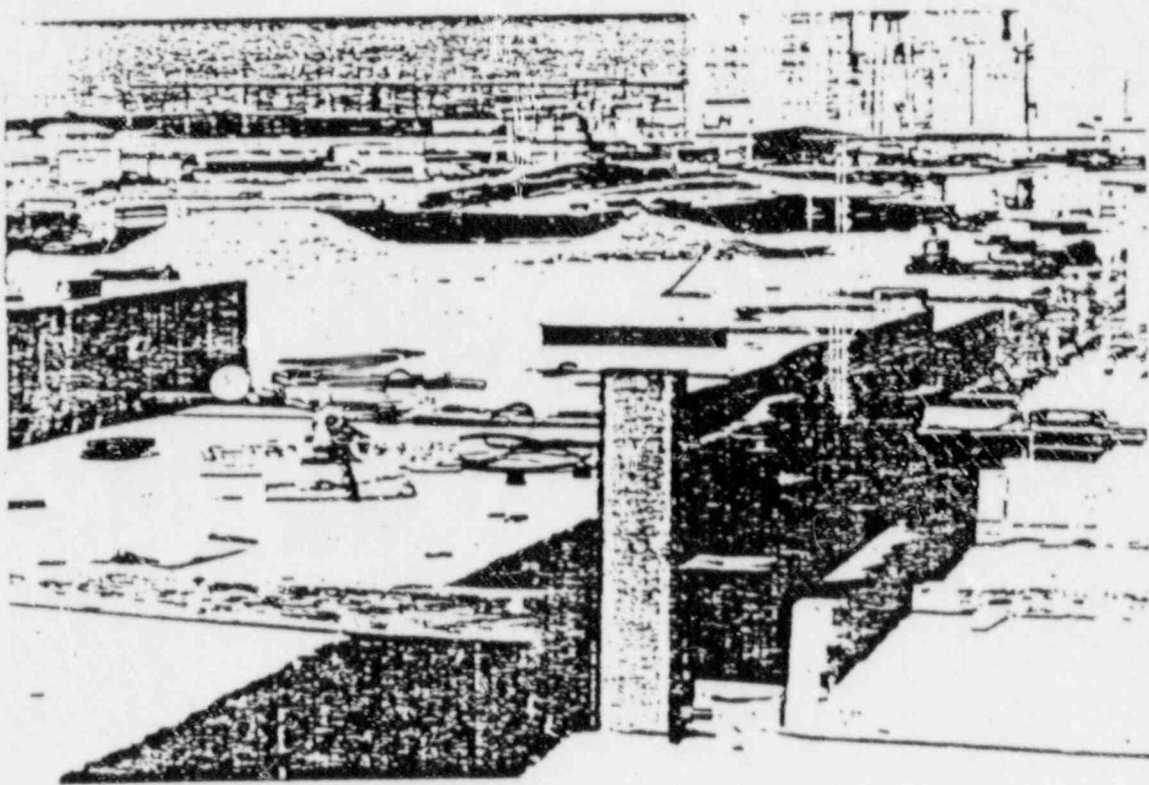
LOAD-DEFLECTION CURVES 1-INCH TYPE EC-2W TENSION TEST



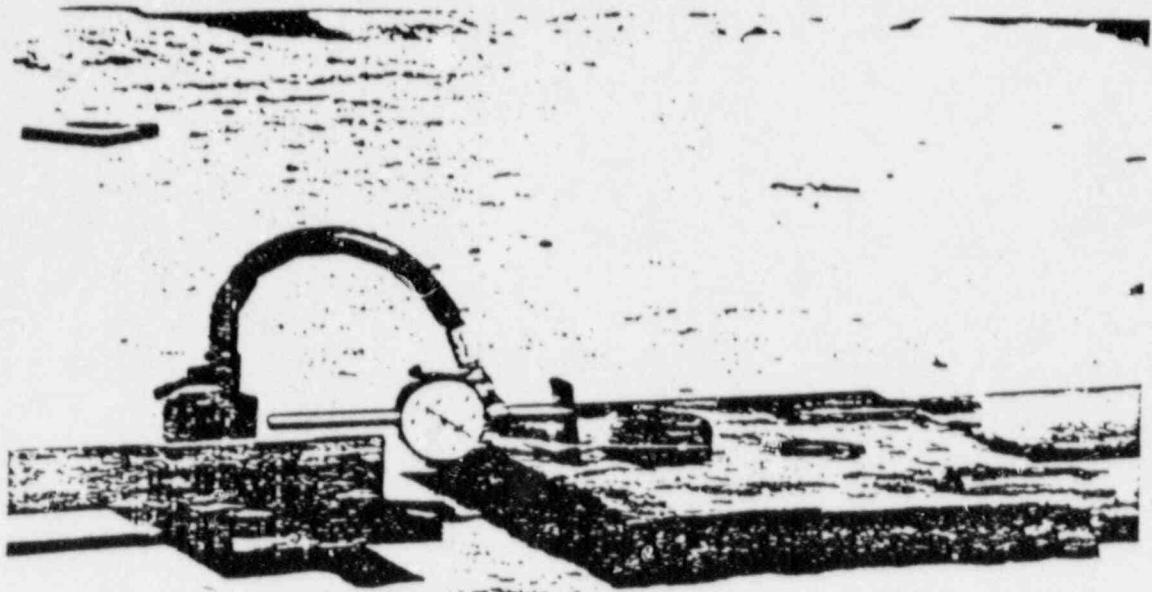
APPENDIX 4

PICTURES OF ACTUAL TEST APPARATUS

SHEAR TEST



TEST APPARATUS

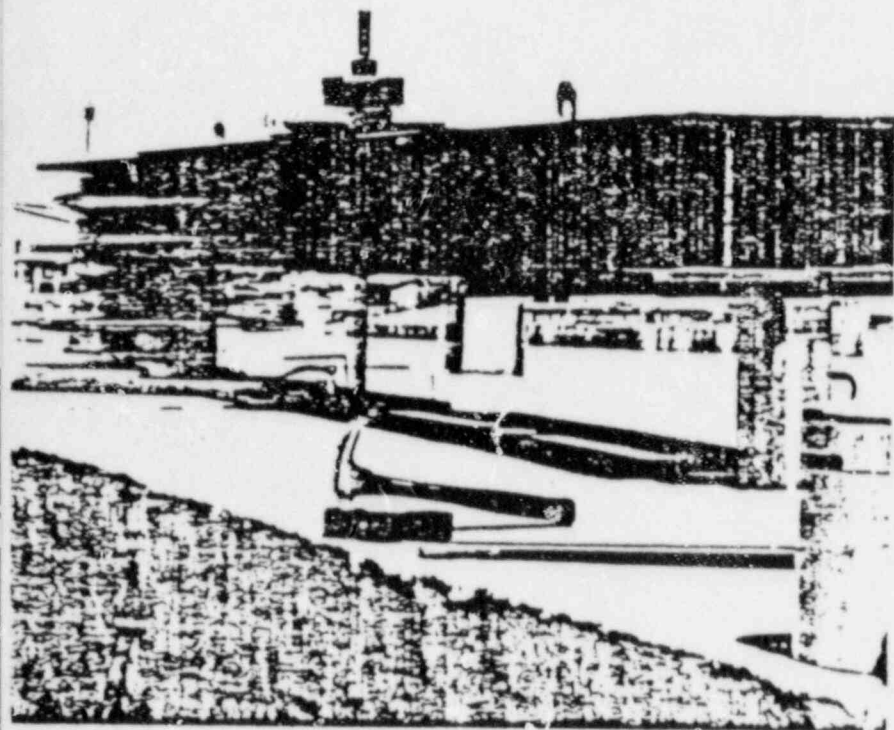


DIAL INDICATOR ARRANGEMENT

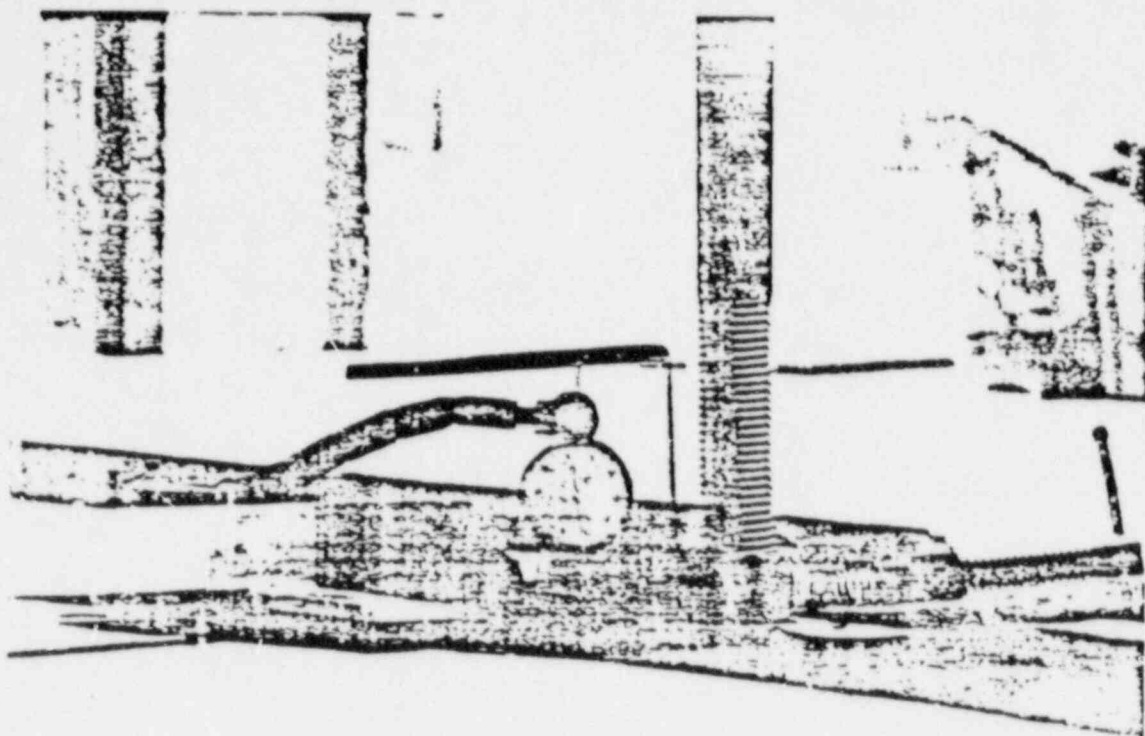


TYPICAL SHEAR FAILURE

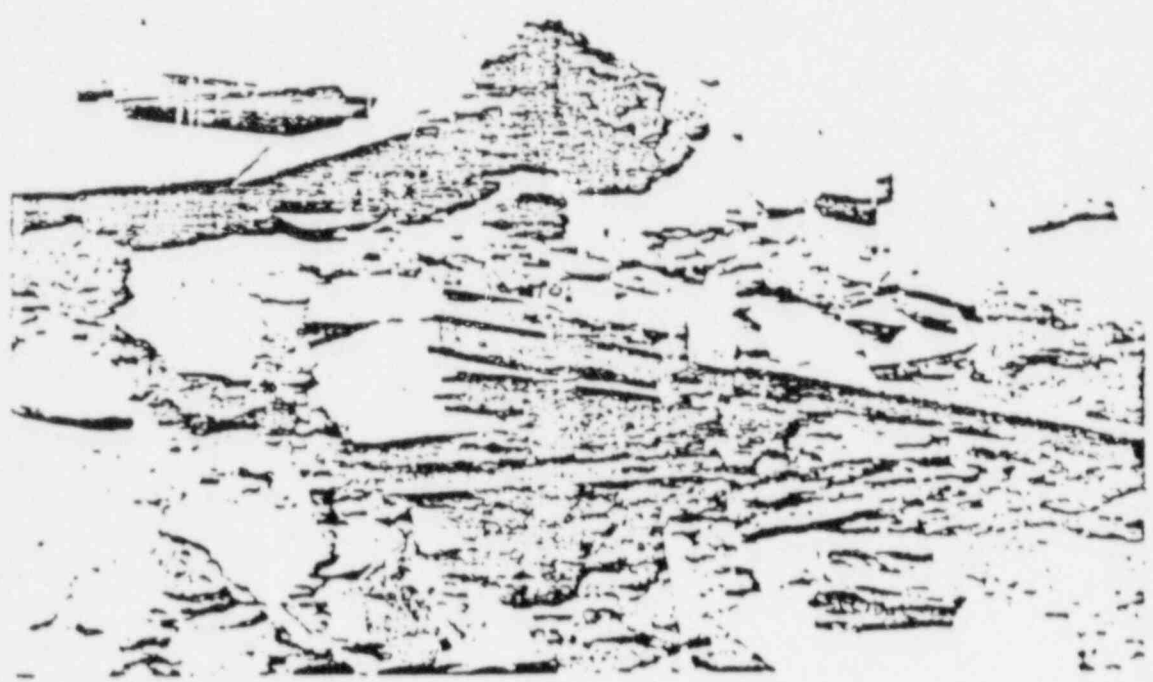
NSION TEST



TEST APPARATUS

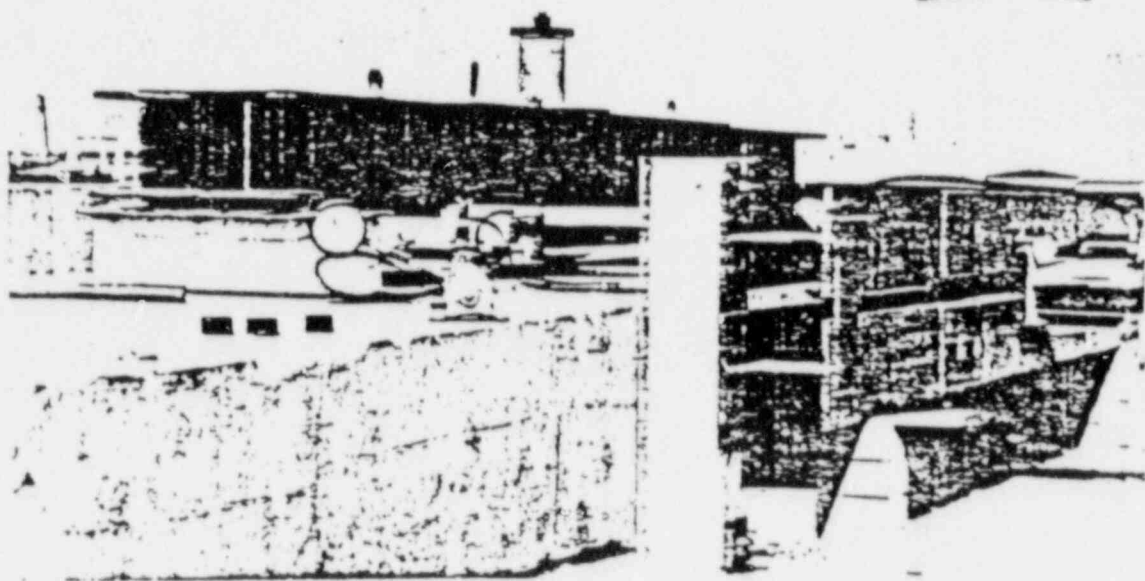


27-1 1/2" TOP APPROXIMATE

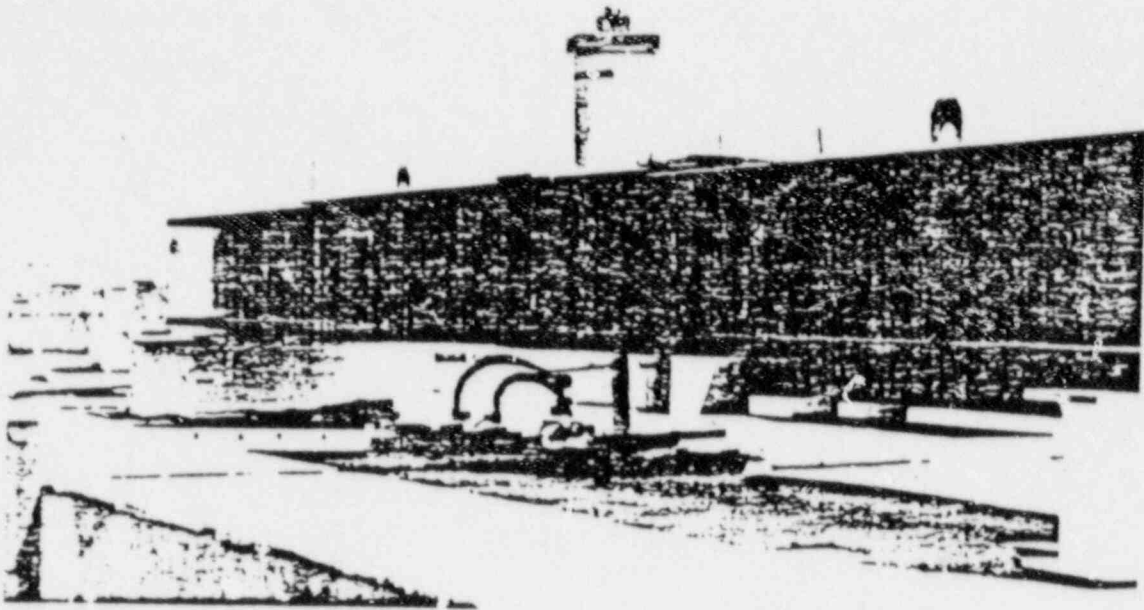


27-1 1/2" TOP APPROXIMATE

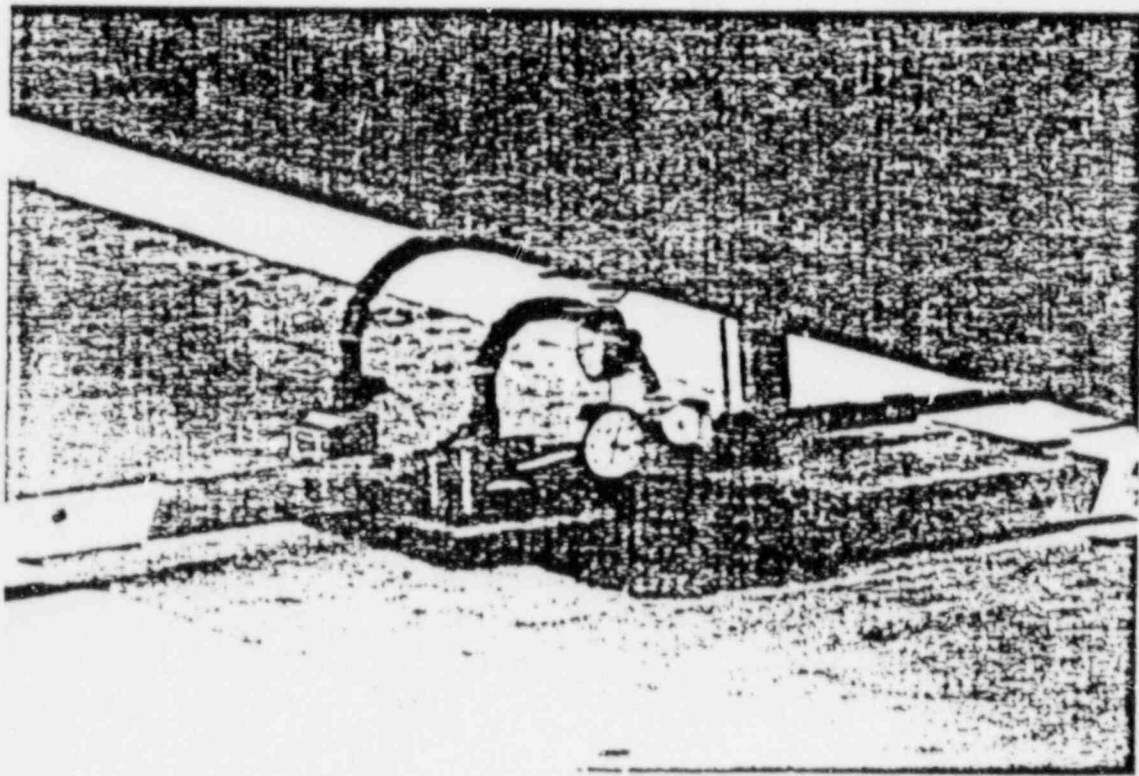
COMBINED SHEAR AND TENSION
TEST



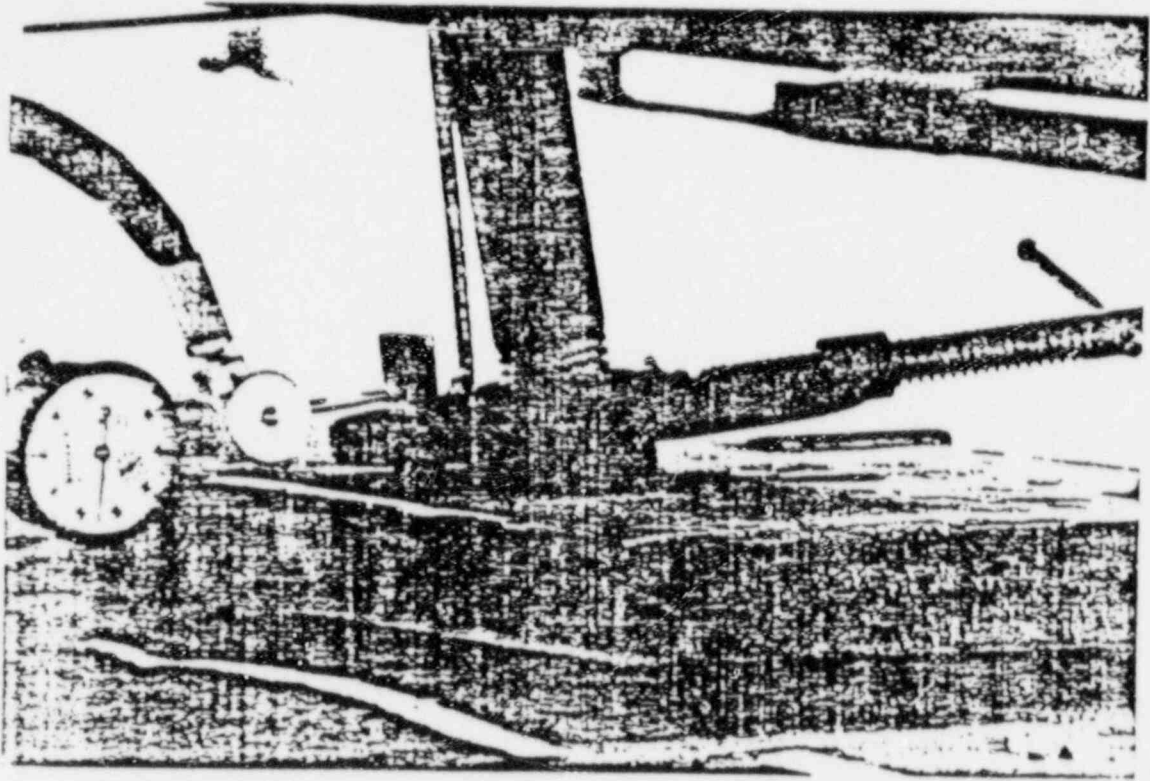
— TEST APPARATUS



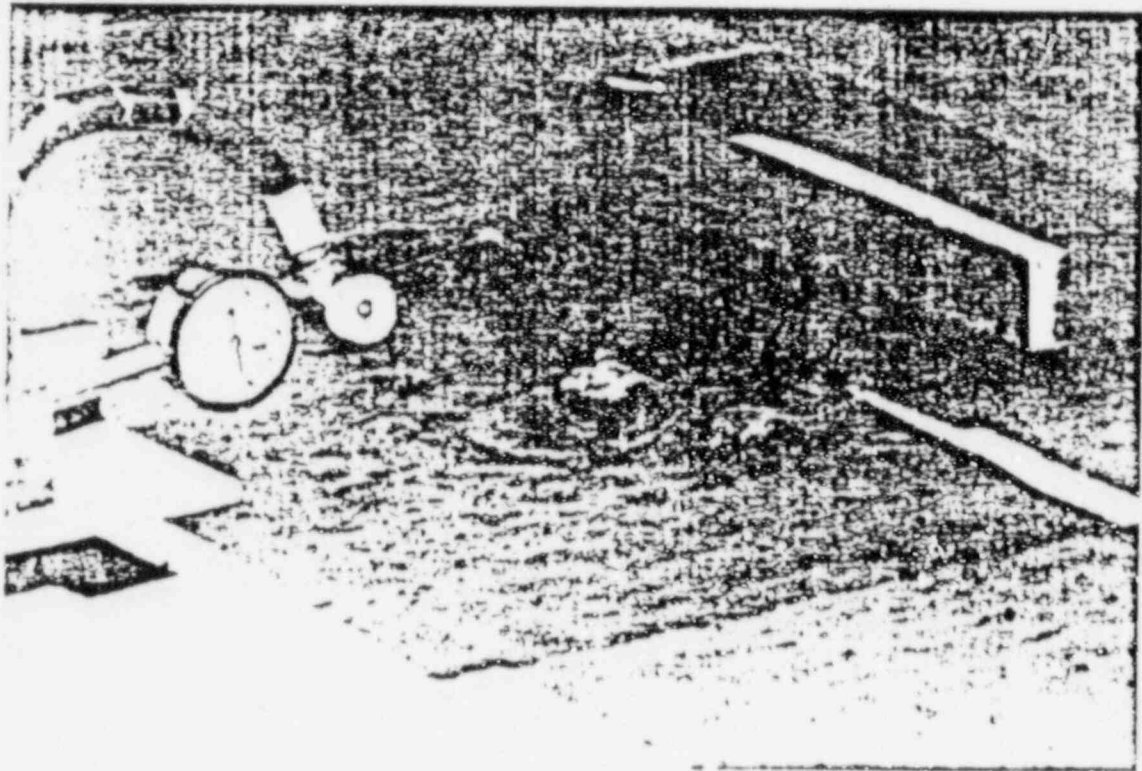
TEST APPARATUS



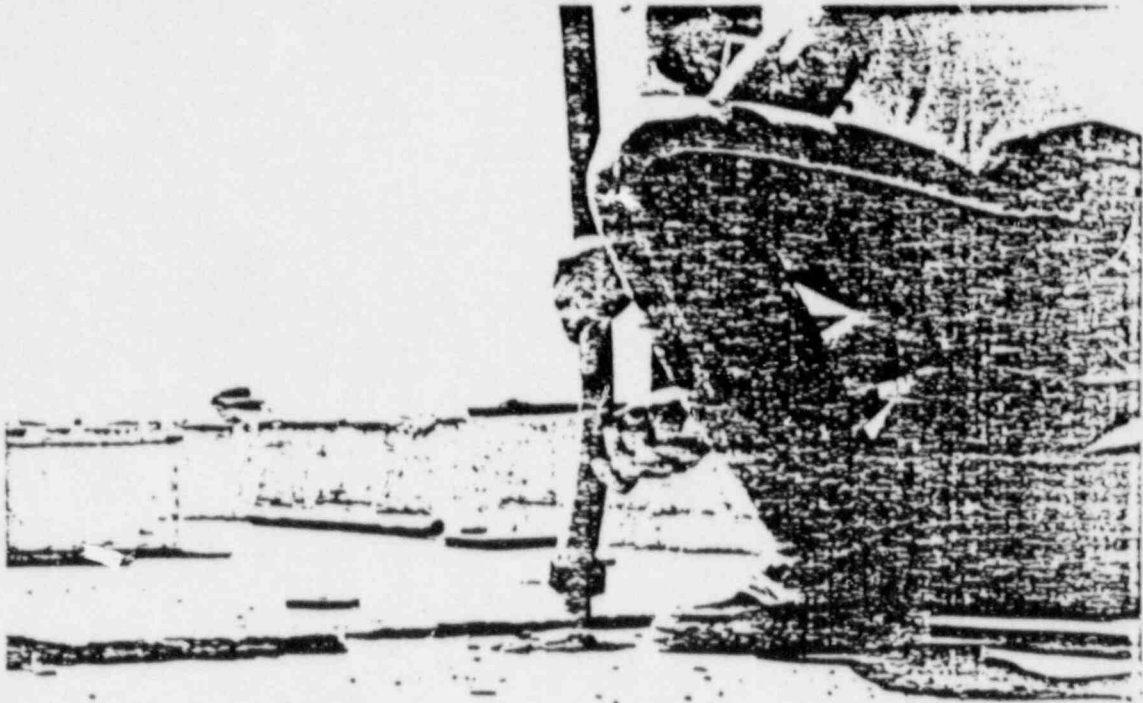
DIAL INDICATOR ARRANGEMENT



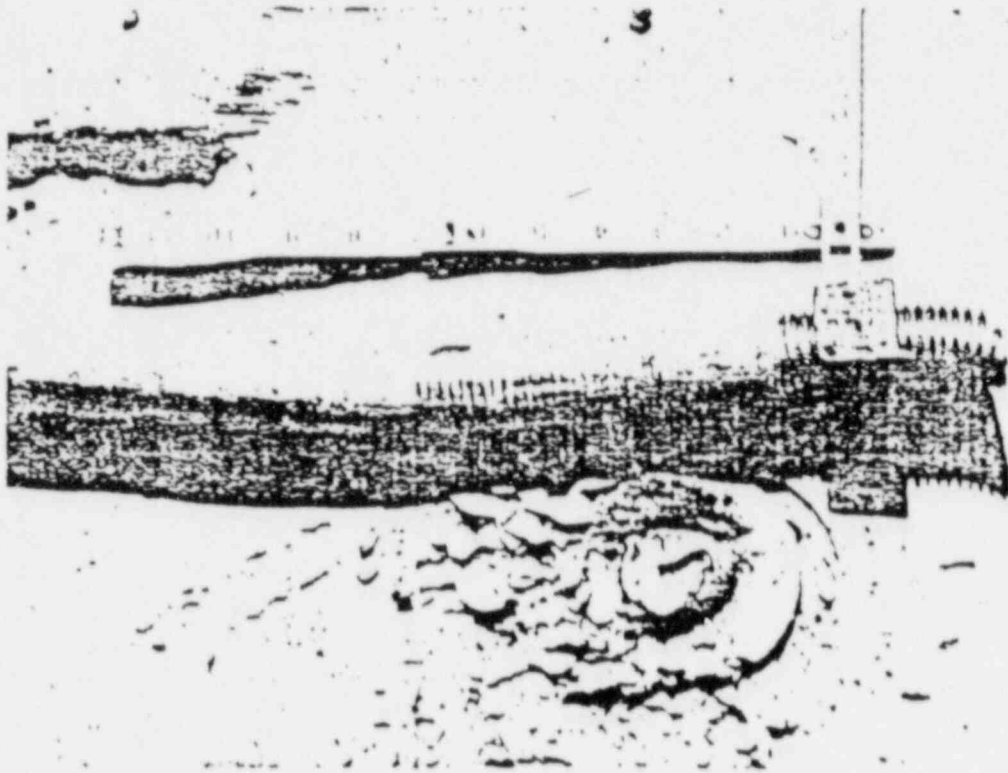
1/2-INCH SPECIMEN JUST PRIOR TO FAILURE



1/2-INCH SPECIMEN AT FAILURE



16-1114 FAILED SPECIMEN



TYPICAL FAILURE

COMPARISON PLAR SES
COMBINED SHEAR & TENSION TESTS
 Richmond / Inch, Type ²⁰/₃₂ Insert
 Reference: CP 11-13.0 9/1/54

Specimen Number: 21 (6 1/4" diam. Hex. Rod) Inverted Load Rod: A-193 Date: 9 Apr 54

SHEAR		TENSION		Gauge Press. (PSI)	2-4 Jack Thrust (lb.)	Gauge Press. (PSI)	1-4 Jack Thrust (lb.)	Deflection (Inch) After 2-Min.	Deflection (Inch) After 2-Min.	Insert Load (lb.)	Net Jack Thrust (lb.)
Gauge Press. (PSI)	Jack Thrust (lb.)	Deflection (Inch) Int.	Deflection (Inch) Int.								
400	5,300	0.000	0.020		5,300			0.000	0.020		
800	10,600	0.001	0.000		10,600			0.000	0.000		
1200	15,900	0.015	0.022		15,900			0.022	0.022		
1600	21,200	0.173	0.044		21,200			0.044	0.044		
2400	26,500	0.330	0.111		24,100			0.111	0.052		
2900	27,225	0.400	0.154		27,225			0.154	0.134		

1-4 Jack Thrust = Shear Load on Insert.
 1-4 Jack Thrust (lb.) = Gauge Pressure (PSI) x (2.25" for Shear Load).
 2-4 Jack Thrust (lb.) = Gauge Pressure (PSI) x (2.25" for Tension Load).
