ATTACHMENT E

INTERIM TEST REPORT

WELDS OF ANCHOR RODS AND STUDS

TO EMBEDDED PLATES

BECHTEL POWER CORPORATION

Gaithersburg, Maryland

August 27, 1980

Prepared by:
K. Parikh

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1. Statement of Problem

The testing program described herein was authorized by Union Electric Company following a request by the NRC. The tests furnished physical evidence regarding the adequacy of welds at the junction of anchor rods and studs to plates which were to be embedded in concrete. The testing program supplements a previous study and report submitted to the NRC on March 10, 1978 (see ULNRC-238).

2. Description of Testing

All tests were performed in accordance with the "Detailed Procedures for the Test Program to Evaluate Welds of Anchor Rods and Studs to Embedded Plates" which was submitted to the NRC (see ULNRC-365 dated July 17, 1980).

Six anchor rods selected by Union Electric for tension testing were tested at Lehigh University on August 6, 1980. Six additional anchor rods were bend tested to a 30° angle at Lehigh University on the same day. The rods chosen and direction of bend were specified by the NRC.

With NRC concurrence six readily accessible embedded plates with machine welded studs were selected at the Callaway jobsite by Union Electric (D. Stecko and K. Kuechenmeister) and Bechtel (K. Parikh) for tension testing. The plates were prepared for testing by Daniel International Corp. in accordance with the program test procedures and were tested on August 14, 1980.

All test results were observed and recorded by Dr. R. Slutter of Lehigh University. Dr. Slutter also assisted with the development of test procedures and implementation of the test program. An NRC representative witnessed all tests.

3. Test Results

Field data sheets of the test results and a graphical representation of the data obtained for the tension and bend tests are included in Appendix A.

Tension tests on the six designated rods showed the capacities of the welds to be fairly close to the ultimate strength of the rod material, and significantly higher than the 13.65 kips designated in the criteria for acceptability of the welds. The ultimate loads on the six rods were found to be between 46.2 and 51.5 kips.

The six bend tests were successfully completed to an angle of 30+ degrees without any sign of visual distress or other detrimental effect on the welds.

Jobsite tension tests on four EP512 embedded plates tested to a load of 15 kips and two EP912 embedded plates tested to a load of 30 kips indicated that the embeds satisfactorily support the imposed load (note - design loads were 14.5 kips and 29.5 kips respectively). Recorded deflections were less than one tenth of the acceptance criteria.

4. Conclusions

Samples were selected for testing either randomly (embeds at the Callaway jobsite) or specifically (rods with the most undesirable visual weld characteristics). All test results met or exceeded the design requirements and acceptance criteria and further demonstrate the acceptability of the subject embeds.

The testing supports the conclusions presented in the report forwarded by ULNRC-238 dated March 10, 1978 that the embeds at the Callaway jobsite are an acceptable product.

APPENDIX A

TEST RESULT DATA SHEETS

TENSION TEST

PLATE

SPECIMEN: F 1

FRITZ ENGINEERING LABORATORY #13
LEHIGH UNIVERSITY
BETHLEHEM, PENNSYLVANIA 18015

200.80.240.1

LOAD CELL	LOAD (kips) (Kips)	LEFT DIAL	DIFF.	RIGHT DIAL	DIFF	AVG.	REMARKS
105	1000	.829	0	812	0	0	
302	3000	827	0.001	812	0	0.0005	
602	6000	824	0.004	812	0	0.0020	
900	9000	822	0.0065	812	0	0.0025	
1200	12000	8205	0.0095	812	0	0.0038	
1498	15000	8185	0.0115	812	0	0.0043	
1498	15000	8185	0.0115	812	0	0.0043	Load held 2 Min. No spalling or Cracks

Dial Readings in Inches, 7/8" diameter pull rod used

8/14/80 Roger D. Stutts Lehigh Univ
8/14/80 OB Stark UE
8/14/80 Frank L. Bedwell
8/14/80 Kim W. Kuchenmeister (UE)
8/14/80 Ray Smith UE

TENSION TEST [illegible]

