#42

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

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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.

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

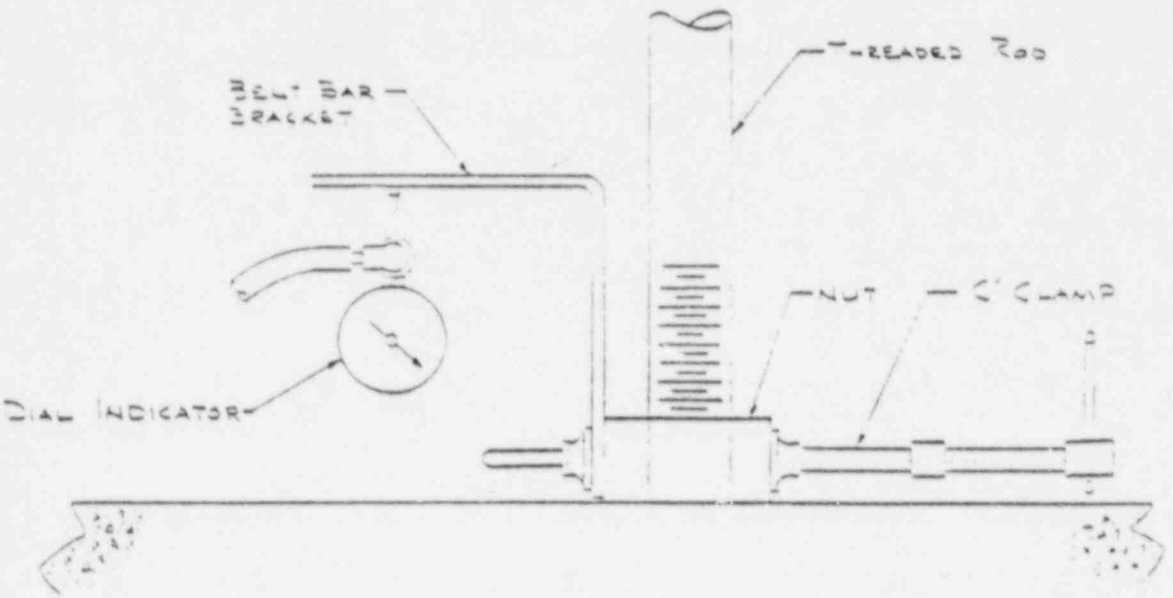
The arrangement and details of the test apparatus are shown on Drawing No. FSC-00464, Sheet 1, 2 and 3, which are included in Appendix 1 to this report. (Note that only MK C-14, C-15, C-16 and Assembly 'D' on Sheet 1 were used in this test.) The insert specimens tested were taken at random from the Constructor's 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 "bridge" 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 20 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 B7) 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 8300 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 8300 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 occured (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 84,300 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-~~325~~ 490 bolts.

SPECIMEN NO.	ULTIMATE LOAD (lbs)	FAILURE LOAD (lbs)
1	90,100	84,300
2	95,400	90,100
3	95,400	90,100
4	106,000	100,700
5	106,000	106,000
Average	98,580	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.) = $\frac{\text{Average Failure Ld.}}{\text{Design Allowable Ld.}}$

SPECIMEN NO.'s	AVERAGE FAILURE LOAD (k)	FACTOR OF SAFETY
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 striping 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.

SPECIMEN NO.	ULTIMATE LOAD	FAILURE LOAD
11	106,200	103,850
12	114,150	108,350
13	114,150	108,350
14	87,650	87,650
15	100,300	100,300
Average	104,610	101,960

Allowable Tension = 31.3k

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

SPECIMEN NO.'s	AVERAGE FAILURE LOAD (k)	FACTOR OF SAFETY
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 striping 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.

SPECIMEN NO.	ULTIMATE LOAD (lbs)	FAILURE LOAD (lbs)
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.)

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

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

F.S. = 3.63

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.

SPECIMEN NO.	ULTIMATE LOAD (lbs)	FAILURE LOAD (lbs)
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 = 11.6k

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

SPECIMEN NO's.	Average Failure Load (k)	Factor of Safety
16 thru 20	40.28	40.28/11.6 = 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.

SPECIMEN NO.	ULTIMATE LOAD (lbs)	FAILURE LOAD (lbs)
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.) = $\frac{\text{Average Failure Ld.}}{\text{Design Allowable Ld.}}$

SPECIMEN NO's.	AVERAGE FAILURE LOAD (k)	FACTOR OF SAFETY
26 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.

SPECIMEN NO.	ULTIMATE LOAD (lbs)	FAILURE LOAD (lbs)
21	27,825	27,825
22	29,150	29,150
23	30,475	29,150
24	29,150	27,825
25	28,487	27,825
Average	29,017	28,355

Allowable Tension = 11.5k

Allowable Shear = 11.5k

Factor of Safety (F.S.)

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

SPECIMEN NO's	TENSION AND SHEAR AVERAGE FAILURE LOAD (k)	FACTOR OF SAFETY
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

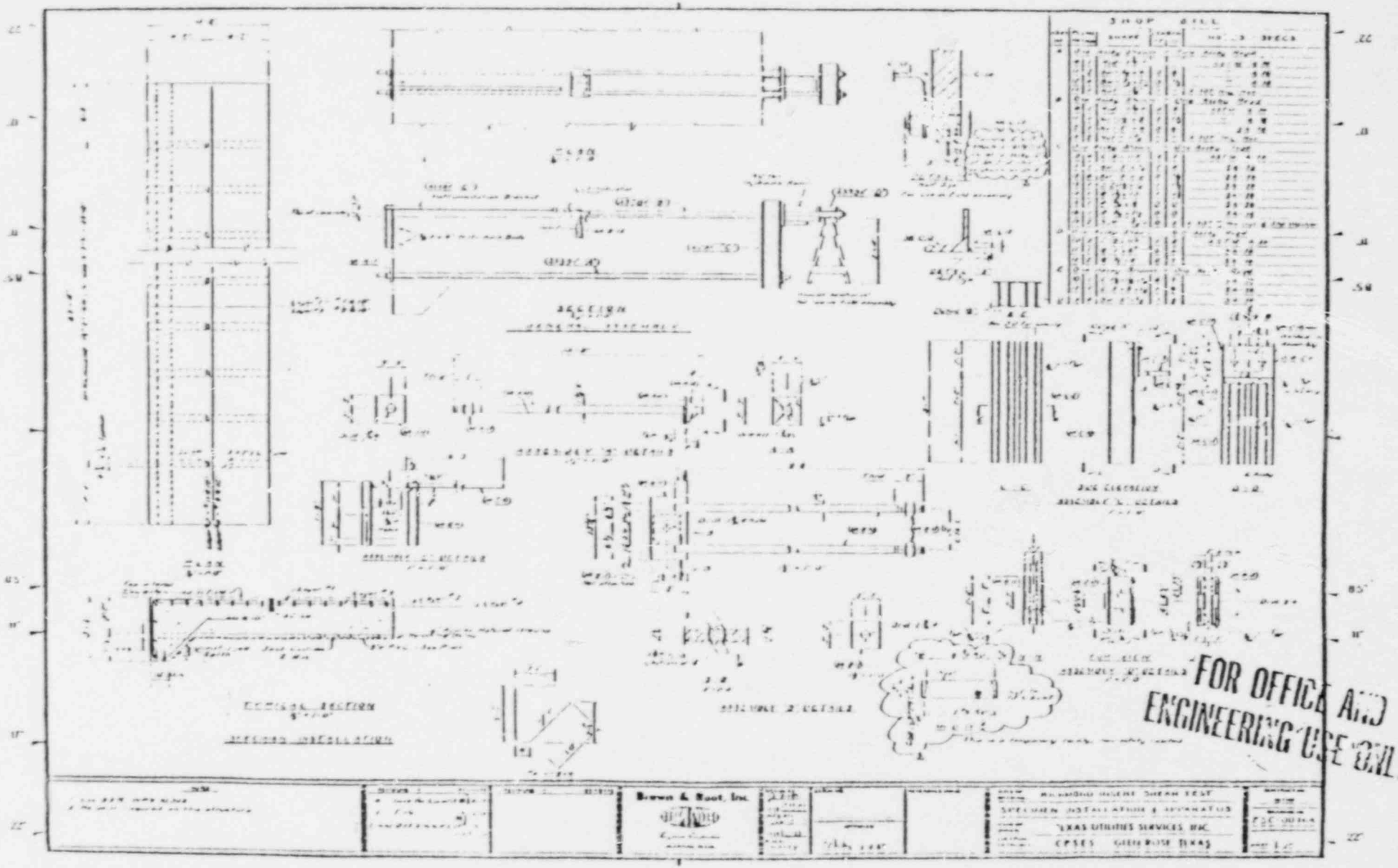
5.0 CONCLUSIONS

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.

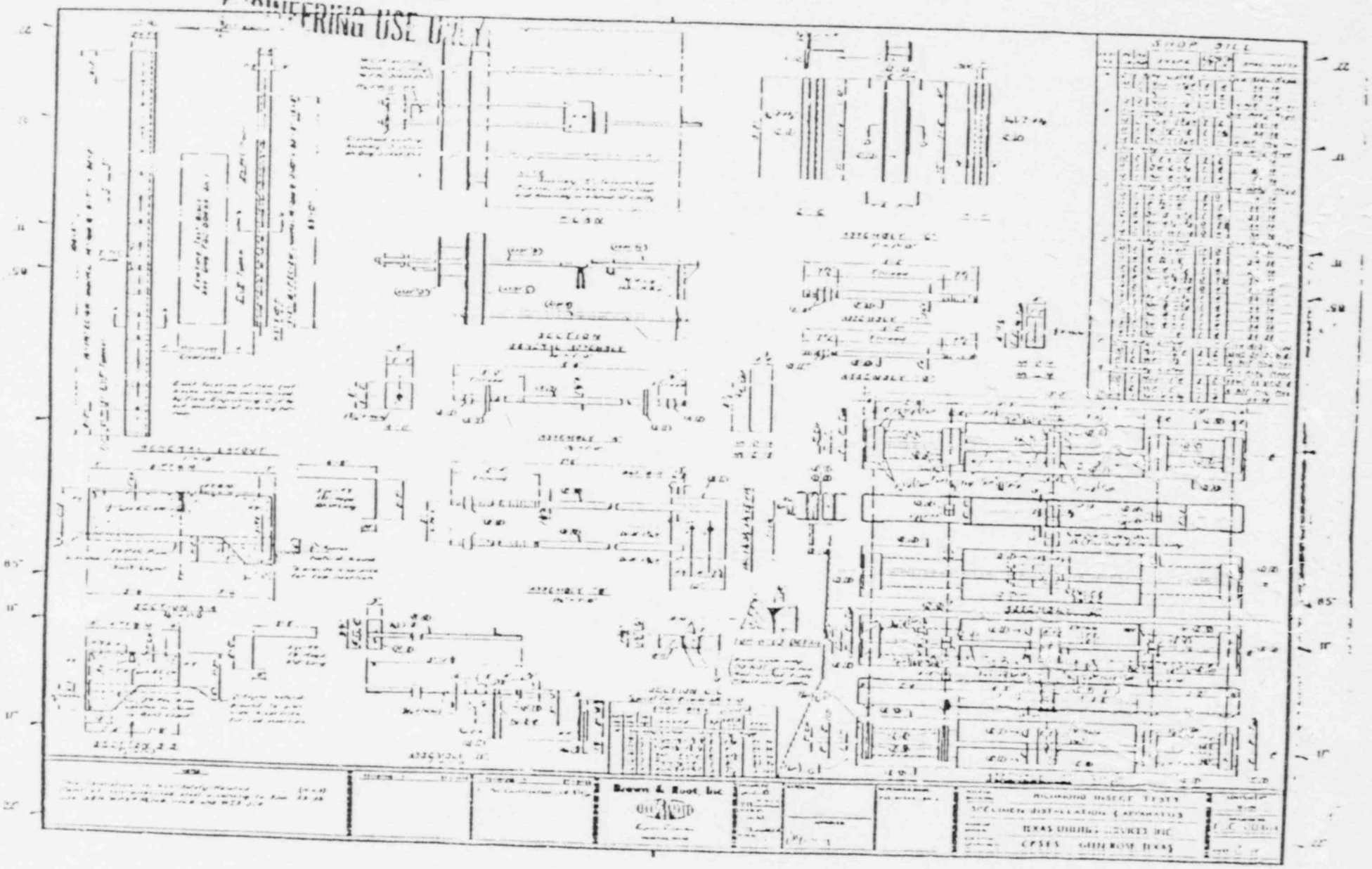
APPENDIX 1

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

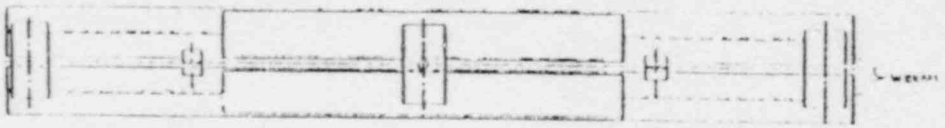

SHOP BILL
Brown & Root, Inc.
FOR OFFICE AND
ENGINEERING USE ONLY

FOR OFFICE AND

ENGINEERING USE ONLY

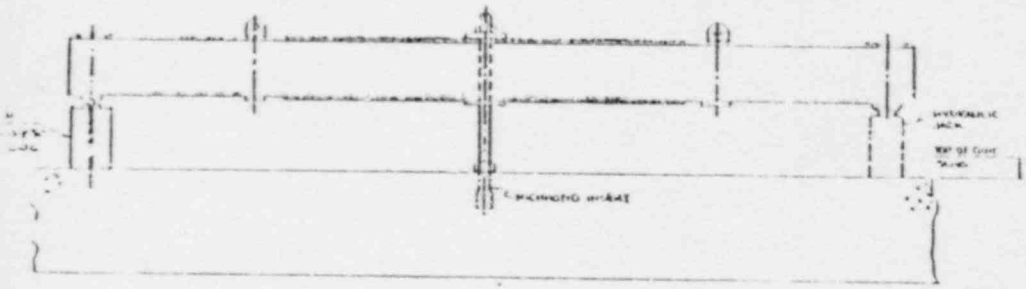


ENGINEERING DEPT.

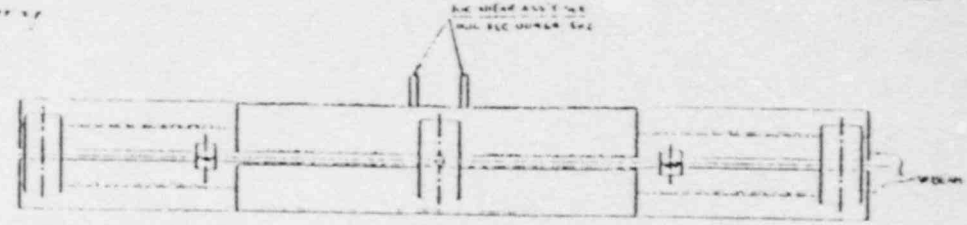


PLAN VIEW

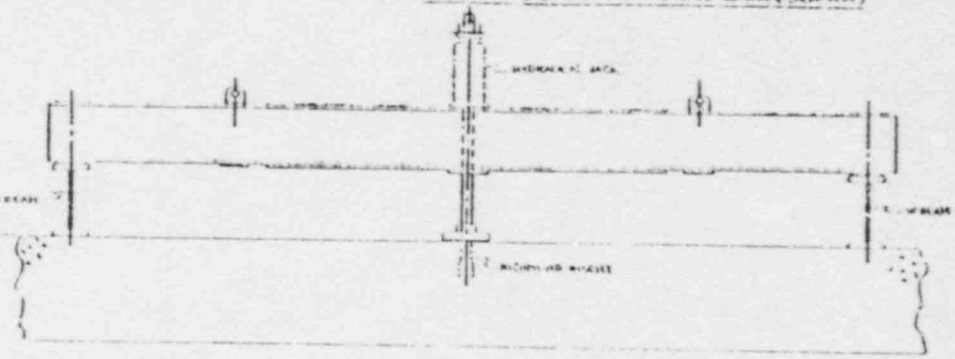
RICHMOND INVERT - TENSION TEST



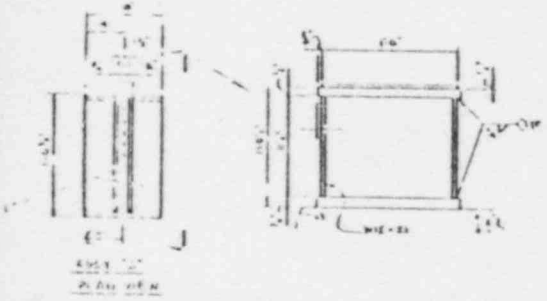
ELEVATION VIEW



PLAN VIEW - (2) RICHMOND INVERT - CONNECTED TOGETHER (SHEAR TEST)



ELEVATION VIEW



PLAN VIEW

			Brown & Root, Inc.				RICHMOND INVERT TESTS TENSION AND SHEAR TESTING TEXAS UTILITIES SERVICES INC CPSES GLEN ROSE TEXAS

APPENDIX 2

CONCRETE COMPRESSIVE TEST REPORT

COMANCHE PEAK SES

2-29-84

POUR NO 612-4834-001

CYL SET NO 2473

(TEST BLOCK)

REPORT ON COMPRESSIVE TESTS OF CONCRETE

PROCEDURE QI-QP-11.1-41

MIX							
COMPLETE DATA AS APPLICABLE FROM BATCH TICKET	(A) MOIST AGGR	F.A. 9608 LBS	H_2O F.A. 289 LBS	C.A. 13560 LBS	H_2O C.A. 0 LBS	TOTAL WATER/BATCH 1966 LBS	TYPE OF CURING M+W
	CEMENT CU YD 5041 LBS		H_2O ADDED 0 GAL	H_2O/CEMENT RATIO 0.380	AIR CU YD 1145 $^{4}/_{32}$	TOTAL AIR 73 $^{4}/_{32}$	SPECIFIED DESIGN STRENGTH 4000 PSI 28 DAYS

MATERIALS				
BRAND OF CEMENT: G-H	TYPE OF CEMENT: II	BRAND OF AIR ENTRAINING ADMIXTURE: MBVR	BRAND OF WATER REDUCING ADMIXTURE: NA	MAX SIZE C.A.: 3/4
SOURCE C.A.: TXI-TIN TOP	SP GR C.A.: 2.65	SOURCE F.A.: TXI-TIN TOP	SP GR F.A.: 2.63	FINENESS MODULES F.A.: 2.71

SAMPLING							
TYPE OF MIXING: PLANT I	BATCH LOAD: 8 CY	TICKET NO: 62789	SAMPLE TAKEN AT: ☐ CENTRAL MIXER ☐ FORMS ☒ POINT OF DISCHARGE				
METHOD OF PLACING: ☐ PUMP ☐ BUCKET ☐ BUGGIES ☐ BELT ☒ CHUTE		DATE SAMPLED: 2-29-84	HOUR: 1030 AM	WEATHER: Clear	AIR TEMP: 46 °F	CONC. TEMP: 60 °F	SLUMP: 3 3/4 IN
TIME OF MIXING AT CENTRAL PLANT: 70 REV MIN		UNIT WT CU. FT: 144.36 LBS	MIX ID: 132	SPECIMEN TAKEN BY: Birchfield	SPECIMEN CAST BY: RG-DO-IJTS		AIR: 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
LAB CURED	2473A	7	5.980 / 6.000	5.990	3-6-84	RW	0702	3-7-84	116000	4120	IK	IK	Reg
	2473B	7	6.002 / 6.000	6.001	3-6-84	RW	0704	3-7-84	118000	4210	IK	IK	Reg
	2473C	28	5.998 / 6.002	6.000	3-23-84	RW	[illegible]	3-28-84	153500	5430	[illegible]	[illegible]	[illegible]
	2473D	28	6.000 / 6.016	6.008	3-23-84	RW	0648	3-28-84	155000	5490	[illegible]	[illegible]	[illegible]
FIELD CURED	2473E	28	6.001 / 6.002	6.002	3-23-84	RW	[illegible]	3-28-84	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	2473F	28	6.016 / 5.991	6.004	3-23-84	RW	0656	3-28-84	[illegible]	4020	[illegible]	[illegible]	[illegible]
	NA												
	NA												

DATE & TIME STRIPPED: 3-1-84 915 AM

REMARKS

CURING CONTROL TEST RESULTS
FOR 28 DAY BREAK

LABARATORY CURED CYLINDER(S)

STRENGTH (P.S.I.) 5430 (C)

5490 (d)

1. (a)+(b) ÷ (c)+(d) = 0.91 *

FIELD CURED CYLINDERS

STRENGTH (P.S.I.) 4930 (a)

4930 (b)

2. (a)+(b) ÷ 2 = 4955 *

* 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

MICROMETER OR CALIPERS NO [illegible]

COMPRESSION MACHINE NO. [illegible]

CAPPING MOLD NO [illegible]

7 DAY PREPARED BY IK CHECKED BY IRS

28 DAY PREPARED BY IK CHECKED BY IRS

QA ENGINEERS COMMENTS (IF APPLICABLE)

[signature]
[illegible]

APPENDIX 2

TEST DATA SHEETS

COMANCHE PEAK SES

SHEAR TESTS

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

Reference: CP-EI-13.0-E 13 pg 2

Specimen Number: 1 Bolt Spec: A-490 Date: 3 April 84

(First insert @ west end of conc. slab)

DEFLECTION (IN.)		GAUGE PRESSURE	JACK * THRUST	NOTES-FAILURE MODE
INITIAL	AFTER 2-MIN.	(P.S.I.)	(Lbs.)	
0.003	0.003	400	5300	
.032	.035	800	10 600	
.060	.060	1200	15 900	
.076	.079	1600	21 200	
.095	.098	2000	26 500	
.111	.116	2400	31 800	
.128	.132	2800	37 100	
.144	.150	3200	42 400	
.160	.167	3600	47 700	
.172	.185	4000	53 000	
.195	.206	4400	58 300	
.220	.233	4800	63 600	
.250	.264	5200	68 900	
.277	.297	5600	74 200	
.304	.328	6000	79 500	Bolt deformed.
.360	.429	6400	84 800	Crushing of concrete and principal failure. No increase in load with increased deflection. Did not lead to destruction
.510	1.125	6800	90 100	
				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 RCH 606
Pressure Gauge: M & TE Number 2355 Due Date: 16 Jan 84
Dial Gauge:.....M & TE Number 2049 Due Date: 29 June 84

Performed By:

J C. Gilbert 3 April 84
Name Date

Witnessed By:

[signature] 4-3-84
QA Representative Date

COMANCHE PEAK SES
SHEAR TESTS

RICHMOND 1½ -INCH, TYPE EC-6W INSERT

Reference: CP-EI-13.0-~~F~~12,04

Specimen Number: 2 (2nd from west end) Bolt Spec: A-490 Date: 4 April 84

DEFLECTION (IN.) INITIAL	DEFLECTION (IN.) AFTER 2-MIN.	GAUGE PRESSURE (P.S.I.)	JACK * THRUST (Lbs.)	NOTES-FAILURE MODE
.004	0.002	400	5,300	
.021	.022	800	10,600	
.034	.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	
.137	.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	
.293	.314	6000	79,500	
.338	.370	6400	84,800	
.420	.555	6800	90,100	
.770	1.110	7200	95,400	Bolt sheared abruptly. Concrete spalled on compression side of insert across 1½" dia, running out to zero @ 7" away. Spall zone 6½" wide near insert.

* 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 ~~TTE2355~~ Due Date: 16 Apr 84
Dial Gauge:.....M & TE Number 2949 Due Date: 29 Jun 84

Insert for deflection of 7"

Performed By:

J C Gilbreath 4 April 84
Name Date

Witnessed By:

Arlen Rutzick 4-4-84
QA Representative Date

COMANCHE PEAK SES

SHEAR TESTS

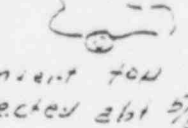
RICHMOND 1/2-INCH, TYPE EC-6W INSERT

Reference: CP-EI-13.0-A 13 pg 4

Specimen Number: 3 (3rd from West End) Bolt Spec: A-490 Date: 4 April 84

DEFLECTION (IN.) INITIAL	DEFLECTION (IN.) AFTER 2-MIN.	GAUGE PRESSURE (P.S.I.)	JACK * THRUST (Lbs.)	NOTES-FAILURE MODE
0.000	.000	400	5300	
.002	.002	800	10 600	
.003	.003	1200	15 900	
.006	.007	1600	21 200	
.012	.018	2000	26 500	
.032	.036	2400	31 800	
.049	.052	2800	37 100	
.067	.069	3200	42 400	
.078	.083	3600	47 700	
.096	.107	4000	53 000	
.126	.131	4400	58 300	
.144	.154	4800	63 600	
.174	.182	5200	68 900	
.206	.218	5600	74 200	
.242	.259	6000	79 500	
.283	.315	6400	84 800	
.365	.399	6800	90 100	
.520	(1.2)	7200	95 400	Bolt sheared abruptly concrete spalled 1" deep @ insert tapering to zero depth @ 5" out (on compression side of insert). Insert deformed where visible (ins. #3). Insert seeminsly 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 Due Date: 16 Apr 84
Dial Gauge:.....M & TE Number 2949 Due Date: 29 Jun 84



Performed By:

E P Gilbert 4 April 84
Name Date

Witnessed By:

Anthony Armstrong 4-5-84
QA Representative Date

COMANCHE PEAK SES

SHEAR TESTS

RICHMOND 1½-INCH, TYPE EC-6W INSERT

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

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

DEFLECTION (IN.) INITIAL	DEFLECTION (IN.) AFTER 2-MIN.	GAUGE PRESSURE (P.S.I.)	JACK * THRUST (Lbs.)	NOTES-FAILURE MODE
.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	.094	4000	53,000	
~~.102~~	~~..~~	~~4400~~		accidental [illegible] - load [illegible]
.107	.109	4400	58 300	
.116	.120	4800	63 600	
.128	.133	5200	68 900	
.142	.146	5600	74 200	
.156	.164	6000	79,500	
.173	.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 spall 1" deep @ insert to 0" @ 4" out. Spall 8" wide

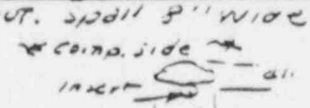
* Jack Thrust equal Shear Load on Insert..

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

Jack:.......Equipment Number RCH 606

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

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



Insert deflected about ¼"

Performed By: J. C. Gilbert 4 April 84

Name Date

Witnessed By: Adrian Rietz[illegible] 4-4-84

QA Representative Date

COMANCHE PEAK SES
SHEAR TESTS

RICHMOND 1/2-INCH, TYPE ___ INSERT

Reference: CP-EI-13.0-1/2 pg 2

Specimen Number: 5 (5th from West End) Bolt Spec: A-490 Date: 4 April 84

DEFLECTION (IN.) INITIAL	DEFLECTION (IN.) AFTER 2-MIN.	GAUGE PRESSURE (P.S.I.)	JACK * THRUST (Lbs.)	NOTES-FAILURE MODE
0.002	0.002	400	5 300	
.004	.005	800	10 600	
.013	.015	1200	15 900	
.035	.037	1600	21 200	
.057	.063	2000	26 500	
.090	.094	2400	31 800	
.117	.124	2800	37 100	
.150	.157	3200	42 400	
.176	.183	3600	47 700	
.200	.209	4000	53 000	
.223	.236	4400	58 300	
.248	.261	4800	63 600	
.276	.295	5200	68 900	
.307	.322	5600	74 200	
.338	.356	6000	79 500	
.370	.389	6400	84 800	
.403	.428	6800	90 100	
.447	.479	7200	95 400	
.506	.536	7600	100 700	
.585	.	8000	106 000 Bolt sheared abruptly. Concrete spalled 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 Due Date: 16 Apr 84
Dial Gauge:.....M & TE Number 2944 Due Date: 29 Jun 84

Thru: ⊙ Insert top deflected 3/8".

Performed By:

L.C. Silkett 4 Apr 84
Name Date

Witnessed By:

Adrian Pietzsch 4-4-84
QA Representative Date

COMANCHE PEAK SES
COMBINED SHEAR & TENSION TESTS
SC-CW
Richmond 1½ Inch, Type Insert
Reference: CP-ET-13.04 17 Sec ~

Specimen Number: 6 (6th from wall) Inserted Load Rod: A-173 Date: 10 April 84

Common Gauge Press. (PSI)	SHEAR 1-* Jack Thrust (lb.)	Deflection (Inch) Init.	Deflection (Inch) After 2-Min.	TENSION Gauge Press. (PSI)	2-* Jack Thrust (lb.)	** Net Jack Thrust (lb.)	*** Insert Load (lb.)	Deflection (Inch) Init.	Deflection (Inch) After 7-Min.	Notes - Failure Mode
400	5300	0.007	0.007		5300			0.0015	0.0015	
800	10 600	.023	.024		10 600			.005	.005	
1200	15 900	.041	.042		15 900			.0095	.0105	
1600	21 200	.062	.064		21 200			.019	.019	
2000	26 500	.088	.095		26 500			.031	.031	
2400	31,800	.146	.153		31,800			.046	.048	
2800	37,100	.192	.199	N/A	37,100	N/A	N/A	.054	.056	
3200	42 400	.236	.246		42,400			.062	.0635	
3600	47,700	.290	.304		47,700			.0715	.074	
4000	53 000	.334	.382		53,000			.083	.087	
4250	56,313	.420			56,313					
4360	56,975	.510			56,975					
4400	58 300	.475	.559		58,300			.115	.139	
4510	59,625		.58		59,625					
4603	60,950	.630			60,950					

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~~ same

Shear Apparatus: Jack---Equipment No: RCH 606
Pressure Gauge-M&TE No: 2355 Due Date: 16 Jan 84
Dial Gauge-M&TE No: 2949 Due Date: 29 Jan 84
Tension Apparatus: Jack-Equipment No: RCH 603T
Pressure Gauge M&TE No: same Due Date:
Dial Gauge-M&TE No: 2094 Due Date: 18 Jan 84

Performed By: J C Hilbert 4-10-84
Name Date

Witnessed By: [illegible] 4-10-84
QA Representative Date

COMANCHE PEAK SES

COMBINED SHEAR & TENSION TESTS

Richmond 1½-Inch, Type EC-GIV Insert

Reference: CP-CI-13.0 Rev 11

Specimen Number: 6 (P.2 of 2) Inserted Load Rod: A-183 Date: 10 April 84

Comanche	SHEAR			TENSION						
	1.*	Deflection (Inch)			2.*	**	***	Deflection (Inch)		
Gauge Press. (PSI)	Jack Thrust (lb.)	Init.	After 2-Min.	Gauge Press. (PSI)	Jack Thrust (lb.)	Net Jack Thrust (lb.)	Insert Load (lb.)	Init.	After 2 Min.	Notes - Failure Mode
4800	63600	.750	.808		63 600			.164	.167	
5000	66 250	.820			66 250					
5100A	67 575	.910			67 575					
5200	68 900	1.080			68 900	N/A	N/A	2.86		
5100	67575			N/A	67 575					Abrupt shearing of Rod. Rod deformed in bending at shear plane, carrying insert further some ½" horizontally

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.~~ DCW

Shear Apparatus: Jack---Equipment No: RCH 606
Pressure Gauge-M&TE No: 2355 Due Date: 16 Apr 84
Dial Gaus, M&TE No: 2949 Due Date: 22 Mar 84

Tension Apparatus: Jack-Equipment No: RCH 6037
Pressure Gauge-M&TE No: ~~5000~~ Due Date:
Dial Gauge-M&TE No: 2044 Due Date: 18 Mar 84

Performed By: J C Gilbell 4-10-84
Name Date

Witnessed By: Alan Ratzlaff 4-10-84
QA Representative Date

COMANCHE PEAK SES

COMBINED SHEAR & TENSION TESTS

Richmond 1½-Inch, Type EC-CW Insert

Reference: CP CI-11.04-17 y=A

Specimen Number: 7 (7th from west end) Inserted Load Rod: A-193 Date: 11 April 84

Common Gauge Press. (PSI)	SHEAR 1-* Jack Thrust (lb.)	Deflection (Inch) Init.	Deflection (Inch) After 2-Min.	TENSION Gauge Press. (PSI)	2-* Jack Thrust (lb.)	** Net Jack Thrust (lb.)	*** Insert Load (lb.)	Deflection (Inch) Init.	Deflection (Inch) After 2-Min.
400	5 300	0.000	0.000		5 300			0.000	0.000
800	10 600	.009	.000		10 600			.003	.003
1200	15 900	.023	.026		15 900			.012	.012
1600	21 200	.041	.043		21 200			.022	.023
2000	26 500	.070	.0765		26 500			.039	.043
2400	31 800	.125	.133		31 800			.063	.065
2800	37 100	.173	.182		37 100			.084	.086
3200	42 400	.237	.243	N/A	42 400	N/A	N/A	.102	.099
3600	47 700	.295	.311		47 700			.117	.121
4000	53 000	.345	.377		53 000			.135	.146
4400	58 300	.218	.222		58 300			.162	.174
4600	60 950	.58			60 950			.185	
4700	62 275	.770			62 275			.210	
4800	63 600	.802	.846		63 600			.206	.198
4950	65 588	.870			65 588				
5000	66 250	.900			66 250				
5050	66 913	1.15			66 913				
5100	67 575	1.200 1.38			67 575				

Notes - Failure Mode

Vert deflection sensor corrected direction due to loading of bracket with bending rod.