 Total Wt. of Tension Load Beam = N/A lb.
 4-4 Jack Thrust = Total Thrust = 27,225 lb.
 Insert Load = 444 lb. Jack Thrust = 27,225 lb.

Notes - Failure Mode

Sound of a weld breaking, with associated 2 1/2" gap in 1/2" insert washer, pulled out laterally 1/2". Some bending of rod but fractured surface indicated a shear break. Top of insert rotated thru.

Concrete cracked all around & about 12" dia. 1/2" deep & insert, new duct & cage.

Shear Apparatus: Jack - Equipment No: ACN 606
 Pressure Gauge-MHI No: 2355 Due Date: 1-31-54
 Dial Gauge-MHI No: 2749 Due Date: 29 Jan 54
 Tension Apparatus: Jack - Equipment No: ACN 6037
 Pressure Gauge-MHI No: 2750 Due Date: 18 Jan 54
 Dial Gauge-MHI No: 2750 Due Date: 18 Jan 54

Witnessed By: J. C. H. H. H. Date: 4-7-54
 Representative

Performed By: J. C. H. H. H. Date: 9 Apr 54

CONRAD PEAR SES
CORBIER & HERSTON TESTS
Richmont / - Inch. Type ²² Insert
Reference: CP (1) 11.0 @ 17,000

Specimen Number: 22 (17M Test - MS-17)
Date: 9 April 68

Inserted Load Rod: A-191

Comment	SHEAR		Gauge Press. (PSI)	2- [*] Jack Thrust (lb.)	1- [*] Jack Thrust (lb.)	Deflection (Inch) After 2-Min.	Deflection (Inch) After 2-Min.	Insert Load (lb.)	1- [*] Jack Thrust (lb.)
	1- [*] Jack Thrust (lb.)	2- [*] Jack Thrust (lb.)							
	2,300	5,800	0.004	0.004	0.001	0.001	0.001	0.001	0.001
	10,600	10,600	0.07	0.07	0.19	0.19	0.19	0.19	0.19
	15,800	15,900	0.09	0.09	0.255	0.26	0.255	0.26	0.26
	21,000	21,200	0.05	0.05	0.53	0.50	0.53	0.50	0.50
	25,500	29,150	0.24	0.24	1.1	1.15	1.1	1.15	1.15
	29,150	23,800	0.52	0.52	1.6	1.6	1.6	1.6	1.6
	23,800	19,875	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	19,875	19,875	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Notes - Failure Mode
 wear broke - sharp noise. Concrete unknown
 Rod sheared. Rod had rotated @ shear
 line. Wire springs, 20" when broke.
 Concrete spalled approx 15" diameter,
 being 15" on tension side & 3" on comp. (Round
 shear rods) side 2" deep @ inward.
 Latex contained intact.