FRITZ ENGINEERING LABORATORY #13
LEHIGH UNIVERSITY
BETHLEHEM, PENNSYLVANIA 18015

200.80.240.1

PLATE

F2

LOAD CELL	LOAD (kips) lbs.	LEFT DIAL	DIFF	RIGHT DIAL	DIFF	AVG.	REMARKS
105	1000	.787	0	.2675	0	0	
302	3000	.7807	+.0020	.2670	0.0005	—	
602	6000	.7655	0.0015	.2685	0.0010	0.0012	
900	9000	.7595	0.0275	.2685	0.0010	0.0143	
1200	12000	.7565	0.0305	.2685	0.0010	0.0158	
1498	15000	.7535	0.0335	.2685	0.0010	0.0172	
1496	15000	.7530	0.0340	.2685	0.0010	0.0175	Load held 2 min
							No Spalling of Concrete

Dial Guage readings in Inches

1/8" diameter pull rod used

Loading Started at Center

Left Dial on plate

Right plate on Concrete

8/14/80 [signature] Lehigh University

8/14/80 OB Stuka OE

8/14/80 [signature] Bechtel

8/14/80 Ken W. Kuechenmeister (UE)

8/14/80 [signature] UE

TENSION TEST ...

PLATE ______________________

F 3

FRITZ ENGINEERING LABORATORY #13
LEHIGH UNIVERSITY
BETHLEHEM, PENNSYLVANIA 18015

200.80.240.1

LOAD CELL	LOAD (kips) lbs.	LEFT DIAL	DIFF	RIGHT DIAL	DIFF	AVG.	REMARKS
105	1000	0.644	0	0.021	0	0	
302	3000	0.644	0	0.021	0	0	
600	6000	0.644	0	0.0205	0.0005	0.0003	
900	9000	0.6425	0.0015	0.0185	0.0025	0.0020	
1200	12000	0.6400	0.0040	0.0175	0.0035	0.0058	
1498	15000	0.6370	0.0070	0.0165	0.0045	0.0058	Load held 2 min
1498	15000	0.6368	0.0072	0.0165	0.0045	0.0058	

No Spalling of Concrete

Dial gage readings in inches

7/8" diameter rod used

8/14/80 Roger G. Slutter Lehigh University

8/14/80 O.B. Steckes UE

8/14/80 K Parikh Bechtel

8/14/80 Klaus W. Kuckenmeister (UE)

8/14/80 Roy Ukaleck UE

PLATE F4

LEHIGH UNIVERSITY
BETHLEHEM, PENNSYLVANIA 18015

200.80.240.1

LOAD CELL	LOAD (kips)	LEFT DIAL	DIFF.	RIGHT DIAL	DIFF	AVG.	REMARKS
199	2000	.56[illegible]	0	.7255	0	0	
605	6000	.5565	0.0080	.72[illegible]	-0.0005	0.0038	
999	10000	.5530	0.0115	.7260	-0.0005	0.0055	
1403	14000	.5495	0.0150	.7260	-0.0005	0.0075	
1796	18000	.5465	0.0180	.7260	-0.0005	0.0090	Ram out of Stroke
2200	22000	.5245	0.0200	.7260	-0.0005	0.0150	
2595	26000	.5300	0.0345	.7255	0	0.0173	
2991	30000	.5235	0.0410	.7230	0.0025	0.0218	
2991	30000	.5225	0.0420	.7228	0.0027	0.0224	Held load 2 [illegible]

Dial gage reading in inches

No Spalling of Concre[illegible]

1" diameter pull rod used

8/14/80 [illegible] Lehigh Univ.
8/14/80 [illegible] UE
8/14/80 [illegible] Bechtel
8/14/80 Ken W. [illegible] (UE)
8/14/80 [illegible]