* Rod failed in shear. Top of insert deflected horizontally some ⅝". Rod distorted to some 30° from vert @ shear zone. Concrete spalled slightly around insert gasket. Insert intact

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 ~~÷ 2~~ OC K

Performed By: J. C. Gilbreth, 4-11-84
Name: Date

Witnessed By: [signature], 4-11-84
QA Representative Date

Shear Apparatus: Jack---Equipment No: RCM 606
Pressure Gauge-M&TE No: 2355 Due Date: 16 Jan 85
Dial Gauge-M&TE No: 2999 Due Date: 29 Jun 84

Tension Apparatus: Jack-Equipment No: RCM 6037
Pressure Gauge-M&TE No: [illegible] Due Date:
Dial Gauge-M&TE No: 2084 Due Date: 18 Jun 84

COMANCHE PEAK SES
COMBINED SHEAR & TENSION TESTS
Richmond 1/2-Inch, Type SC-2H Insert
Reference: CP II 13.0-9/3912

Specimen Number: 8 (8th from west end) Inserted Load Rod: A-183 Date: 11 April '84

Common	SHEAR			TENSION						
	1-*	Deflection (Inch)			2-*	**	***	Deflection (Inch)		
Gauge Press. (PSI)	Jack Thrust (lb.)	Init.	After 2-Min.	Gauge Press. (PSI)	Jack Thrust (lb.)	Net Jack Thrust (lb.)	Insert Load (lb.)	Init.	After 2 Min.	Notes - Failure Mode
400	5300	0.000	0.000		5300			0.000	0.000	
800	10600	.021	.021		10600			.001	.001	
1200	15900	.046	.047		15900			.0035	.045	
1600	21200	.062	.068		21200			.008	.009	
2000	26500	.081	.084		26500			.014	.023	
2400	31800	.130	.136		31800			.018	.033	
2800	37100	.177	.189		37100			.030	.043	
3200	42400	.229	.237		42400			.035	.048	
3600	47700	.275	.319		47700			.615	.629	
4000	53000	.900	.925		53000			.235	.529	
4200	55650	.920		N/A	55650	N/A	N/A	.4233		
4400	58300	.90			58300			.50		
4500	59625				59625					
4600	60950				60950					
4650	60288				60288					

Dial indicators removed to prevent damage @ time of failure.
Break! Shear failure of rod RH bent about 30° @ shear zone. Washer of insert moved horizontally 1/2". @ Shear broke @ weld from washer. Concrete spalled 1" deep to scale 5" out on compr side of insert.

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 - 2. JCH

Shear Apparatus: Jack---Equipment No: RCN 606
Pressure Gauge-M&TE No: 2355 Due Date: 10 Apr '84
Dial Gauge-M&TE No: 2479 Due Date: 8 Jun '84
Tension Apparatus: Jack-Equipment No: ACH 603T
Pressure Gauge M&TE No: Same Due Date:
Dial Gauge-M&TE No: 2048 Due Date: 18 Jun '84

Performed By: J.C. Hilbell 4-11-84
Name Date

Witnessed By: [signature] 4-11-84
QA Representative Date

COMANCHE PEAK SES
COMBINED SHEAR & TENSION TESTS

Richmond 1½-Inch, Type CC-GW Insert
Reference: CP-CI-13.0 Typ-6

Specimen Number: 9 (9th from west end) Inserted Load Rod: A-193 Date: 11 April '84

Common Gauge Press. (PSI)	SHEAR 1-* Jack Thrust (lb.)	Deflection (Inch) Init.	Deflection (Inch) After 2-Min.	TENSION Gauge Press. (PSI)	2-* Jack Thrust (lb.)	** Net Jack Thrust (lb.)	*** Insert Load (lb.)	Deflection (Inch) Init.	Deflection (Inch) After 2-Min.
400	5,300	0.000	0.000		5,300			0.000	0.000
800	10,600	.002	.002		10,600			.000	.000
1200	15,900	.020	.022		15,900			.002	.003
1600	21,200	.042	.047		21,200			.0063	.008
2000	26,500	.063	.080		26,500			.016	.019
2400	31,800	.135	.173		31,800			.037	.041
2800	37,100	.200	.241		37,100			.060	.067
3200	42,400	.257	.303		42,400			.092	.098
3600	47,700	.311	.370		47,700			.122	.133
4000	53,000	.393	.512		53,000			.163	.179
4300	57,000	.520	.636		57,000			.215	.242
4630	60,950	.720		N/A	60,950	N/A	N/A	.30	
4650	61,613	.77			61,613				
3500	46,375				46,375				

Notes - Failure Mode

Did not exceed to prevent damage

Break! Shear failure of rod. Rod sheared rotated about 25° Struts on comp. & tension side of insert broke loose from washer @ welds. Washer moved ½" horizontally. Insert below washer pressed to be pulled out through coil slightly distorted. Cone washer 1½" x 6" on compression

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.~~ 8 CC

Shear Apparatus: Jack---Equipment No: KCH 606
Pressure Gauge-M&TE No: 2355 Due Date: 16 Jan '84
Dial Gauge-M&TE No: 2749 Due Date: 29 Nov 84

Tension Apparatus: Jack-Equipment No: KCH 6037
Pressure Gauge-M&TE No: 5316 Due Date:
Dial Gauge-M&TE No: 2074 Due Date: 18 Jan '84

Performed By: J. C. Gilbreth 4-11-84
Name Date

Witnessed By: [signature] 4-11-84
QA Representative Date

COMANCHE PEAK SES
CORRECTED SHEAR & TENSION TESTS
EC-GW
Richmond 1/2 - Inch, Type Insert
Reference: CP-ET 13.0-9-13 rev 4

Specimen Number: 10 (10th from west end) Inserted Load Rod: A-113 Date: 6 Apr 84

Ammon	SHEAR			TENSION						
	1.*	Deflection (Inch)			2.*	**	***	Deflection (Inch)		
Gauge Press. (PSI)	Jack Thrust (lb.)	Init.	After 2-Min.	Gauge Press. (PSI)	Jack Thrust (lb.)	Net Jack Thrust (lb.)	Insert Load (lb.)	Init.	After 2 Min.	Notes - Failure Mode
400	5 300	0.000	0.000		5 300			0.000	0.000	
800	10 600	.004	.004		10 600			.000	.000	
1200	15 900	.055	.056		15 900			.006	.001	
1600	21 200	.046	.048		21 200			.008	.003	
2000	26 500	.063	.067		26 500			.012	.007	
2400	31 800	.082	.085		31 800			.016	.017	
2800	37 100	.108	.103		37 100			.020	.119	
3200	42 400	.129	.101		42 400			.120	.120	
3600	47 700	.148	.139		47 700			.120		Reset Tension dial due to its testing beam
4000	53 000	.185	.174		53 000			.127	.127	
4400	58 300	.226	.212		58 300			.131	.139	
4600	60950	.270		N/A	60 950	N/A	N/A			
4700	62 275	.310			62 275					
4800	63 600	.335			63 600			.165		
4850	63 600	.510			63 600					
4900	63 600	.600	.625		63 600			.230	.245	Threads stripped. Lifted insert washer loose from strut. Insert remained in place.
4950	64 925				64 925					
↑										

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 - 2.~~ DCW

Shear Apparatus: Jack---Equipment No: RCH 606
Pressure Gauge-M&TE No: 2352 Due Date: 16 Apr 84
Dial Gauge-M&TE No: 2479 Due Date: 29 Jan 84
Tension Apparatus: Jack-Equipment No: RCH 603T
Pressure Gauge-M&TE No: Same Due Date:
Dial Gauge-M&TE No: 2094 Due Date: 18 Jun 84

Performed By: J.C. Gilbert 4-11-84
Name Date

Witnessed By: [signature] 4-11-84
QA Representative Date

COMANCHE TENDONS
TENSION TESTS

EC-6W
RICHMOND 1½-INCH, TYPE ___ INSERT

Reference: CP-EI-13.0-#13, Rev 2

Specimen Number: 11 Load Rod Spec: A-193 Date: 5 Apr 84
(11th from west, 5th from east

GAUGE PRESS. (P.S.I.)	* JACK THRUST (Lb.)	** NET JACK THRUST (Lb.)	*** INSERT LOAD (Lb.)	DEFLECTION (IN.) INIT.	DEFLECTION (IN.) AFTER 2-MIN.	NOTES-FAILURE MODE
200	2650	1425	2850	0.000	0.000	
400	5300	4075	8150	0.000	.000	
600	7950	6725	13450	.000	.000	
800	10600	9375	18750	.001	.001	
1000	13250	12025	24050	.003	.0035	
1200	15900	14675	29350	.005	.006	
1400	18550	17325	34650	.009	.011	
1600	21200	19975	39950	.013	.015	
1800	23850	22625	45250	.0155	.017	
2000	26500	25275	50550	.0175	.020	
2200	29150	27925	55850	.022	.023	
2400	31800	30575	61150	.027	.028	
2600	34450	33225	66450	.032	.035	
2800	37100	35875	71750	.073	.078	
3000	39750	38525	77050	.094	.099	
3200	42400	41175	82350	.103, [illegible]	.1055	
3400	45050	43825	87650	.109	.111	
3600	47700	46475	92950	.123	.123	
3800	50350	49125	98250	.138	.148	
4000	53000	51775	103550	.190	.214	
4100	~~[illegible]~~ 54325	53100	106,200	Adapt failure of threads (Insert and rod). Thread engagement was "full". Threads on both rod & insert were stripped. Concrete spalled for about 12" depth 18 x 15" over concrete only. Tendon not stressed.		

* Jack Thrust (Lb.) = Gauge Pressure (PSI) x 13.25 — {By dynamometer M & TE # 1432 due Apr. 17, '84}
Total Weight of Load Beam = 2450 — — — — — — — —
** Net Jack Thrust = Total Thrust Minus 1/2 Weight of Beam. (½ Wt. of bm. = 1225#)
*** Insert Load = Net Jack Thrust x 2.

Jack:.....Equipment Number FCM 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:
R C Gilbert 5 Apr 84
Name Date

Witnessed By:
Andrew Petrik 5-5-84
QA Representative Date

COMANCHE PEAK STEAM ELECTRIC STATION
TENSION TESTS

RICHMOND 1½-INCH, TYPE EC-6W INSERT

Reference: CP-EI-13.0-#13,CH

Specimen Number: 12 (12 from West, 42" from East) Load Rod Spec: A-193 Date: 5 April 84

GAUGE PRESS. (P.S.I.)	* JACK THRUST (Lb.)	** NET JACK THRUST (Lb.)	*** INSERT LOAD (Lb.)	DEFLECTION (IN.) INIT.	DEFLECTION (IN.) AFTER 2-MIN.	NOTES-FAILURE MODE
200	2650	1425	2850	0.000	0.000	
400	5300	4075	8150	0.000	.000	
600	7950	6725	13450	.000	.000	
800	10600	9375	18750	.0015	.002	
1000	13250	12025	24050	.0035	.0055	
1200	15900	14675	29350	.007	.008	
1400	18550	17325	34650	.009	.010	
1600	21200	19975	39950	.0115	.012	
1800	23850	22625	43250	.014	.0145	
2000	26500	25275	50550	.017	.0175	
2200	29150	27925	55850	.0195	.020	
2400	31800	30575	61150	.022	.0225	
2600	34450	33225	66450	.0245	.0265	
2800	37100	35875	71750	.028	.0295	
3000	39750	38525	77050	.032	.034	
3200	42400	41175	82350	.036	.037	
3400	45050	43825	87650	.040	.043	
3600	47700	46475	92950	.048	.051	
3800	50350	49125	98250	.057	.0625	
4000	53000	51775	103550	.070	.075	
4200	55650	54425	108850	.084	.092	
4400	58300	57075	114150	.120		Failure by stripped threads, Rod to insert. Thread engagement was "full" stripped length was 3". Concrete surface spalled in 18" dia. area. Spalling appears to 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. (½ 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:

C C Gilbreth 5 Apr 84
Name Date

Witnessed By:

Andrew Pietrak 4-5-84
QA Representative Date

COMANCHE PE[illegible]
TENSION TESTS

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

Reference: CP-EI-13.0 ~~=~~ 13 pg 4

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.) INIT.	DEFLECTION (IN.) AFTER 2-MIN.	NOTES-FAILURE MODE
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	45250	.0045	.0045	
2000	26500	25275	50550	.0055	.007	
2200	29150	27925	55850	.0075	.008	
2400	31800	30575	61150	.009	.010	
2600	34450	33225	66450	.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	.0325	
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 discernable sign of a cone failure in the concrete. Concrete visible to rebar 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. (1/2 wt = 1225#)

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

Jack:.....Equipment Number PCH 606

Pressure Gauge: M & TE Number 2357 Due Date: 16 Apr 84

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

Performed By:

C P Whitt 5 Apr 84
Name Date

Witnessed By:

[signature] 4.5.84
QA Representative Date

COMANCHE PEAK SES
TENSION TESTS

RICHMOND 1½-INCH, TYPE EC-6W INSERT

Reference: CP-EI-13.0-#13 pg 14

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.) INIT.	DEFLECTION (IN.) AFTER 2-MIN.	NOTES-FAILURE MODE
200	2650	1425	2 850	0.000	0.000	
400	5300	4075	8 150	0.001	0.001	
600	7950	6725	13 450	.0015	.0015	
800	10 600	9375	18 750	.002	.002	
1000	13 250	12 025	24 050	.004	.004	
1200	15 900	14 675	29 350	.004	.0065	
1400	18 550	17 325	34 650	.008	.0085	
1600	21 200	19 975	39 950	.0095	.0095	
1800	23 850	22 625	45 250	.010	.010	
2000	26 500	25 275	50 550	.010	.010	
2200	29 150	27 925	55 850	.010	.010	
2400	31 800	30 575	61 150	.012	.012	
2600	34 450	32 225	64 450	.0135	.012	
2800	37 100	35 875	71 750	.016	.0165	
3000	39 750	38 525	77 050	.018	.019	
3200	42 400	41 175	82 350	.020	.024	
3400	45 050	43 825	87 650	.028	.035	Concrete failed
				Shear cone type failure. Depth of cone equal full depth of inner Top of cone limited in size by recess (@ 10" E.W.) After initial failure rebar lifted cover concrete, fracturing in area about 3' x 5' the long dimension corresponding 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. (½ wt = 1225#)

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

Jack:.....Equipment Number RCH 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:

C. P. Gilbert 5 Apr 84
Type Date

Witnessed By:

Andrew Richard 4-5-84
Signature Date

COMANCHE PEAK SES
TENSION TESTS

RICHMOND 1½ -INCH, TYPE EC-6W INSERT

Reference: CP-EI-13.0 ⇌ 13.4

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.) INIT.	DEFLECTION (IN.) AFTER 2-MIN.	NOTES-FAILURE MODE
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	10600	9375	18750	0.003	0.003	
1000	13250	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	.036	.036	
3000	39750	38525	77050	.038	.040	
3200	42400	41175	82350	.041	.042	
3400	45050	43825	87650	.040	.043	
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 ~~type~~ in area by rebar pattern. Concrete ~~cone~~ groove removed in oval 3' x 4', cone outer cone. Cone about 10" dia at top. depth = insert ~~height~~, dimension top of conc. to effective vertical rods of insert, (Adj. 6")

* Jack Thrust (Lb.) = Gauge Pressure (PSI) x 13.25 / 2 = 1225 (By dynamometer No. M&TE 1432 due Apr 17, '84)
Total Weight of Load Beam = 2450 Lb.
** Net Jack Thrust = Total Thrust Minus 1/2 Weight of Beam.
*** Insert Load = Net Jack Thrust x 2.
Jack:.....Equipment Number RCH 666

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

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

Performed By: R C Gilbert 4 Apr 84
Witnessed By: Andrew Rutzick 4-4-84

COMANCHE PEAK SES
SHEAR TESTS

RICHMOND 1 -INCH, TYPE EC-2W INSERT

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

Specimen Number: 16 (1st on west end) Bolt Spec: ~~A-193~~ A490 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		3,500 ~~3500~~ ~~4000~~	46,375	Failure of bolt in shear.

Insert to be 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 2749 Due Date: 29 Jun 84

Performed By:

C O Gillock, 6 April 84
Name Date

Witnessed By:

[signature] 4-6-84
QA Representative Date

COMANCHE PEAK SES
SHEAR TESTS

RICHMOND 1 -INCH, TYPE EC-2W INSERT

Reference: CP-EI-13.0-~~X~~ 13 pg 24

Specimen Number: 17 (22' fr West End) Bolt Spec: A-490 Date: 6 Apr '84

DEFLECTION (IN.)		Jack ~~Gauge~~ Thrust (Lbs)	Gauge ~~Jack~~ Pressure (PSI) *	NOTES-FAILURE MODE
INITIAL	AFTER 2-MIN.			
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	2400	
.166	.186	37,100	2800	
.313	.332	42,400	3200	
.		43,060	3250	Failure by bolt shear

Insert deflected horizontally 3½", 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 PCH 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:

Q C Gilbert 6 Apr '84
Name Date

Witnessed By:

[signature] 4-6-84
QA Representative Date

COMANCHE PEAK SES
SHEAR TESTS

RICHMOND 1 -INCH, TYPE EC-2W INSERT

Reference: CP-EI-13.0-~~X~~ 13 Rev 4

Specimen Number: 18 Bolt Spec: A-490 Date: 6 Apr 84

(3'-0" from West end)

DEFLECTION (IN.) INITIAL	DEFLECTION (IN.) AFTER 2-MIN.	GAUGE PRESSURE (P.S.I.)	JACK * THRUST (Lbs.)	NOTES-FAILURE MODE
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	
.134	.148	3200	42 400	
.200	.322	3600	47 700	
.440		3800	50 350	Failure by bolt shear insert top deflected about 1/2" no apparent rotation of insert Top of concrete crushed/spalled about 2" in front of insert. The insert washer sheared off from the struts, thus no further 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 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:

E. C. Hilton, 6 Apr 84
Name Date

Witnessed By:

[signature] 4-6-84
QA Representative Date

COMANCHE PEAK SES
SHEAR TESTS

RICHMOND 1 -INCH, TYPE EC-2W INSERT

Reference: CP-EI-13.0-#13 Rev 4

Specimen Number: 19 (4th from west end) Bolt Spec: A-490 Date: 9 Apr '84

DEFLECTION (IN.)		GAUGE PRESSURE	JACK * THRUST	NOTES-FAILURE MODE
INITIAL	AFTER 2-MIN.	(P.S.I.)	(Lbs.)	
0.004	0.0035	400	5300	
.036	.036	800	10600	
.053	.0605	1200	15900	
.080	.081	1600	21200	
.098	.099	2000	26500	
.122	.127	2400	31800	
.147	.155	2800	37100	
.190	.2225	3200	~~2400~~	
		~~3500~~		
.270		3500	46375	Insert failed by breaking weld between upper coil and struts. Bolt failed after rotating with the engaged 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 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:

L. C. Gilbreth 9 apr '84
Name Date

Witnessed By:

Antonio Rodriguez 4-9-84
QA Representative Date

COMANCHE PEAK SES
SHEAR TESTS
EC-2W
RICHMOND 1 -INCH, TYPE ___ INSERT

Reference: CP-EI-13.0~~5~~13 rev 4

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

DEFLECTION (IN.) INITIAL	DEFLECTION (IN.) AFTER 2-MIN.	GAUGE PRESSURE (P.S.I.)	JACK * THRUST (Lbs.)	NOTES-FAILURE MODE
~~0.001~~	~~0.017~~	~~400~~		
		~~800~~		
~~0.004~~	~~0.006~~	~~1200~~		Slack not out of apparatus
~~0.003~~	~~0.007~~	~~1600~~		
		~~2000~~		
0.003	0.003	~~400~~	5300	
.025	.032	~~800~~	10600	
.046	.046	1200	15900	
.063	.064	1600	21200	
.085	.087	2000	26500	
.115	~~0~~.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 39,750. Rotation caused conc spall to lift on tension side 1½ over ~~~~ spalling to zero 10" back. Spall 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 Due Date: 16 Apr '84
Dial Gauge:.....M & TE Number 2949 Due Date: 29 Jun '84

Performed By:

J C Gilbreth 9 Apr '84
Name Date

Witnessed By:

[signature] 4-9-84
QA Representative Date

COMANCHE PEAK SES
COMBINED SHEAR & TENSION TESTS

Richmond 1 -Inch, Type ~~EC-3V~~ Insert
Reference: CP CI-13.0 ~~913~~, 14

Specimen Number: 21 (6th from West End) Inserted Load Rod: A-193 Date: 9 Apr 84

(Comm.) SHEAR				TENSION						
Gauge Press. (PSI)	1-* Jack Thrust (lb.)	Deflection (Inch) Init.	After 2-Min.	Gauge Press. (PSI)	2-* Jack Thrust (lb.)	Net Jack Thrust (lb.) **	Insert Load (lb.) ***	Deflection (Inch) Init.	After 2 Min.	Notes Failure Mode
400	5,300	0.000	0.000		5,300			0.000	0.000	
800	10,600	.001	.001		10,600			.000	.000	
1200	15,900	.065	.061		15,900			.022	.022	
1600	21,200	.173	.183		21,200			.044	.053	
2000	26,500	.330	.378		26,100			.111	.134	
~~2403~~ 2400	27,825	.400			27,825			.15		Rod Sound of a weld breaking. ~~Rod~~ Thread @ 25K = 900 = 11,925#. Insert washer deflected laterally 1/8". Some bearing of rod but fractured surface indicated a shear break. Top of insert rotated thru
				N/A		N/A	N/A			Concrete vaulted all around @ about 12" dia. 1½" deep @ insert, zero depth @ edge

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 ~~- 2.~~

Shear Apparatus: Jack---Equipment No: RCH 60C
Pressure Gauge-M&TE No: 2355 Due Date: 16 Jan 84
Dial Gauge-M&TE No: 2948 Due Date: 29 Jun 84
Tension Apparatus: Jack-Equipment No: RCH 60ST
Pressure Gauge M&TE No: ~~None~~ Due Date:
Dial Gauge-M&TE No: ~~2450-2184~~ Due Date: 18 Jan 84

Performed By: J. C. McHall 9 Apr 84
Name Date

Witnessed By: Arlen Patrick 4-7-84
QA Representative Date

COMANCHE PEAK SES
COMBINED SHEAR & TENSION TESTS
Richmond 1 -Inch, Type SC-SW Insert
Reference: CP E1-13.0-19, Rev

Specimen Number: 22 (7th from West) Inserted Load Rod: A-193 Date: 9 April 84

Common	SHEAR			TENSION						
Gauge Press. (PSI)	1-* Jack Thrust (lb.)	Deflection (Inch) Init.	Deflection (Inch) After 2-Min.	Gauge Press. (PSI)	2-* Jack Thrust (lb.)	Net Jack Thrust (lb.)	Insert Load (lb.)	Deflection (Inch) Init.	Deflection (Inch) After 2-Min.	Notes - Failure Mode
400	~~5300~~	0.004	0.004		5300			0.001	0.001	
800	10,600	.037	.038		10600			.013	.014	
1200	15,900	.105	.109		15900			.0255	.026	
1600	21,200	.196	.205		21200			.055	.058	
2000	26,500	.342	.428		26500			.115	.145	
2200	29150	.52			29150			.16		
1800	23850			N/A	23850	N/A	N/A			Wear Brake - Strip nose. Cause unknown
1500	19875				19875					Rod sheared non flat, stated @ shear
										line thru approx. 20° when broke.
										Concrete spalled approx 15" diameter,
										being 12" on tension side & 3" on comp. (front
										shear jack) side 2" deep @ insert.
										Insert remained intact

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~~ 8 C 6

Shear Apparatus: Jack---Equipment No: RCH 606
Pressure Gauge-M&TE No: 2955 Due Date: 16 Apr 84
Dial Gauge-M&TE No: 2989 Due Date: 29 Jun 84
Tension Apparatus: Jack-Equipment No: RCH 603T
Pressure Gauge M&TE No: Same Due Date:
Dial Gauge-M&TE No: 2092 Due Date: 18 Jun 84

Performed By: J. C. Hebbitt 9 Apr 84
Name Date

Witnessed By: A. L. Richards 4-9-84
QA Representative Date

COMANCHE PEAK SES
COMBINED SHEAR & TENSION TESTS
Richmond 1 -Inch, Type 2C-24 Insert
Reference: CP-EI-13.09 Sht 24

Specimen Number: 23 (8" from west end) Inserted Load Rod: A-193 Date: 12&10 Apr 84

Specimen	SHEAR			TENSION						
Gauge Press. (PSI)	1-* Jack Thrust (lb.)	Deflection (Inch) Init.	Deflection (Inch) After 2-Min.	Gauge Press. (PSI)	2-* Jack Thrust (lb.)	** Net Jack Thrust (lb.)	*** Insert Load (lb.)	Deflection (Inch) Init.	Deflection (Inch) After 2-Min.	Notes - Failure Mode
400	5300	0.002	0.006		5300			0.0005	0.0005	
800	10600	.075	.0375		10600			.009	.010	
1200	15900	.122	.122		15900			.034	.041	
1600	21200	.29?	.269		21200			.075	.084	
2000	26500	.350	.410		26500			.140	.158	
2200	29150	.430			29150			.20		Deflection increased rapidly.
2320	30975	.620		N/A	30975	N/A	N/A			At pt failure by shear of ⅜ 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 defor-
										mation of threaded coil. Rod failure
										was by shear after considerably defor-
										mation

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 = 2 SC#

Shear Apparatus: Jack---Equipment No: RCH 602
Pressure Gauge M&TE No: 2755 Due Date: 26 Nov 84
Dial Gauge-M&TE No: 2744 Due Date: 29 Jun 84
Tension Apparatus: Jack Equipment No: RCH 603T
Pressure Gauge M&TE No: same Due Date:
Dial Gauge-M&TE No: 2094 Due Date: 1 Jun 84

Performed By: J. C. Webb 10 Apr 84
Name Date

Witnessed By: Adrian Gil 4-10-84
QA Representative Date

COMANCHE PEAK SES
COMBINED SHEAR & TENSION TESTS
EC-2hr
Richmond / -Inch, Type Insert
Reference: CP-EI-13.0 9pg 9

Specimen Number: 24 (9th from west end) Inserted Load Rod: A-173 Date: 10 April '84

Common	SHEAR			TENSION						
	1-*	Deflection (Inch)			2-*	**	***	Deflection (Inch)		
Gauge Press. (PSI)	Jack Thrust (lb.)	Init.	After 2-Min.	Gauge Press. (PSI)	Jack Thrust (lb.)	Net Jack Thrust (lb.)	Insert Load (lb.)	Init.	After 2-Min.	Notes - Failure Mode
400	5,300	0.001	0.001		5303			.002	.002	
800	10,600	.008	.008		10 600			.0065	.0065	
1200	15 900	.060	.070		15 900			.027	.030	
1600	21 200	.153	.171		21 200			.062	.069	
2000	26 500	.325	.370		26 500			.135	.159	
2100	27 825	.400			27 825			.17		Rapid yielding began
2100	27 825	.500		N/A	27 825	N/A	N/A	.20		
2200	29 150	.540			29 150			.227		
2200	29 150	.700			29 150			.227		
2000	26 500				26 500					Break. About shear failure of rod. Some ½" horizontal deflection of top of insert permitted by rotation crushing of concrete and deflection of upper coil of insert. Concrete spalled 2" deep on tension. Double 2" of insert seem to have tilted 5°(±). Least lateral

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 - 2 - 3 of 5

Shear Apparatus: Jack---Equipment No: RCH 606
Pressure Gauge-M&TE No: 2355 Due Date: 16 Jan 84
Dial Gauge M&TE No: 2979 Due Date: 22 Jun 84
Tension Apparatus: Jack-Equipment No: RCH 607
Pressure Gauge-M&TE No: Same Due Date:
Dial Gauge-M&TE No: 2094 Due Date: 12 Jun 84

Performed By: J. C. Gilbreath 10 April 84
Name Date

Witnessed By: [signature] 4-10-84
QA Representative Date

COMANCHE PEAK SES
COMBINED SHEAR & TENSION TESTS
Richmond 1-Inch, Type EC-2N Insert
Reference: CP-EI-13.09.28

Specimen Number: 25 (10th from West End) Inserted Load Rod: A-173 Date: 10 April '84

SHEAR				TENSION						
Gauge Press. (PSI)	1-* Jack Thrust (lb.)	Deflection (inch) Init.	Deflection (inch) After 2-Min.	Gauge Press. (PSI)	2-* Jack Thrust (lb.)	** Net Jack Thrust (lb.)	*** Insert Load (lb.)	Deflection (inch) Init.	Deflection (inch) After 2 Min.	Notes - Failure Mode
400	5 300	0.005	0.015		5 300			0.000	0.000	
800	10 600	0.026	.028		10 600			.005	.009	
1200	15 900	.115	.122		15 900			.005		
1600	21 200	.217	.229		21 200			.006	.010	
2000	26 500	.260	.304		26 500			.079	.063	
2100	27825	.320			27825			.070		
2150	28487	.400		N/A	28487	N/A	N/A	.080		Abrupt break. Insert deflected 1/32" (-). Rod failed in shear.

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 Wt. of Tension Load Beam = N/A lb.~~
~~** Net Jack Thrust = Total Thrust Minus 177 Wt. of Beam.~~
*** Insert Load = ~~Net~~ Jack Thrust - 2. 2.5%

Shear Apparatus: Jack---Equipment No: RCH 606
Pressure Gauge-M&TE No: 2355 Due Date: 16 Apr '84
Dial Gauge-M&TE No: 2797 Due Date: 27 Jun '84
Tension Apparatus: Jack-Equipment No: RCH 607T
Pressure Gauge-M&TE No: 5MA Due Date:
Dial Gauge-M&TE No: 2074 Due Date: 18 Oct '84

Performed By: J. C. Gibbs, 10 April 84
Name Date

Witnessed By: [signature] 4-2-84
QA Representative Date

[illegible] PEAK SES
[illegible] TESTS

EC-2W
RICHMOND 1 -INCH, TYPE ___ INSERT

Reference: CP-EI-13.0-[illegible] 13; 14

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

GAUGE PRESS. P.S.I.)	* JACK THRUST (Lb.)	** NET JACK THRUST (Lb.)	*** INSERT LOAD (Lb.)	DEFLECTION (IN.) INIT.	DEFLECTION (IN.) AFTER 2-MIN.	NOTES-FAILURE MODE
200	2650	1425	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	21300	19975	39950	.098	.105	
1700	22525	21300	42600	.134		Failure.
			Insert remained intact. Shear cone type failure of concrete. Insert was located near center between E-W & N-S centers. Cone was restricted somewhat by 4-bars 2-each way. Some lifting force on back corner concrete to small 5-ft. ea. side of insert. Shear cone depth = full height of insert less 3/4" @ bottom.			