Shear Apparatus: Jack - Equipment No: RCN 606
 Pressure Gauge-MHE No: 2353 Due Date: 16 Apr 68
 Dial Gauge-MHE No: 2882 Due Date: 22 Oct 68
 Tension Apparatus: Jack-Equipment No: RCN 6037
 Pressure Gauge-MHE No: 2710 Due Date: 18 Oct 68
 Dial Gauge-MHE No: 2078 Due Date: 18 Oct 68

1-^{*} Jack Thrust = Shear Load on Insert.
 1-^{*} Jack Thrust (lb.) = Gauge Pressure (PSI) x 18.25 for Shear Load.
 2-^{*} Jack Thrust (lb.) = Gauge Pressure (PSI) x 17.25 for Tension Load.
 Total Wt. of Tension Load Beam = 11.9 lb.
 1-^{*} Jack Thrust = Total Force minus 1/2 Wt. of Beam.
 2-^{*} Insert Load = 4x1 Jack Thrust Load = 2 x 22

Performed By: J. C. McWhorter 8 Apr 68
 Date: 8 Apr 68
 Witnessed By: A. C. Ricketts 9 Apr 68
 Date: 9 Apr 68
 QA Representative

CRIMMIE PEAK SES
 COPBIBB JAWB & HURSTON 11515
 Richmond 7 - Inch, Type ^{SC-24} Insert
 Reference: CP 11-11-0-9, 24

Specimen Number: 23 (1/4 from west end)

Date: 2 Apr 54

Gauge Press. (PSI)	SHEAR		Gauge Press. (PSI)	HERSTON		Insert Load (lb.)	Deflection (Inch) After 2 Hrs.
	1- Jack Thrust (lb.)	Deflection (Inch) Int.		2- Jack Thrust (lb.)	Deflection (Inch) Int.		
400	5300	0.002	5300	0.005			
800	10600	0.075	10600	0.08			
1200	15900	0.122	15900	0.234			
1600	21200	0.290	21200	0.75			
2000	26500	0.350	26500	1.40			
2200	29100	0.430	29100	1.20			
2300	30975	0.50	30475				

Notes - Failure Mode

Deflection increased rapidly. About failure by shear of rod. Insert washer moved horizontally 1/8". No breakage of insert. Rod rotated some 30° above threads of insert. This permitted by crushing of concrete and probably deformation of threaded coil and failure was by shear after considerable deformation.

Shear Apparatus: Jack - Equipment no. NCH 600
 Pressure Gauge-BHI No. 2755 Due Date: 6, Apr 54
 Dial Gauge-BHI No. 2757 Due Date: 24 Jun 54
 Test Apparatus: Jack Equipment No. NCH 600T
 Pressure Gauge-BHI No. 2755 Due Date: 6, Apr 54
 Dial Gauge-BHI No. 2757 Due Date: 24 Jun 54

Witnessed By: Richard R. Kelly Date: 4-12-54
 Representative

1- Jack Thrust = Shear Load on Inserts.
 1- Jack Thrust (lb.) = Gauge Pressure (PSI) x 17.25 for Shear Load.
 2- Jack Thrust (lb.) = Gauge Pressure (PSI) x 17.25 for Tension Load.
 Total Mt. of Tension Load Beam = 47 lb.
 3- Net Jack Thrust = Jack Thrust minus 1/2 Mt. of Beam.
 4- Insert Load = 4-4 Jack Thrust - 2.30

Performed By: J. C. Hewitt Date: 10 Apr 54
 Name

COMPARICH PEAK SES
COMBINED SHEAR & TENSION TESTS
Richmond / - Inch, Type Insert
Reference: CP 11-13.0 9.9.29

Specimen Number: 24 (4th from west end) Date: 10 April 44

Gauge Press. (PSI)	SHEAR		Gauge Press. (PSI)	Jack Thrust (lb.)	Net Jack Thrust (lb.)	Insert Load (lb.)	Deflection (Inch)	
	1-*	2-*					Init.	After 2 Min.
400	5,300	5,500					0.002	0.002
800	10,600	10,600					0.065	0.065
1200	15,900	15,900					0.27	0.30
1600	21,200	21,200					0.62	0.64
2000	26,500	26,500					1.35	1.59
2400	31,800	27,425	N/A	N/A	N/A		1.7	
2800	37,100	27,825	N/A	N/A	N/A		2.0	
3200	42,400	29,150					2.27	
3600	47,700	29,150					2.27	
4000	53,000	26,500						

Notes - Failure Mode

Break. Abrupt shear failure of test. Splice of horizontal deflection of top of insert permitted by rotation crushing of concrete and delamination of upper coil of insert. Concrete spalled 2" deep on top of insert. Table 2 of insert seems to have tilted 5" (1) least lateral.

Shear Apparatus: Jack - Equipment No. NCA 506
Pressure Gauge - BHI No. 2355 Due Date: 6-30-44
Dial Gauge - BHI No. 2939 Due Date: 8-30-44

Tension Apparatus: Jack - Equipment No. NCA 5037
Pressure Gauge - BHI No. 5012 Due Date: 8-30-44
Dial Gauge - BHI No. 2074 Due Date: 8-30-44

Witnessed By: J. C. Richmond, 10 June 44
Date

Witnessed By: J. C. Richmond, 10 April 44
Date

CORONA PEAK SFS
CORBIER SHEAR & TENSION TESTS
Richmond 7 - Inch, Type $\frac{22}{24}$ - 24W
Reference: CP 11-13-0-9-20

Date: 10 April 84

Specimen Number: 25 (10th Green Window) Insert Load Rod: A-193

Gauge Press. (PSI)	SHEAR		Gauge Press. (PSI)	2" Jack Thrust (lb.)	Net Jack Thrust (lb.)	Insert Load (lb.)	Deflection (Inch)		Notes - Failure Mode
	1" Jack Thrust (lb.)	After 2 Min.					Init.	After 2 Min.	
400	5300	0.003	0.0015	5300			0.000	0.000	
800	10600	0.056	0.028	10600			0.025	0.009	
1200	15900	0.115	0.022	15900			0.105		
1600	21200	0.217	0.229	21200			0.006	0.010	
2000	26500	0.260	0.304	26500			0.017	0.023	
2400	27825	0.320		27825			0.020		
2800	28987	0.400		28987			0.080		

Notes - Failure Mode:
Abrupt break, insert deflected 1/2" (1/2")
and failed in shear.

Shear Apparatus: Jack - Equipment No: RCH 606
Pressure Gauge - MHI No: 2355 Due Date: 12/29/84
Dial Gauge - MHI No: 2474 Due Date: 2/2/84
Tension Apparatus: Jack - Equipment No: RCH 603T
Pressure Gauge - MHI No: J2222 Due Date: 12/29/84
Dial Gauge - MHI No: 2044 Due Date: 12/29/84

1" Jack Thrust = Shear Load on Insert.
1" Jack Thrust (lb.) = Gauge Pressure (PSI) x 19.25 for Shear Load.
2" Jack Thrust (lb.) = Gauge Pressure (PSI) x 13.25 for Tension Load.
Total lb. of Tension Load Beam = N/A
Net Jack Thrust = Total Thrust minus 177 lb. of beam.
Insert Load = Net Jack Thrust x 2.

Performed By: J.C. Gilchrist 10 April 84
Date: 10 April 84
Representative: R.A. Richey Date: 4-12-84

PEAK SES
TENSION TESTS

RICHMOND 1 -INCH, TYPE EC-2W INSERT

Reference: CP-EI-13.0-1390*

Specimen Number: 26 Load Rod Spec: A-193 Date: 6 Apr '84
~~11" dia~~ from west end, 5" from east

GAUGE PRESS. (P.S.I.)	JACK THRUST (Lb.)	NET JACK THRUST (Lb.)	INSERT LOAD (Lb.)	DEFLECTION (IN.)		NOTES-FAILURE MODE
				INIT.	AFTER 2-MIN.	
200	2650	1225	2850	0.000	0.000	
400	5300	4075	8150	.003	.003	
600	7950	6725	13450	.007	.0075	
800	10600	9375	18750	.012	.0125	
1000	13250	12025	24050	.0175	.019	
1200	15900	14675	29350	.037	.038	
1400	18550	17325	34650	.070	.070	
1600	21200	19975	39950	.098	.105	
1700	22525	21300	42600	.134		Failure.
<p>Insert remained intact. Shear cone type failure of concrete. Insert was located near center between E-W & N-S rebar. Cone was restricted somewhat by 4-bar 2-each way. Some lifting force caused concrete to spall 3-ft. ea. side of insert. Shear cone depth = full height of insert less 1/4" @ bottom.</p>						

- * Jack Thrust (Lb.) = Gauge Pressure (PSI) x 13.25
- Total Weight of Load Beam = 2450
- ** Net Jack Thrust = Total Thrust Minus 1/2 Weight of Beam. ($\frac{1}{2}$ wt. = 1225-16)
- *** Insert Load = Net Jack Thrust x 2.
- Jack: Equipment Number ACH 606

Pressure Gauge: M & TE Number 2353 Due Date: 16 Apr '84
 Dial Gauge: M & TE Number 2944 Due Date: 29 Jun '84

Performed By: C. B. White 6 Apr '84
 Name Date

Witnessed By: Richard R. ... 5.5.84
 QA representative Date

COMANCHE PD SES
TENSION TESTS

RICHMOND / -INCH, TYPE ^{2" C-2W} INSERT

Reference: CP-EI-13.C ~~13~~ 13204

Specimen Number: 27

Load Rod Spec: A-193

Date: 6 Apr '84

~~12" from~~ from West End ~~4" from~~ east

GAUGE PRESS. (P.S.I.)	JACK THRUST (Lb.)	NET JACK THRUST (Lb.)	INSERT LOAD (Lb.)	DEFLECTION (IN.)		NOTES-FAILURE MODE
				INIT.	AFTER 2-MIN.	
200	2650	1225	2850	0.000	0.000	
400	5300	2450	5150	.000	.000	
600	7450	3675	7450	.000	.000	
800	10600	4900	12750	.0005	.0005	
1000	13250	6125	24050	.0005	.0075	
1200	15900	7350	34350	.0165	.0175	
1400	18550	8575	34050	.050	.056	
1600	21200	9800	39950	.080	.092	
1750	23188	11025	43920	.146		Failure

Failure occurred by failure of the insert. Weld between lower coil and vertical struts broke. Threaded, upper, coil came out and carried the two struts with. Concrete spalled an oval area about 1.5' x 2.25' max depth 2" @ insert. Exposed one rebar located 3" o.c. from insert. Rebar not disturbed. Only concrete cover removed.

- * Jack Thrust (Lb.) = Gauge Pressure (PSI) x 13.25
Total Weight of Load Beam = 2450
- ** Net Jack Thrust = Total Thrust Minus 1/2 Weight of Beam. ($\frac{1}{2}$ Wt. = 1225)
- *** Insert Load = Net Jack Thrust x 2.
- Jack: Equipment Number RCH 606
- Pressure Gauge: M & TE Number 2355 Due Date: 16 Apr '84
- Dial Gauge: M & TE Number 2949 Due Date: 29 Jun '84

Performed By: G. C. Libbeth 6 Apr '84
Name Date

Witnessed By: R. J. ... 6 Apr '84
QA representative Date

COMANCHE PEAK
TENSION TESTS

RICHMOND 1 -INCH, TYPE EC-2W INSERT

Reference: CP-61-13.0 13.204

Specimen Number: 28
(3' from east end)

Load Rod Spec: A-193

Date: 10 April '84

GAUGE PRESS. (P.S.I.)	JACK THRUST (Lb.)	NET JACK THRUST (Lb.)	INSERT LOAD (Lb.)	DEFLECTION (IN.)		NOTES-FAILURE MODE
				INIT.	AFTER 2-MIN.	
200	2650	1425	2850	0.000	0.000	
400	5300	4075	8150	.000	.000	
600	7950	6725	13450	.000	.000	
800	10600	9375	18750	.002	.002	
1000	13250	12025	24050	.004	.005	
1200	15900	14675	29350	.009	.010	
1400	18550	17325	34650	.015	.029	
1500 1550	20538	19318	38426	.055	-	
1600	21200	19975	39950	.067	.082	
1700 1700	22525	21300	42600	.15		Concrete shear
1800 1900 2000						Cone failure. Insert and rod remained intact. Cone height equal insert height. Size of cone too limited by rebar area area. Rebars lifted with cone and lifted area 45' x 3.5'. Rebars @ 9" o.c. E.W.

- * Jack Thrust (Lb.) = Gauge Pressure (PSI) x 13.25
- Total Weight of Load Beam = 2450
- ** Net Jack Thrust = Total Thrust Minus 1/2 Weight of Beam. ($\frac{1}{2}$ Wt. = 1225 Lb)
- *** Insert Load = Net Jack Thrust x 2.

Jack: Equipment Number ACH 606

Pressure Gauge: M & TE Number 2355 Due Date: 16 Apr '84

Dial Gauge: M & TE Number 2049 Due Date: 18 Jun '84

Performed By: B.C. Feltz
Name Date

Witnessed By: Alan Peterson
QA Representative Date

COMANCHE PEAK SES
TENSION TESTS

EC-2W
RICHMOND / -INCH, TYPE _____ INSERT

Reference: CP-EI-13.0 ~~13~~ ²⁰⁴

Specimen Number: 29 Load Rod Spec: A-192 Date: 6 April '84
(2nd from East 14th fr. West)

GAUGE PRESS. (P.S.I.)	JACK THRUST (Lb.)	NET JACK THRUST (Lb.)	INSERT LOAD (Lb.)	DEFLECTION (IN.)		NOTES-FAILURE MODE
				INIT.	AFTER 2-MIN.	
200	2450	1225	2850	0.000	0.000	
400	5300	4075	8150	.005	.005	
600	7950	6725	13450	.009	.009	
800	10600	9375	18750	.0125	.015	
1000	13250	12025	24050	.021	.022	
1200	15900	14675	29350	.033	.037	
1400	18550	17325	34650	.101	.104	
1600	21200	19975	39950	.135	.145	
1800						
2000						
1700	22525	21300	42600			Concrete failed by the load on insert lifting the rebar mat. Areas some 3.5' x 6.0' failed in this manner when insert pulled out taking a small cone with it. Top rebar was placed in contact with insert, thus contributing to the cause of this large area concrete failure.

- * Jack Thrust (Lb.) = Gauge Pressure (PSI) x 13.25
- Total Weight of Load Beam = 2450
- ** Net Jack Thrust = Total Thrust Minus 1/2 Weight of Beam. ($\frac{1}{2} W.B. = 1225$)
- *** Insert Load = Net Jack Thrust x 2.
- Jack: Equipment Number RCH 606

Pressure Gauge: M & TE Number 2355 Due Date: 16 Jan '84
Dial Gauge: M & TE Number 2949 Due Date: 29 Jan '84

Performed By: Cliff Barrett 6 April '84
Name Date

Witnessed By: Andrew Pistrone 4 April '84
QA Representative Date

COMANCHE PEAK SES
TENSION TESTS

EC-2W
RICHMOND / -INCH, TYPE INSERT

Reference: CP-EI-13.0-F204

Specimen Number: 30

Load Rod Spec: A-93

Date: 5 April '84

(1st on east end)

GAUGE PRESS. (P.S.I.)	* JACK THRUST (Lb.)	** NET JACK THRUST (Lb.)	*** INSERT LOAD (Lb.)	DEFLECTION (IN.)		NOTES-FAILURE MODE
				INIT.	AFTER 2-MIN.	
500				0.000	0.000	
1000				0.000	0.000	
1500				0.000	0.000	
200	2650	1425	2850	0.000	0.000	
400	5300	4075	8150	0.000	0.000	
600	7950	6725	12450	.001	.001	
800	10600	9375	16750	.005	.006	
1000	13250	12025	24050	.019	.021	
1200	15900	14675	29350	.027	.049	
1400	18550	17325	34650	0.106	.109	
1600	21200	19975	39950	.153	.174	
1800						
5000	21860	20635	41270	.250		Load Peaked Out
1650						Insert failed by breaking area between lower coil and vertical struts. Upper (threaded coil) came out w/rod, also struts came out. Top concrete spalled over 18" diam. Surface spall only. Lower surface exposed. by removal of cover. Bar not deformed. Concrete

- * Jack Thrust (Lb.) = Gauge Pressure (PSI) x 15.25
- Total Weight of Load Beam = 2450
- ** Net Jack Thrust = Total Thrust Minus 1/2 Weight of Beam. ($\frac{1}{2}$ WT. = 1225)
- *** Insert Load = Net Jack Thrust x 2.
- Jack:.....Equipment Number ROH 606

Pressure Gauge: M & TE Number 2355 Due Date: 16 Apr '84
 Dial Gauge: M & TE Number 2020 Due Date: 29 Jun '84