TENSION TEST

PLATE F5

FRITZ ENGINEERING LABORATORY #13
LEHIGH UNIVERSITY
BETHLEHEM, PENNSYLVANIA 18015

200.80.240.1

LOAD CELL	LOAD (kips)	LEFT DIAL	DIFF	RIGHT DIAL	DIFF	AVG.	REMARKS
105	1000	0.7645	0	0.6850	0	0	
302	3000	0.7654	-0.0009	0.6810	0.0050	0.0021	
602	6000	0.7662	-0.0017	0.6765	0.0095	0.0039	
900	9000	0.7642	0.0003	0.6755	0.0105	0.0054	
1200	12000	0.7610	0.0035	0.6745	0.0115	0.0075	
1498	15000	0.7580	0.0065	0.6725	0.0125	0.0095	
1498	15000	0.7580	0.0065	0.6725	0.0125	0.0095	Load held 2 min

No spalling of concrete

Dial readings in inches

7/8" diameter pull rod used

8/14/80 Roger G. Fields Lehigh Univ

8/14/80 DS Harris UE

8/14/80 Charles Beckett

8/14/80 Ken W. Kuechenmeister UE

8/14/80 Raymond UE

PLATE F6

FRITZ ENGINEERING LABORATORY #19
LEHIGH UNIVERSITY
BETHLEHEM, PENNSYLVANIA 18015
200.80.240.1

LOAD CELL	LOAD (kips)	LEFT DIAL	DIFF	RIGHT DIAL	DIFF	AVG.	REMARKS
194	2000	0.5720	0	6017	0	0	
605	6000	0.5745	0.0025	0.6096	-0.0001	0.0012	
999	10000	0.5930	0.0050	0.6097	-0.0001	0.0025	
1403	14000	0.5975	0.0055	0.6097	0	0.0043	
1799	18000	0.5770	0.0110	0.6097	0	0.0055	
2202	22000	0.5745	0.0135	0.6097	0	0.0068	
2595	26000	0.5670	0.0210	0.6151	-.0057	0.0077	
2991	30000	0.5545	0.0335	0.6220	-.00123	0.0106	
2991	30000	0.5540	0.0340	0.6221	-.00124	0.0103	Load held for 2 min No Spalling of Concrete

Dial gage readings in inches
1" diameter pull rod used.

8/14/80 Roy A. Hunt Lehigh Univ.
8/14/80 DG Hunt UE
8/14/80 Kenneth Bedford
8/14/80 Kim W. Kuechenmeister UE
8/14/80 Roy Dean UE

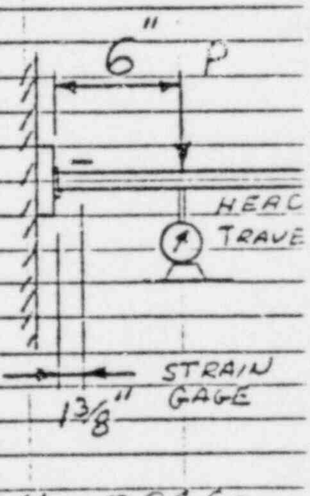
LEHIGH UNIVERSITY
BETHLEHEM, PENNSYLVANIA 18015

BEND TEST

SPECIMEN B1
PLATE EP611 A31-2 Rod#2

200.80.240.1

LOAD (lbs.)	HEAD TRAVEL READING	HEAD TRAVEL DIFF.	ANGLE (degrees)	STRAIN DATA READING	REMARKS
0	~~0~~			0	
100	~~197~~	0.000	0	197	
200		0.009		330	
300		0.015		470	
400		0.023		614	
500		0.030		770	
600		0.039		922	
700		0.047		1074	
800		0.052		1200	
900		0.060		1364	
1000		0.069		1554	
1100		0.077		1730	
1200		0.088		1954	
1300		0.102		2214	
1400		0.129		2942	First drop
1500		0.247		8540	
1600		0.346		15285	
1700		0.473		23010	
1800		0.600		29670	
1900		0.764		37560	
2000		0.917		44950	
2100		1.115		out	
2160		1.300			
2210	Reset	1.500			
2250	0.400	1.570			
2280	0.500	1.670			
2320	0.700	1.870			
2390	0.900	2.070	26° measured		Drop to 2280
2400	1.100	2.270			
2400	1.300	2.470			
2390	1.500	2.670	34° measured		
Reset	0.800				
2340	1.000	2.870			
2300	1.200	3.070			
2280	1.400	3.270	39½° measured		
0	—	—	37½°		