* 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 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 2044 Due Date: 29 Jun 84

Performed By:
[signature] 6 Apr 84
Name Date

Witnessed By:
[signature] 6 Apr 84
QA Representative Date

COMANCHE PEAK STEAM ELECTRIC STATION
TENSION TESTS

RICHMOND 1 -INCH, TYPE EC-2W INSERT

Reference: CP-EI-13.0 ~~#13,911~~

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.) INIT.	DEFLECTION (IN.) AFTER 2-MIN.	NOTES-FAILURE MODE
200	2650	1325	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	12625	25050	.0065	.0075	
1200	15900	14675	29350	.0165	.0175	
1400	18550	17325	34650	.050	.056	
1600	21200	19975	39950	.082 ~~.060~~	.092	
~~1800~~ 1750 ~~2000~~	23,188	21,960	43920	.146		Failure

Failure occurred by failure of the insert. Weld between lower coil and vertical strut 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 = 2650

** Net Jack Thrust = Total Thrust Minus 1/2 Weight of Beam. (½ Wt. = 1325)

*** 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:

J. C. Stobbe 6 Apr '84
Name Date

Witnessed By:

[signature] 4-6-84
QA Representative Date

COMANCHE PEAK
TENSION TESTS

EC-2W
RICHMOND 1 -INCH, TYPE ___ INSERT

Reference: CP-EI-10.0 ⇐ 13 pcs

Specimen Number: 28 (3rd 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.) INIT.	DEFLECTION (IN.) AFTER 2-MIN.	NOTES-FAILURE MODE
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	12,025	24,050	.004	.005	
1200	15,900	14,675	29,350	.009	.010	
1400	18550	17325	34650	.015	.029	
~~1550~~ 1550	20538	19313	38626	.055	—	
1600	21,200	19975	39,950	.067	.082	
~~1700~~ 1700	22,525	21300	42,600	.15		concrete under
				cone failure.		Insert and rebar
				remained intact.		Cone height
				equal insert height.		Size of cone
				was limited by rebar ~~mat~~ mat.		
				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. (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:
D. C. Hewitt 4-10-84
Name Date

Witnessed By:
[signature] 4-10-84
QA Representative Date

COMANCHE PEAK SES
TENSION TESTS

EC-2W
RICHMOND 1 -INCH, TYPE ___ INSERT

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

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.) INIT.	DEFLECTION (IN.) AFTER 2-MIN.	NOTES-FAILURE MODE
200	2650	1325	2650	0.000	0.000	
400	5300	4075	8150	.005	.005	
600	7950	6725	13450	.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	
~~1800~~						
~~2000~~						
1760	22,525	21,300	42,600			Concrete failed by the load on insert lifting the rebar mat. An area some 3.5' x 6.0' failed in this manner when insert pulled out taking 5 #3's come with it. No 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. (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 Jun '84

Performed By:
C. L. Gilbert 6 April 84
Name Date

Witnessed By:
Andrew Pietryka 4-6-84
QA Representative Date

COMANCHE PEAK SES
TENSION TESTS

RICHMOND 1 -INCH, TYPE EC-2W INSERT

Reference: CP-EI-13.0-~~F2C4~~

Specimen Number: 30 Load Rod Spec: A-09 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.) INIT.	DEFLECTION (IN.) AFTER 2-MIN.	NOTES-FAILURE MODE
~~200~~ ~~400~~ ~~600~~ ~~800~~				~~0.000~~ ~~.000~~ ~~.001~~ ~~.005~~	~~0.000~~ ~~.000~~ ~~.001~~ ~~.006~~	
200	2650	1425	2850	0.000	0.000	
400	5300	4075	8150	0.000	.000	
600	7950	6725	13450	.001	.001	
800	10600	9375	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~~ ~~2000~~ 1850	21860	20635	41270	.250		Load Peaked Out

Insert failed by breaking weld between lower coil and vertical strut. Upper (threaded coil) came out w/rod, also strut came out. Top concrete spalled dia. 18" diam. surface spall only. Lower ~~6~~ 4 1/2" was exposed by removal of cover. Bar not deformed. Concrete

* 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 RCH 606

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

Dial Gauge: M & TE Number 2920 Due Date: 24 Jun '84

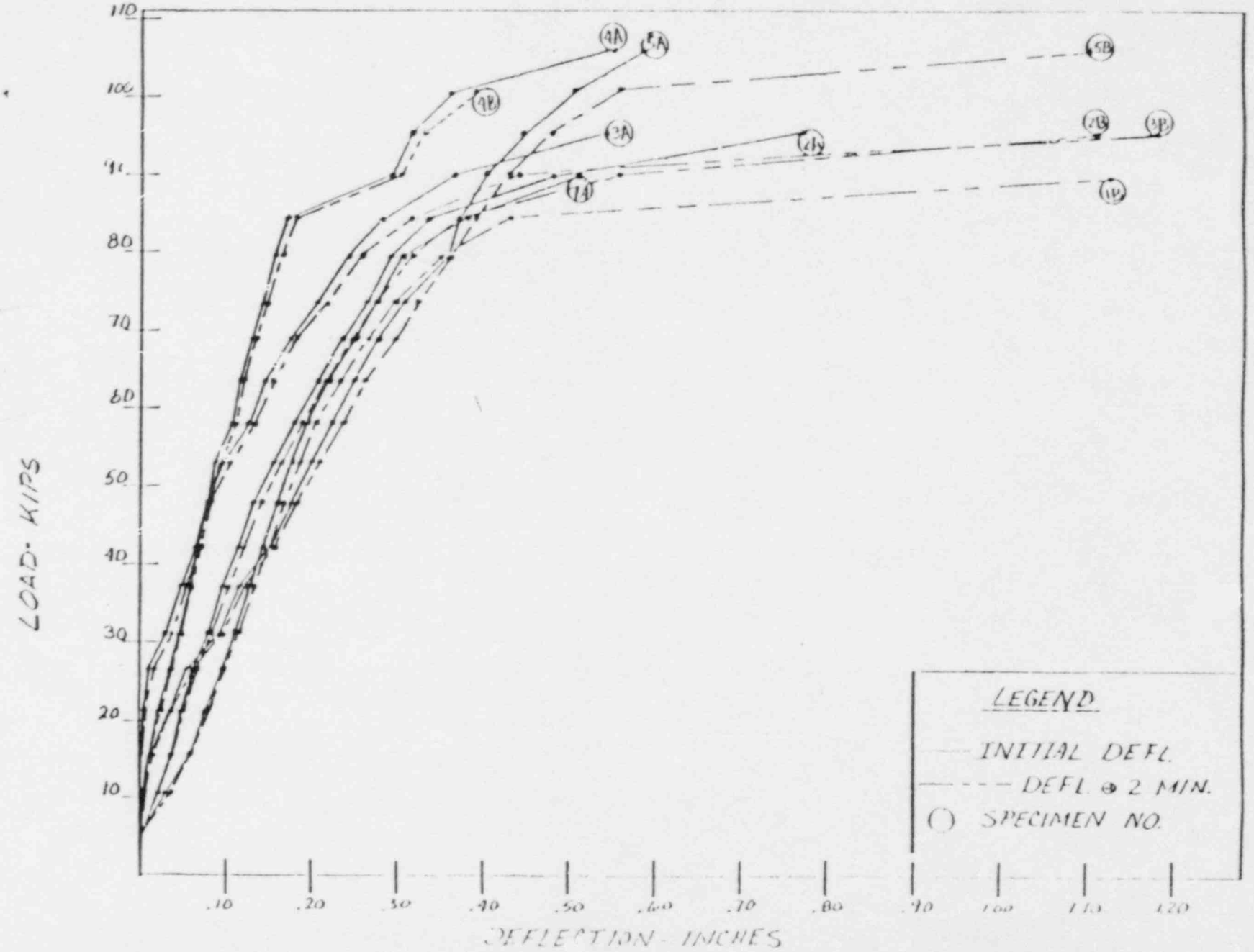
Performed By: [signature] 5 Apr 84

Witnessed By: [signature] 4-5-84

APPENDIX 3

LOAD-DEFLECTION CURVES

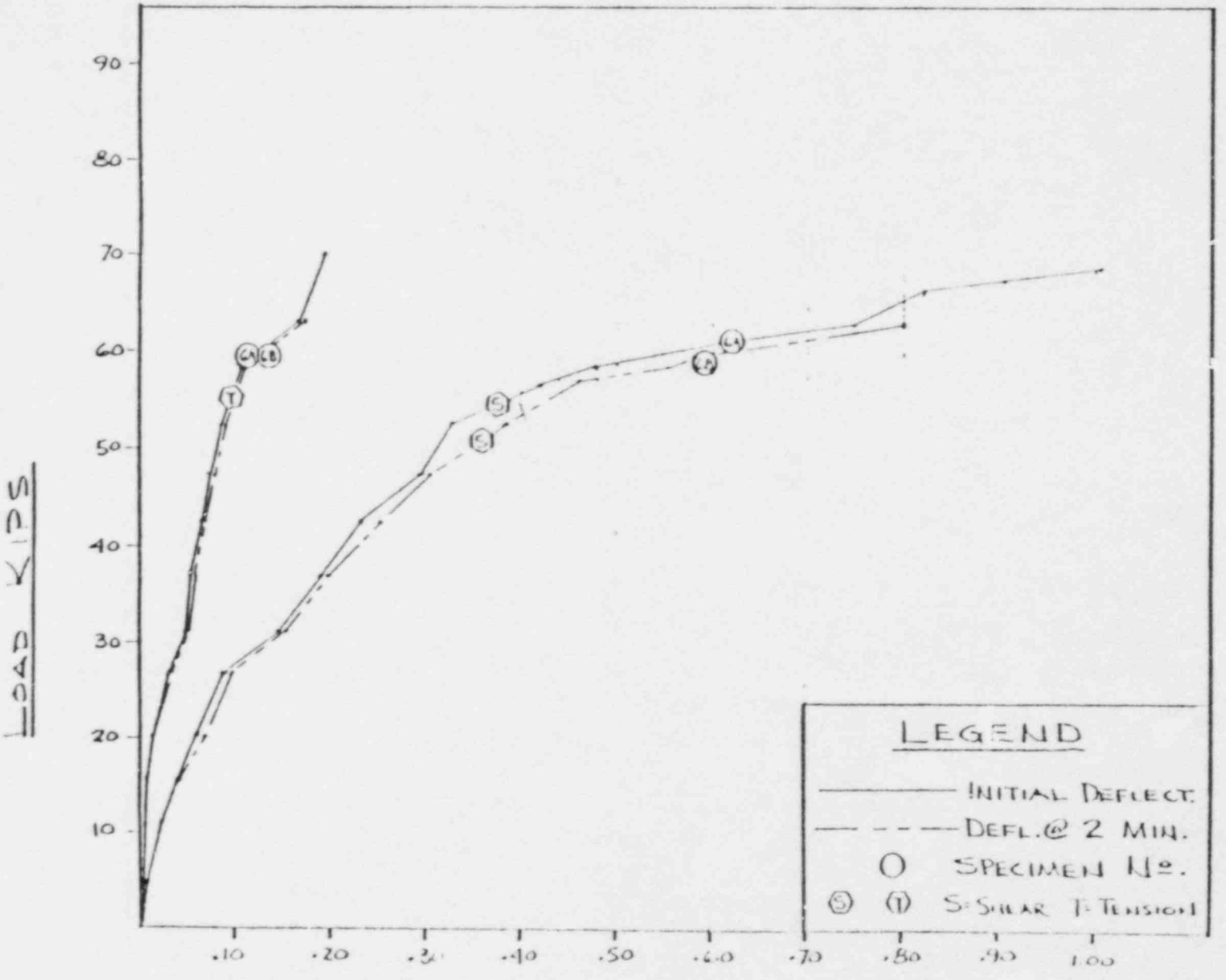
LOAD-DEFLECTION CURVES
1½-INCH TYPE EC-6W, SHEAR TEST

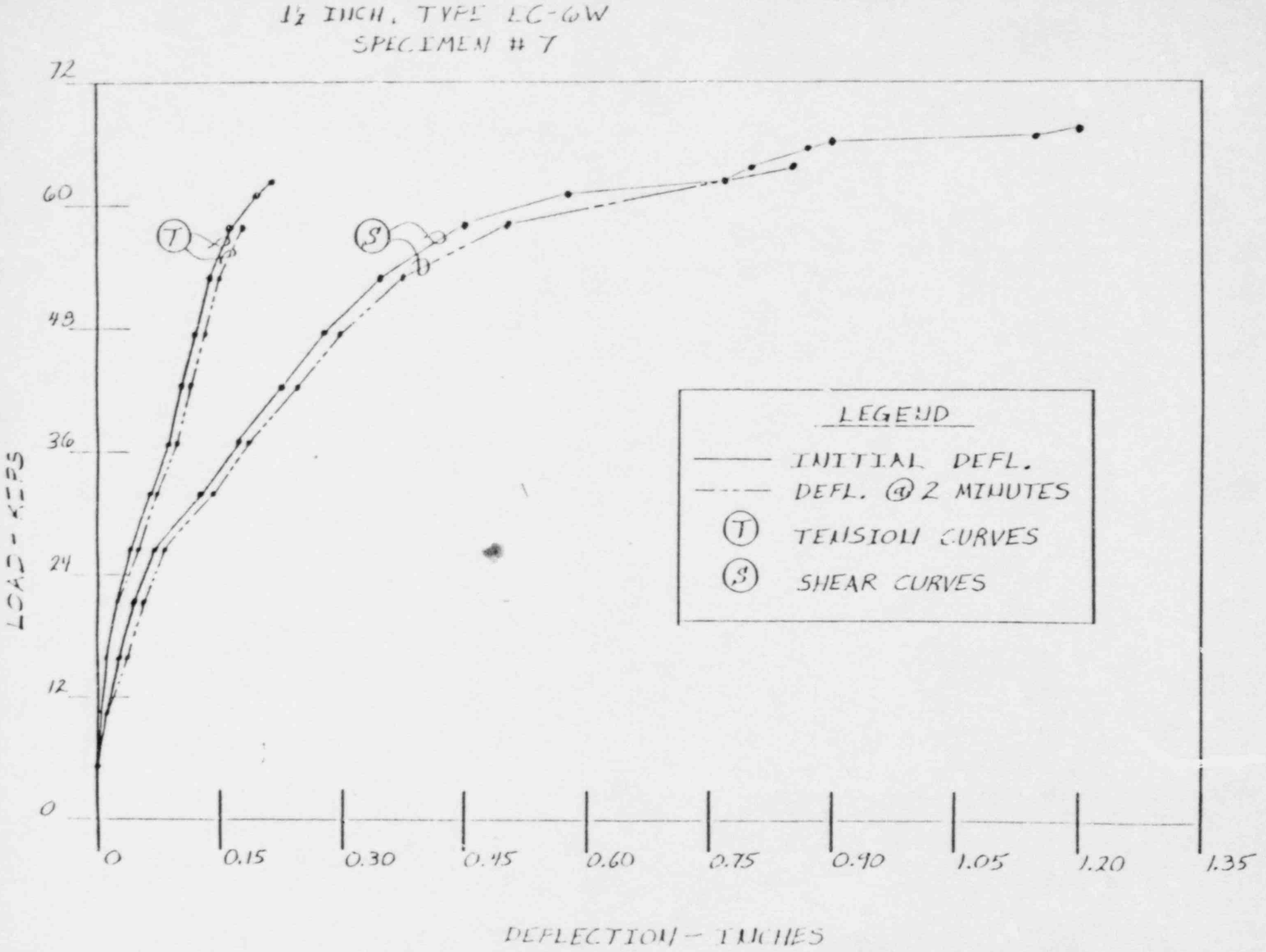


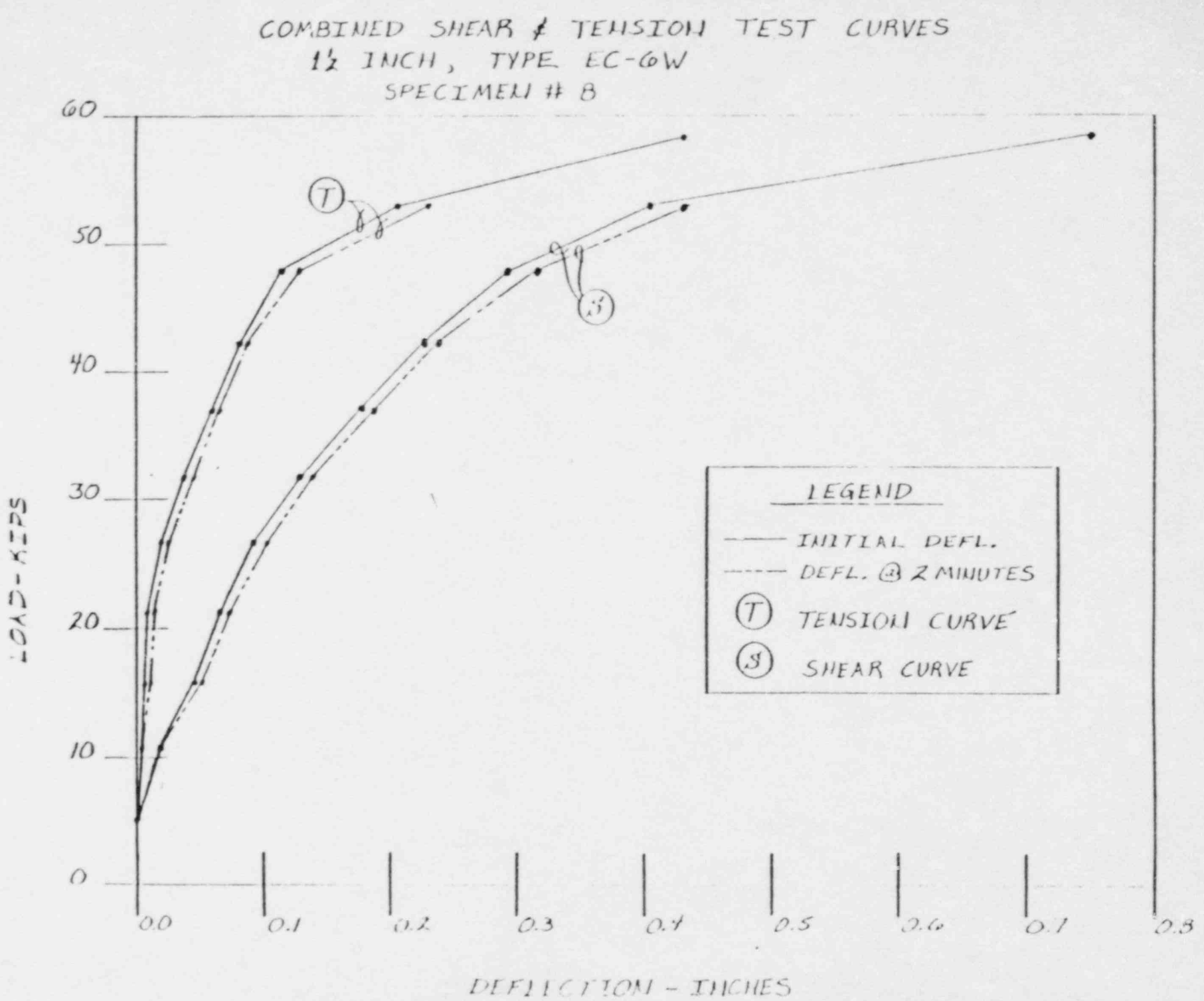
COMBINED SHEAR & TENSION TEST CHART

RICHMOND 1½ INCH, TYPE EC-6W INSERT

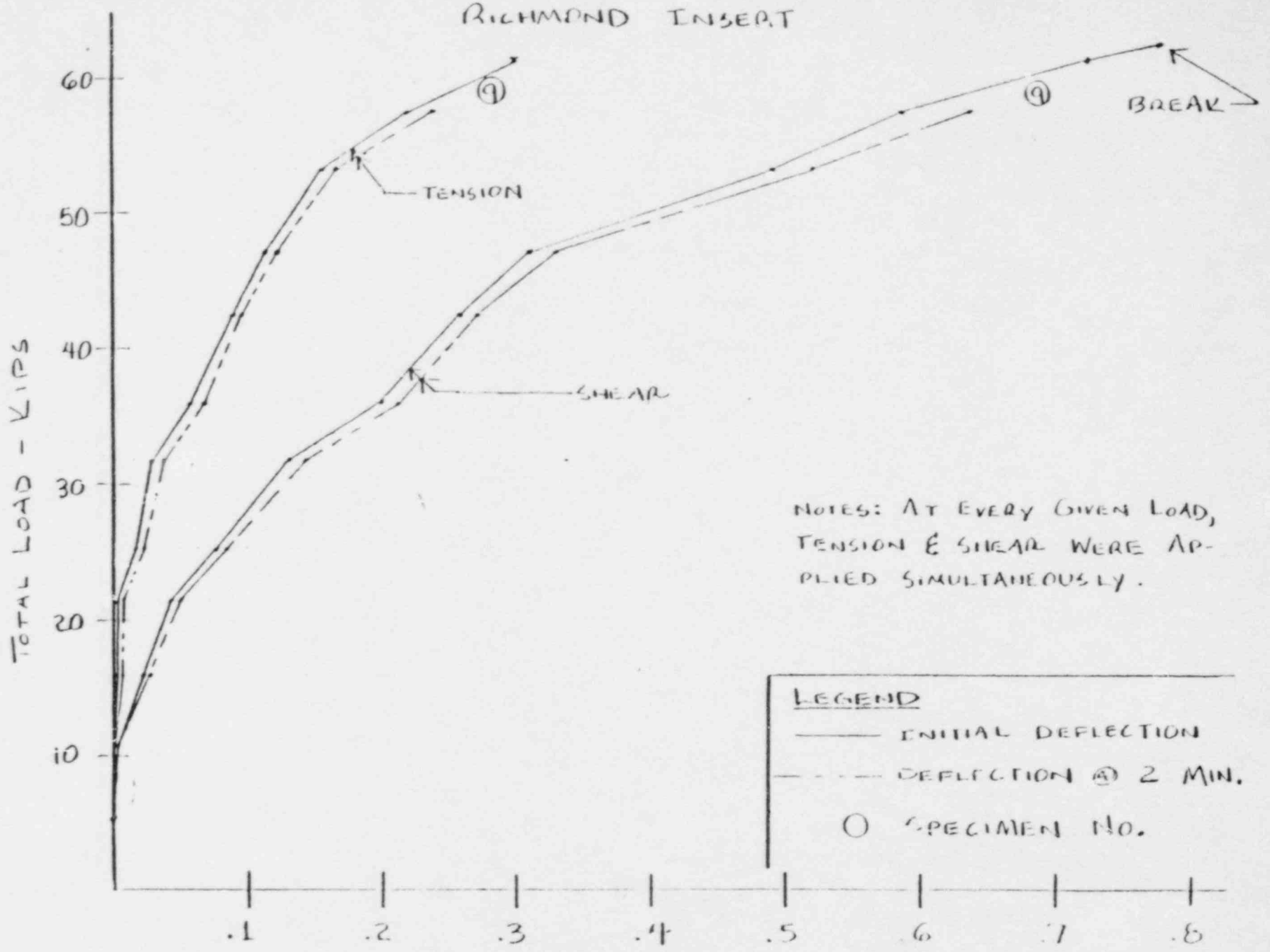
SPECIMAN Nº. 6



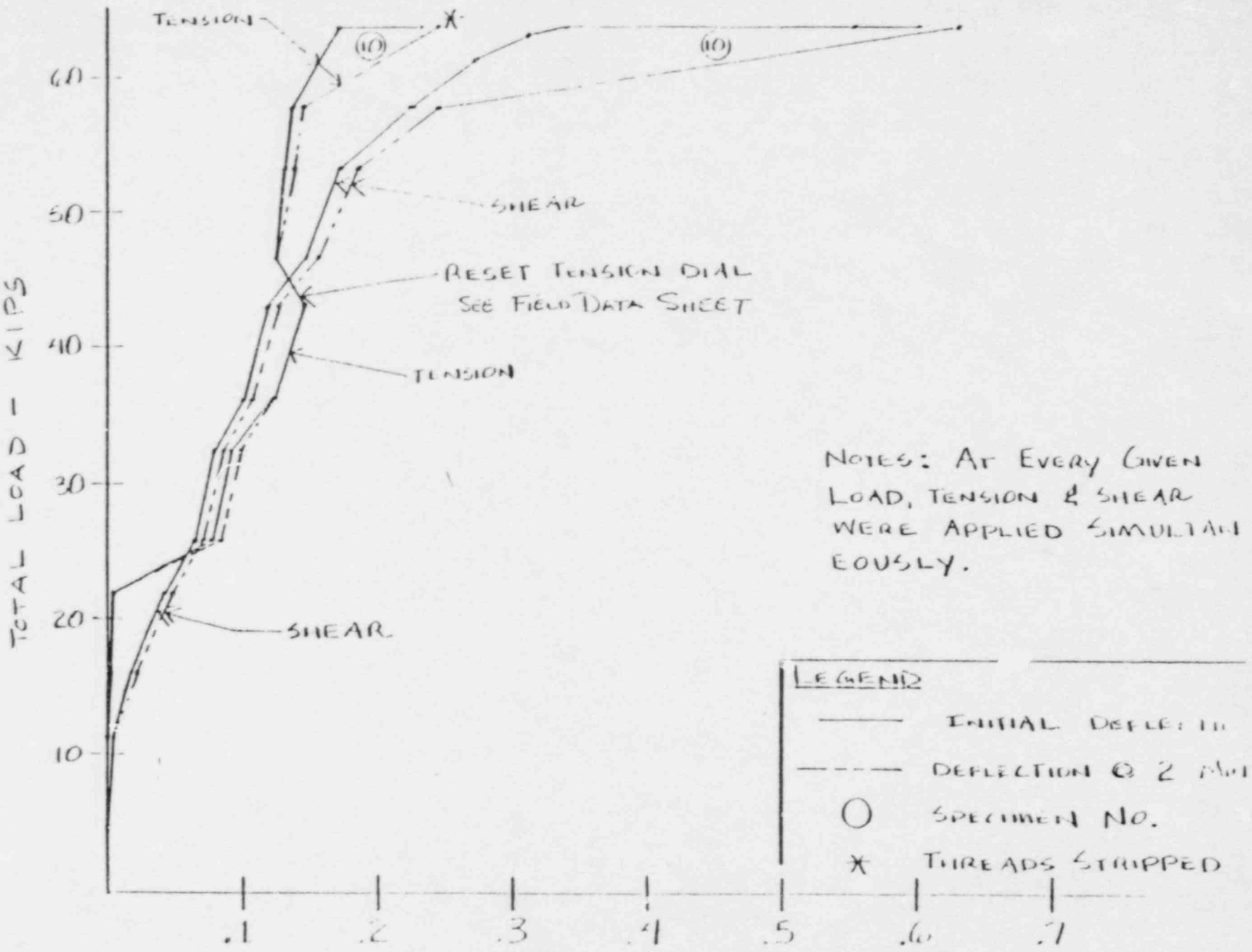

½ INCH, TYPE LC-6W
SPECIMEN # 7
72
60
48
36
24
12
0
LOAD - KIPS
T
S
LEGEND
INITIAL DEFL.
DEFL. @ 2 MINUTES
T TENSION CURVES
S SHEAR CURVES
0
0.15
0.30
0.45
0.60
0.75
0.90
1.05
1.20
1.35
DEFLECTION - INCHES


COMBINED SHEAR & TENSION TEST CURVES
1½ INCH, TYPE EC-6W
SPECIMEN # 8
60
50
40
30
20
10
0
LOAD - KIPS
T
S
LEGEND
INITIAL DEFL.
DEFL. @ 2 MINUTES
T TENSION CURVE
S SHEAR CURVE
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
DEFLECTION - INCHES