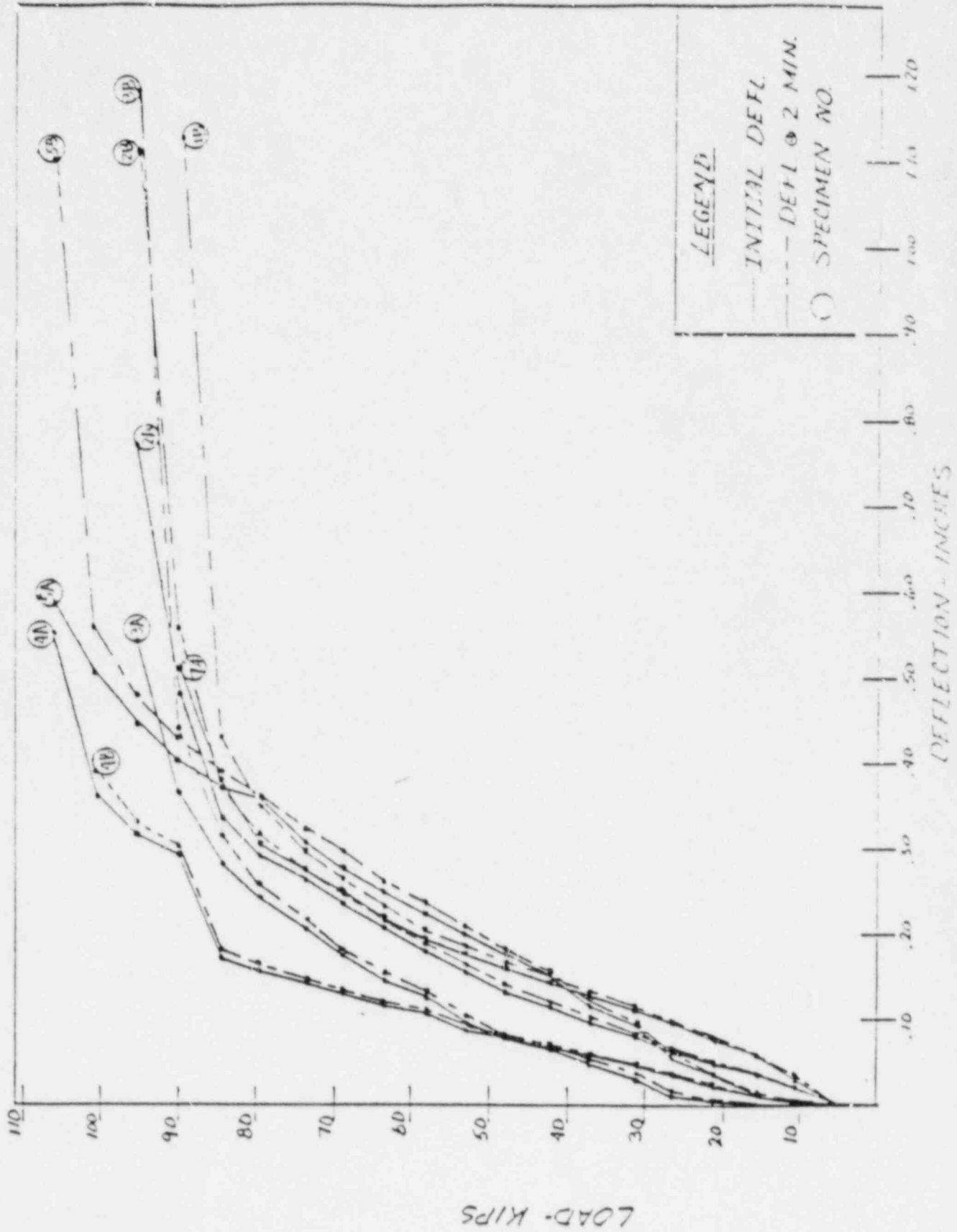
Performed By: A. C. Gilbert Date: 5 Apr '84