Dan Stecka UF 8/6/80
Roy Ventil 8/6/80
K Parikh 8/6/80

Testing Machine: 300,000 lb. Capacity Baldwin Serial No. 39460

Test by: "Detailed Procedure for Test Program to Evaluate Welds of Anchor Rods and Studs to Embedded Plates" Prepared by K. Parikh Bechtel Power Corporation, Revised 7-11-80

BEND TEST

SPECIMEN B2

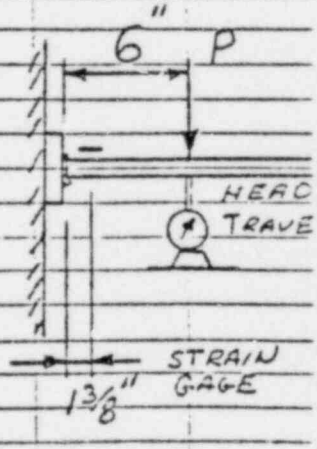
PLATE EPS11 A32-2 Rod #5

LEHIGH UNIVERSITY
BETHLEHEM, PENNSYLVANIA 18015

200.80.240.1

LOAD (lbs.)	HEAD TRAVEL READING	HEAD TRAVEL DIFF.	ANGLE (degrees)	STRAIN DATA READING	REMARKS
0		—		0	
100		0.000		148	
200		0.008		321	
300		0.015		462	
400		0.023		628	
500		0.032		792	
600		0.040		962	
700		0.047		1122	
800		0.056		1370	
900		0.065		1702	
1000		0.075		2160	
1100		0.090		2765	
1200		0.104		3515	
1300		0.029		4730	
1900		0.175		7350	
1500		0.364		12365	
1600		0.446		17470	
1700		0.474		24495	
1800		0.612		31715	
1900		0.875		39700	
2000		0.935		47050	
2100		1.102		=	
2200	Read.	1.349			
2280	0.400	1.576			
2300	0.427	1.663			
2340	0.700	1.876			
2380	0.900	2.076			
2400	1.100	2.276			
2400	1.300	2.476			
2380	1.500	2.676	32½	measured	
0			30½		

Dan Stanko UE 8/6/80
Roy Veatch 8/6/80
K Parikh 8/6/80



Testing Machine: 300,000 lb. Capacity Baldwin Serial No. 39460

Test by: "Detailed" Procedure for Test Program to Evaluate Welds of Anchor Rods and Studs to Embedded Plates" Prepared by K. Parikh Bechtel Power Corporation, Revised 7-11-80

BEND TEST

SPECIMEN B3

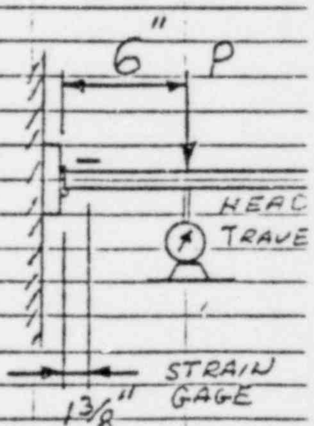
PLATE EPS11 A11-46 Rod #9

LEHIGH UNIVERSITY
BETHLEHEM, PENNSYLVANIA 18015

200.80.240.1

SHEET 3 OF 12

LOAD (lbs.)	HEAD TRAVEL READING	HEAD TRAVEL DIFF.	ANGLE (degrees)	STRAIN DATA READING	REMARKS
0	0			0	
100		0.000		204	
200		0.008		338	
400		0.023		642	
600		0.037		900	
800		0.053		1210	
1000		0.068		1500	
1200		0.085		1900	
~~1400~~					
1300		0.180		5230	
1400		0.275		8340	
1500		0.402		21470	
1600		0.532		28590	
1700		0.712		37880	
1800		0.962		—	
1870		1.100			
1920		1.200			
1980		1.300			
2030	Reset	1.400			
2080	0.300	1.500			
2060	0.400	1.600			
2120	0.500	1.700			
2150	0.600	1.800			
2170	0.700	1.900			
2180	0.800	2.000			
2200	0.900	2.100			
2200	1.000	2.200			
2220	1.100	2.300			
2230	1.200	2.400			
2230	1.300	2.500			
2240	1.400	2.600			
2240	1.500	2.700	31½° measured		
Reset	0.800				
2220	0.900	2.800			
2230	1.000	2.900	34° measured		
0			32°		