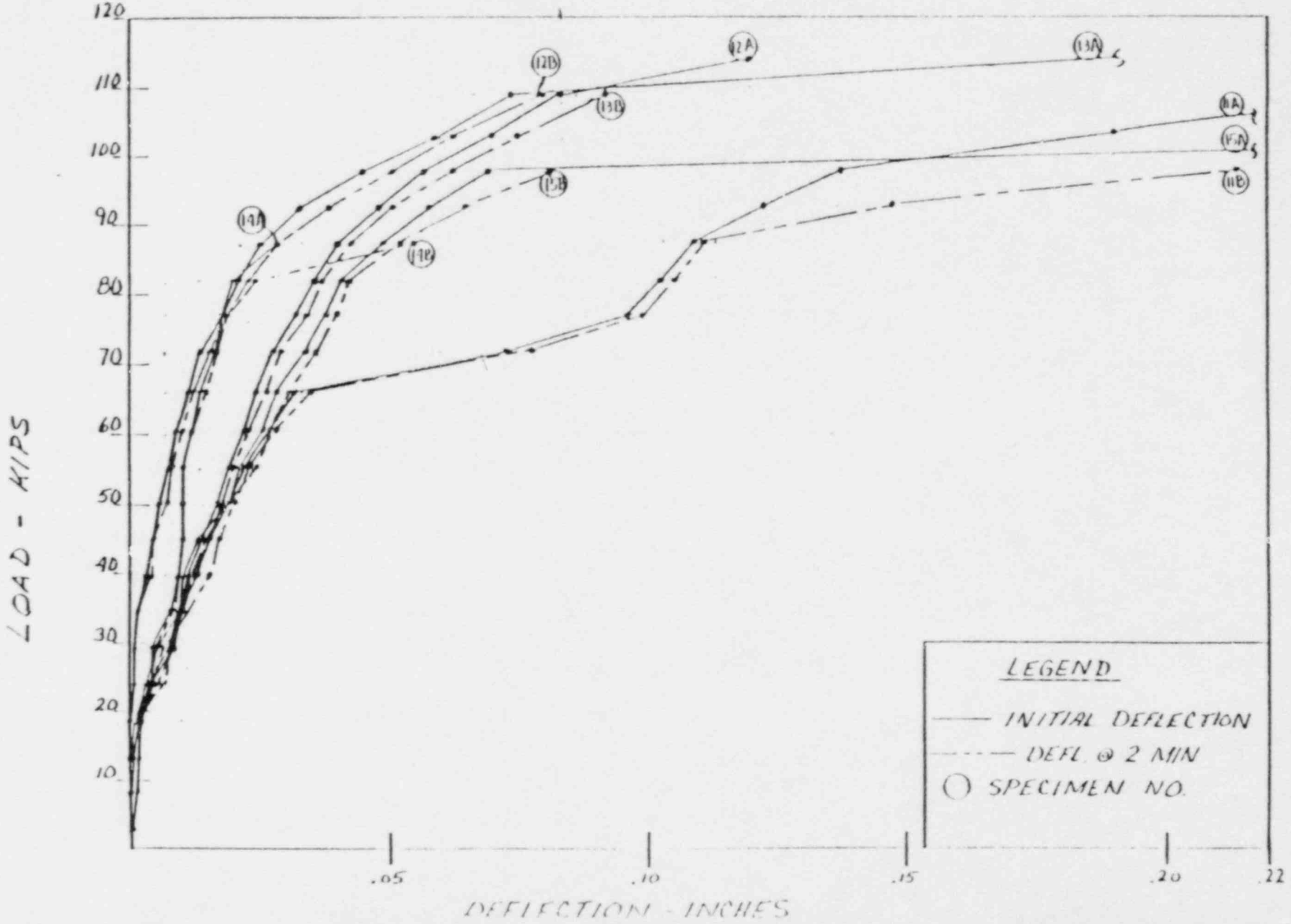
LOAD DEFLECTION CURVES FOR 1½" TYPE EC-6W RICHMOND INSERT



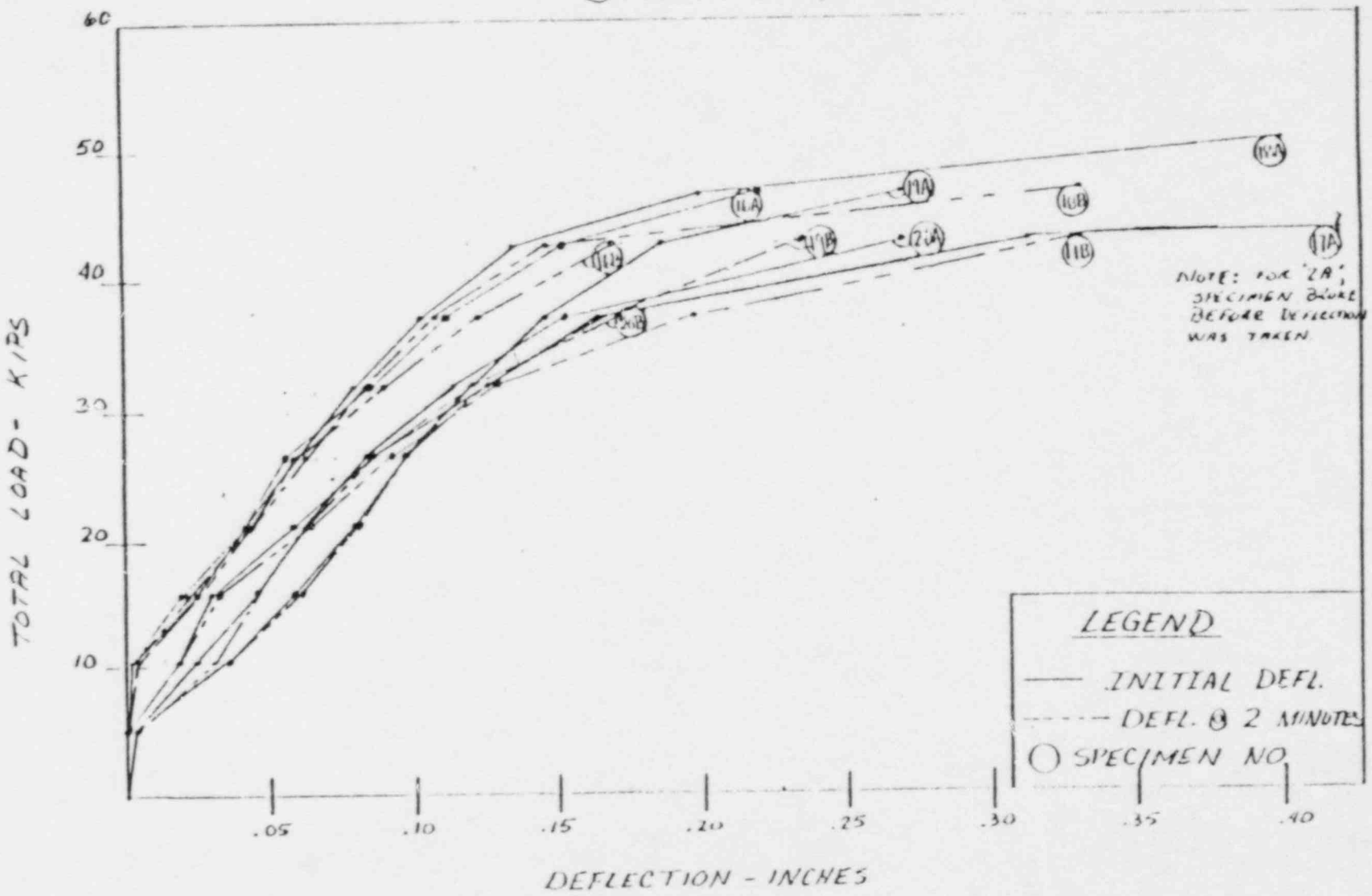
LOAD-DEFLECTION CURVES FOR 1/2" - 13 UNC
RICHMOND INSERT



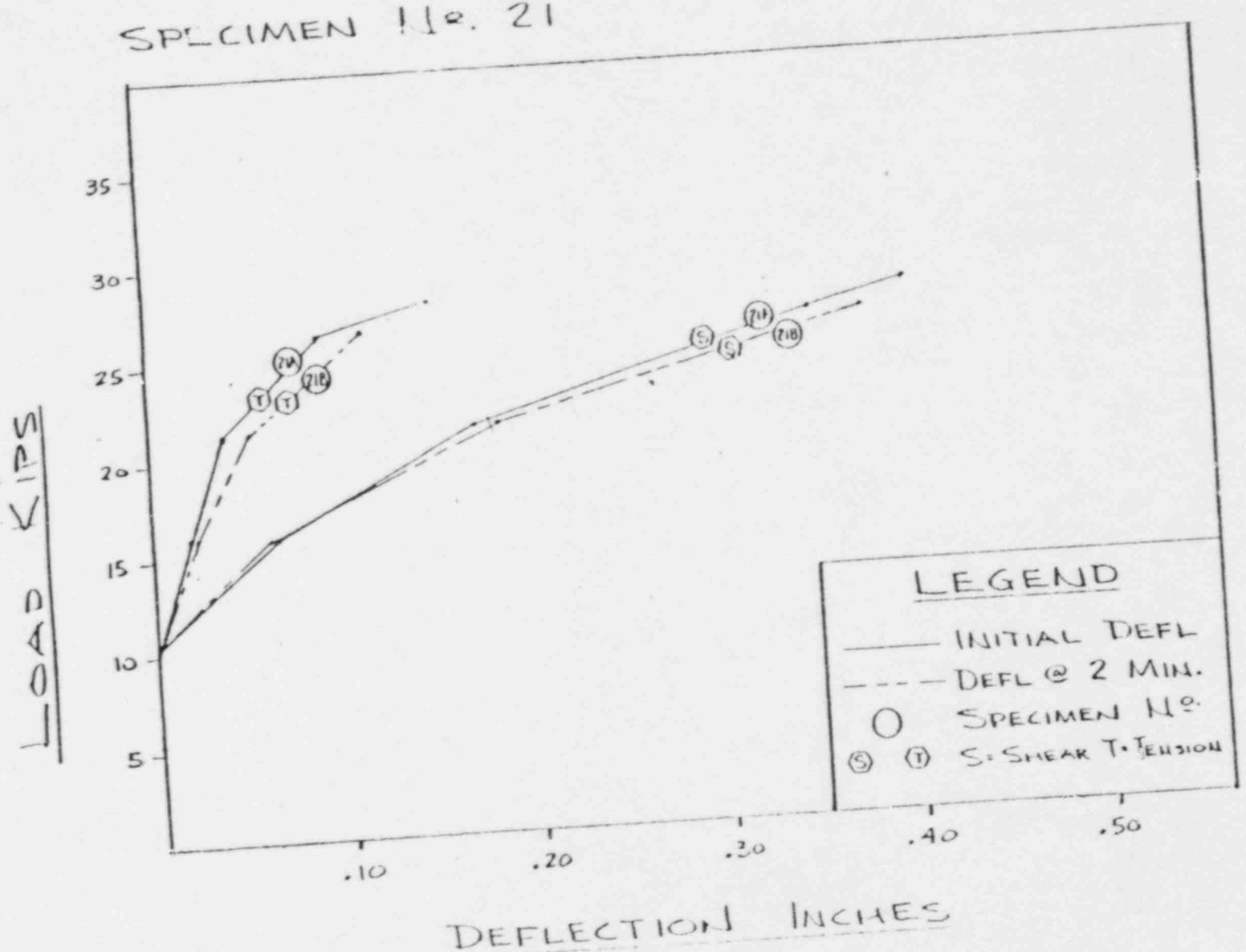
LOAD-DEFLECTION CURVES
1½-INCH TYPE EC-6W, TENSION TEST



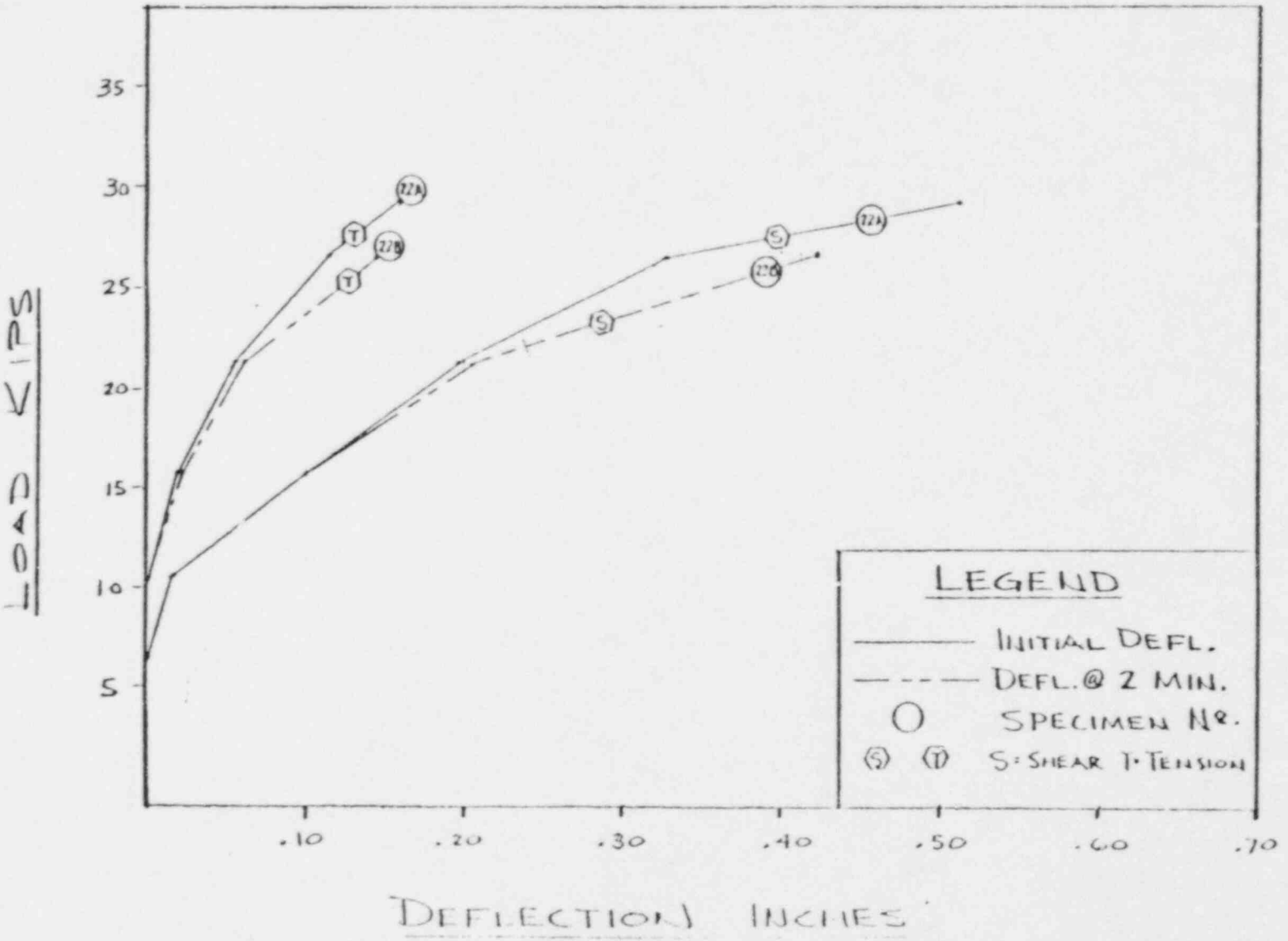
LOAD - DEFLECTION CURVES
1-INCH TYPE EC-2W
SHEAR TEST



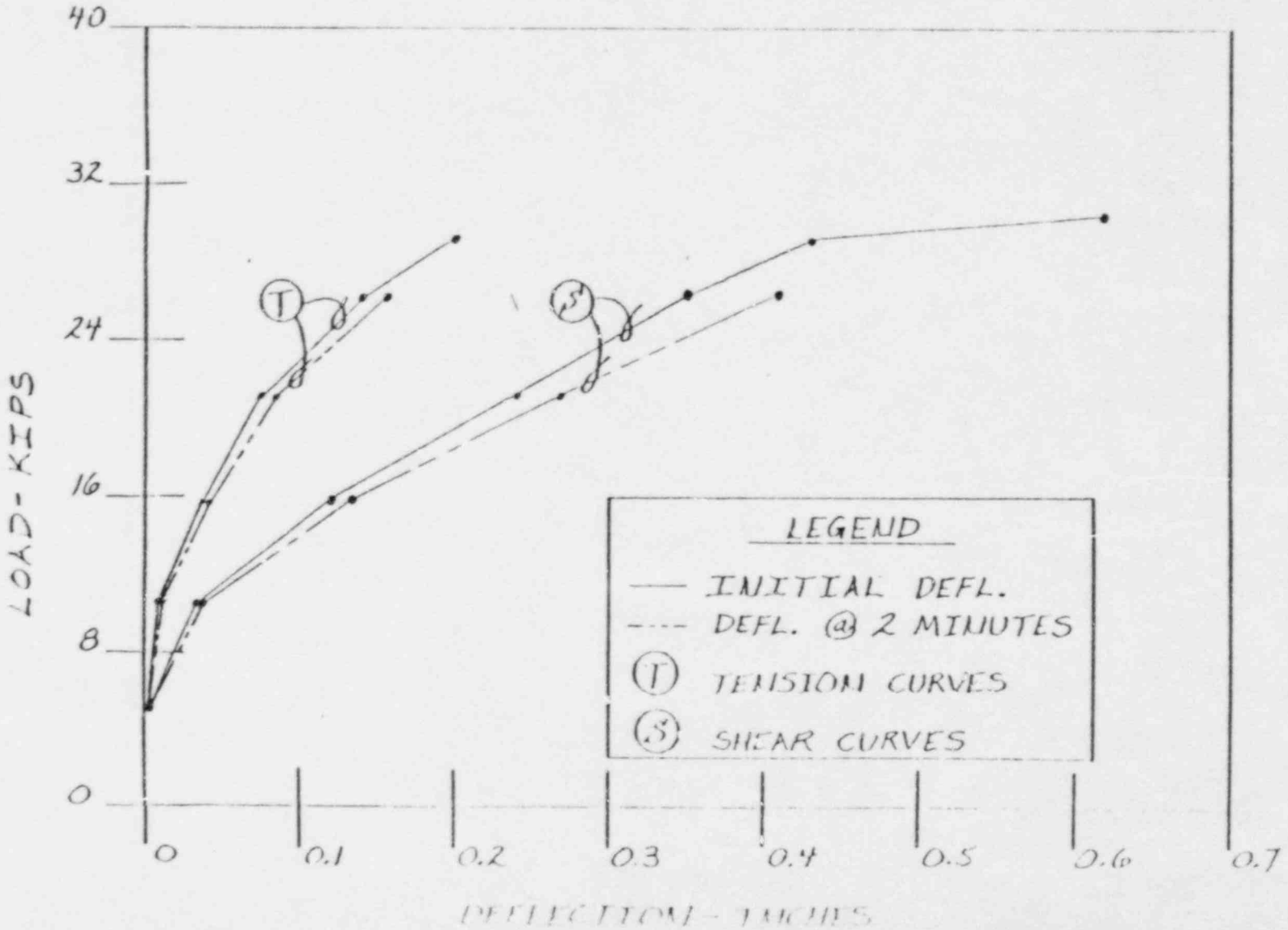
COMBINED SHEAR & TENSION CHART
RICHMOND 1 INCH, TYPE EC-2W INSERT
SPECIMEN No. 21



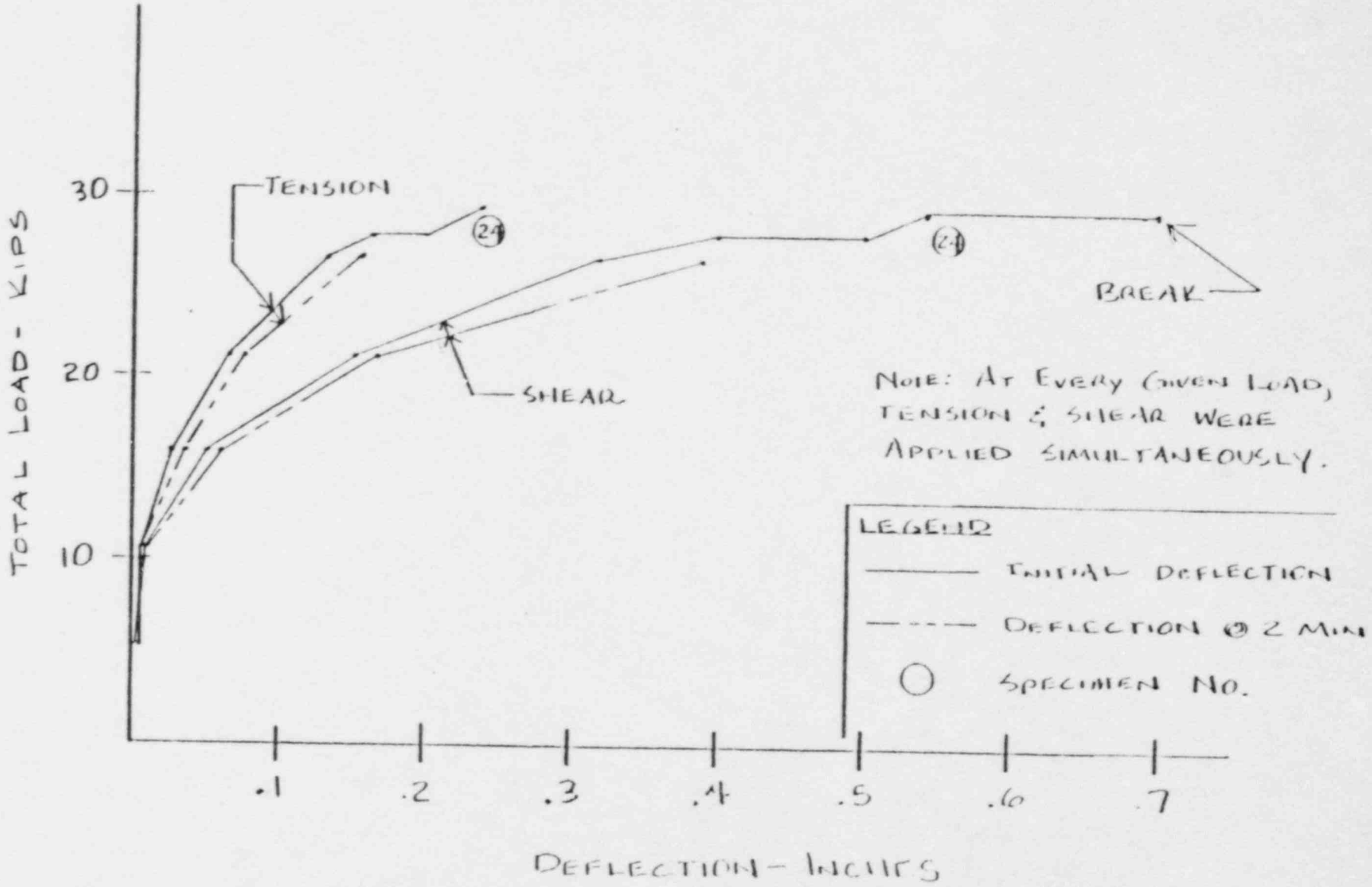
COMBINED SHEAR & TENSION CHART
RICHMOND 1 INCH, TYPE EC-2W INSERT
SPECIMAN NO. 22