Witnessed By: John Peterson Date: 4.5.84
 OR Representative Date

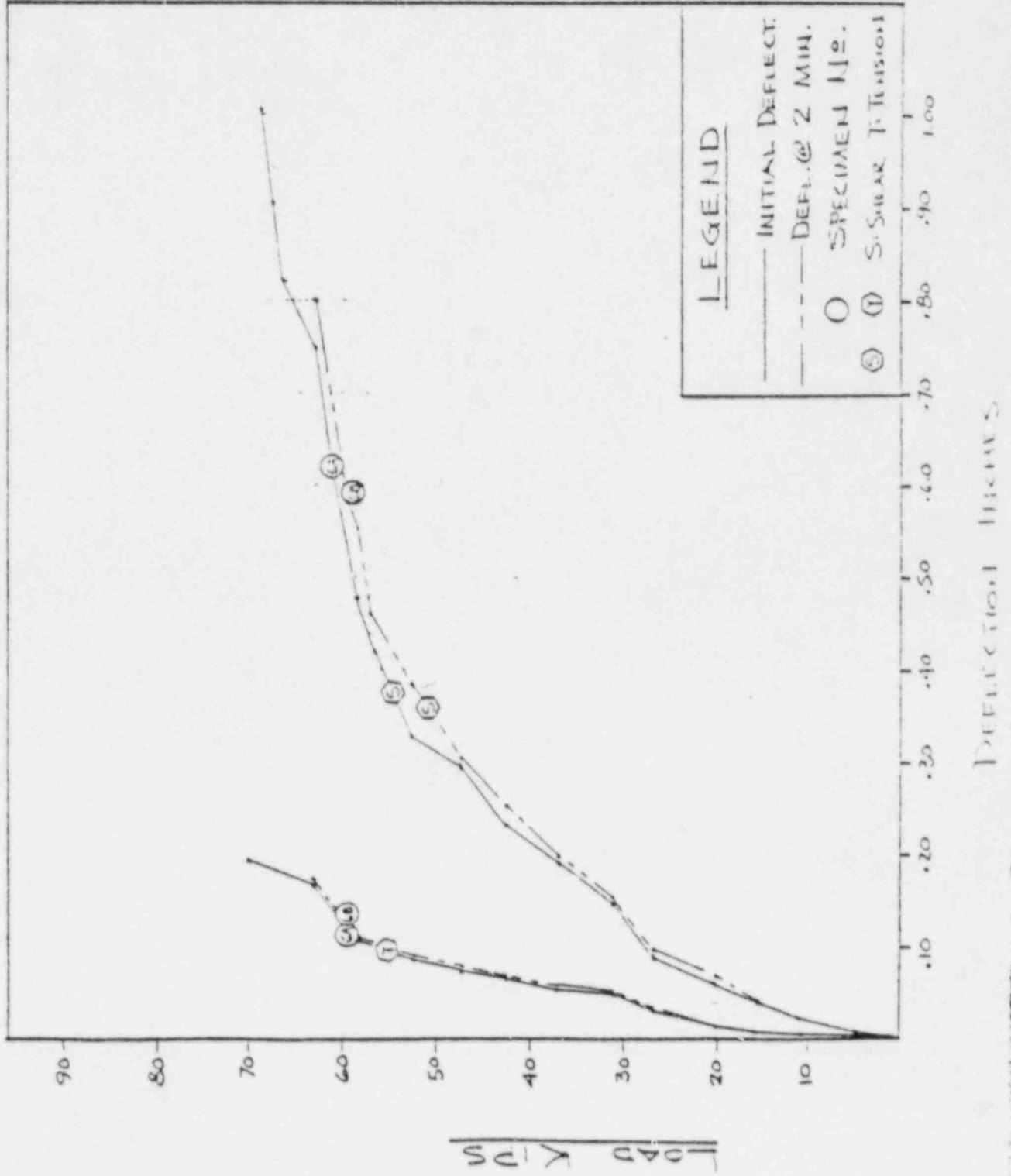
APPENDIX 3

LOAD-DEFLECTION CURVES

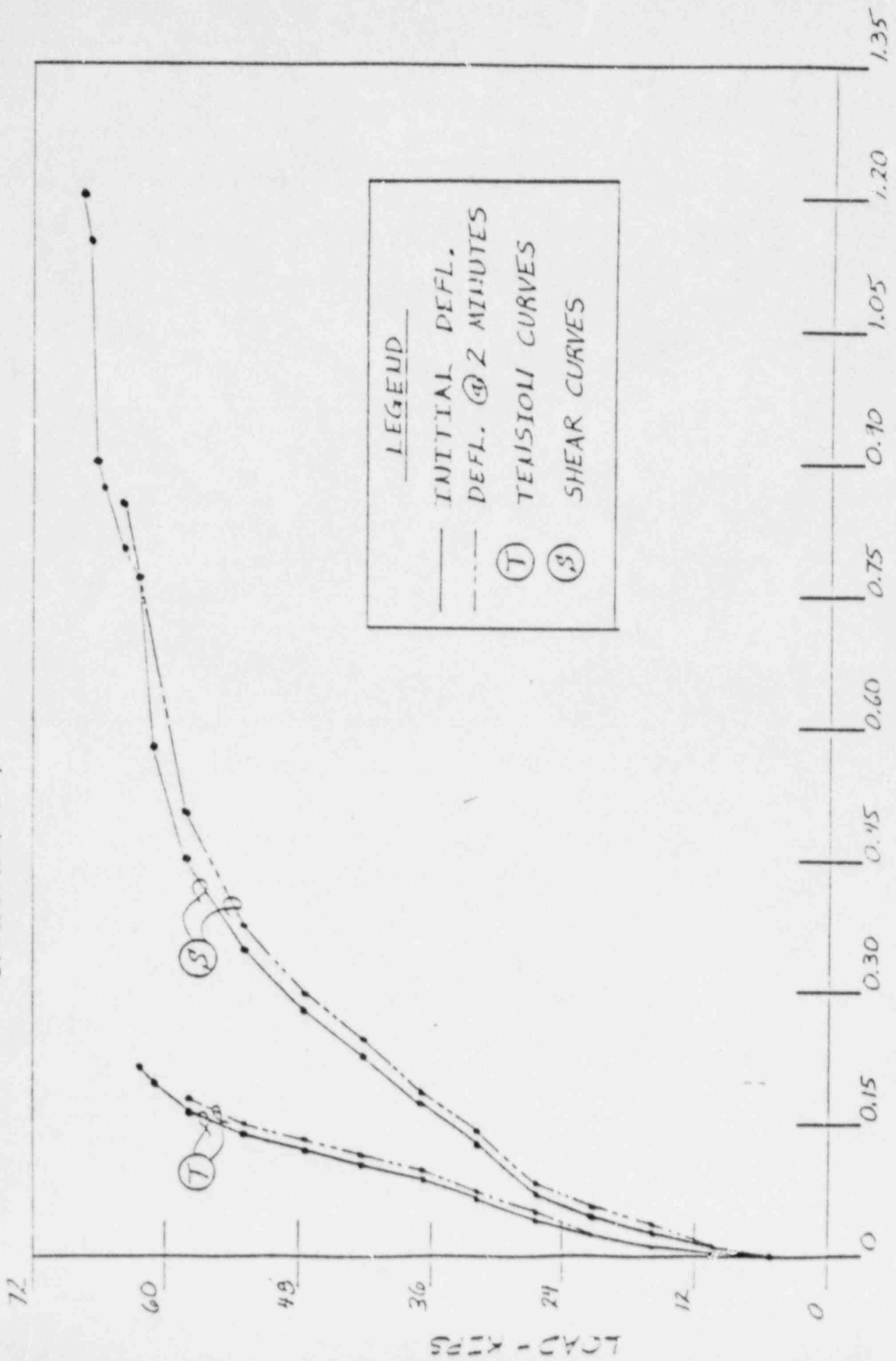
LOAD-DEFLECTION CURVES 1/2-INCH TYPE EC-6W, SHEAR TEST



COMBINED SHEAR & TENSION TEST CHART
 RICHMOND 1 1/2 INCH, TYPE EC-6W INSERT
 SPECIMAN No. 6

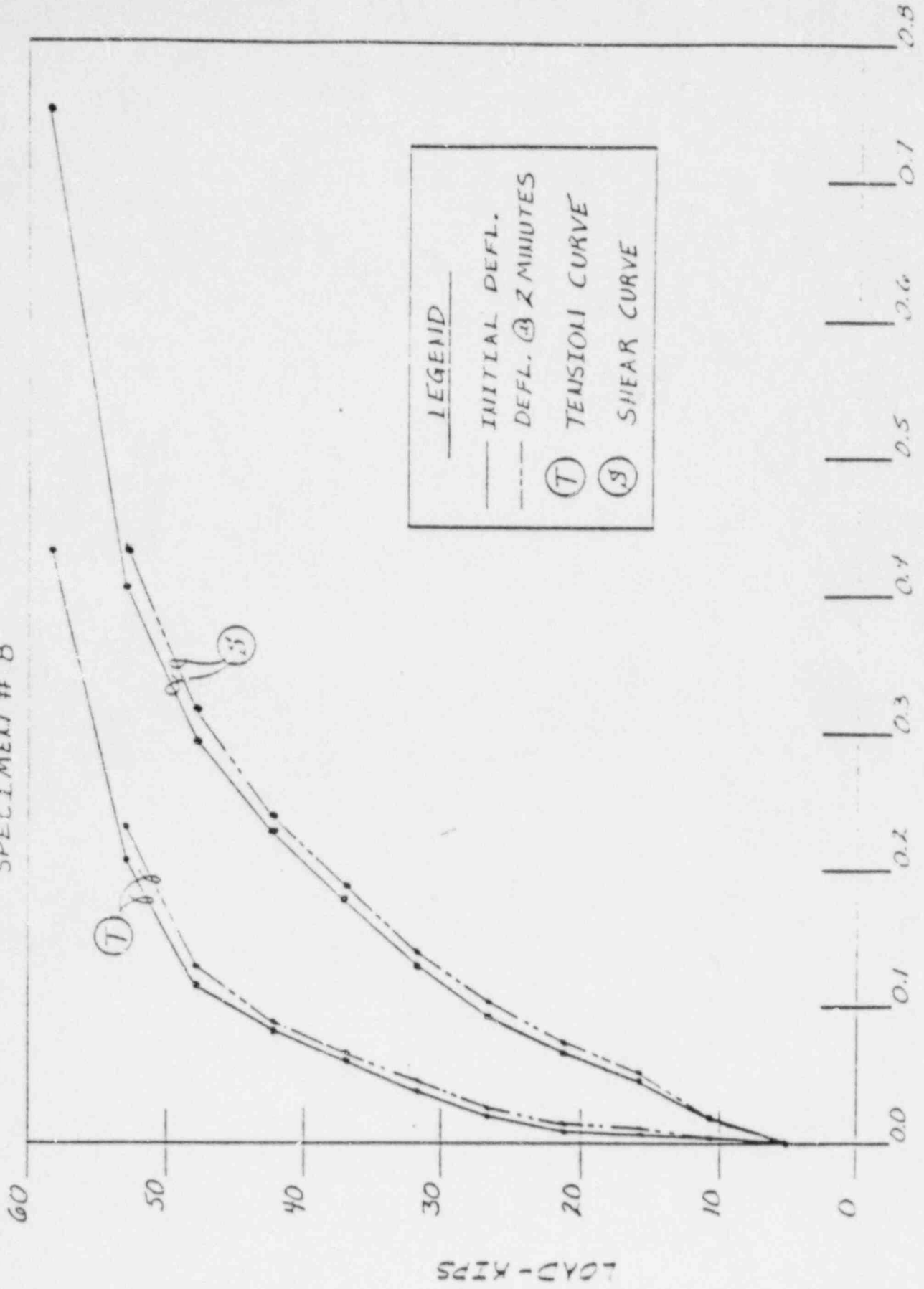


1 1/2 INCH, TYPE LC-6W
SPECIMEN # 7



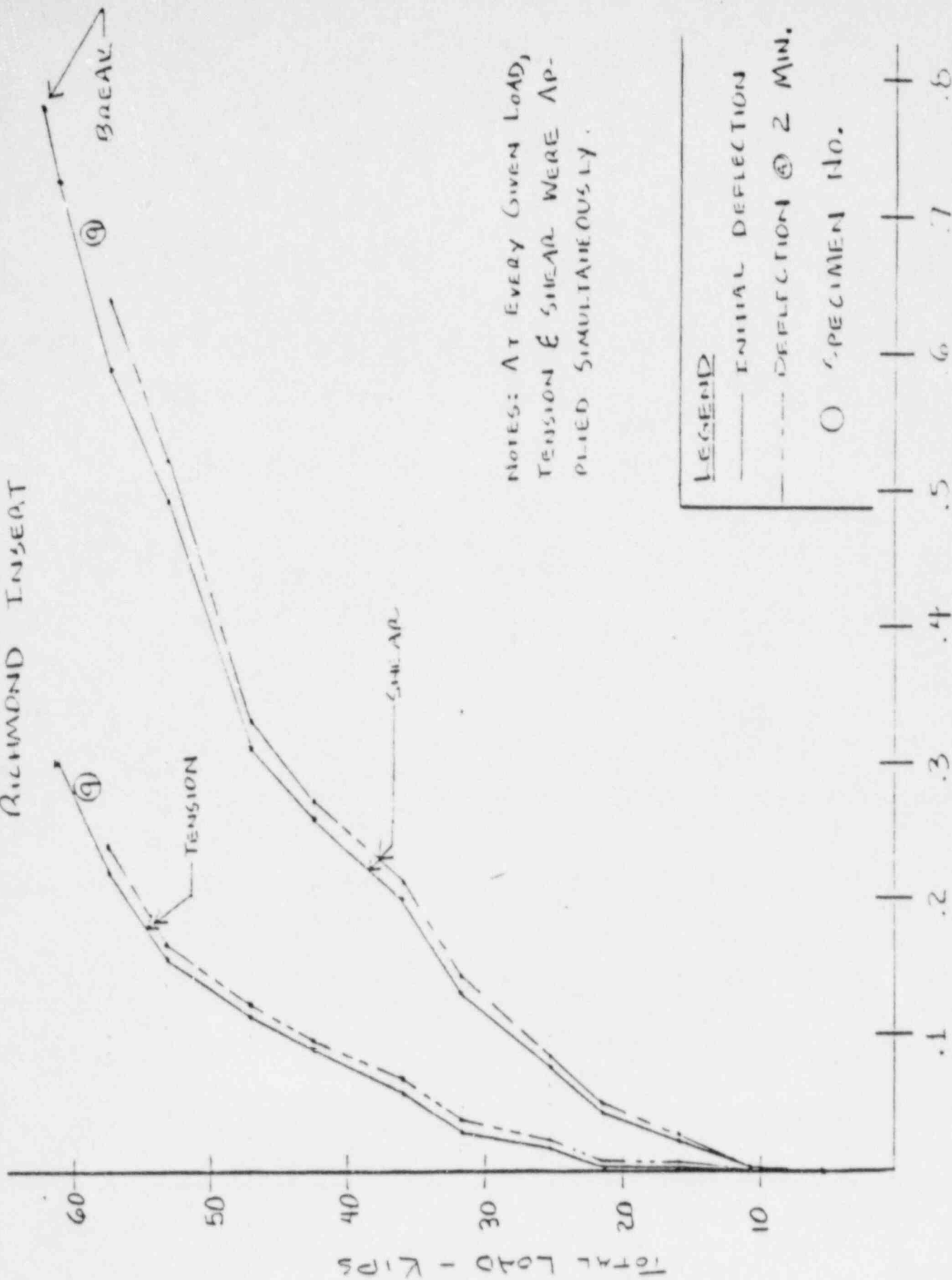
DEFLECTION - INCHES

COMBINED SHEAR & TENSION TEST CURVES
 1 1/2 INCH, TYPE EC-6W
 SPECIMEN # B



DEFLECTION - INCHES

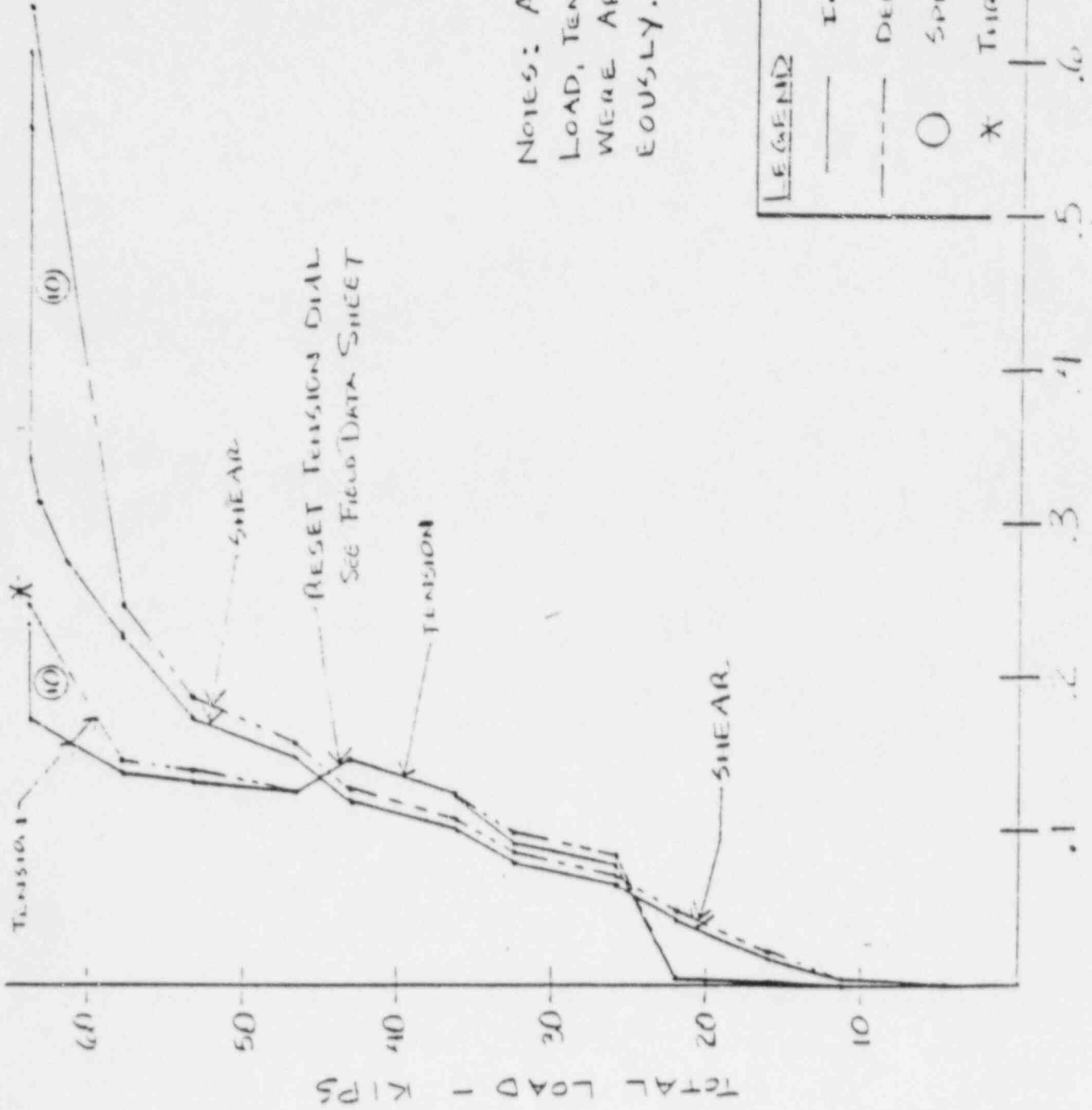
LOAD DEFLECTION CURVES FOR 1 1/2" TYPE EC-60W RICHMOND INSECT



NOTES: AT EVERY GIVEN LOAD,
TENSION & SHEAR WERE AP-
PLIED SIMULTANEOUSLY.

DEFLECTION - INCHES

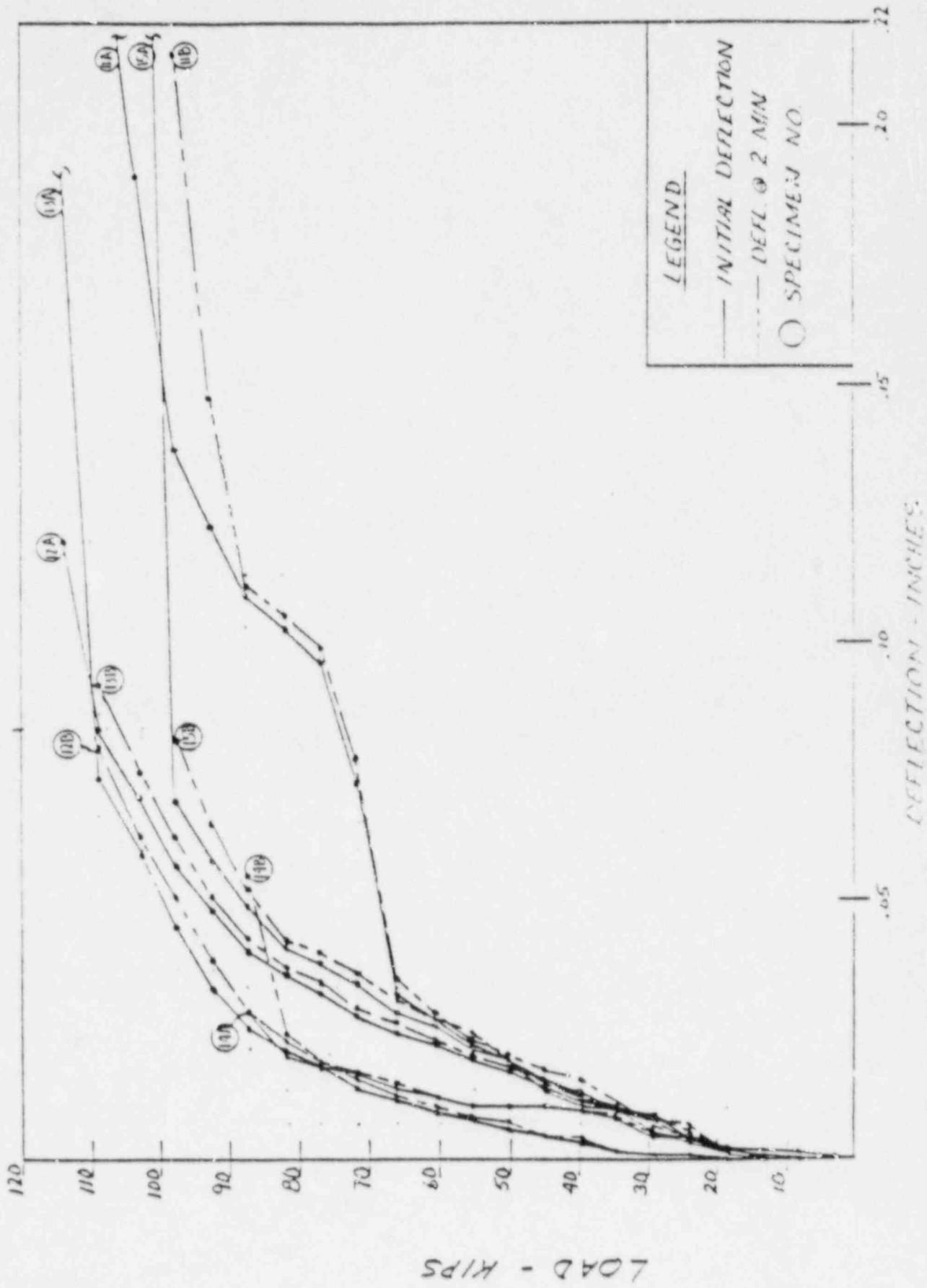
LOAD-DISPLACEMENT CURVES FOR 120-170-LL-00V
RICHMOND INSERT



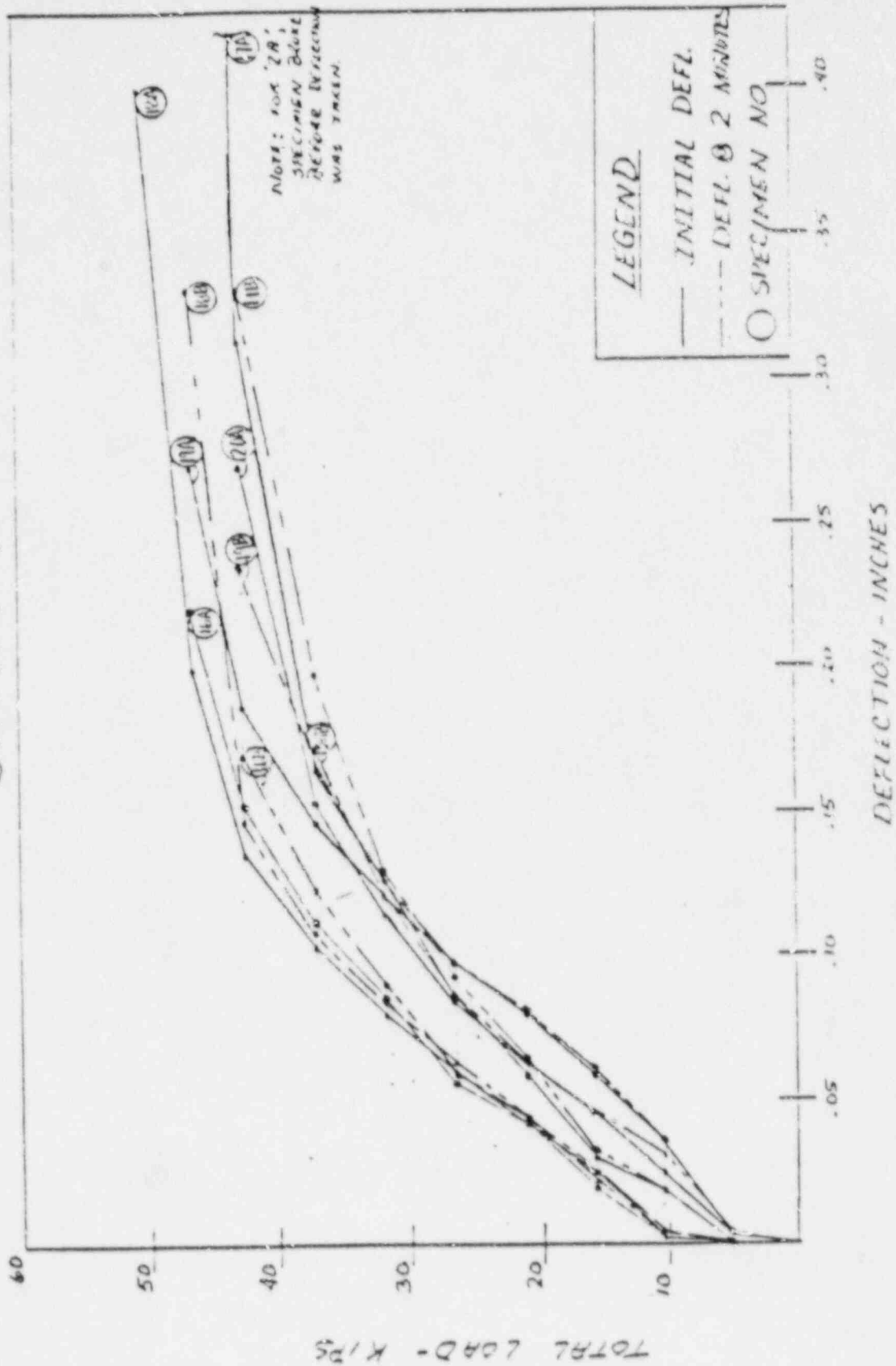
NOTES: AT EVERY GIVEN
LOAD, TENSION & SHEAR
WERE APPLIED SIMULTAN
EOUSLY.