D. Stecher 8/6/80

Ray Ventel 8/6/80

K Parikh 8/6/80

Testing Machine: 300,000 lb. Capacity Baldwin Serial No. 39460

Test by: "Detailed Procedure for Test Programs to Evaluate Welds of Anchor Rods and Studs to Embedded Plates" Prepared by K. Parikh Bechtel Power Corporation, Revised 7-11-80

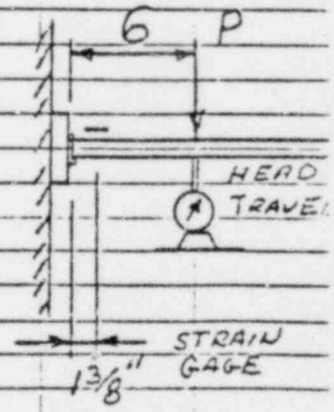
BEND TEST

SPECIMEN B4

PLATE EPSII A11-42 Rod #10

LOAD (lbs.)	HEAD TRAVEL READING	DIFF.	ANGLE (degrees)	STRAIN DATA READING	REMARKS
0		—		0	
100		0.000		160	
200		0.008		295	
400		0.024		660	
600		0.041		935	
800		0.056		1270	
1000		0.072		1595	
1200		0.098		2050	
1300		0.121		2790	
1400		0.236		7940	
1500		0.412		19525	
1600		0.522		26310	
1700		0.681		34150	
1800		0.902		43850	
1900		1.100		out.	
2010		1.350			
2090	0.400	1.500			
2200	0.600	1.700			
2240	0.800	1.900			
2290	1.000	2.100	slip		
2290	1.200	2.300			
2340	1.400	2.500			
2320	1.500	2.600	32° measured		
0			30°		

Don Hertke 8/6/80
Roy Veutel 8/6/80
Kparikh 8/6/80



Testing Machine: 300,000 lb. Capacity Baldwin Serial No. 39460

Test by: "Detailed Procedure for Test Program to Evaluate Welds of Anchor Rods and Studs to Embedded Plates" Prepared by K. Parikh Bechtel Power Corporation Revised 7-11-80

BEND TEST

SPECIMEN B5

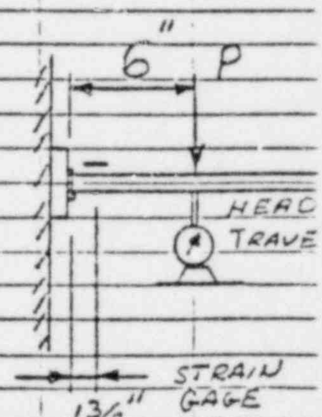
PLATE EP611 D24-1 Rod #5

FRITZ ENGINEERING LABORATORY #13
LEHIGH UNIVERSITY
BETHLEHEM, PENNSYLVANIA 18015

200.80.240.1

LOAD (lbs.)	HEAD TRAVEL READING	HEAD TRAVEL DIFF.	ANGLE (degrees)	STRAIN DATA READING		REMARKS
0		–		1000	0	
100		0.000		1160 ~~1243~~	~~243~~ 160	
200		0.006		1310	310	
400		0.024		1610	610	
600		0.040		1905	905	
800		0.056		2185	1185	
1000		0.072		2485	1485	
1200		0.091		2965	1965	
1300		0.115		4050	3050	
1400		0.157		6510	5510	
1500		0.228		12085	11085	
1600		0.331		19920	18920	
1700		0.410		28225	27225	
1800		0.596		35825	34825	
1900		0.769		44875	43875	
2000		0.960		–		
2080		1.100				
2180	Reset	1.300				
2240	0.200	1.500				
2330	0.400	1.700				
2370	0.600	1.900				
2420	0.800	2.100				
2440	1.000	2.300				
2420	1.200	2.500				
2400	1.400	2.700	34° measured			
0			32° measured			