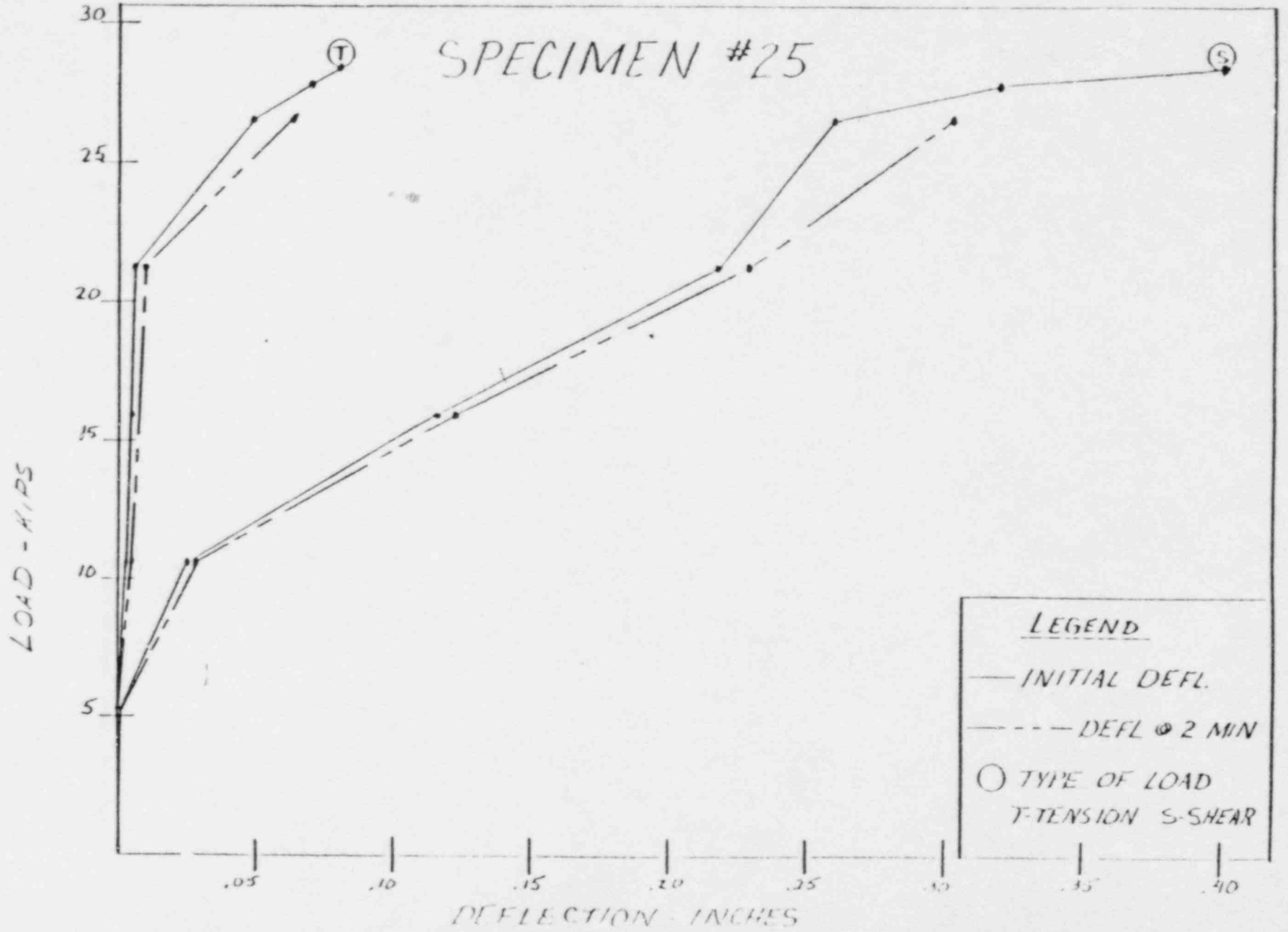
COMBINED SHEAR & TENSION TEST CURVES
1 INCH, TYPE EC-2W
SPECIMEN #23



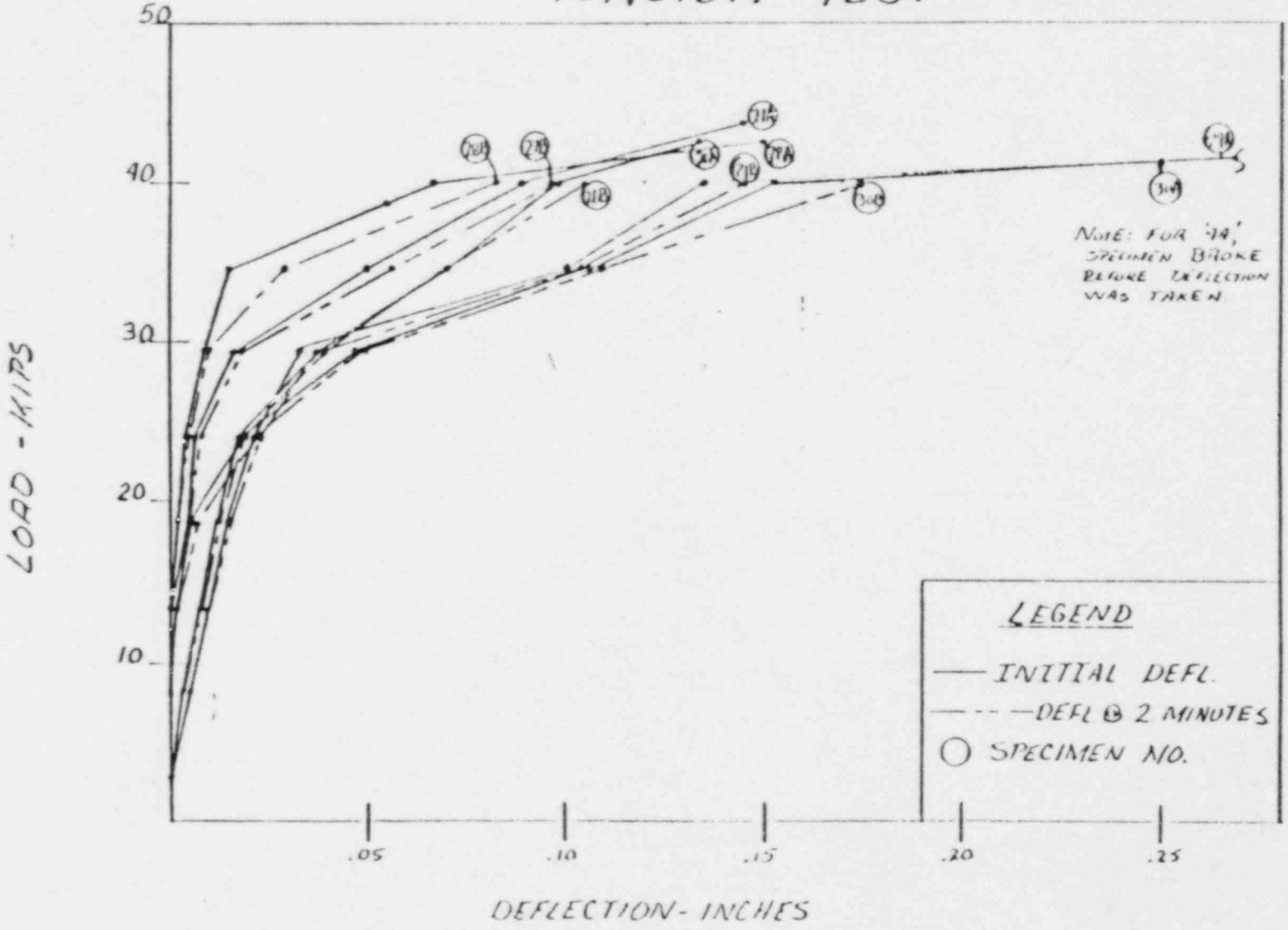
LOAD DEFLECTION CURVES FOR 1"ø TYPE EC-2W RICHMOND INSERT



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



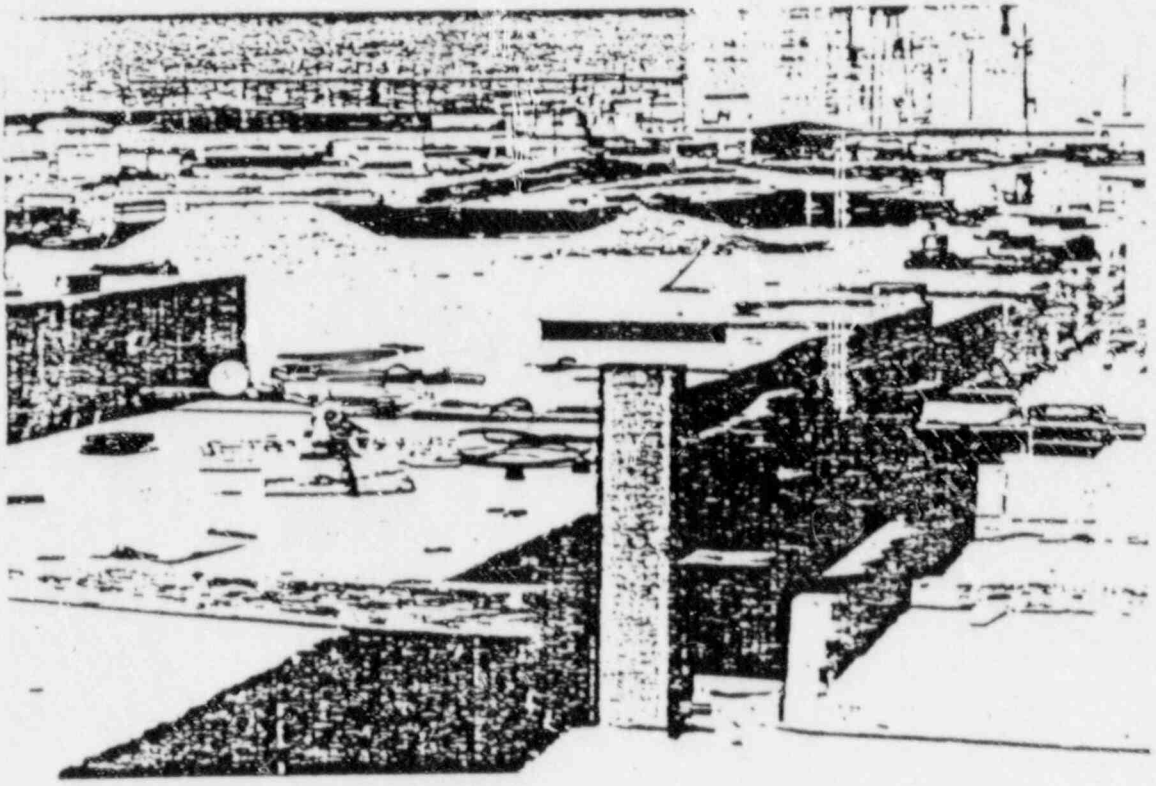
LOAD-DEFLECTION CURVES
1-INCH TYPE EC-2W
TENSION TEST



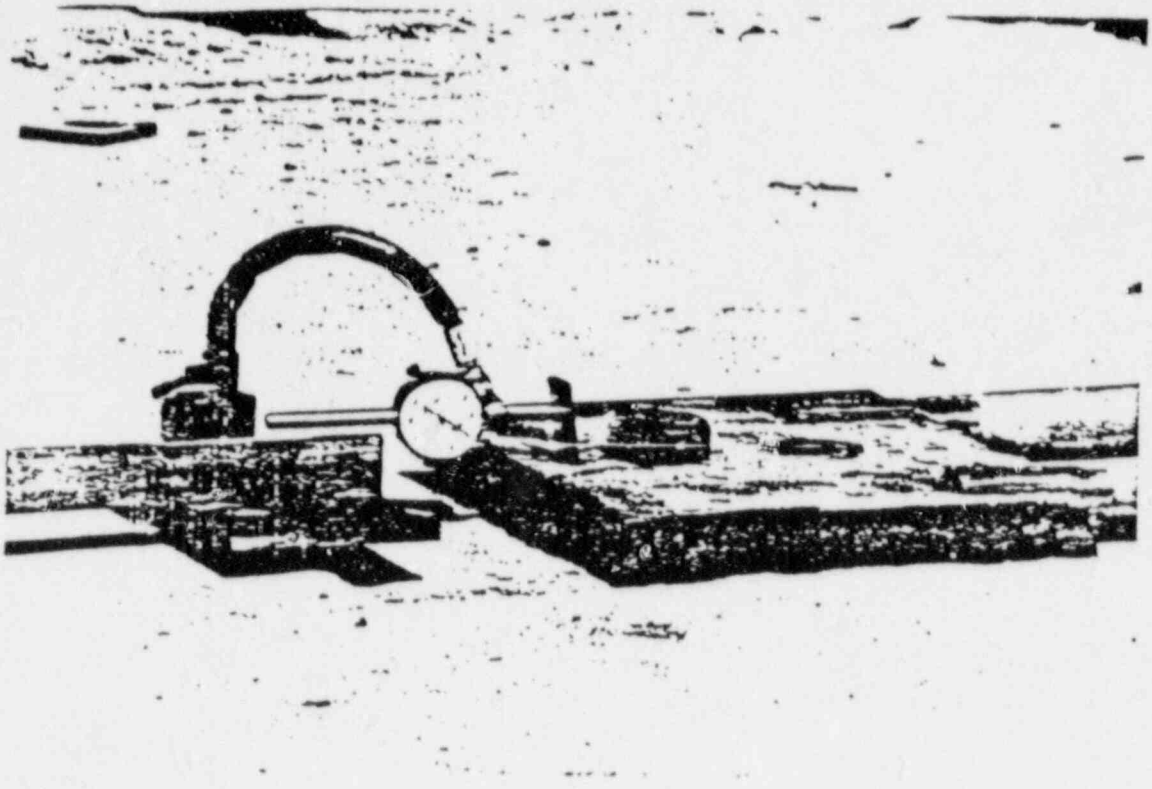
APPENDIX 4

PICTURES OF ACTUAL TEST APPARATUS

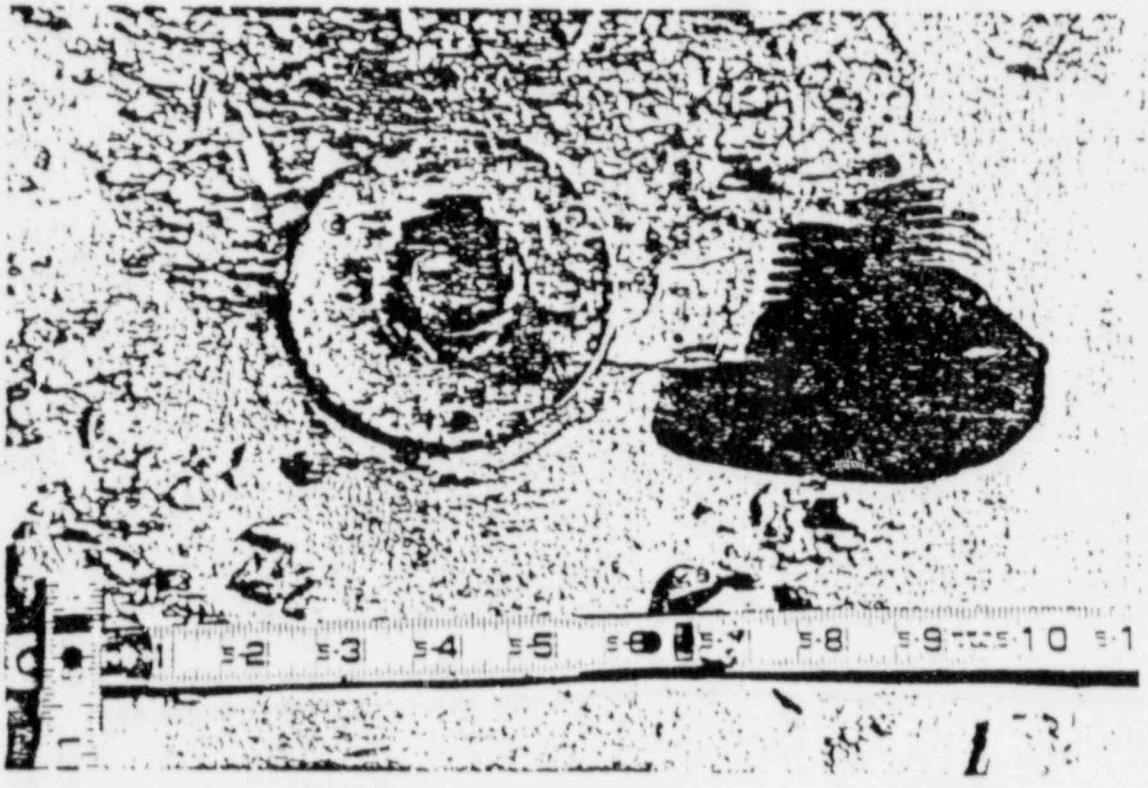
SHEAR TEST



TEST APPARATUS

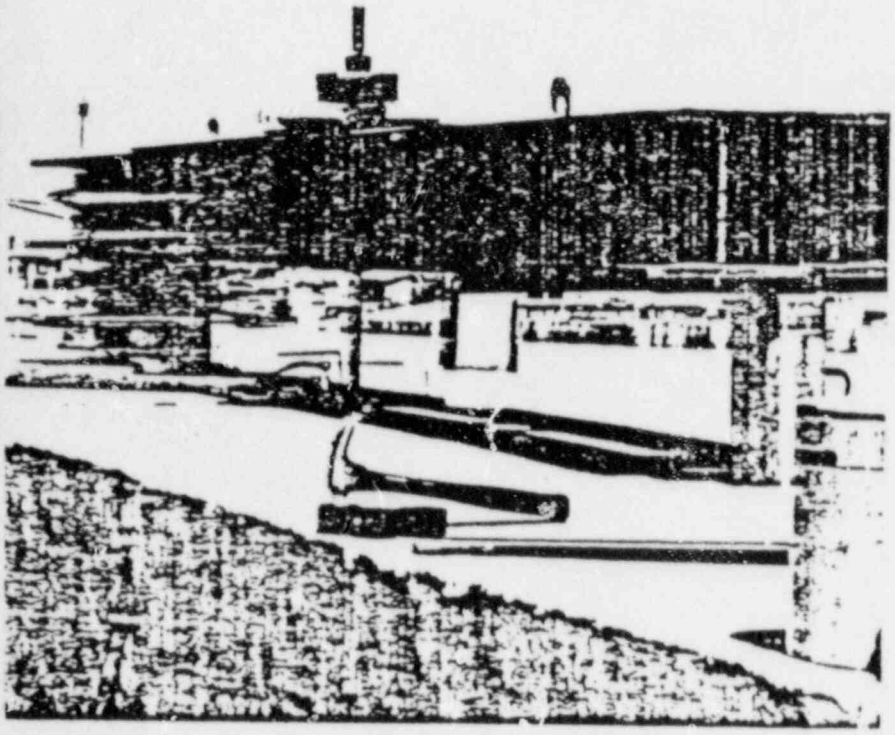


DIAL INDICATOR ARRANGEMENT

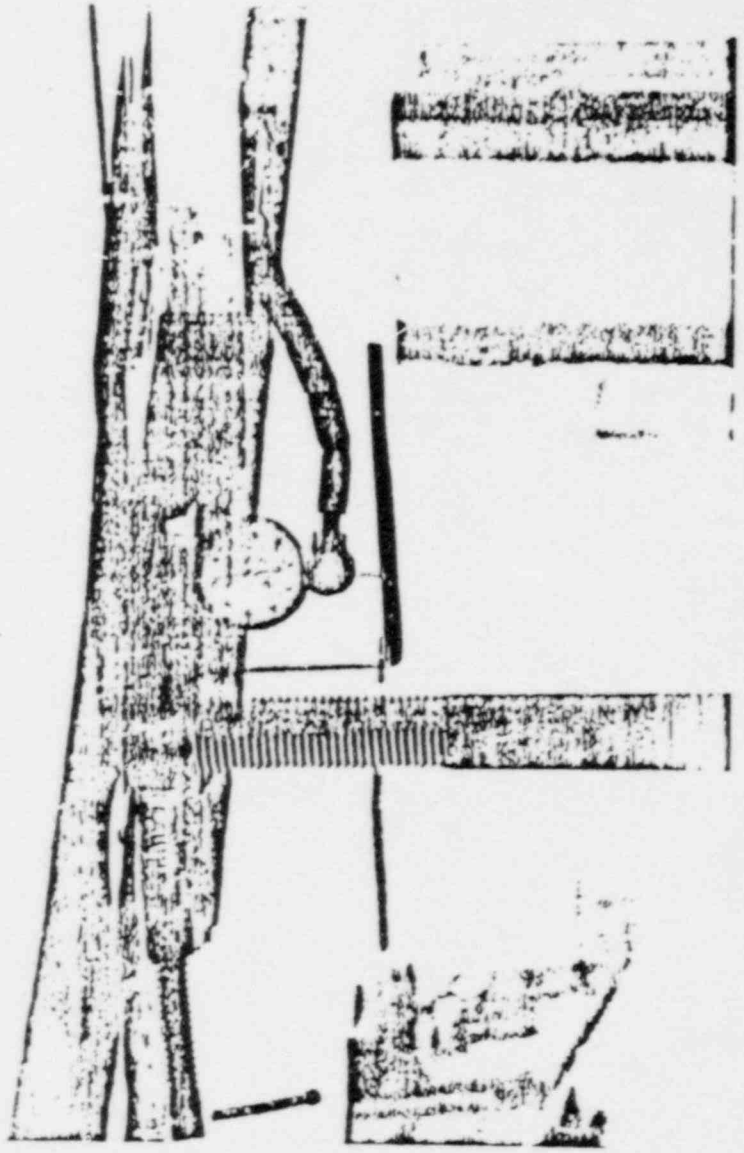


TYPICAL SHEAR FAILURE

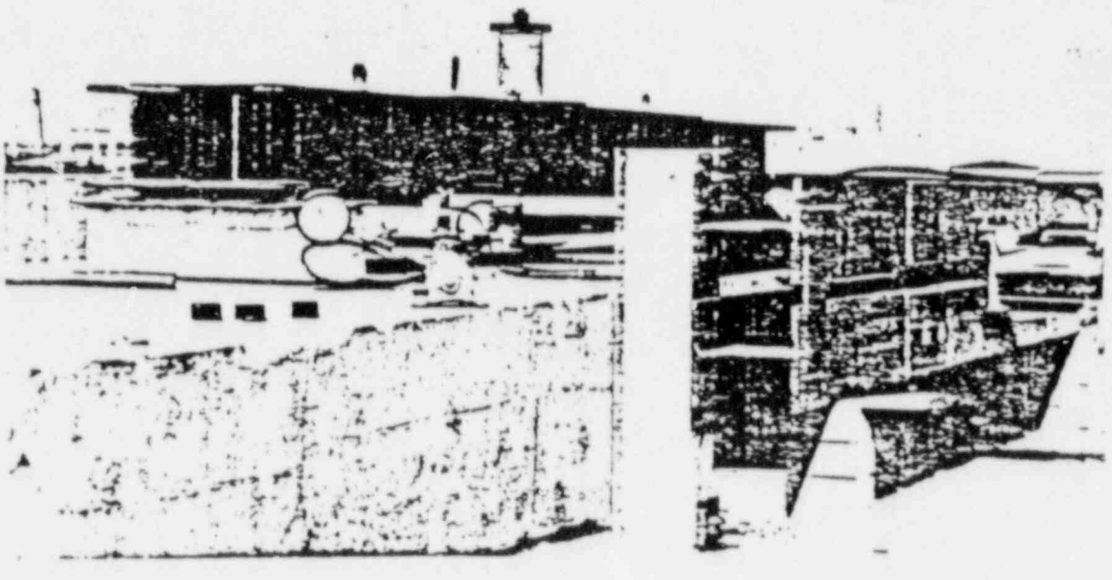
NSION TEST



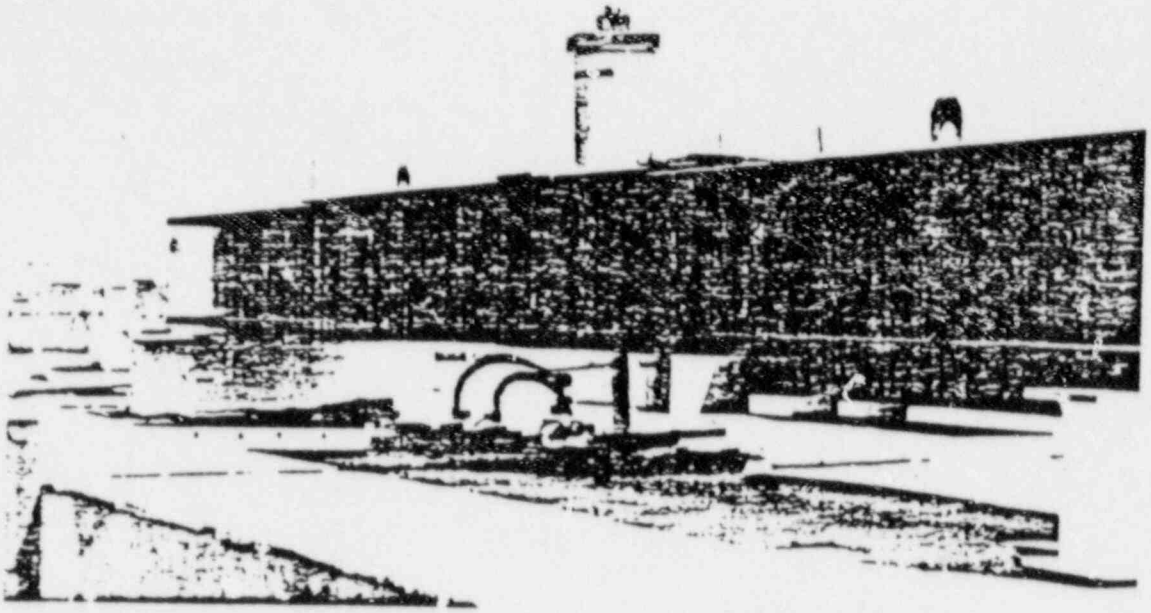
EST APPARATUS



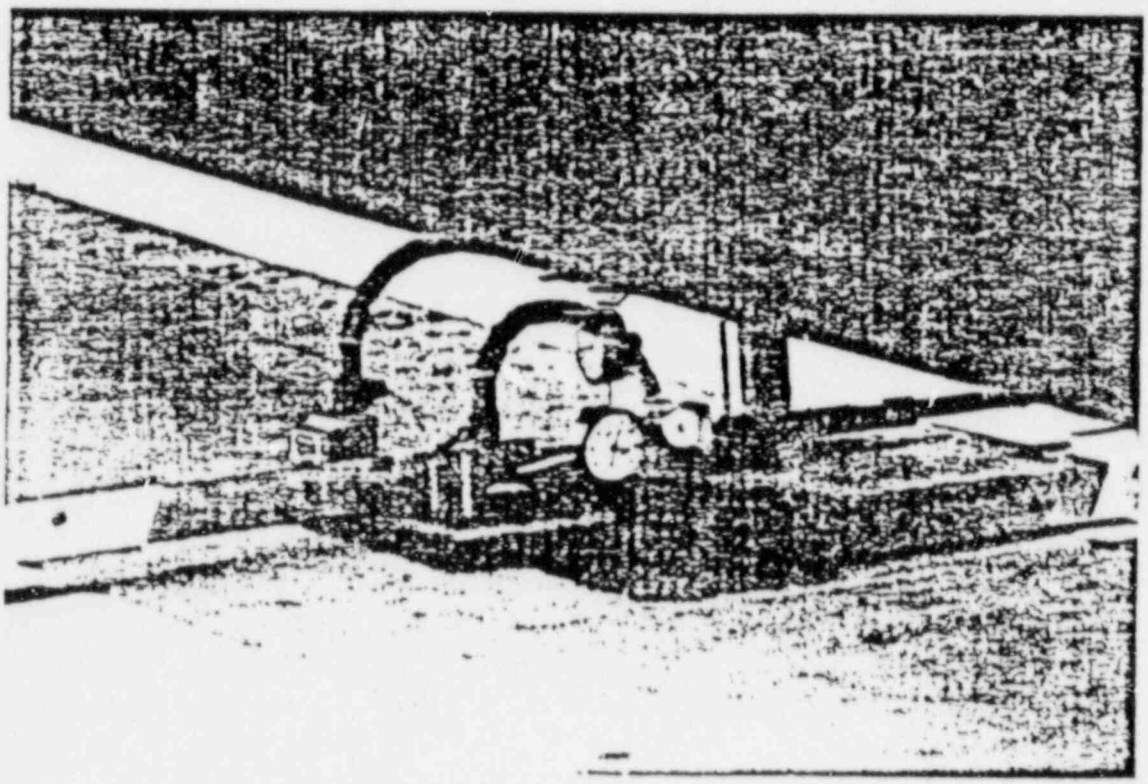
Combined Shear and Tension Test



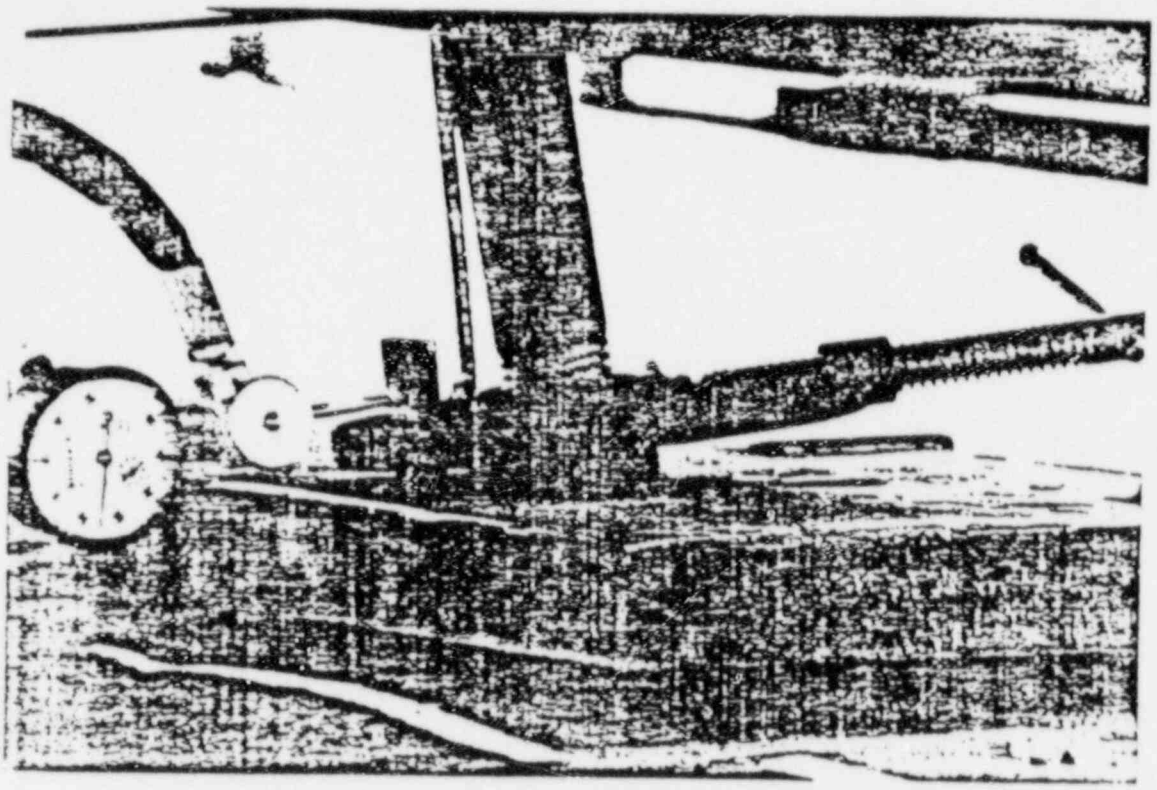
Test Apparatus



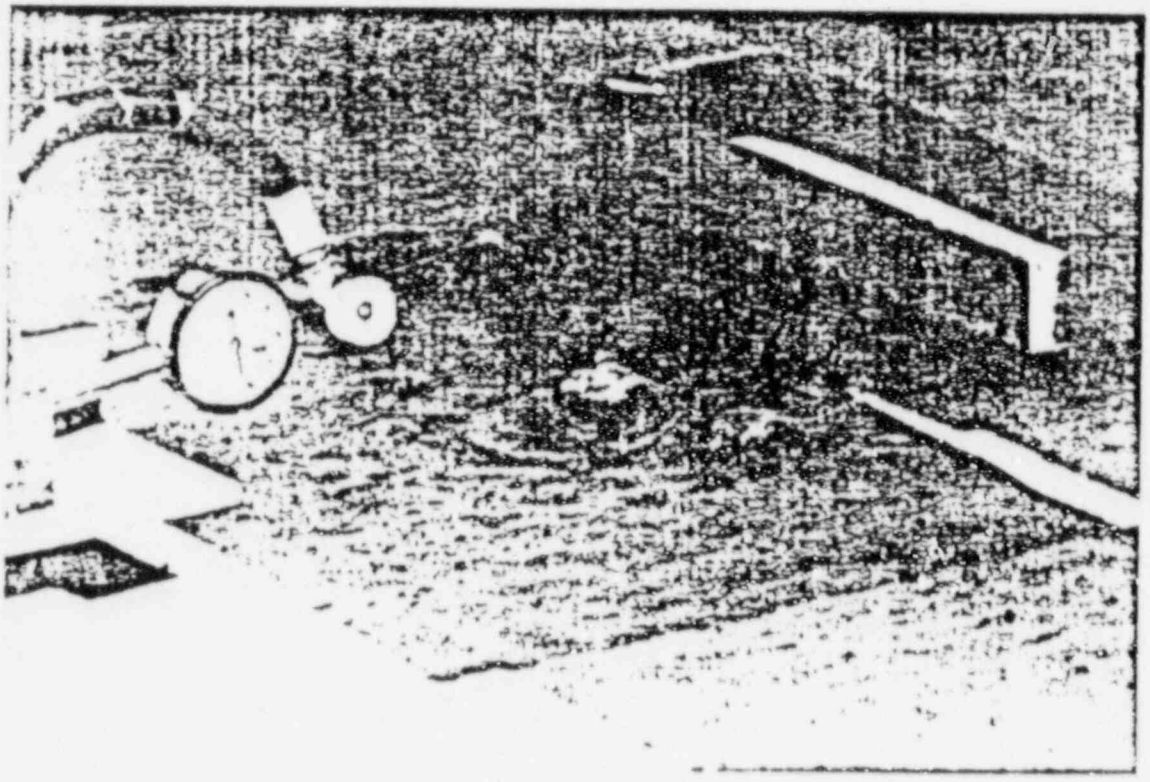
TEST APPARATUS



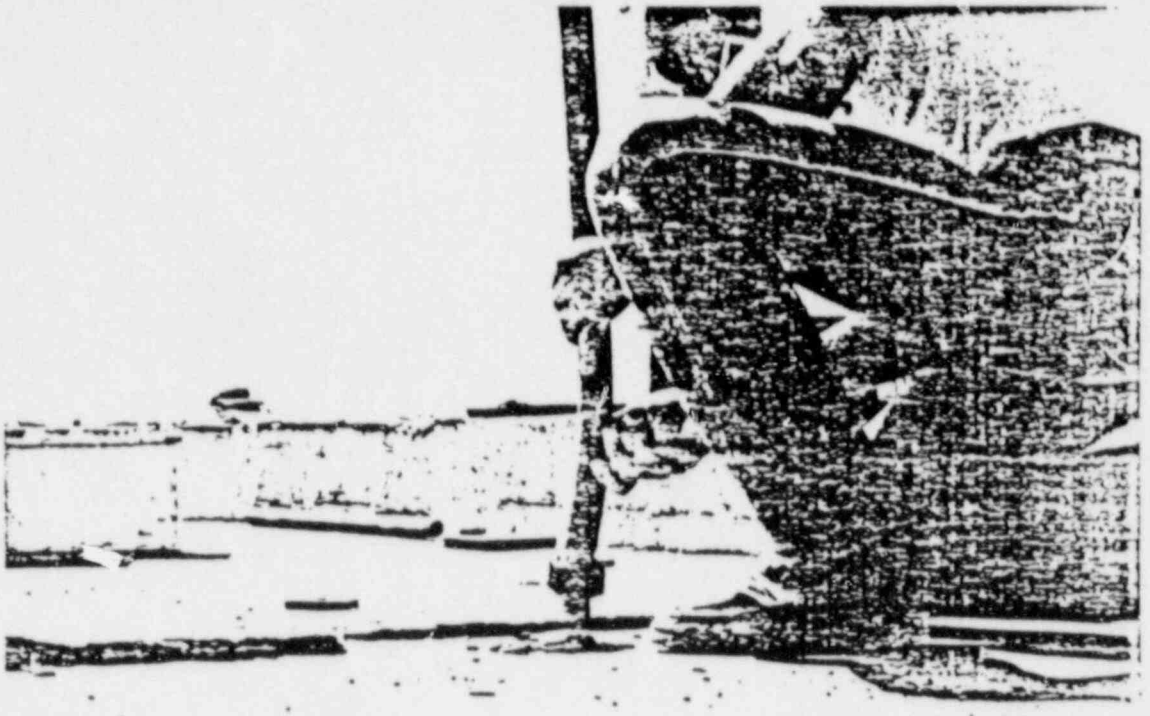
DIAL INDICATOR ARRANGEMENT



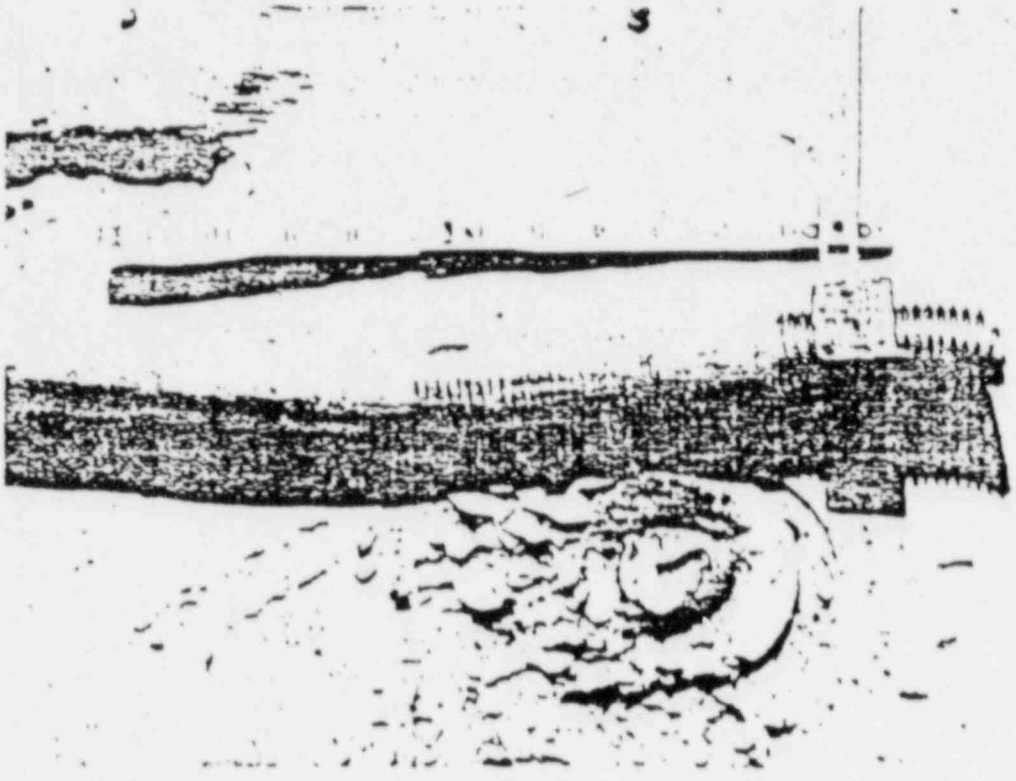
1½-INCH SPECIMEN JUST PRIOR TO FAILURE



1½-INCH SPECIMEN AT FAILURE



TYPICAL FAILED SPECIMEN



TYPICAL FAILURE

COMANCHE PEAK SES
COMBINED SHEAR & TENSION TESTS

Richmond 1 -Inch, Type SC-2W Insert
Reference: CP CI-13.0 ~~9/3~~ 914

Specimen Number: 21 (6th from West End) Inserted Load Rod: A-193 Date: 9 Apr 84

(Comm.) SHEAR				TENSION						
Gauge Press. (PSI)	1-* Jack Thrust (lb.)	Deflection (Inch) Init.	Deflection (Inch) After 2-Min.	Gauge Press. (PSI)	2-* Jack Thrust (lb.)	Net Jack Thrust (lb.) **	Insert Load (lb.) ***	Deflection (Inch) Init.	Deflection (Inch) After 2-Min.	Notes - Failure Mode
700	5,100	0.000	0.000		5,300			0.000	0.000	
800	10,600	.001	.001		10,600			.000	.000	
1200	15,900	.065	.061		15,900			.022	.022	
1600	21,200	.173	.183		21,200			.044	.053	
2000	26,500	.330	.378		26,100			.111	.134	
~~2020~~ 2100	27,825	.400			27,825			.15		Sound of a weld breaking. ~~Nut~~ Rod stressed @ 2% = 900 = 11,925#. Insert washer deflected laterally 3/8". Some bearing 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, zero depth @ edge
				N/A		N/A	N/A			

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 ~~- 1/2~~

Shear Apparatus: Jack---Equipment No: RCH 606
Pressure Gauge-M&TE No: 2355 Due Date: 16 Jan 84
Dial Gauge-M&TE No: 2949 Due Date: 28 Jun 84
Tension Apparatus: Jack-Equipment No: RCH 603T
Pressure Gauge-M&TE No: ~~5000~~ Due Date:
Dial Gauge-M&TE No: ~~2450~~ 2284 Due Date: 18 Jan 84

Performed By: J. C. Hebbett (Name) 9 Apr 84 (Date)

Witnessed By: A. Lee Rudd (QA Representative) 4-9-84 (Date)

COMANCHE PEAK SES
COMBINED SHEAR & TENSION TESTS

Richmond / -Inch, Type FC-3W Insert
Reference: CP EI 13.0 #19 rev

Specimen Number: 22 (1st from West) Inserted Load Rod: A-191 Date: 9 April 84

Common	SHEAR			TENSION						
Gauge Press. (PSI)	1-* Jack Thrust (lb.)	Deflection (Inch) Init.	Deflection (Inch) After 2-Min.	Gauge Press. (PSI)	2-* Jack Thrust (lb.)	Net Jack Thrust (lb.)	Insert Load (lb.)	Deflection (Inch) Init.	Deflection (Inch) After 2-Min.	Notes - Failure Mode
~~400~~	~~5300~~	0.001	0.001		5300			0.001	0.001	
800	10,600	.037	.038		10600			.013	.014	
1200	15,900	.105	.109		15900			.0255	.026	
1600	21,200	.196	.205		21200			.055	.058	
2000	26,500	.34	.428		26500			.113	.145	
2200	29150	.52			29150			.16		
1800	23850				23850					
1500	19875			N/A	19875	N/A	N/A			~~Wear~~ Broke sharp noise, cause unknown. Rod sheared not had rotated & shear line three quarter. 20° when broke. Concrete spalled approx 15" diameter, being 12" on tension side & 3" on comp. (from shear jack) side 2" deep @ insert. Insert remained intact.