DEFLECTION - INCHES

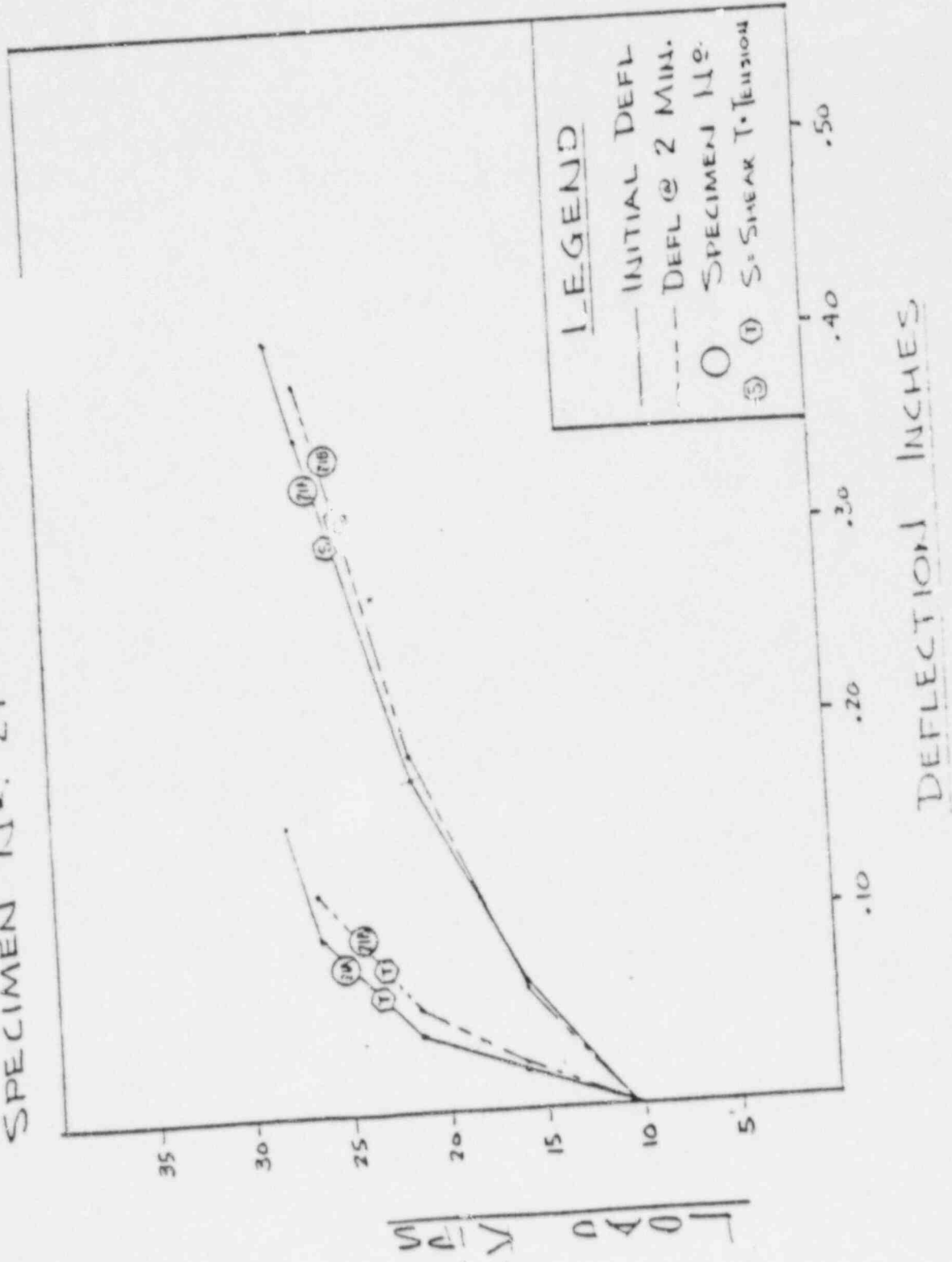
LOAD-DEFLECTION CURVES 1/2-INCH TYPE EC-6W, TENSION TEST



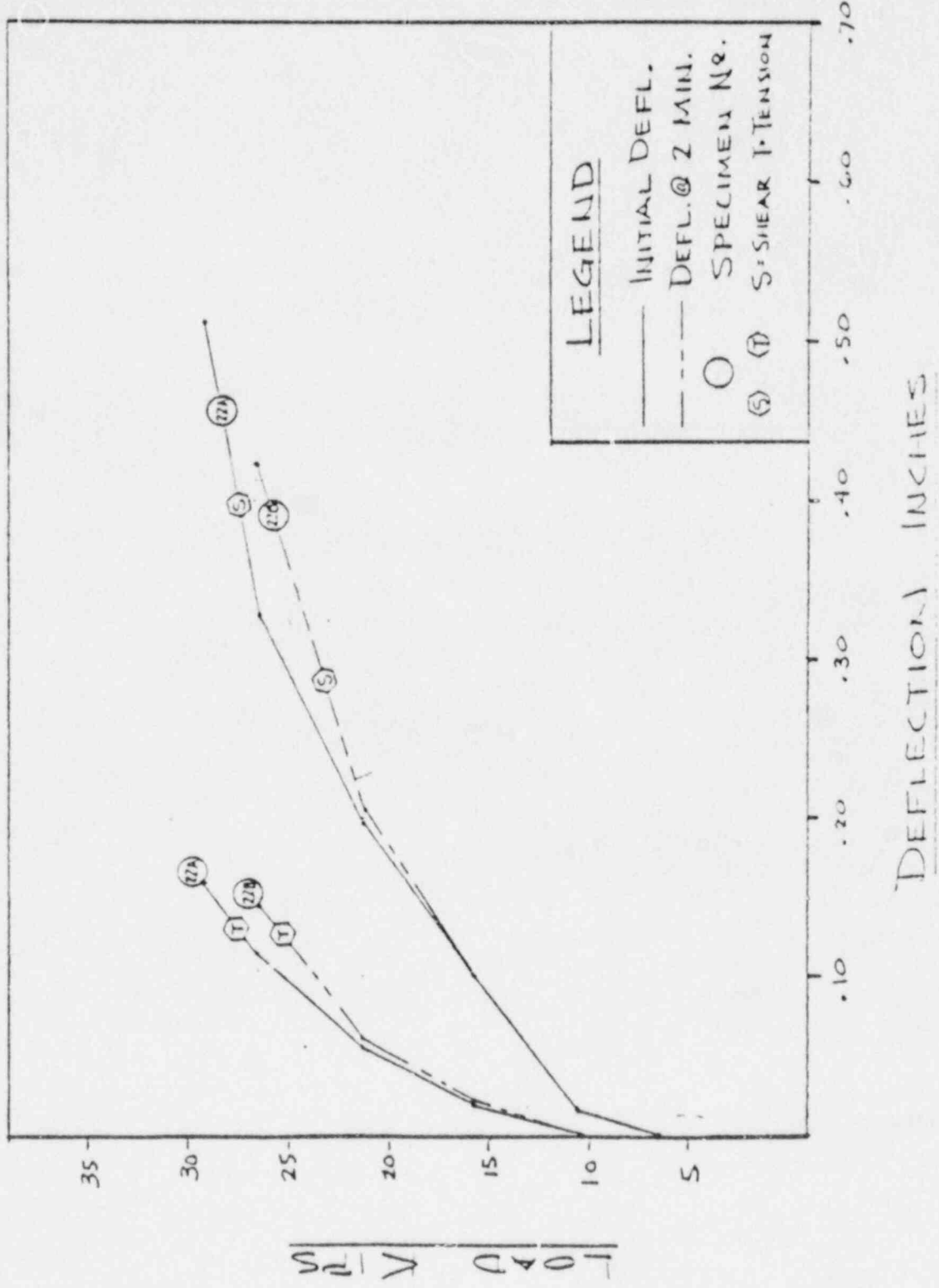
LOAD-DEFLECTION CURVES 1-INCH TYPE EC-2W SHEAR TEST



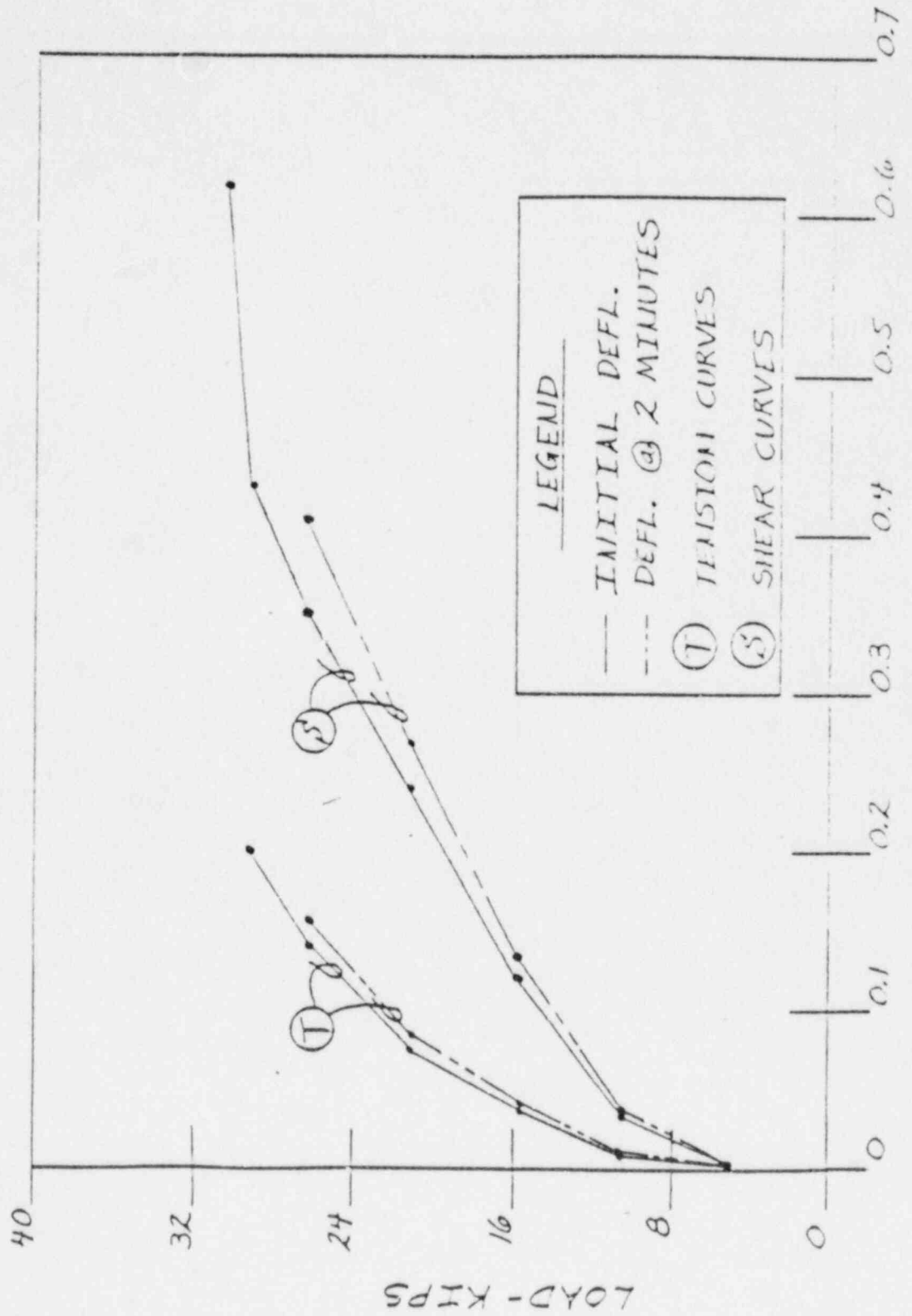
COMBINED SHEAR & TENSION CHART
 RICHMOND 1 INCH, TYPE EC-ZW INSERT
 SPECIMEN No. 21