[signature] 8/6/80
Roy Ventel 8/6/80
K parikh 8/6/80



Testing Machine: 300,000 lb. Capacity Baldwin Serial No. 39460

Test by: "Detailed Procedure for Test Program to Evaluate Welds of Anchor Rods and Studs to Embedded Plates" Prepared by K. Parikh Bechtel Power Corporation, Revised 7-11-80

BEND TEST

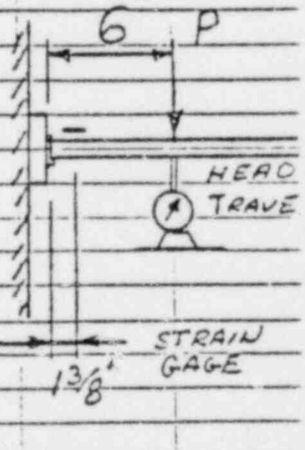
LEHIGH UNIVERSITY
BETHLEHEM, PENNSYLVANIA 18015

SPECIMEN B6
PLATE EP611 A24-2 Rod #1

200.80.240.1
SHEET 6 OF 12

LOAD (lbs.)	HEAD TRAVEL READING	HEAD TRAVEL DIFF.	ANGLE (degrees)	STRAIN DATA READING		REMARKS
0				1000	0	
100		0.000		1160	160	
200		0.009		1280	280	
400		0.026		1525	475	
600		0.041		1835	735	
800		0.058		2150	1150	
1000		0.074		2375	1375	
1200		0.096		2815	1715	
1300		0.228		7810	6810	
1400		0.354		16160	15160	
1500		0.526		26935	25935	
1600		0.700		36310	35310	
1700		0.860		43245	42245	
1800		1.132		—	—	
1820	Reset	1.300				
2000	0.400	1.500				
2040	0.600	1.700				
2080	0.800	1.900				
2130	1.000	2.100				
2170	1.200	2.300				
2210	1.400	2.500				
2180	1.600	2.700	31½° measured			
0			30° measured			

[signature] 8/6/80
Roy Veatch 8/6/80
K. Parikh 8/6/80



Testing Machine: 300,000 lb. Capacity Baldwin Serial No. 39460
Strs 020148

Test by: "Detailed Procedure for Test Program to Evaluate Welds of Anchor Rods and Studs to Embedded Plates" Prepared by K. Parikh Bechtel Power Corporation Revised 7-11-80

TENSION TEST

SPECIMEN T1

PLATE EP412 A16-19 Left Rod #5

LOAD (lbs.)	HEAD TRAVEL READING	HEAD TRAVEL DIFF	
1000	0.500	0.000	
2000	0.515	0.015	
4000	0.563	0.063	
6000	0.594	0.094	
8000	0.617	0.117	
10000	0.637	0.137	
12000	0.653	0.153	
14000	0.668	0.168	
16000	0.683	0.183	
18000	0.696	0.196	
20000	0.710	0.210	
22000	0.722	0.222	
24000	0.732	0.232	
26000	0.745	0.245	
28000	0.756	0.256	
30,000	0.771	0.271	
30,000	0.871	0.371	
32000	1.074	0.574	
34000	1.163	0.663	
36000	1.262	0.762	
38,000	1.379	0.879	
38,000	0.600	0.876	Reset
40,000	0.744	1.022	
42,000	0.816	1.194	
44,000	1.164	1.442	
46,000	1.482	1.760	
46,000	0.400		Reset
47,000	0.642	2.002	
48,000	0.959	2.319	
48,500	1.285	2.645	
49,000	1.559		
49,000	0.200	2.919	Reset
49,900	1.632		
49,900	0.100	4.351	Reset
50,000	0.460	4.711	

Gage Length 14 13/16"

30,400 yield
load dropped 29,600

Gage Length = 16 5/8"