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 19.25 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 - 2x 9.25

Shear Apparatus: Jack---Equipment No: RCH 606
Pressure Gauge-M&TE No: 2755 Due Date: 16 Apr 84
Dial Gauge-M&TE No: 2882 Due Date: 29 Jun 84
Tension Apparatus: Jack-Equipment No: RCH 603T
Pressure Gauge M&TE No: Same Due Date:
Dial Gauge-M&TE No: 2078 Due Date: 19 Jun 84

Performed By: J. C. Nesbitt 9 Apr 84
Name Date

Witnessed By: Alan Ritzk 4/9/84
QA Representative Date

COMANCHE PEAK SES
COMBINED SHEAR & TENSION TESTS
Richmond 1 -Inch, Type SC-2W Insert
Reference: CP LI-13.0 Rev 4

Specimen Number: 23 (8'4 from west end) Inserted Load Rod: A-17.3 Date: 10 & 11 Jan 84

Common	SHEAR			TENSION						
Gauge Press. (PSI)	1-* Jack Thrust (lb.)	Deflection (Inch) Init.	Deflection (Inch) After 2 Min.	Gauge Press. (PSI)	2-* Jack Thrust (lb.)	** Net Jack Thrust (lb.)	*** Insert Load (lb.)	Deflection (Inch) Init.	Deflection (Inch) After 2 Min.	Notes - Failure Mode
400	5300	0.002	0.005		5300			0.0005	0.0015	
800	10 600	.075	.0775		10 600			.009	.010	
1200	15 900	.122	.122		15 900			.034	.041	
1600	21 200	.240	.269		21 200			.075	.084	
2000	26 500	.350	.410		26 500			.140	.158	
2200	29 150	.430			29,50			.20		
2300	30 475	.620		N/A	30 475	N/A	N/A			Deflection increased rapidly. Abrupt failure by shear of rod. Insert washer moved horizontally 1/8". No breakage of insert. Rod rotates some 30° above threads of insert. This permitted by crushing of concrete and probably deformation of thread coil. Rod failure was by shear after considerably deformation

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 = ~~N-A~~ Jack Thrust ~~- 2~~ SC-W

Shear Apparatus: Jack---Equipment No: RCH 606
Pressure Gauge-M&TE No: 2158 Due Date: 26 Apr 84
Dial Gauge-M&TE No: 2744 Due Date: 29 Jun 84
Tension Apparatus: Jack Equipment No: RCH 6037
Pressure Gauge-M&TE No: 2115 Due Date:
Dial Gauge-M&TE No: 2094 Due Date: 10 Jun 84

Performed By: J. C. Pickle (Name) 10 Jan 84 (Date)

Witnessed By: Robert Rickard (QA Representative) 1-10-84 (Date)

COMANCHE PEAK SES
COMBINED SHEAR & TENSION TESTS
Richmond / -Inch, Type EC-2W Insert
Reference: CP-II-13.0 9909

Specimen Number: 24 (9th from west end) Inserted Load Rod: A-193

Date: 10 April '84

Common	SHEAR			TENSION						
Gauge Press. (PSI)	1-* Jack Thrust (Lb.)	Deflection (Inch) Init.	Deflection (Inch) After 2-Min.	Gauge Press. (PSI)	2-* Jack Thrust (Lb.)	** Net Jack Thrust (Lb.)	*** Insert Load (Lb.)	Deflection (Inch) Init.	Deflection (Inch) After 2-Min.	Notes - Failure Mode
400	5,300	0.001	0.001		5500			0.002	0.002	
800	10,600	.008	.008		10 600			.0065	.0065	
1200	15 900	.060	.070		15 900			.027	.030	
1600	21 200	.153	.171		21 200			.062	.064	
2000	26 500	.325	.370		26 500			.135	.159	
2100	27 825	.400			27 825			.17		
2140	27 825	.500		N/A	27 825	N/A	N/A	.20		Rapid yielding began
2200	29 150	.540			29 150			.227		
2200	29 150	.700			29 150			.227		
2000	26500				26 500					

Break. Abrupt shear failure of rod. Some 5/8" horizontal deflection of top of insert permitted by ~~rotation~~ crushing of concrete and deflection of upper coil of insert. Concrete spalled 2" deep on tension. Visible 2" of insert seem to have tilted 5°(±). Insert intact

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~~ J.C.G.

Shear Apparatus: Jack---Equipment No: RCN 606
Pressure Gauge-M&TE No: 2355 Due Date: 14 Jun 84
Dial Gauge M&TE No: 2949 Due Date: 22 Jun 84
Tension Apparatus: Jack-Equipment No: RCN 603T
Pressure Gauge M&TE No: Same Due Date:
Dial Gauge-M&TE No: 2094 Due Date: 18 Jun 84

Performed By: J.C. Gilbreth (Name) 10 April '84 (Date)

Witnessed By: [signature] (QA Representative) 4-10-84 (Date)

COMANCHE PEAK SES
COMBINED SHEAR & TENSION TESTS
EC-2W
Richmond 1-Inch, Type Insert
Reference: CP-11-13.0-9204

Specimen Number: 25 (104 from West Side) Inserted Load Rod: A-173 Date: 10 April '84

Gauge Press. (PSI)	SHEAR 1-* Jack Thrust (lb.)	Deflection (Inch) Init.	Deflection (Inch) After 2-Min.	Gauge Press. (PSI)	TENSION 2-* Jack Thrust (lb.)	** Net Jack Thrust (lb.)	*** Insert Load (lb.)	Deflection (Inch) Init.	Deflection (Inch) After 2 Min.	Notes - Failure Mode
400	5300	0.005	0.015		5300			0.000	0.000	
800	10600	0.026	.028		10600			.005	.009	
1200	15900	.115	.122		15900			.005		
1600	21200	.217	.229		21200			.006	.010	
2000	26500	.260	.304		26500			.027	.063	
2100	27825	.320			27825			.070		
2150	28487	.400		N/A	28487	N/A	N/A	.080		Abrupt break. Insert deflected 1/2" (-). Rod failed in shear.

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 - 2. N/A

Shear Apparatus: Jack--Equipment No: RCH 606
Pressure Gauge-M&TE No: 2355 Due Date: 16 Jan 84
Dial Gauge M&TE No: 2427 Due Date: 27 Jan 84
Tension Apparatus: Jack-Equipment No: RCH 607
Pressure Gauge-M&TE No: 5010 Due Date:
Dial Gauge M&TE No: 2094 Due Date: 18 Jan 84

Performed By: J C Gilbreth (Name) 10 April 84 (Date)

Witnessed By: [signature] (QA Representative) 4-10-84 (Date)

...E PEAK SES
...TION TESTS

RICHMOND 1 -INCH, TYPE EC-2W INSERT

Reference: CP-EI-13.0-F 15pcw

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

GAUGE PRESS. P.S.I.)	* JACK THRUST (Lb.)	** NET JACK THRUST (Lb.)	*** INSERT LOAD (Lb.)	DEFLECTION (IN.) INIT.	DEFLECTION (IN.) AFTER 2-MIN.	NOTES-FAILURE MODE
200	2650	1425	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.
			Insert remained intact. Shear cone type failure of concrete. Insert was located near center between E-W & N-S centers. Cone was restricted somewhat by 2-each #4 bars with some lifting force on each causing concrete to spall 3-ft eq. dia. of insert. Shear cone depth = full height of insert less 3/4" @ bottom.			

* 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 16)
*** Insert Load = Net Jack Thrust x 2.
Jack:.....Equipment Number ACM 606
Pressure Gauge: M & TE Number 2355 Due Date: 16 Apr 84
Dial Gauge: M & TE Number 2044 Due Date: 29 Jun 84

Performed By:
C B Elliott 6 Apr 84
Name Date

Witnessed By:
[signature] 6 Apr 84
QA Representative Date

COMANCHE PEAK STEAM ELECTRIC STATION
TENSION TESTS

RICHMOND 1 -INCH, TYPE EC-2W INSERT

Reference: CP-EI-13.0 #13,917

Specimen Number: 27 Load Rod Spec: A-193 Date: 6 Apr '84

12" ~~from~~ from Weir End 4" from east

GAUGE PRESS. (P.S.I.)	* JACK THRUST (Lb.)	** NET JACK THRUST (Lb.)	*** INSERT LOAD (Lb.)	DEFLECTION (IN.) INIT.	DEFLECTION (IN.) AFTER 2-MIN.	NOTES-FAILURE MODE
200	2650	1425	2850	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	.088~~060~~	.092	
~~1800~~ 1750				.146		Failure
~~2000~~	23,188	21,960	43920			

Failure occurred by failure of the insert. Weld between lower coil and vertical strut 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" c.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 ACH 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. C. Gilbreth 6 Apr 84
Name Date

Witnessed By:
[signature] 6 Apr 84
QA Representative Date

COMANCHE PEAK
TENSION TESTS

RICHMOND 1 -INCH, TYPE EC-2W INSERT

Reference: CP-EI-13.0 ~~=~~ 13 Rev 4

Specimen Number: 28 (3'0 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.) INIT.	DEFLECTION (IN.) AFTER 2-MIN.	NOTES-FAILURE MODE
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	12,025	24,050	.004	.005	
1200	15,900	14,675	29,350	.009	.010	
1400	18550	17325	34650	.015	.029	
~~1550~~ 1550	20538	19313	38626	.055	—	
1670	21,200	19,975	39,950	.067	.082	
~~1700~~	22,525	21,300	42,600	.15		Concrete under cone failure. Insert and rod remained intact. Cone height equal insert height. Size of cone too limited by rebar ~~mat~~. Rebars lifted with cone and lifted area 45 x 35'. Rebars @ 9" o.c. E.W.
~~2000~~						
~~2200~~						

* 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. (½ wt. = 1225 Lb)

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

Jack:.....Equipment Number RCH 606

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

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

Performed By:

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

Witnessed By:

[signature] 4-10-84
QA Representative Date

COMANCHE PEAK SES
TENSION TESTS

RICHMOND 1 -INCH, TYPE EC-2W INSERT

Reference: CP-EI-13.0 ~~+ 13~~ Rev 4

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

GAUGE PRESS. (P.S.I.)	* JACK THRUST (Lb.)	** NET JACK THRUST (Lb.)	*** INSERT LOAD (Lb.)	DEFLECTION (IN.) INIT.	DEFLECTION (IN.) AFTER 2-MIN.	NOTES-FAILURE MODE
200	2650	1325	2650	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~~ 34650	.101	.104	
1600	21200	19975	39950	.135	.145	
~~1800~~						
~~2000~~						
1740	22525	21300	42600			Concrete failed by the load on insert lifting the repair mat. Area some 3.5' x 6.0' failed in this manner when insert pulled out taking 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. (1/2 Wt. = 1225)
*** Insert Load = Net Jack Thrust x 2.
Jack:.....Equipment Number DCH 606
Pressure Gauge: M & TE Number 2355 Due Date: 16 Jan 84
Dial Gauge: M & TE Number 2949 Due Date: 29 Jun 84

Performed By:
C. L. Gilbert 6 April 84
Name Date

Witnessed By:
Andrew Pietrzak 4-6-84
QA Representative Date

COMANCHE PEAK SES
TENSION TESTS

EC-2W
RICHMOND 1 -INCH, TYPE ___ INSERT

Reference: CP-EI-13.0-F2W

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.) INIT.	DEFLECTION (IN.) AFTER 2-MIN.	NOTES-FAILURE MODE
~~200~~				~~0.000~~	~~0.000~~	
~~400~~				~~.000~~		
200	2650	1425	2850	0.000	0.000	
400	5300	4075	8150	0.000	.000	
600	7950	6725	13450	.001	.001	
800	10600	9375	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~~						
~~2000~~						
1650	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 on 18" diam. surface only. Rebar ~~coil~~ was exposed by removal of cover. Bar not deformed. Concrete		

* 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. (½ 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 2020 Due Date: 29 Jun '84

Performed By:

[signature] 5 Apr 84
Name Date

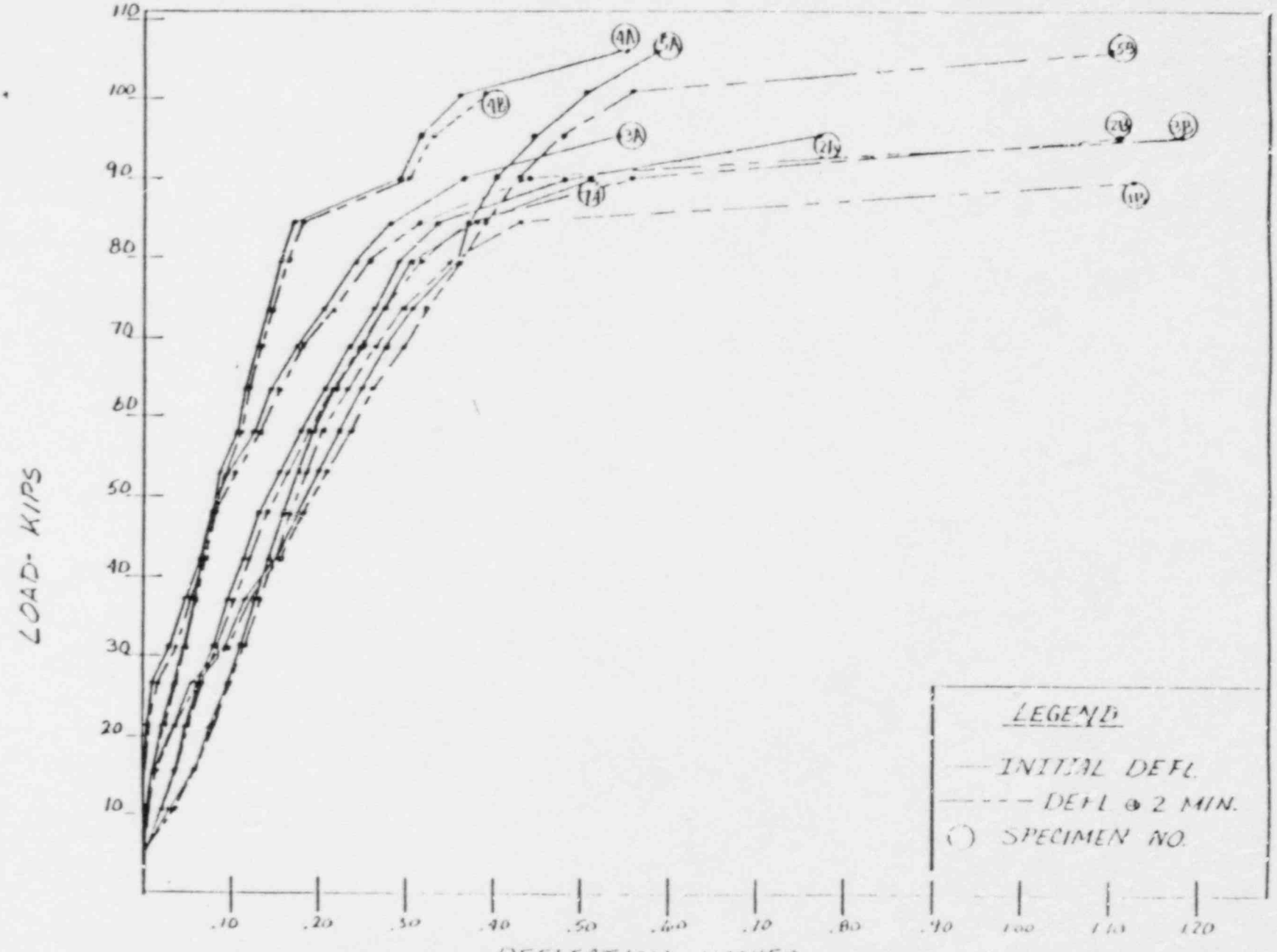
Witnessed By:

Andrew Petrosky 4-5-84
QA Representative Date

APPENDIX 3

LOAD-DEFLECTION CURVES

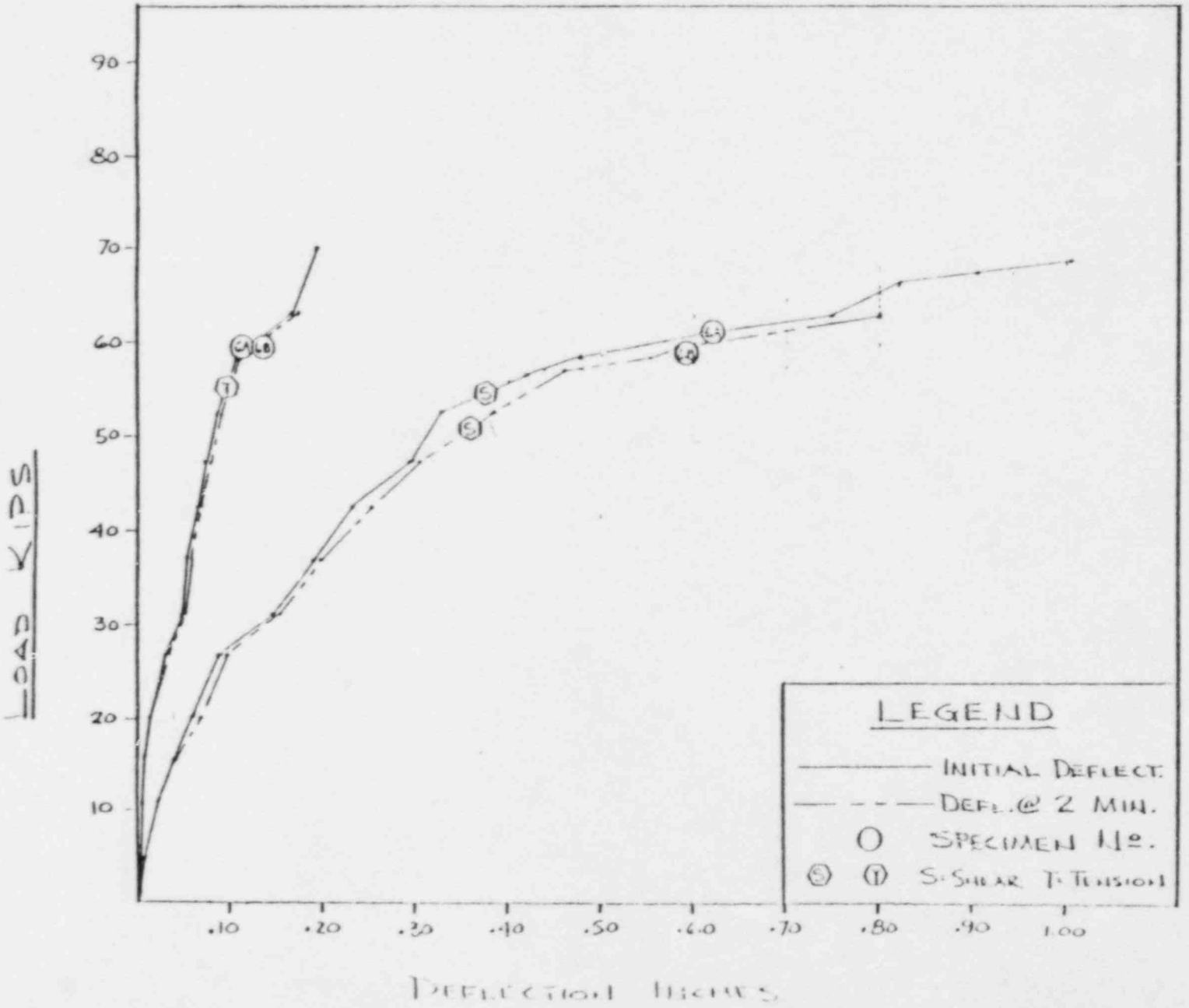
LOAD-DEFLECTION CURVES
1½-INCH TYPE EC-6W, SHEAR TEST

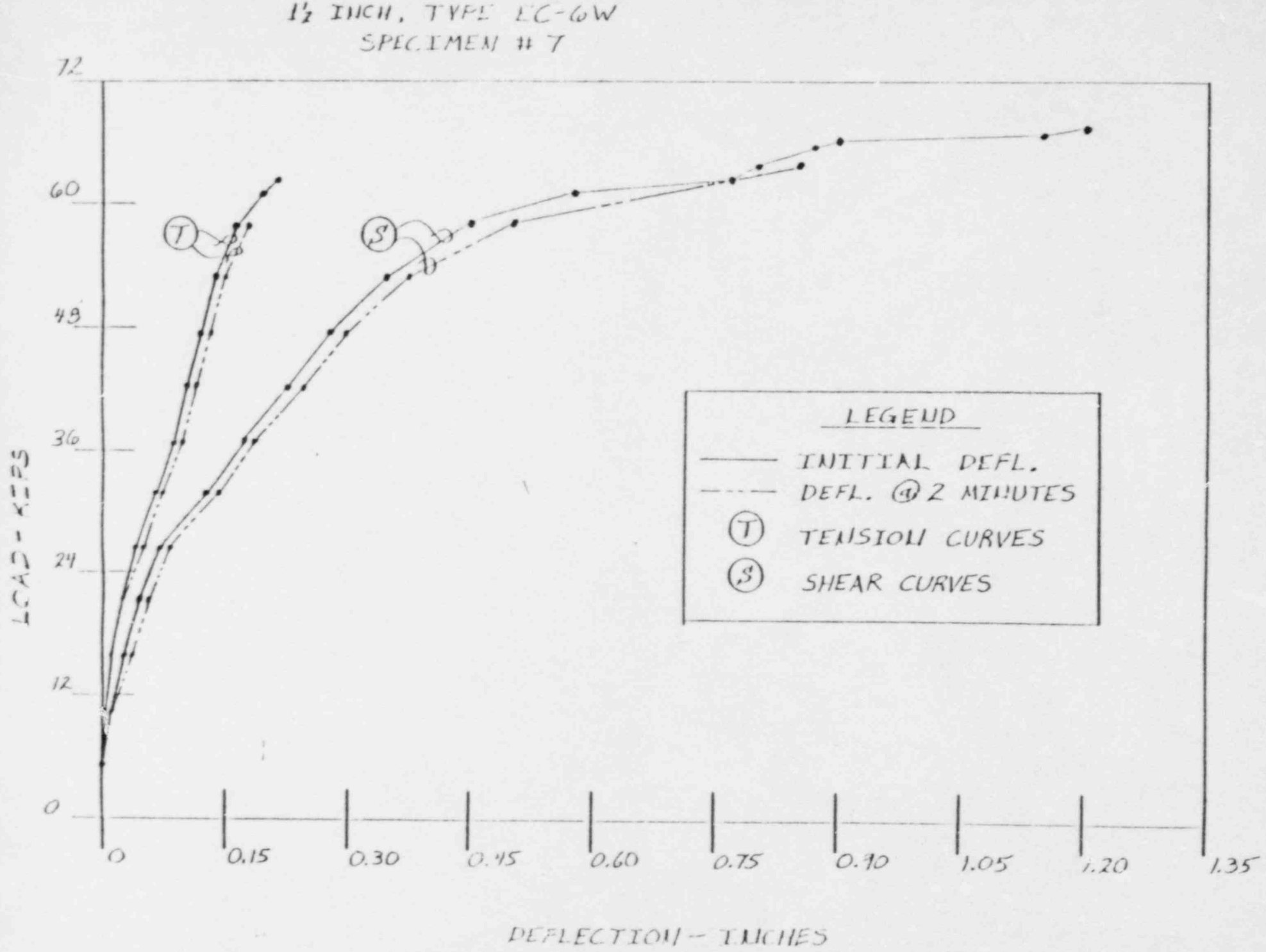


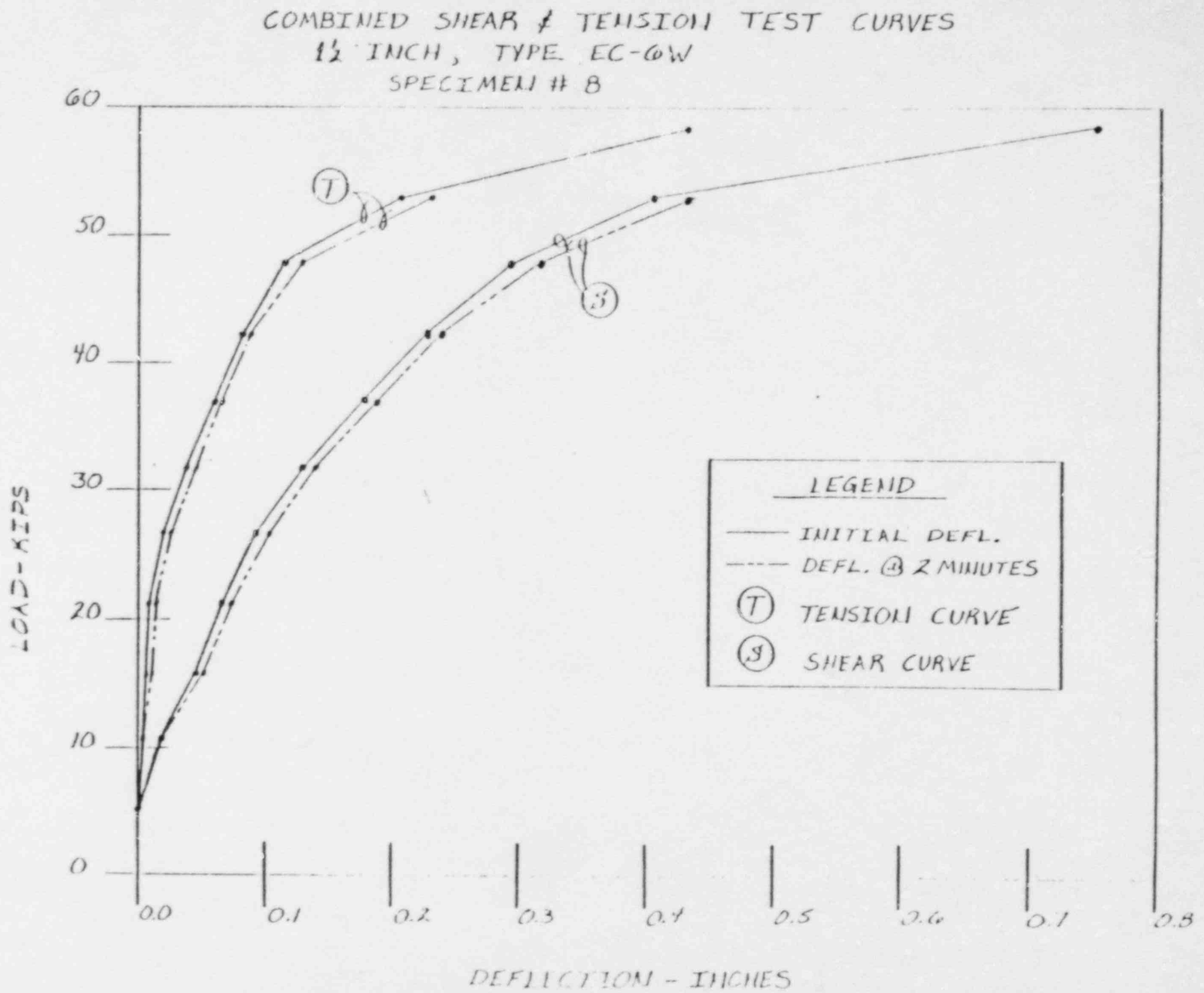
COMBINED SHEAR & TENSION TEST CHART

RICHMOND 1½ INCH, TYPE EC-6W INSERT

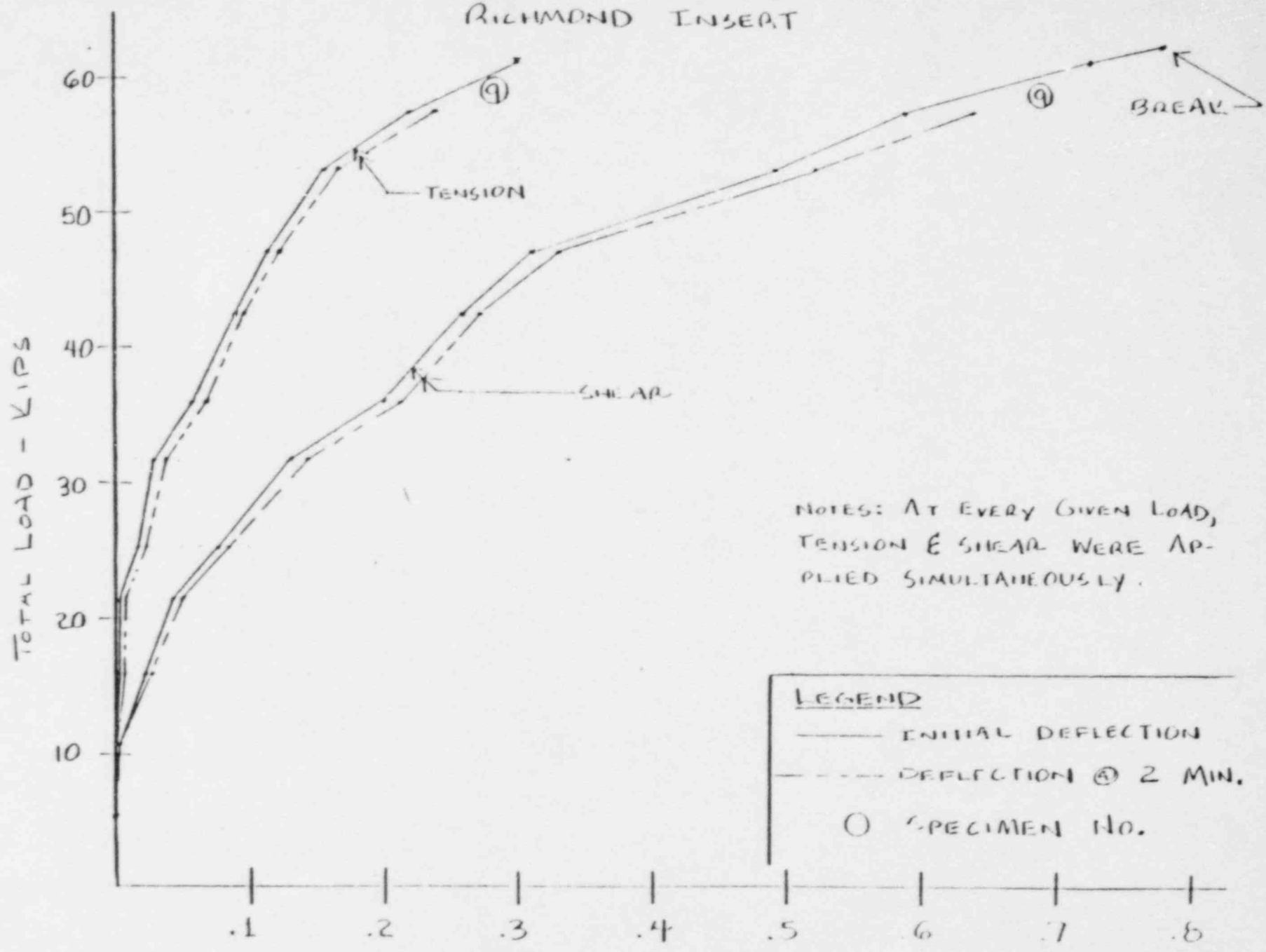
SPECIMAN No. 6




1½ INCH, TYPE EC-6W
SPECIMEN # 7
72
60
48
36
24
12
0
LOAD - KIPS
T
S
LEGEND
INITIAL DEFL.
DEFL. @ 2 MINUTES
T TENSION CURVES
S SHEAR CURVES
0
0.15
0.30
0.45
0.60
0.75
0.90
1.05
1.20
1.35
DEFLECTION - INCHES


COMBINED SHEAR & TENSION TEST CURVES
½ INCH, TYPE EC-6W
SPECIMEN # 8
60
50
40
30
20
10
0
LOAD - KIPS
T
S
LEGEND
INITIAL DEFL.
DEFL. @ 2 MINUTES
T TENSION CURVE
S SHEAR CURVE
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
DEFLECTION - INCHES

LOAD DEFLECTION CURVES FOR 1½" TYPE EC-6W RICHMOND INSERT



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

LEGEND

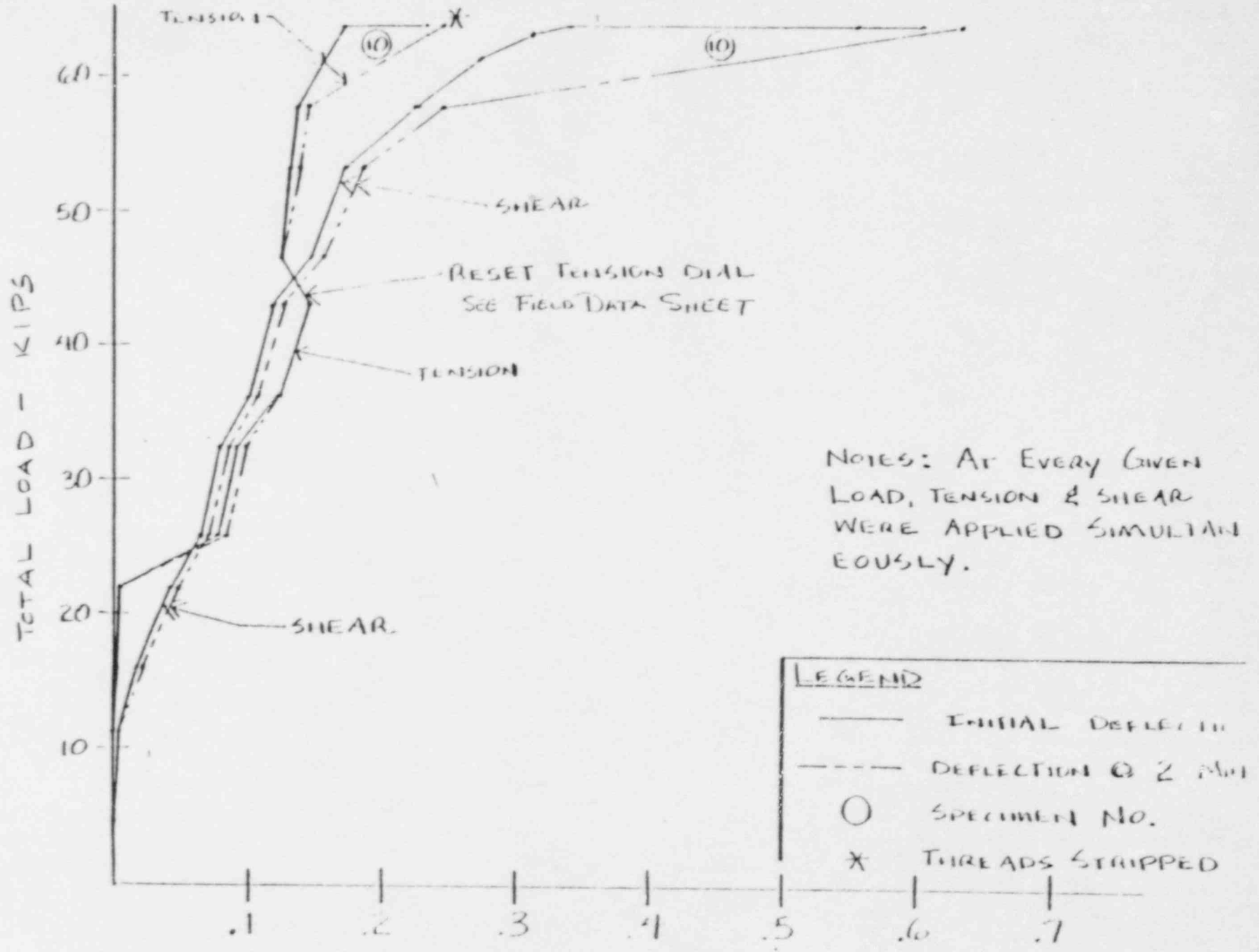
——— INITIAL DEFLECTION

- - - - DEFLECTION @ 2 MIN.