COMBINED SHEAR & TENSION CHART
 RICHMOND 1 INCH, TYPE EC-2W INSERT
 SPECIMAN N^o. 22

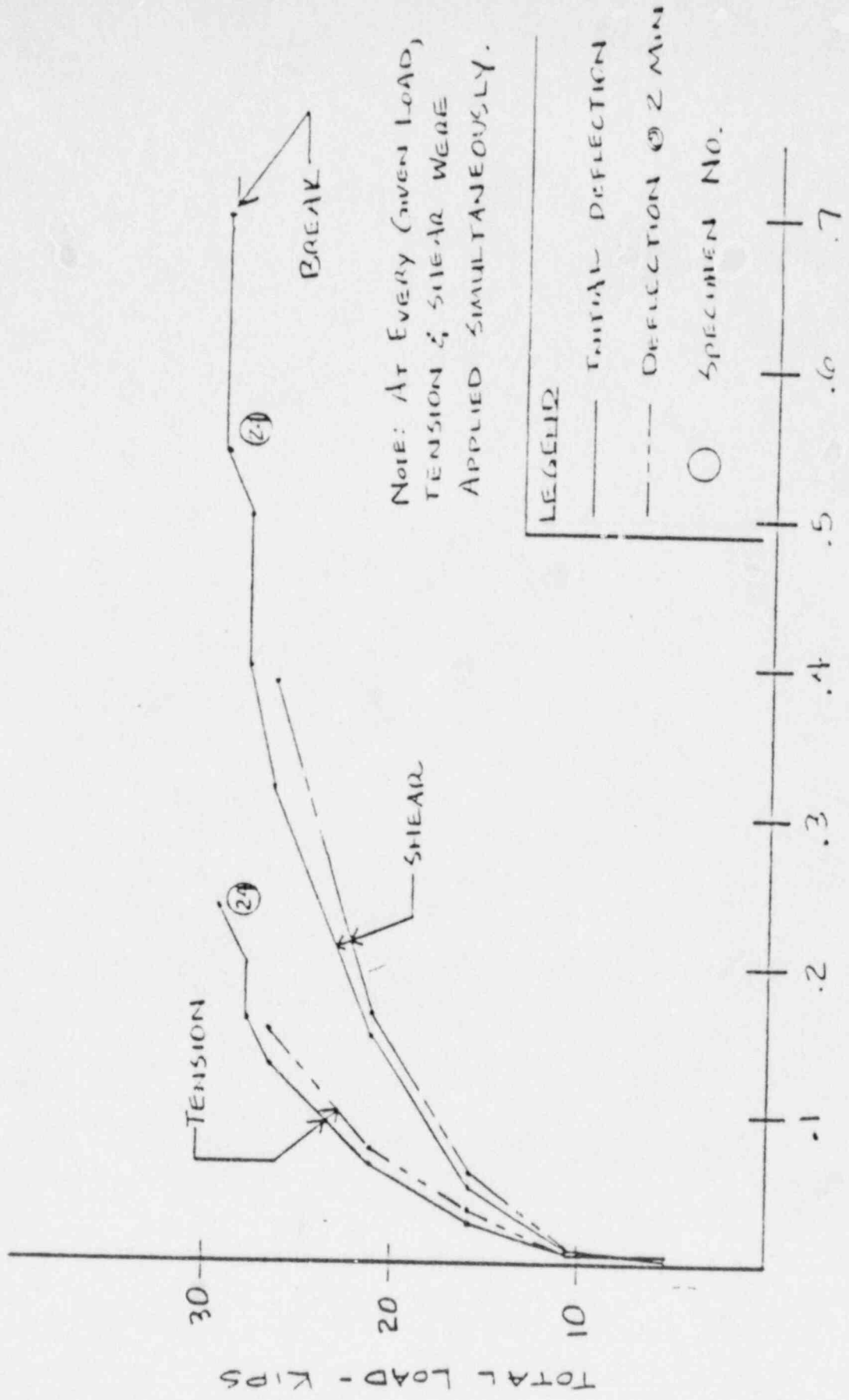


COMBINED SHEAR & TENSION TEST CURVES
 1 INCH, TYPE EC-2W
 SPECIMEN #23



DEFLECTION - INCHES

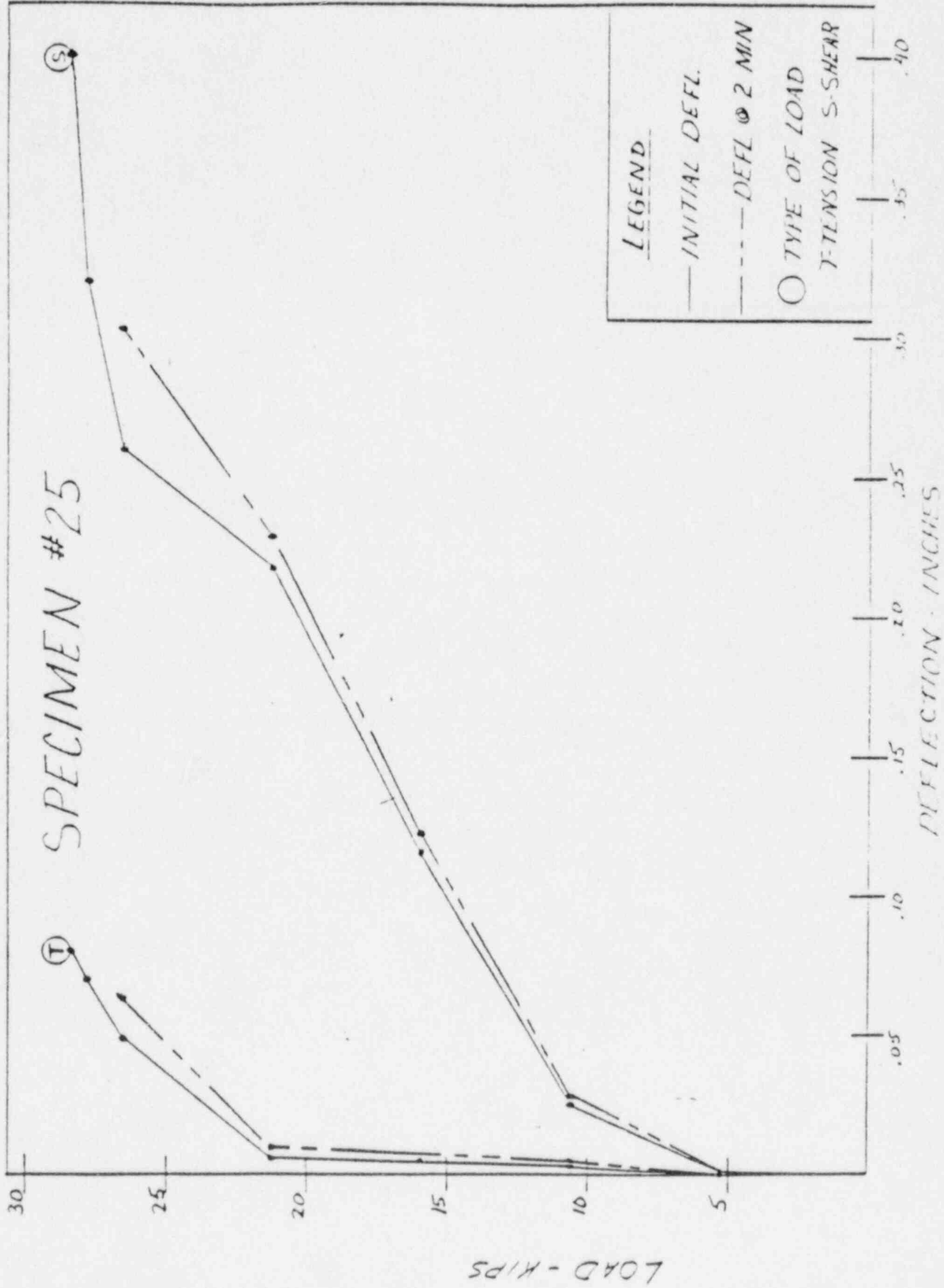
LOAD DEFLECTION CURVES FOR 1" ϕ TYPE EC-2W RICHMOND INSERT



DEFLECTION - INCHES

LOAD-DEFLECTION CURVE
 1-INCH TYPE EC-2W
 COMBINED SHEAR AND TENSION

① SPECIMEN #25

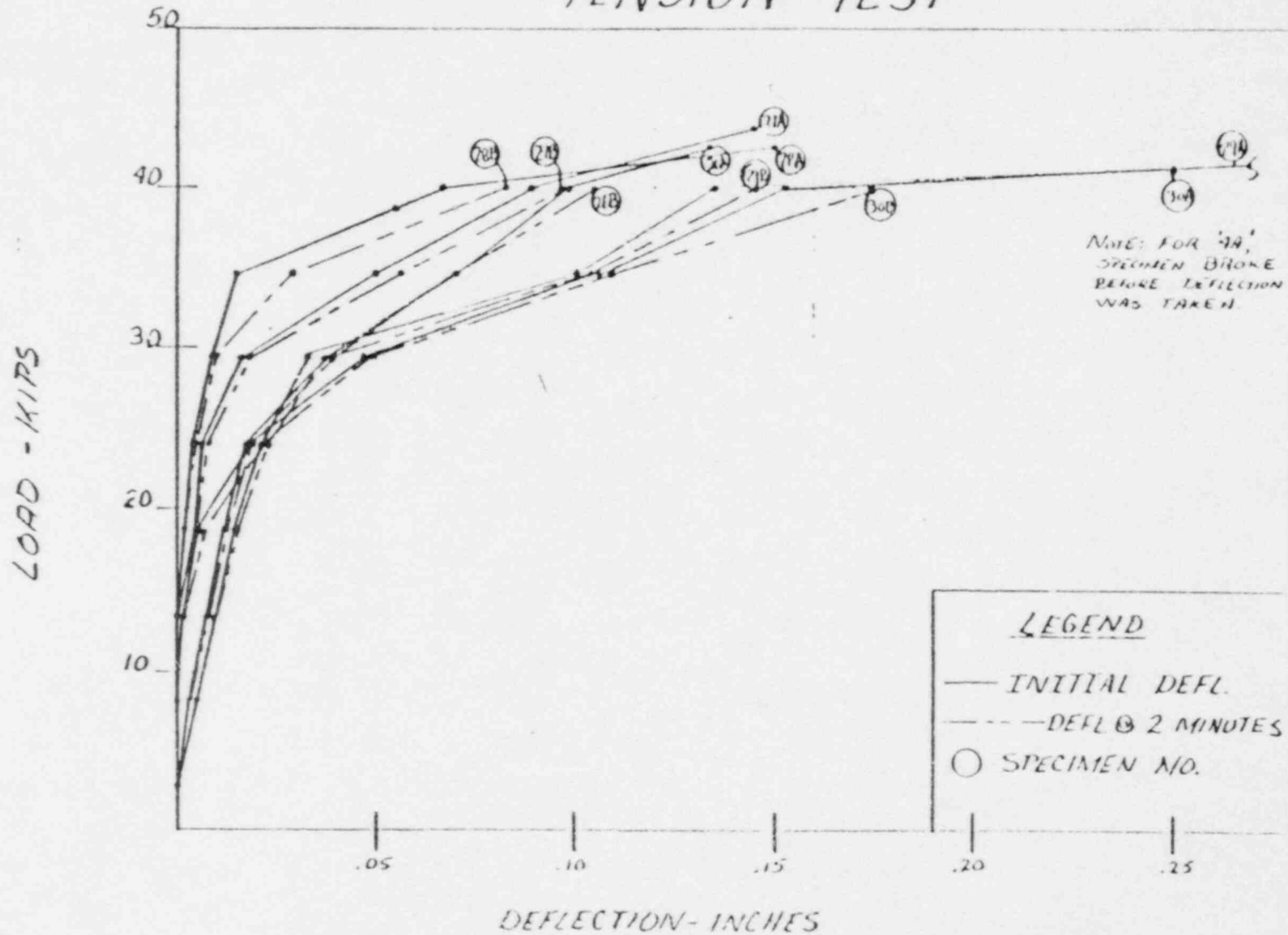


LEGEND

- INITIAL DEFL.
- - - DEFL @ 2 MIN
- TYPE OF LOAD
- T-TENSION S-SHEAR

LOAD-DEFLECTION CURVES

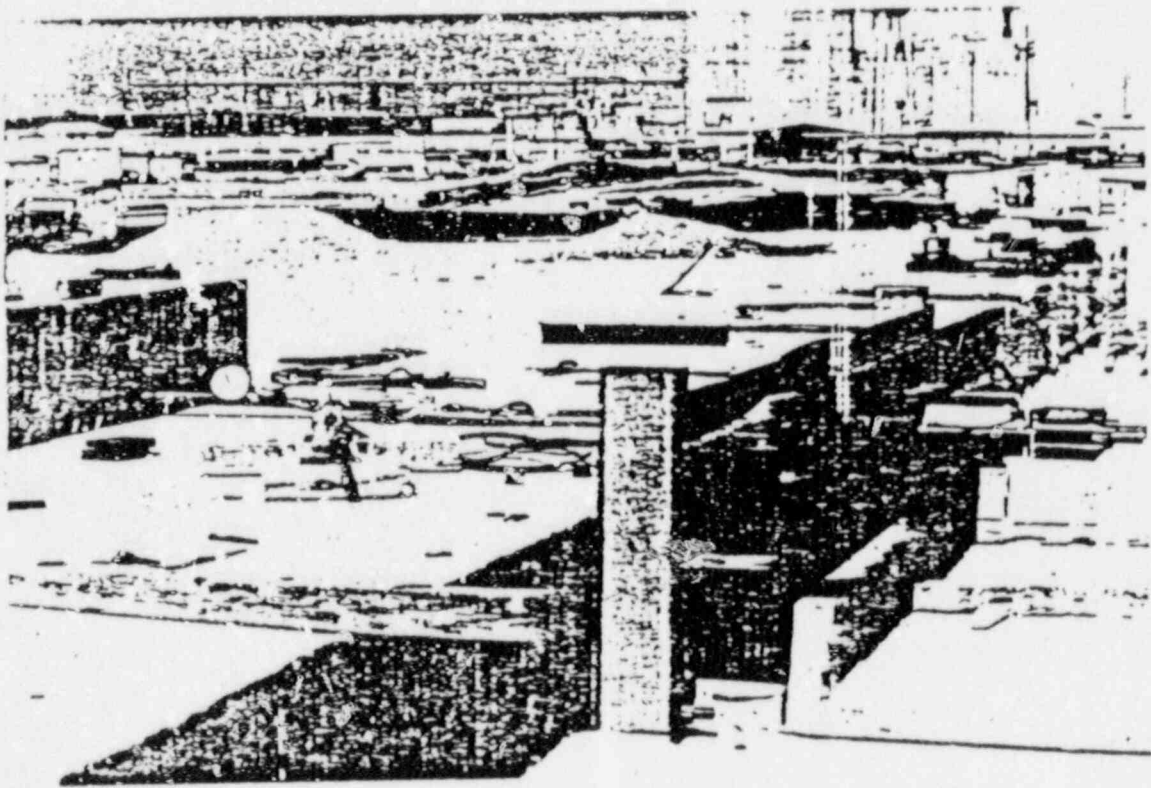
1-INCH TYPE EC-2W TENSION TEST



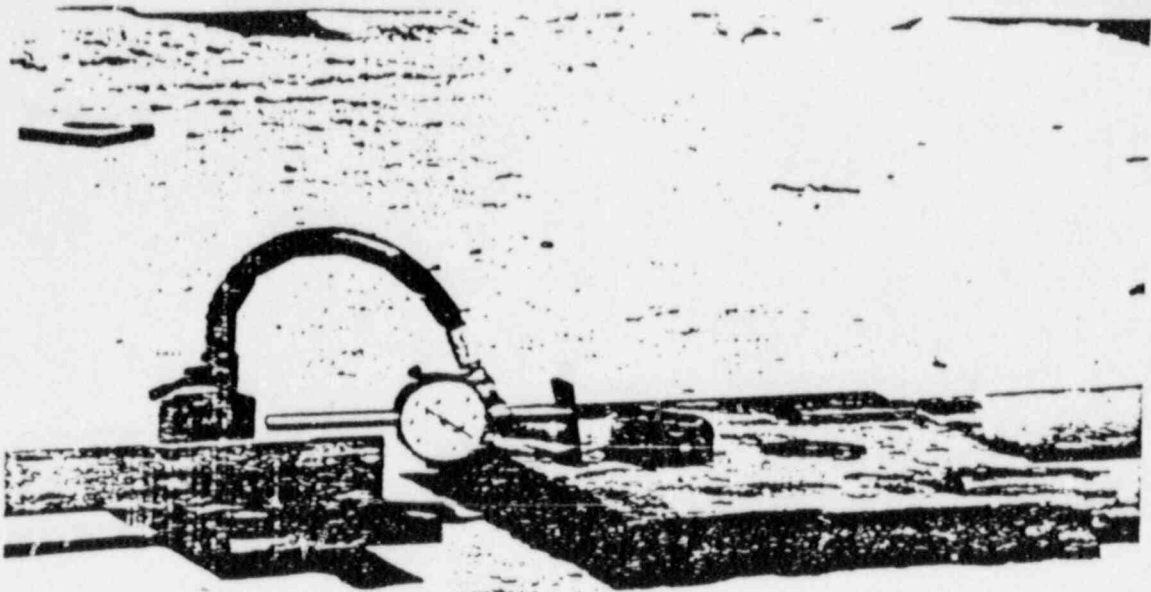
APPENDIX 4

PICTURES OF ACTUAL TEST APPARATUS

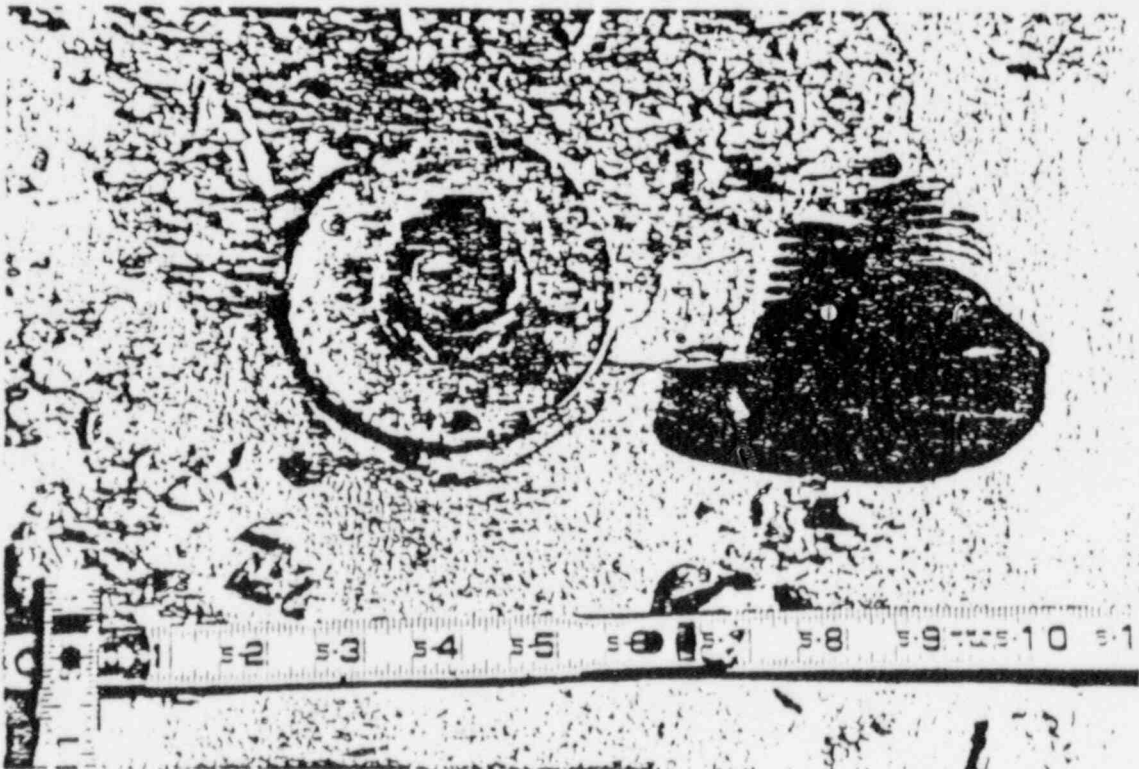
SHEAR TEST



TEST APPARATUS

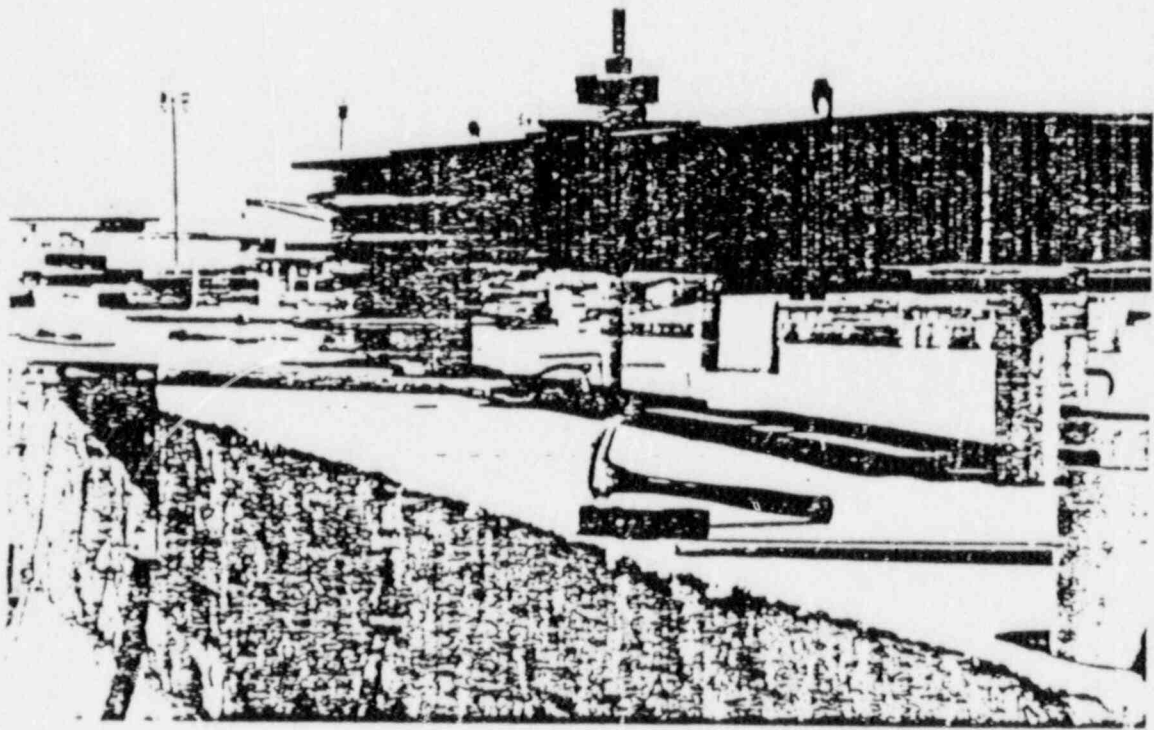


DIAL INDICATOR ARRANGEMENT

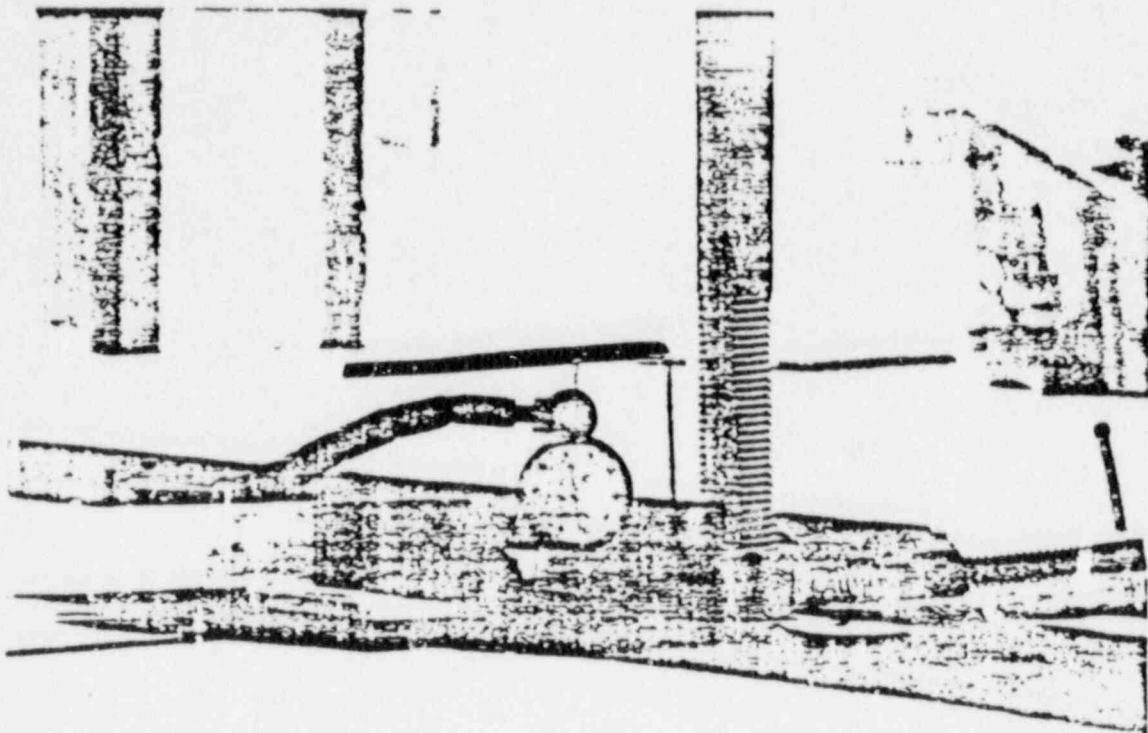


TYPICAL SHEAR FAILURE

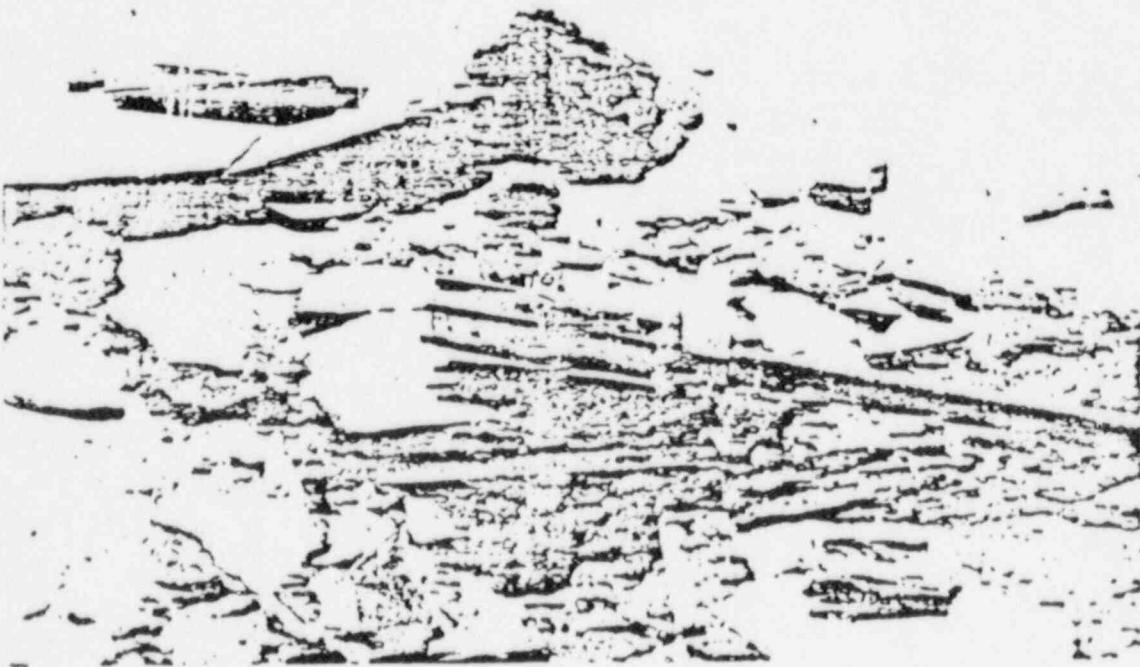
TENSION TEST



TEST APPARATUS

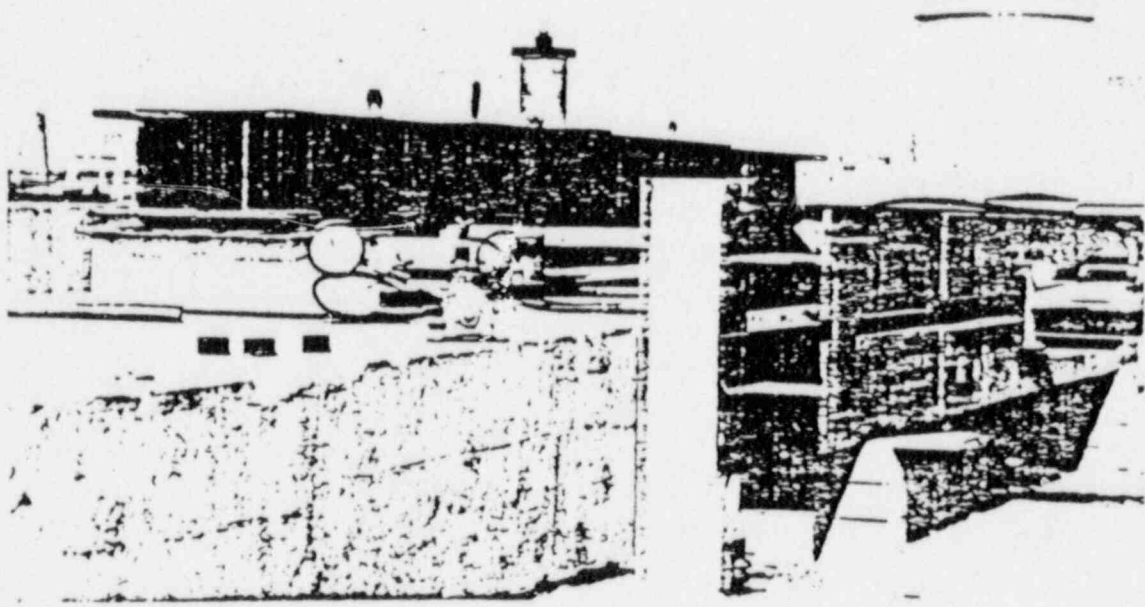


DIAL INDICATOR APPARATUS

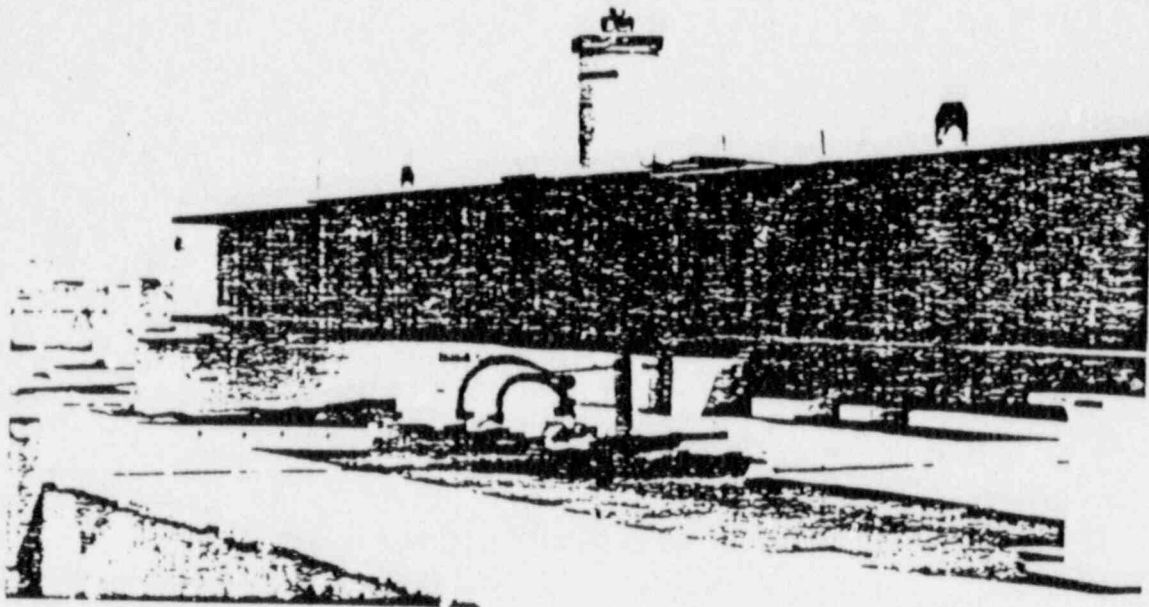


CASTING OF A DIE

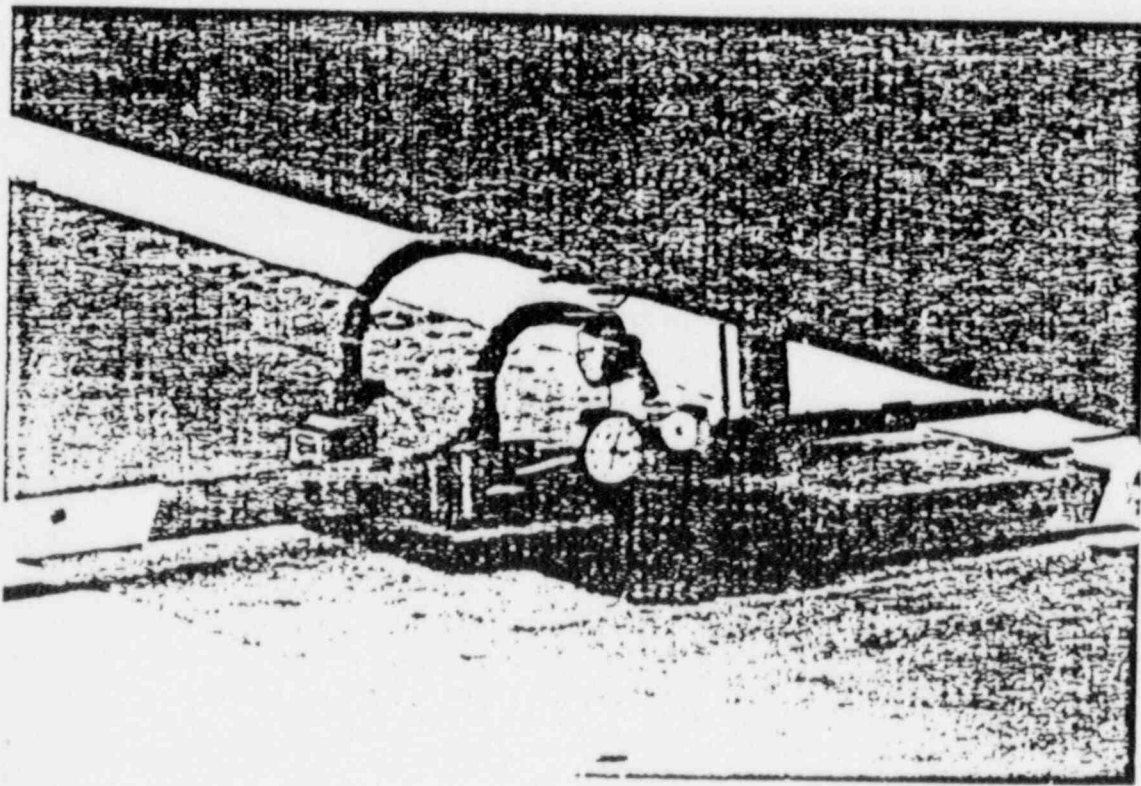
COMBINED SHEAR AND TENSION
TEST



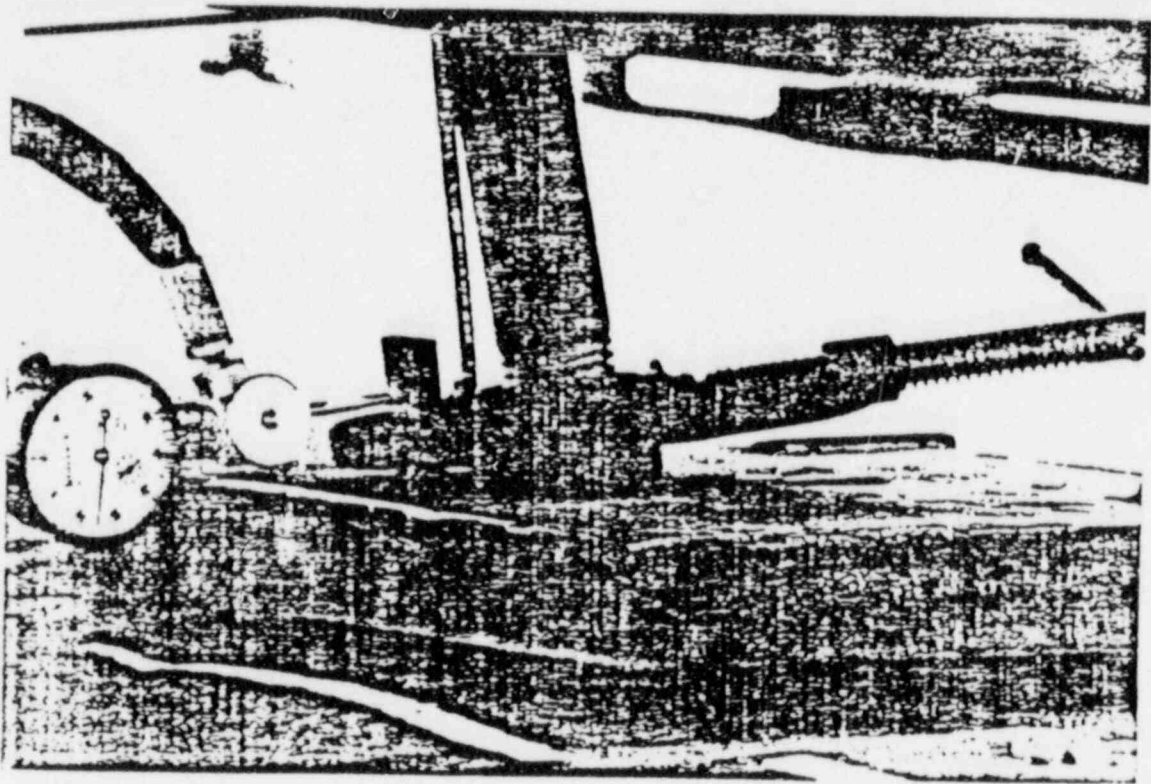
TEST APPARATUS



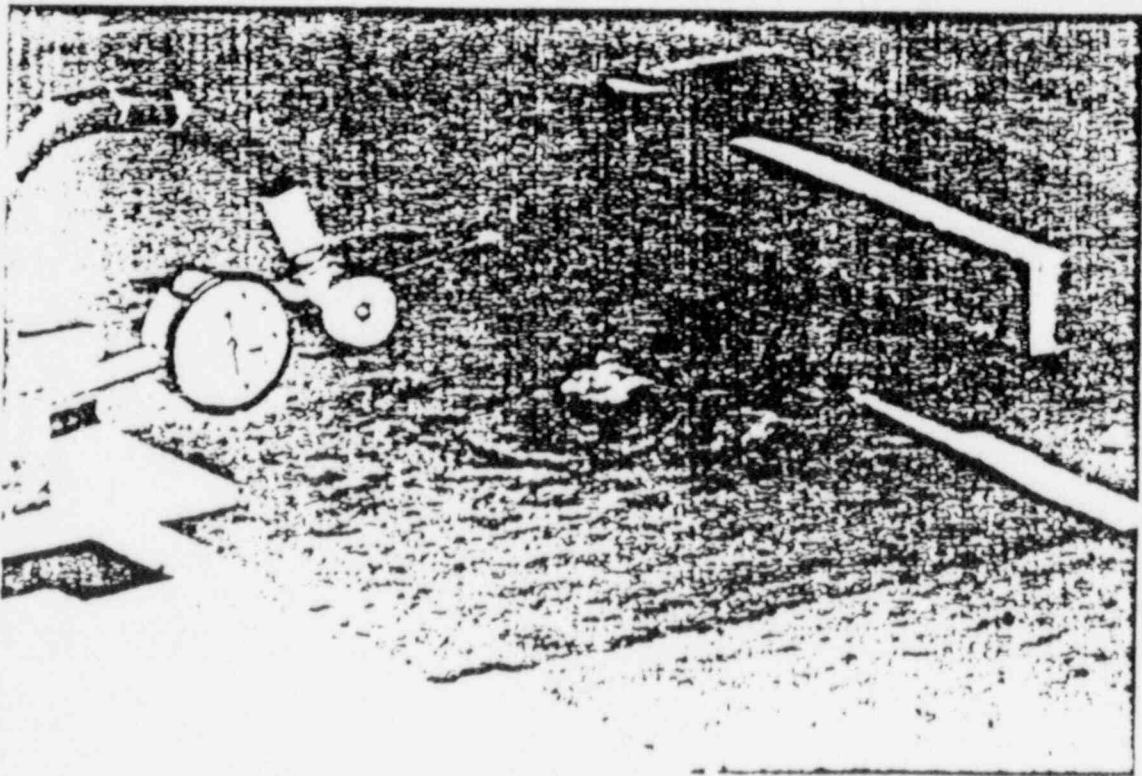
TEST APPARATUS



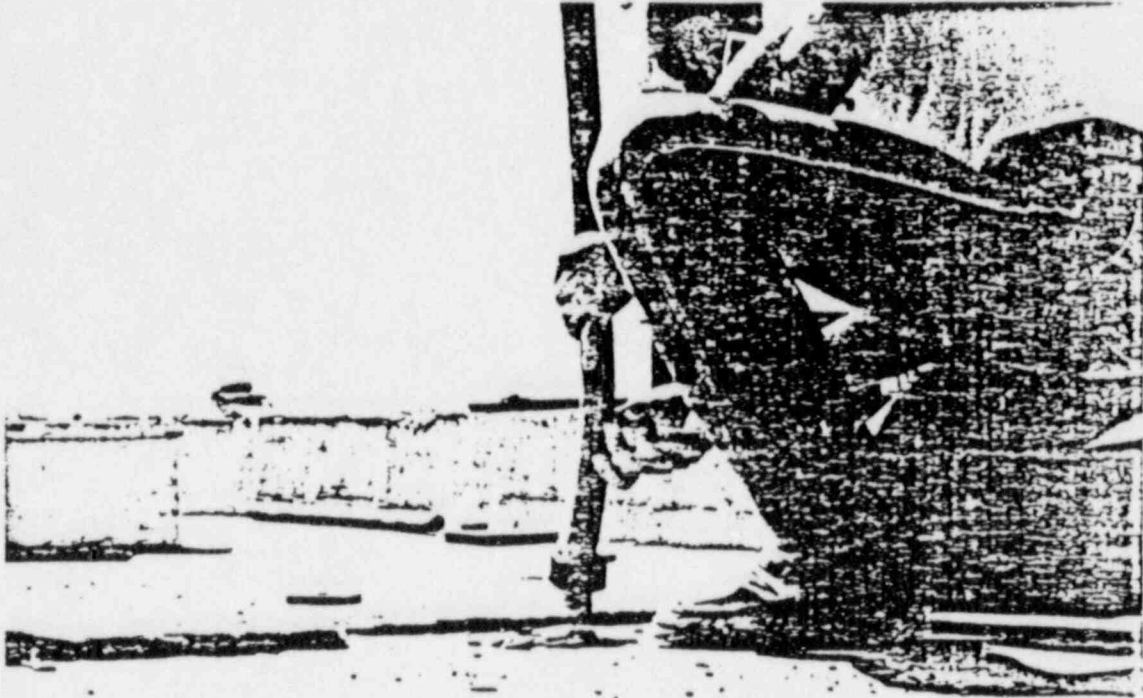
DIAL INDICATOR ARRANGEMENT



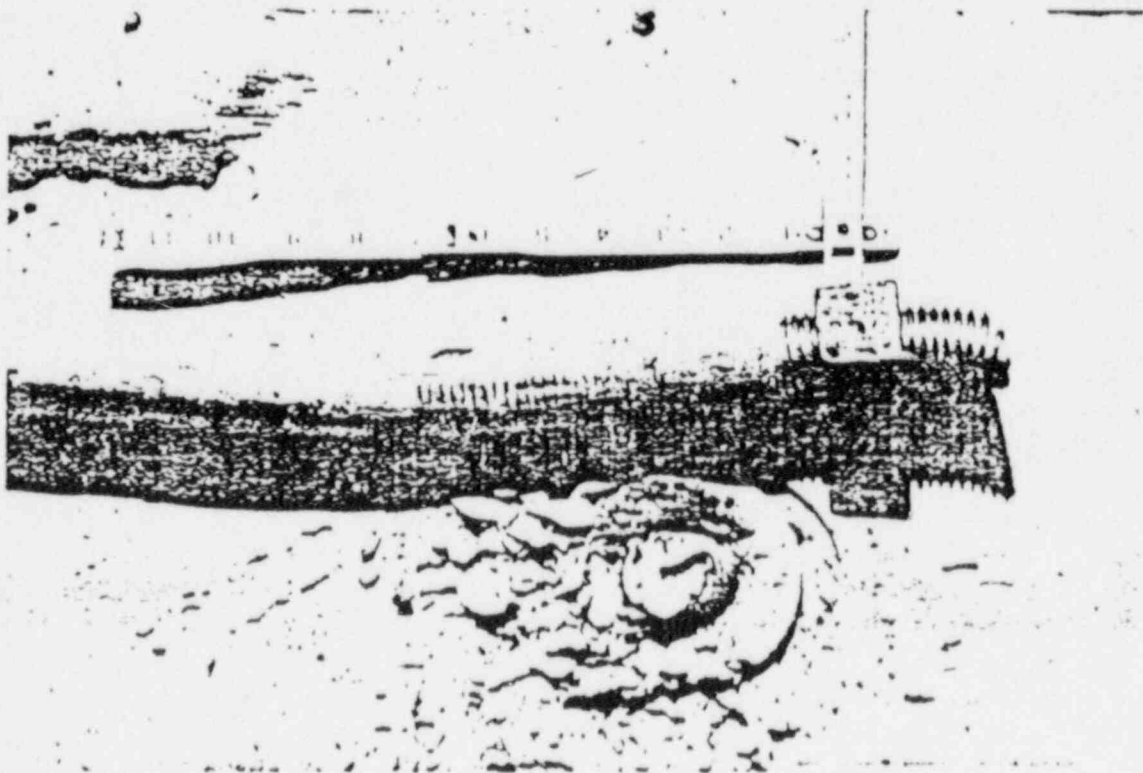
1/2-INCH SPECIMEN JUST PRIOR TO FAILURE



1/2-INCH SPECIMEN AT FAILURE



1 1/2" HIGH FAILED SPECIMEN



TYPICAL FAILURE