○ SPECIMEN NO.

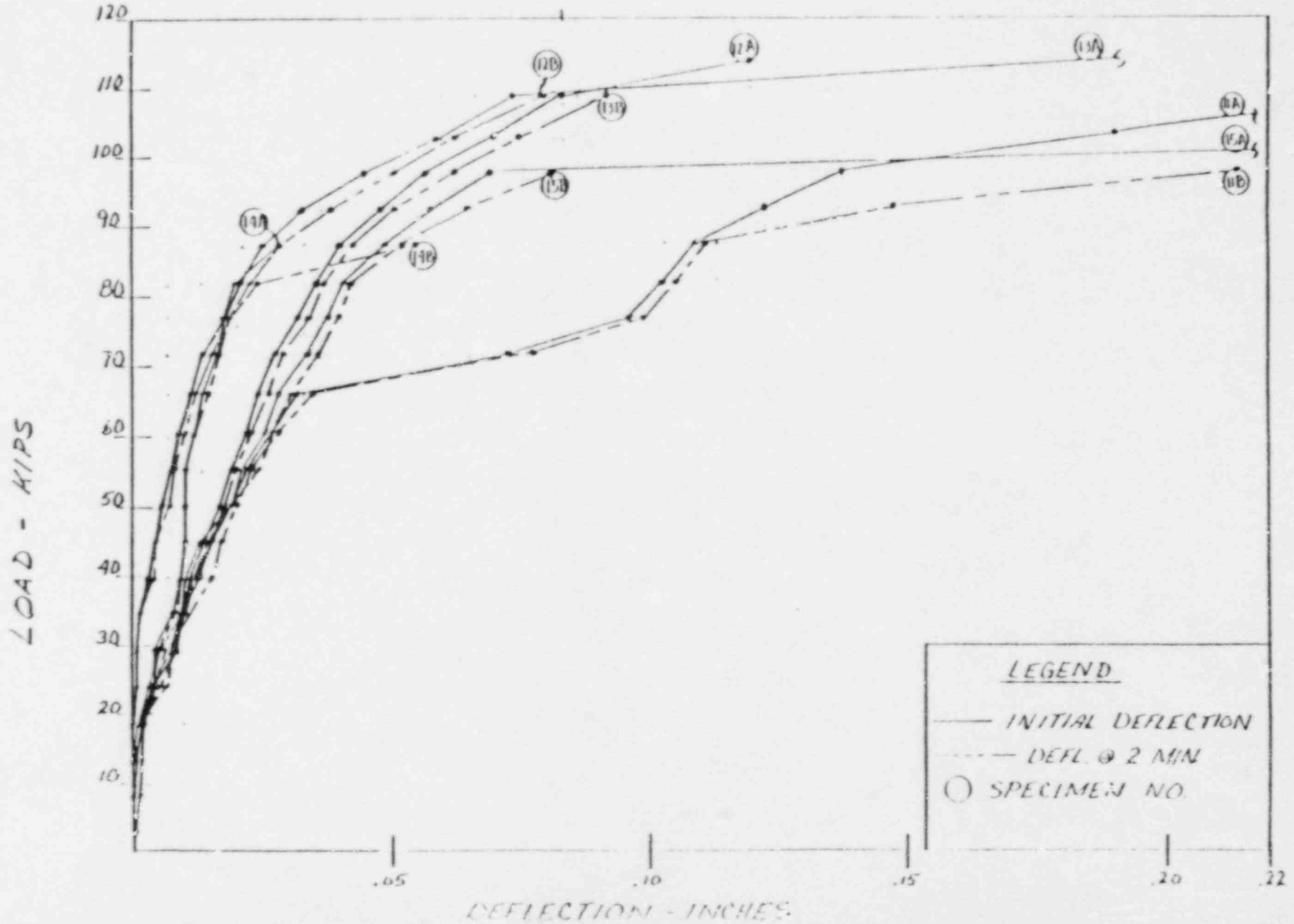
LOAD-DEFLECTION CURVES FOR 1/2" TYPE [illegible] INSERT

RICHMOND INSERT

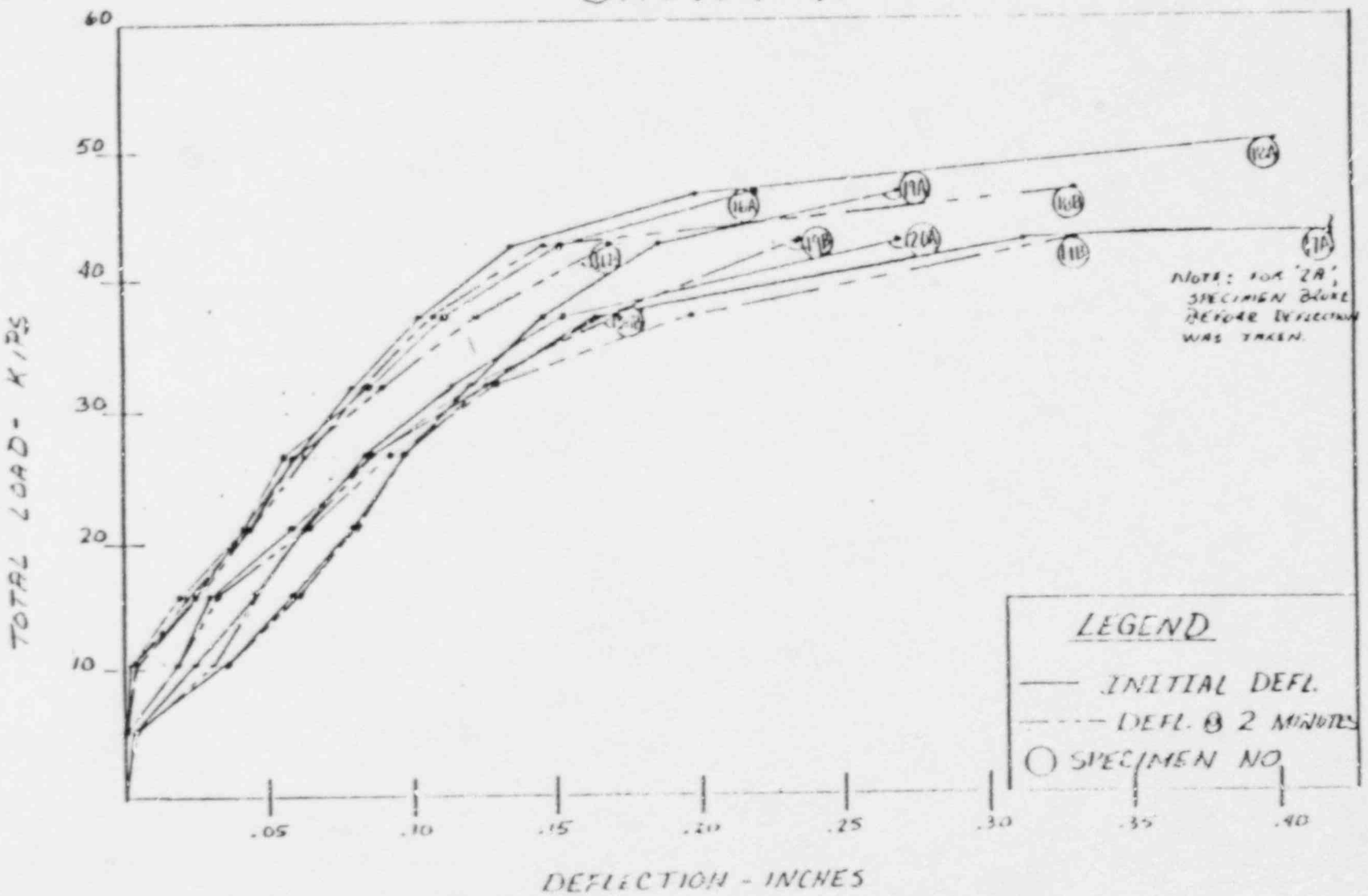


NOTES: AT EVERY GIVEN LOAD, TENSION & SHEAR WERE APPLIED SIMULTANEOUSLY.

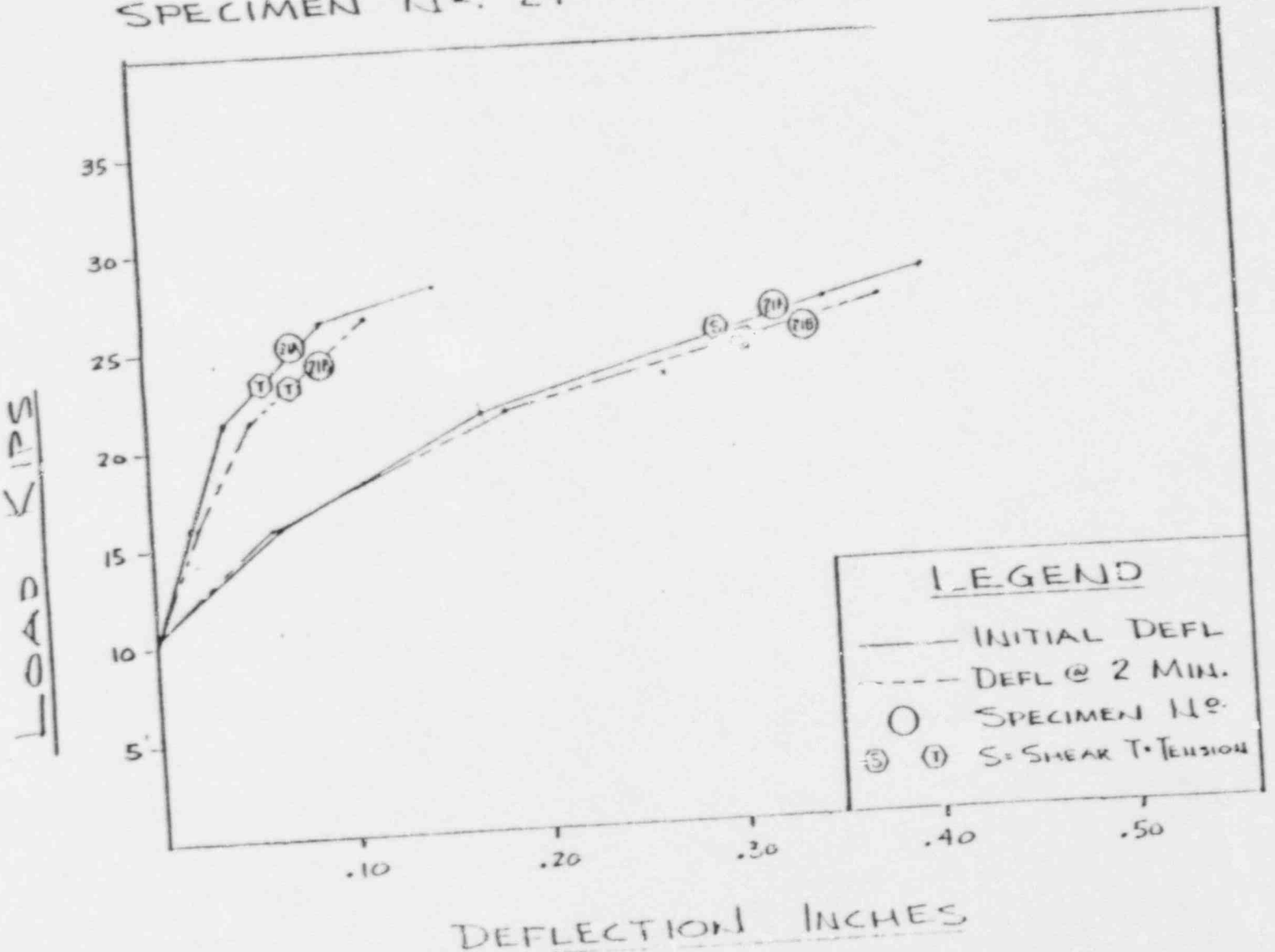
LOAD - DEFLECTION CURVES
1½ - INCH TYPE EC-6W, TENSION TEST



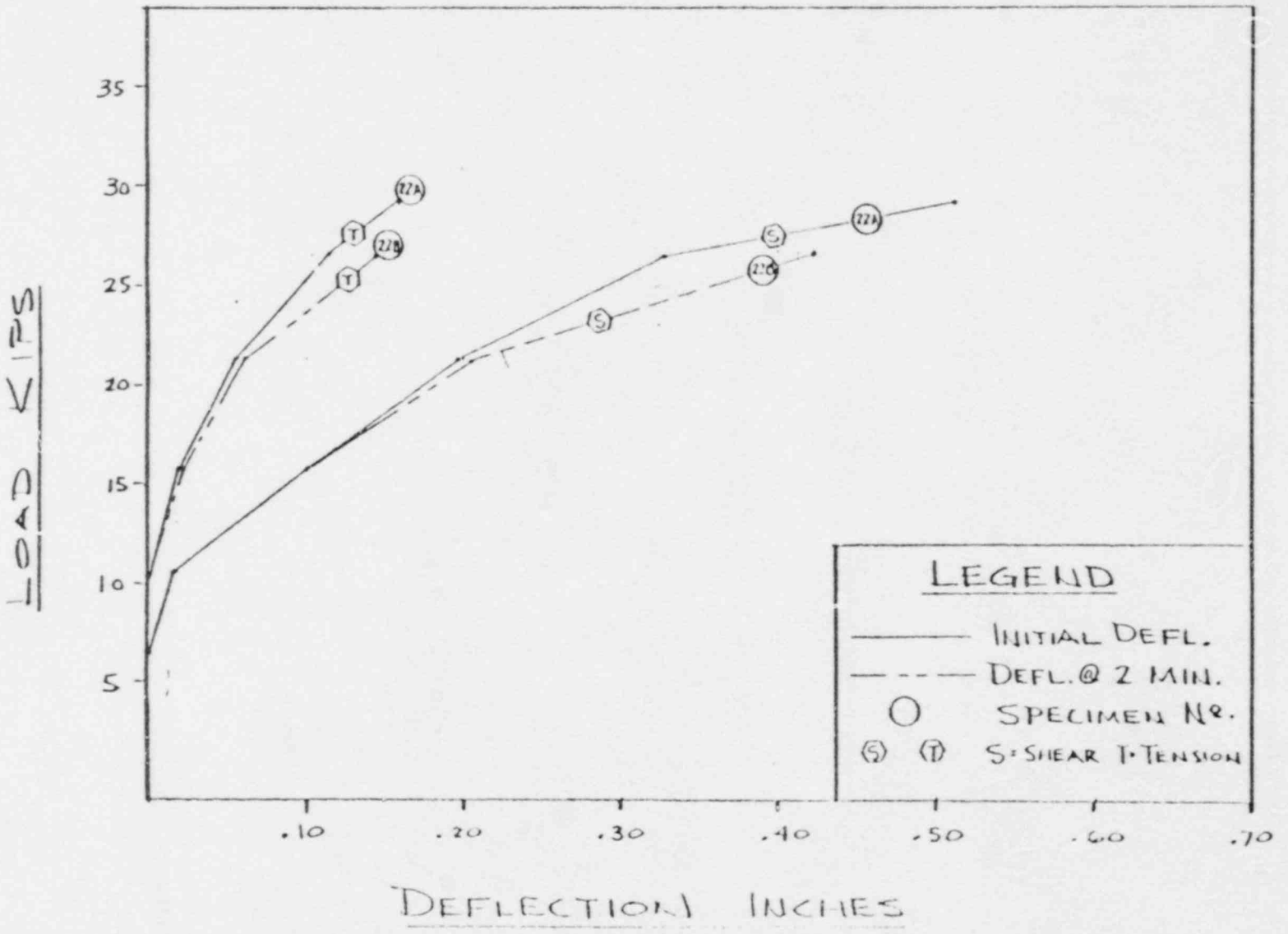
LOAD - DEFLECTION CURVES
1-INCH TYPE EC-2W
SHEAR TEST



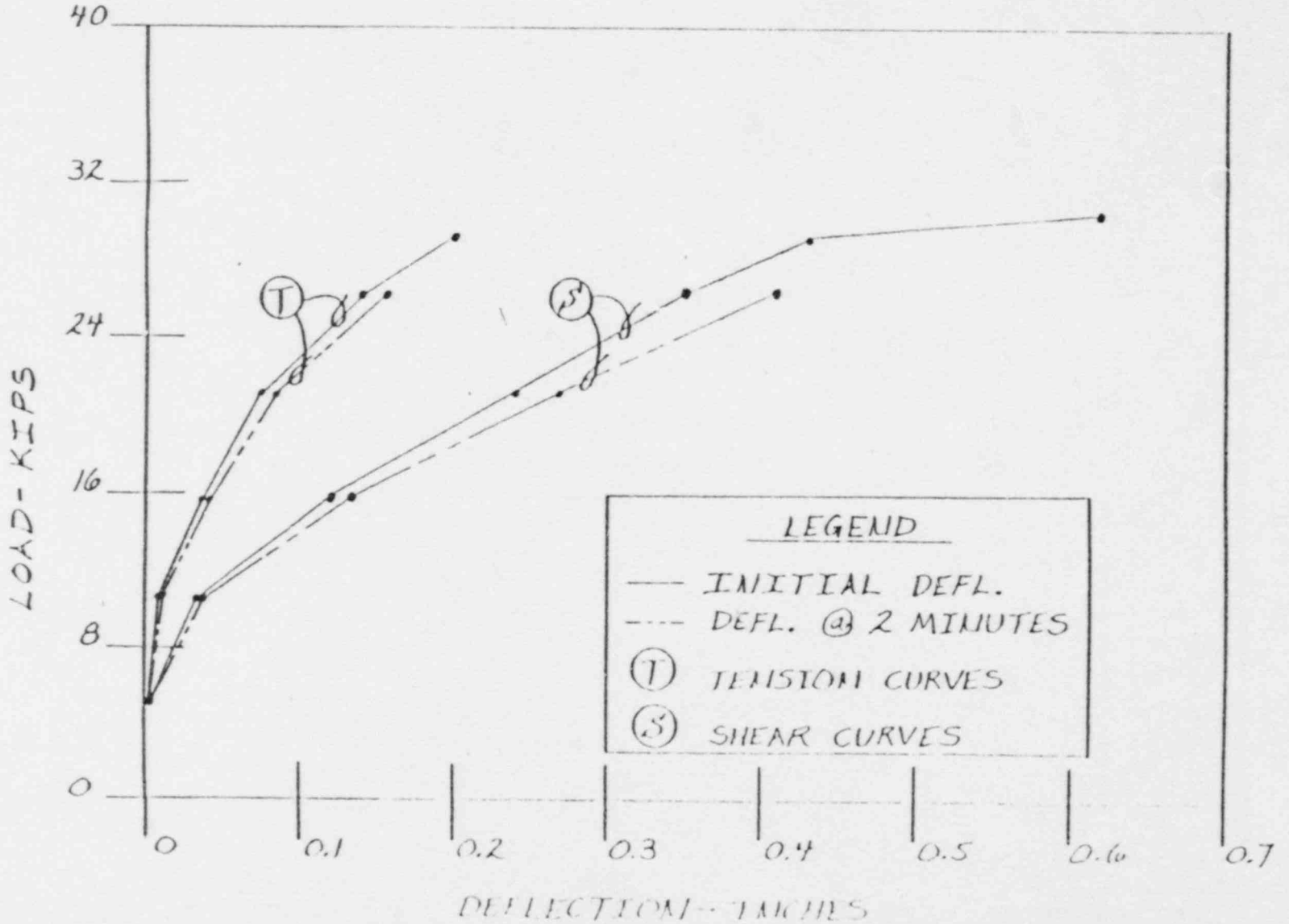
COMBINED SHEAR & TENSION CHART
RICHMOND 1 INCH, TYPE EC-2W INSERT
SPECIMEN No. 21



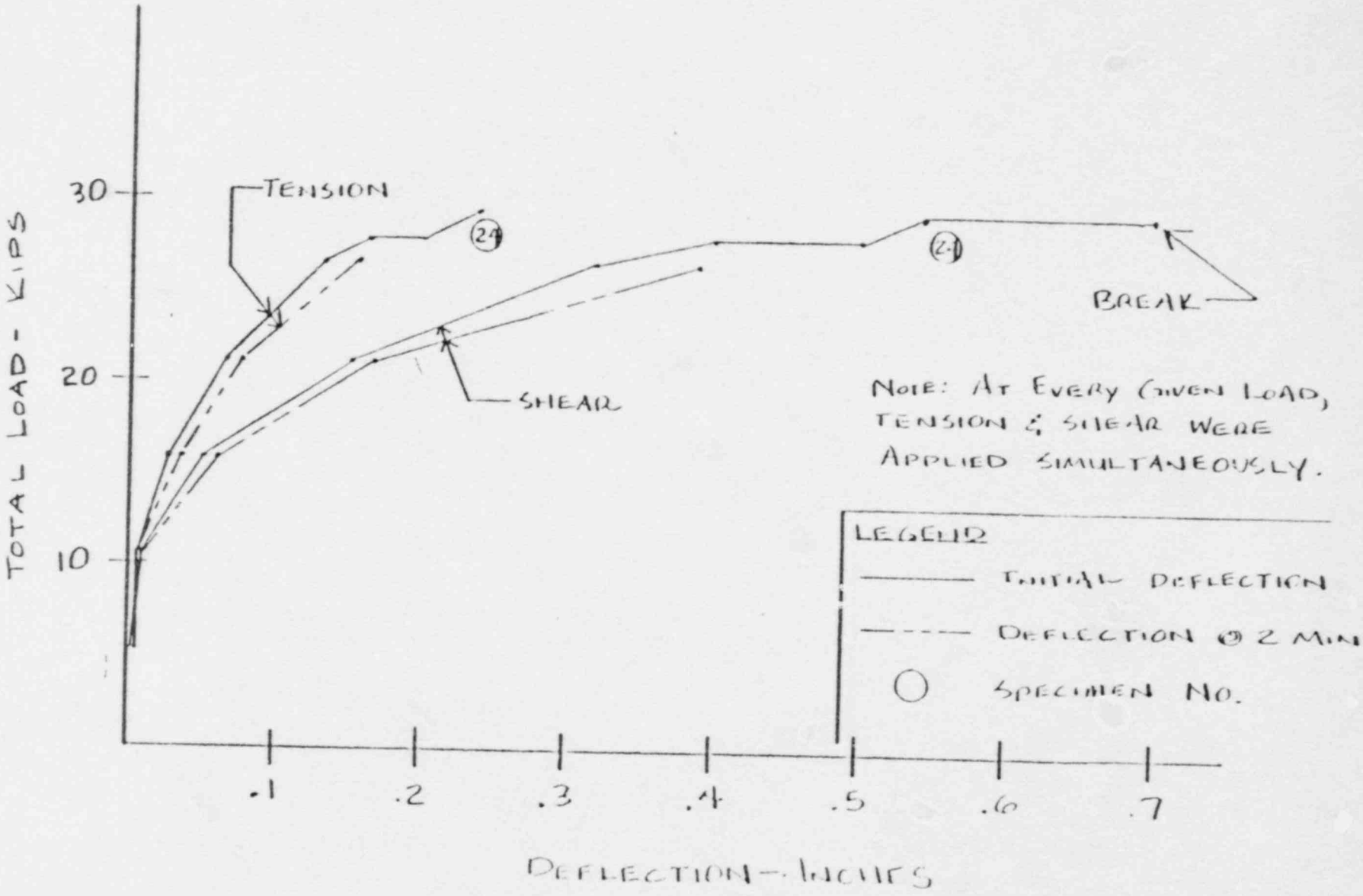
COMBINED SHEAR & TENSION CHART
RICHMOND 1 INCH, TYPE EC-2W INSERT
SPECIMAN Nº. 22



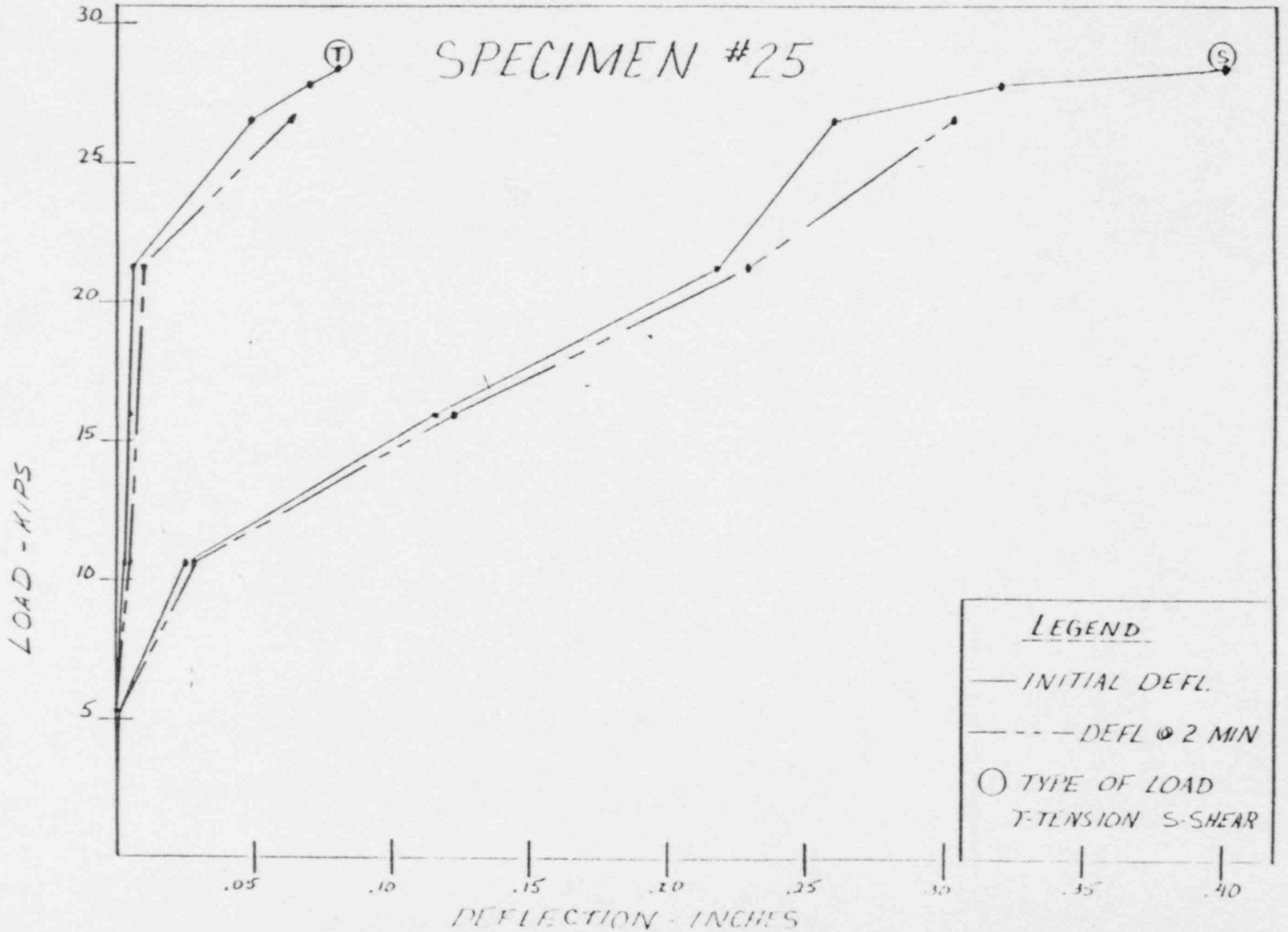
COMBINED SHEAR & TENSION TEST CURVES
1 INCH, TYPE EC-2W
SPECIMEN #23



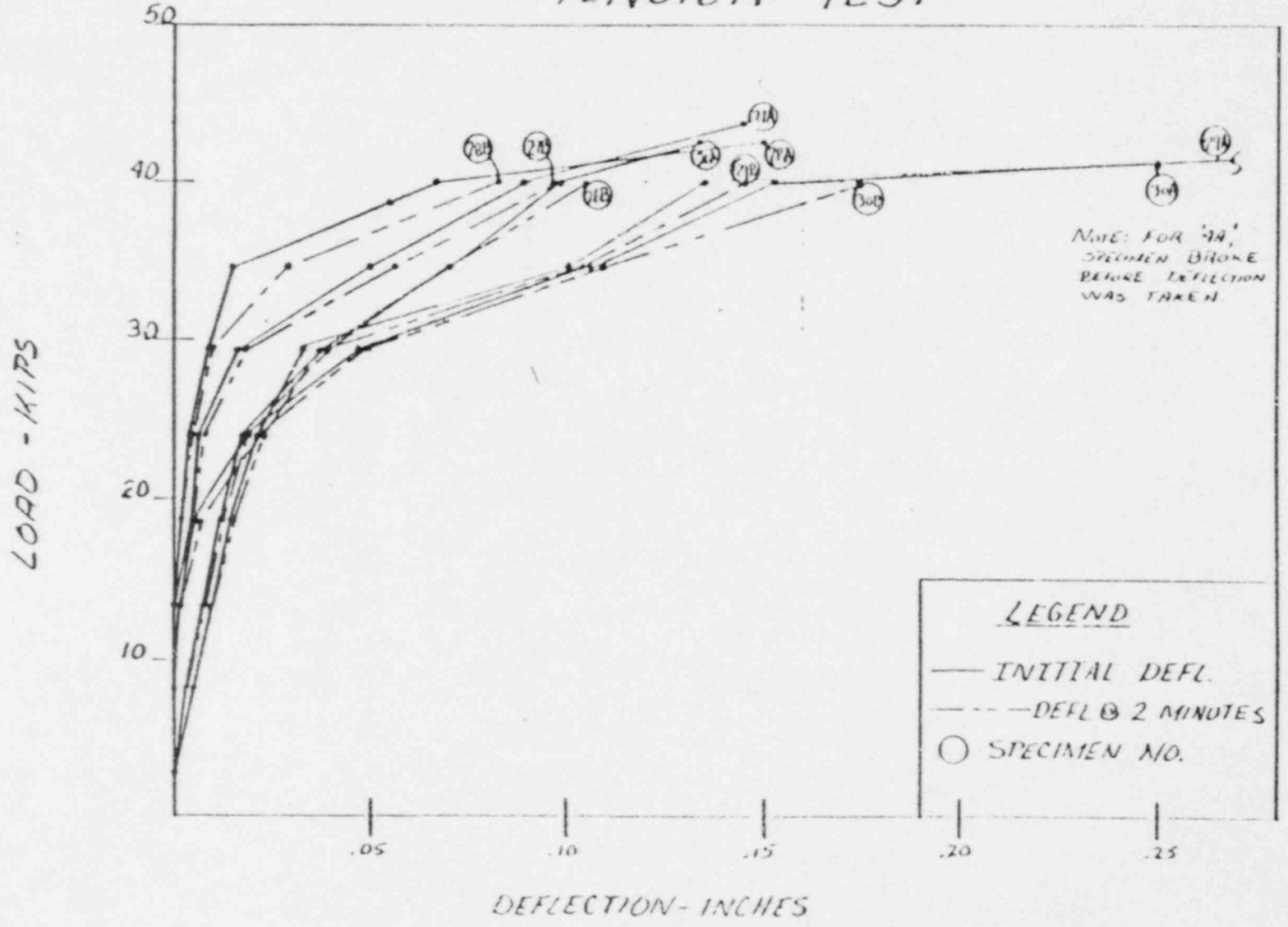
LOAD DEFLECTION CURVES FOR 1"ø TYPE EC-2W RICHMOND INSERT



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



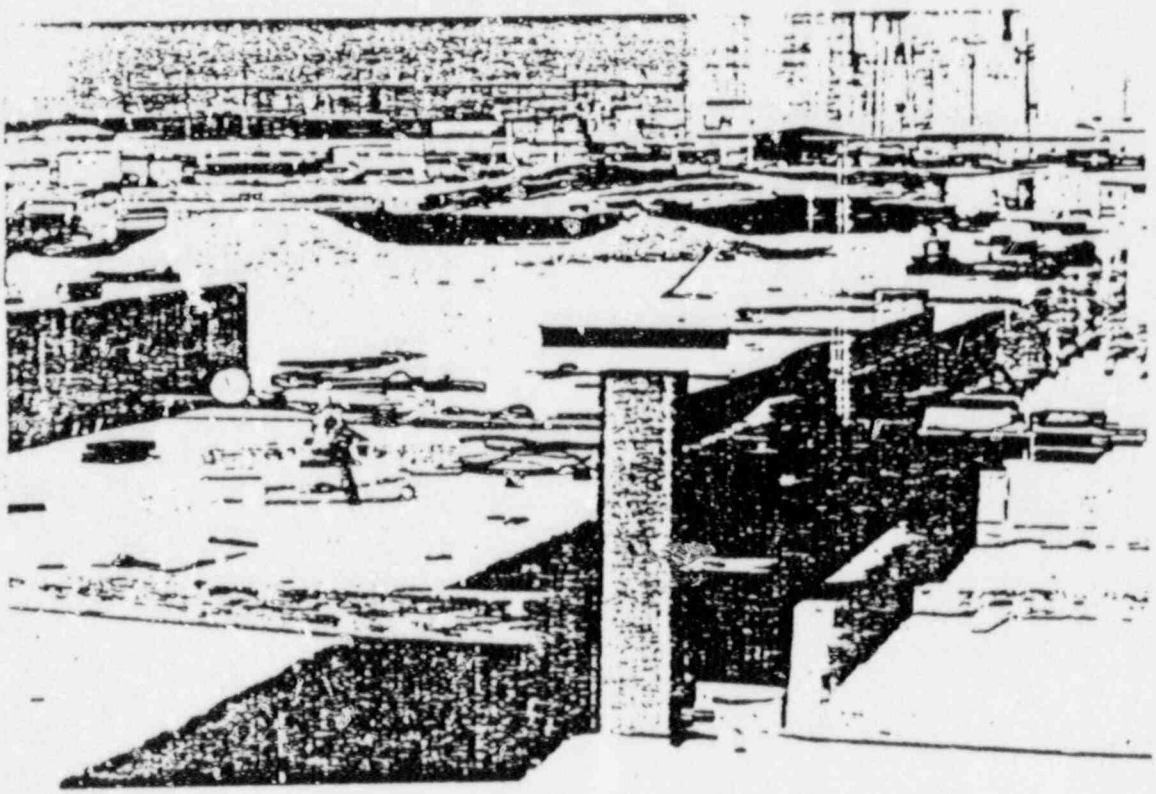
LOAD-DEFLECTION CURVES
1-INCH TYPE EC-2W
TENSION TEST



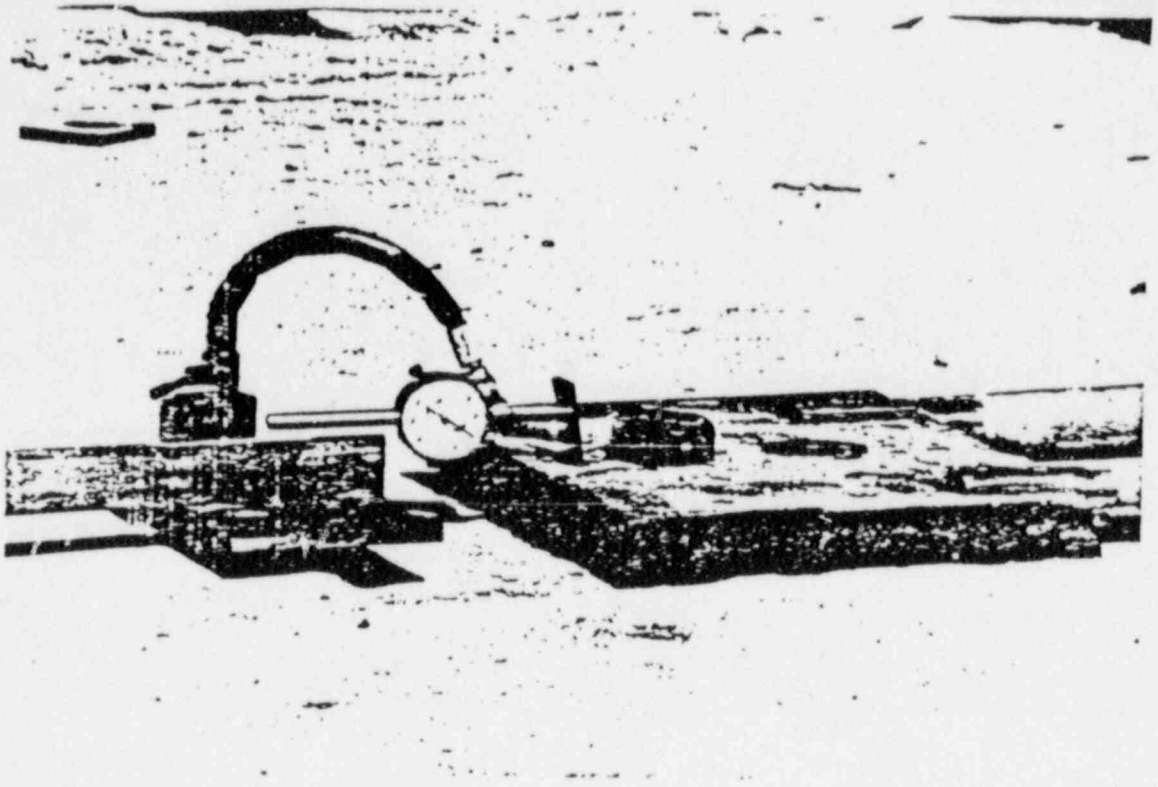
APPENDIX 4

PICTURES OF ACTUAL TEST APPARATUS

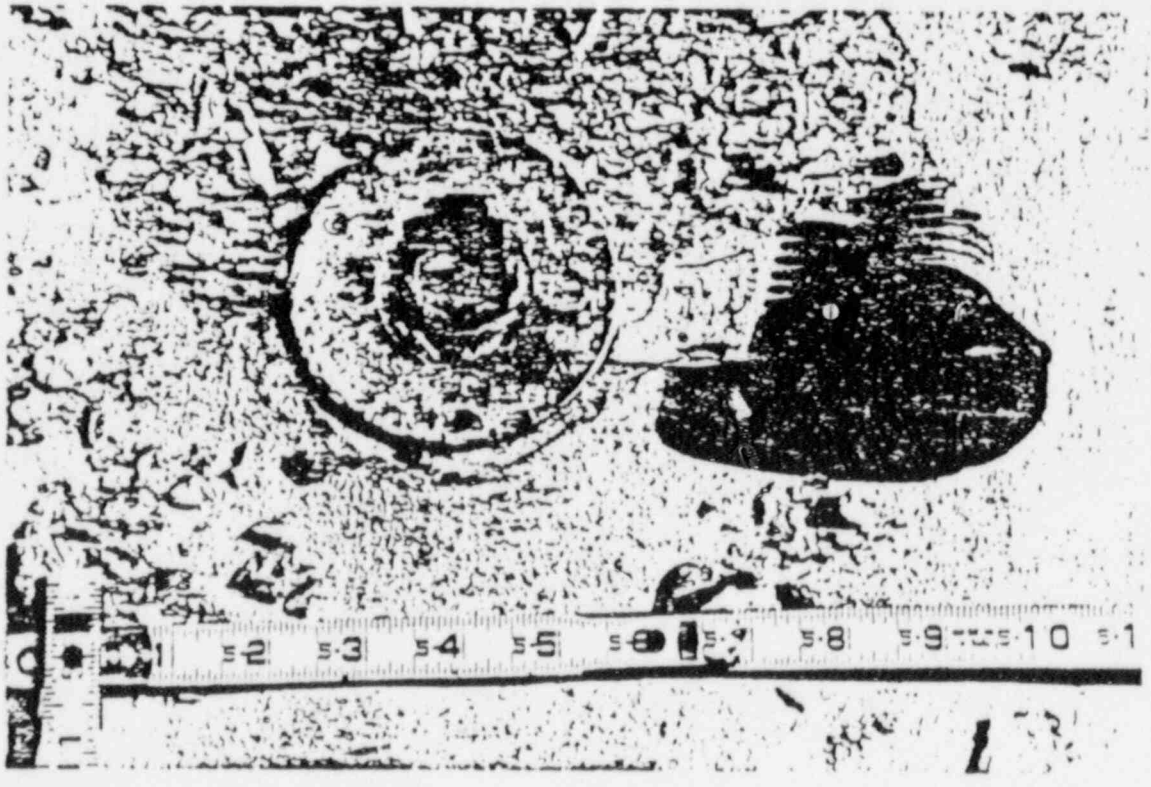
SHEAR TEST



TEST APPARATUS

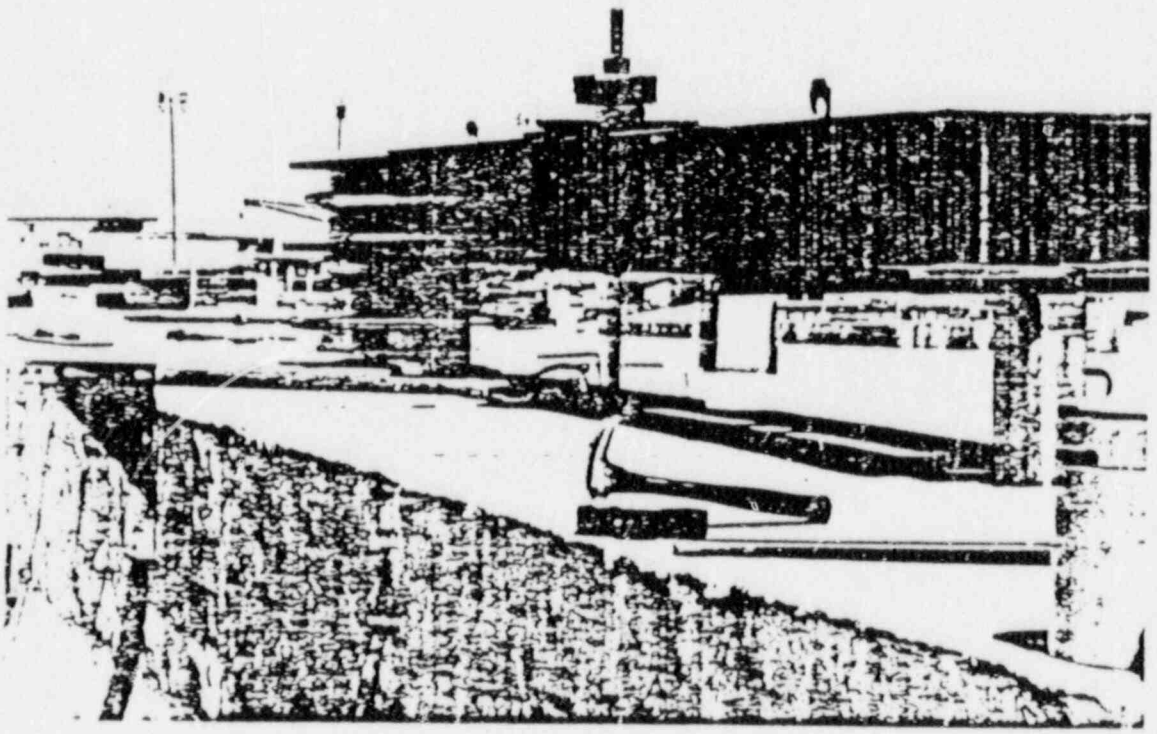


DIAL INDICATOR ARRANGEMENT



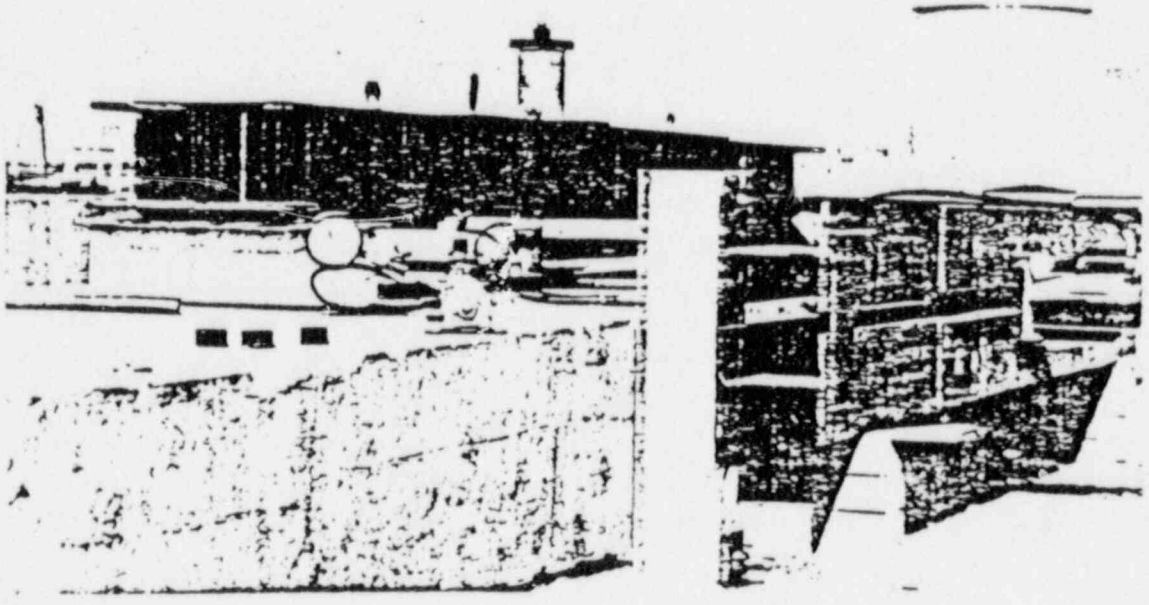
TYPICAL SHEAR FAILURE

TENSION TEST

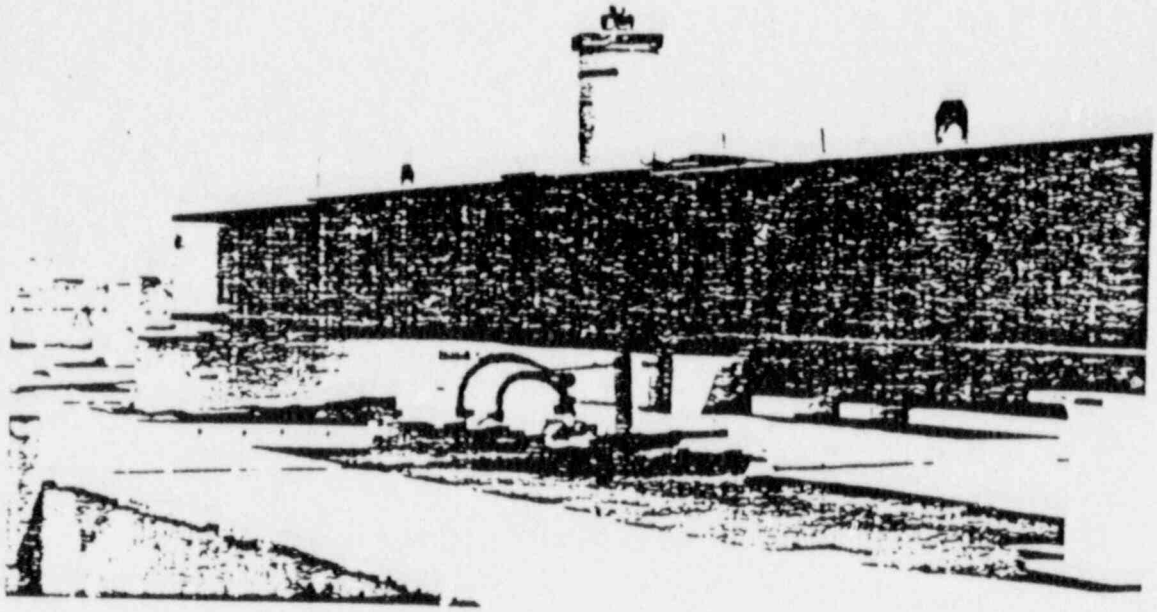


TEST APPARATUS

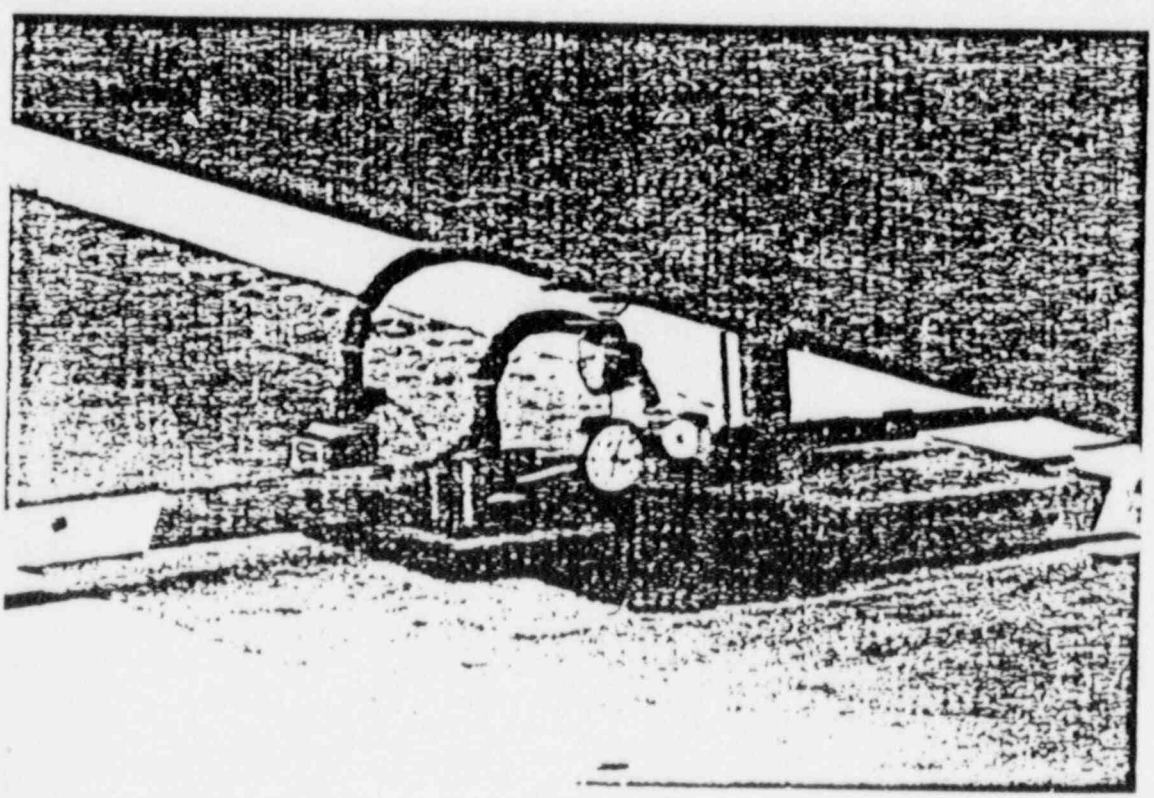
Combined Shear and Tension Test



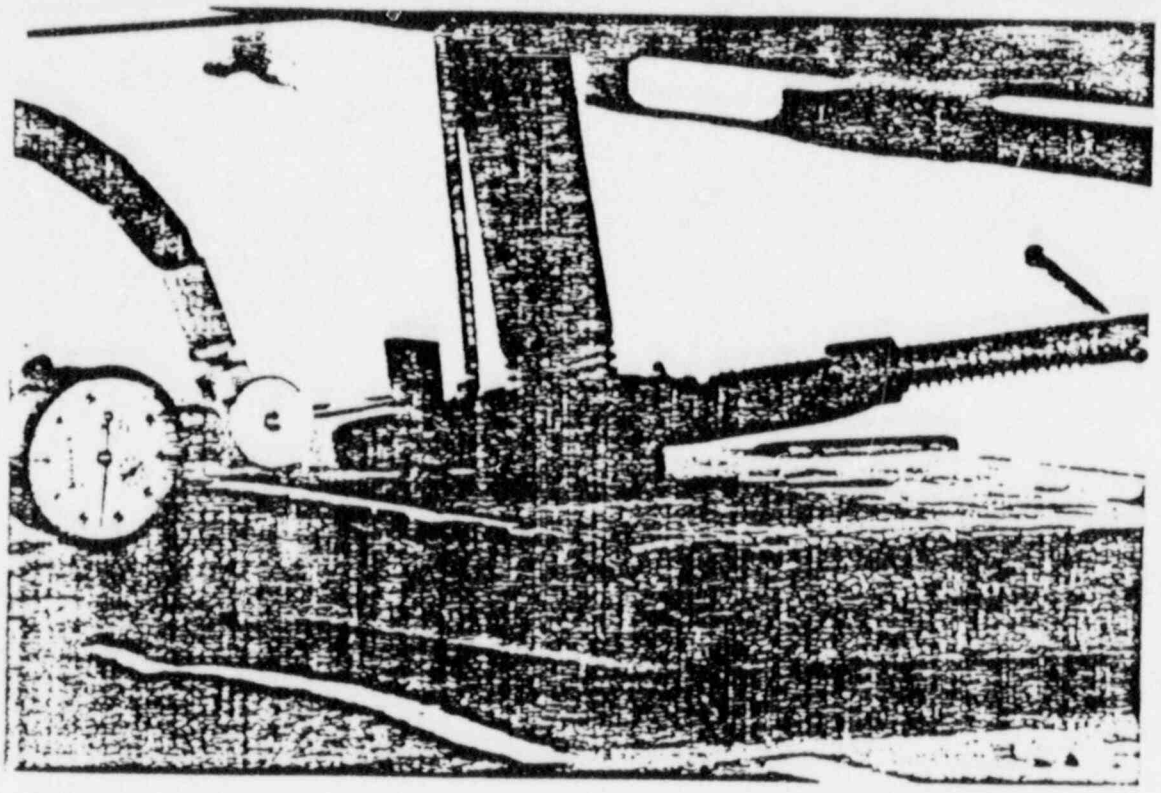
Test Apparatus



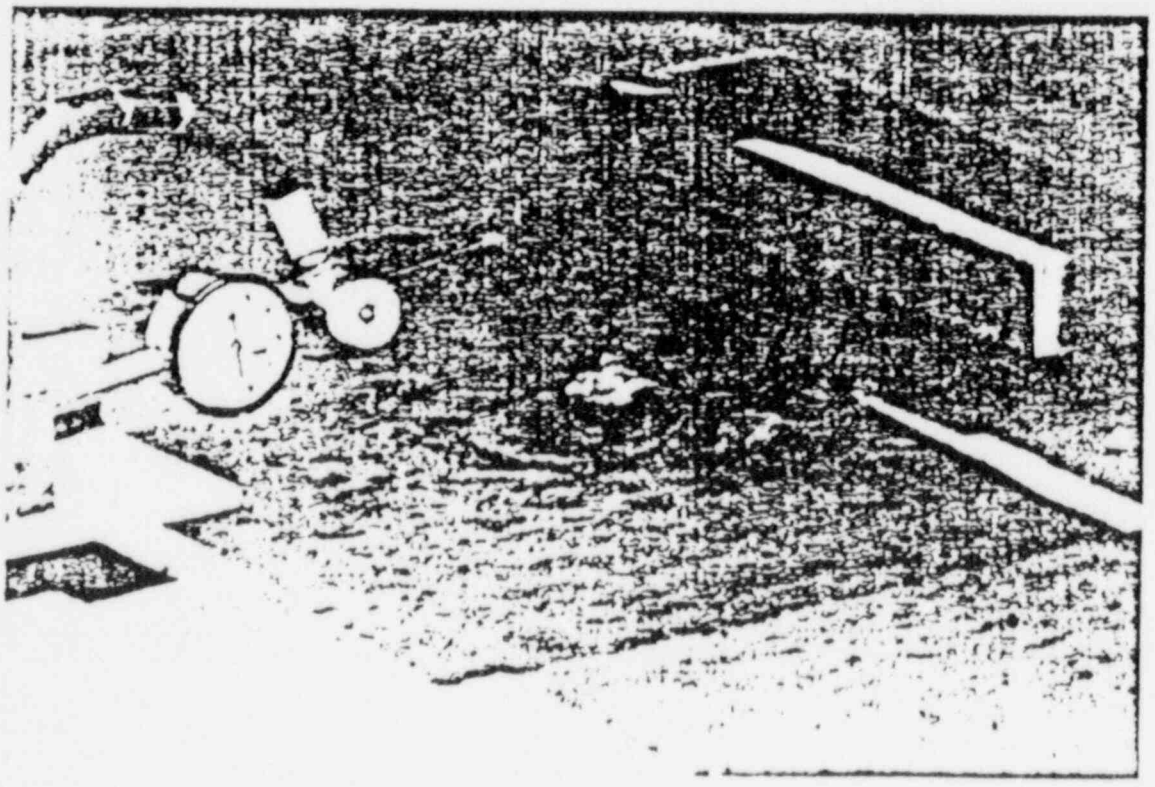
TEST APPARATUS



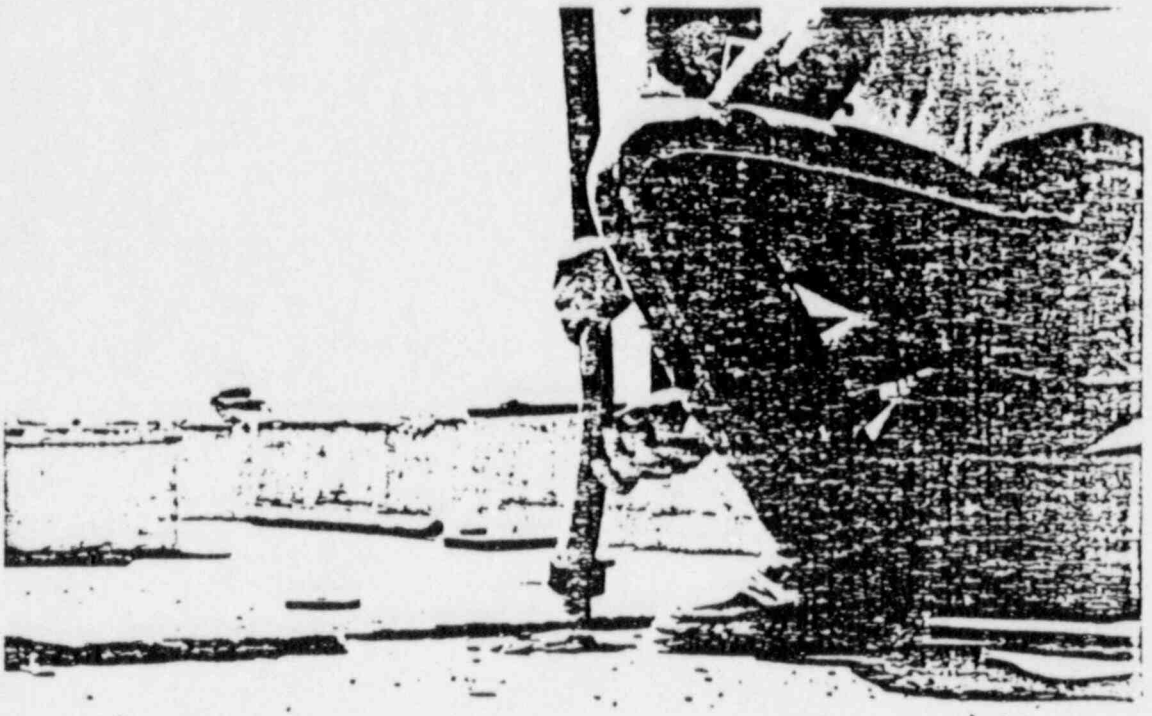
DIAL INDICATOR ARRANGEMENT



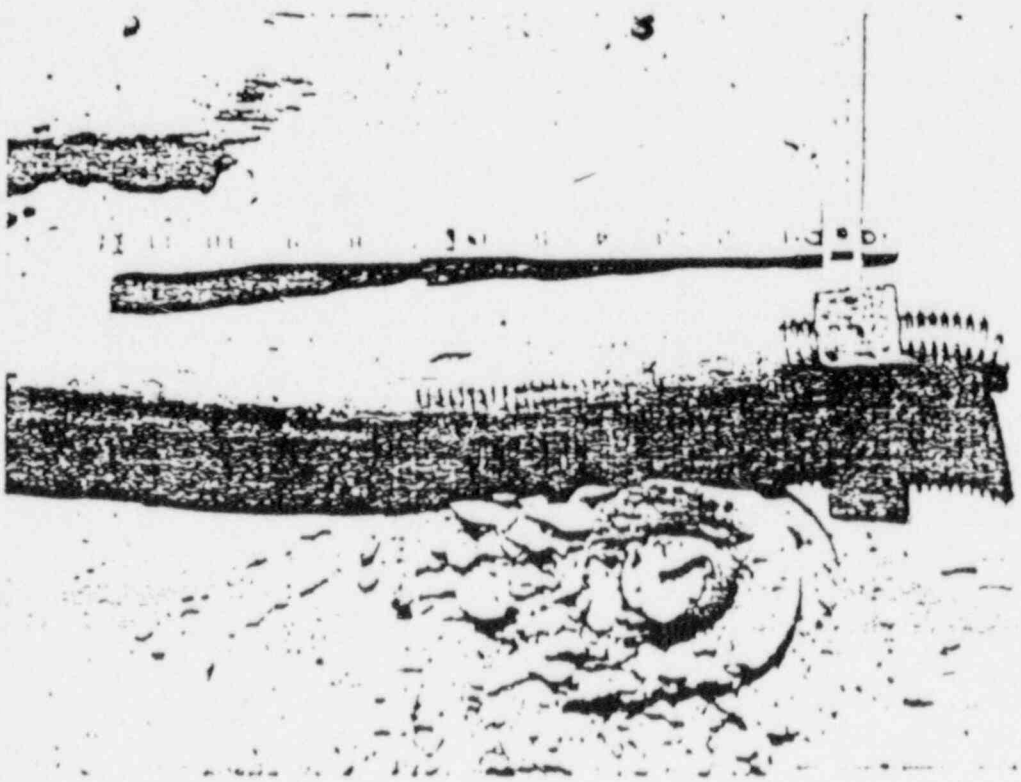
1½-INCH SPECIMEN JUST PRIOR TO FAILURE



1½-INCH SPECIMEN AT FAILURE



1½-INCH FAILED SPECIMEN



TYPICAL FAILURE