Ultimate Load
Gage length = 19 1/2"
after fracture

Failure in bar

Don Slanko 8/6/80
Roy Veatch 8/6/80
Parikh 8/6/80

Testing Machine: 300,000 lb. Capacity Baldwin Serial No. 39460

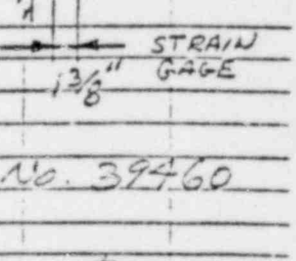
Test by: "Detailed Procedure for Test Programs to Evaluate Welds of Anchor Rods and Studs to Embedded Plates" Prepared by K. Parikh, Bechtel Power Corporation Revised 7-11-80

BEND TEST

SPECIMEN B2
PLATE EPS11 A32-2 Rod #5

LOAD (lbs.)	HEAD TRAVEL READING	HEAD TRAVEL DIFF.	ANGLE (degrees)	STRAIN DATA READING	REMARKS
0		—		0	
100		0.000		148	
200		0.008		321	
300		0.015		462	
400		0.023		623	
500		0.032		792	
600		0.040		962	
700		0.047		1122	
800		0.056		1370	
900		0.065		1702	
1000		0.075		2160	
1100		0.090		2765	
1200		0.104		3515	
1300		0.029		4730	
1400		0.175		7350	
1500		0.364		12365	
1600		0.446		17470	
1700		0.474		24495	
1800		0.612		31715	
1900		0.875		39700	
2000		0.935		47050	
2100		1.102		—	
2200	Reset.	1.349			
2280	0.400	1.576			
2300	0.487	1.663			
2340	0.700	1.876			
2380	0.900	2.076			
2400	1.100	2.276			
2400	1.300	2.476			
2380	1.500	2.676	32½ measured		
0			30½		

Don Stanko UE 8/5/80
Roy Veatch 8/6/80
K. Parikh 8/6/80



Testing Machine: 300,000 lb. Capacity Baldwin Serial No. 39460

Test by: "Detailed Procedure for Test Program to Evaluate Welds of Anchor Rods and Studs to Embedded Plates" Prepared by K. Parikh Bechtel Power Corporation, Revised 7-11-80.

BEND TEST

SPECIMEN B3

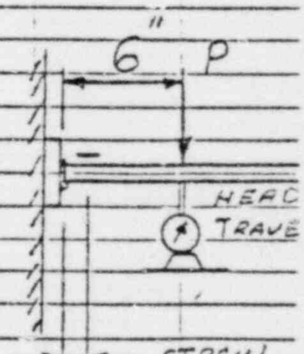
PLATE EPS11 A11-46 Rod #9

LEHIGH UNIVERSITY
BETHLEHEM, PENNSYLVANIA 18015

200.80.240.1

LOAD (lbs.)	HEAD TRAVEL READING	HEAD TRAVEL DIFF.	ANGLE (degrees)	STRAIN DATA READING	REMARKS
0	0			0	
100		0.000		204	
200		0.008		338	
400		0.023		642	
600		0.037		900	
800		0.053		1210	
1000		0.068		1500	
1200		0.095		1900	
~~1400~~					
1300		0.180		5230	
1400		0.275		8340	
1500		0.402		21470	
1600		0.532		28590	
1700		0.712		37680	
1800		0.962		—	
1870		1.100			
1920		1.200			
19'0		1.300			
2 30	Reset	1.400			
2080	0.300	1.500			
2060	0.400	1.600			
2120	0.500	1.700			
2150	0.600	1.800			
2170	0.700	1.900			
2180	0.800	2.000			
2200	0.900	2.100			
2200	1.000	2.200			
2220	1.100	2.300			
2230	1.200	2.400			
2230	1.300	2.500			
2240	1.400	2.600			
2240	1.500	2.700	31½° measured		
Reset	0.800				
2220	0.900	2.800			
2230	1.000	2.900	34° measured		
0			32°		

Don Stecher 8/6/80
Roy Veatch 8/6/80
K Parikh 8/6/80



Testing Machine: 300,000 lb Capacity Baldwin Serial No. 39460

Test by: "Detailed Procedure for Test Program to Evaluate Welds of Anchor Rods and Studs to Embedded Plates" Prepared by K. Parikh Bechtel Power Corporation; Revised 7-11-80

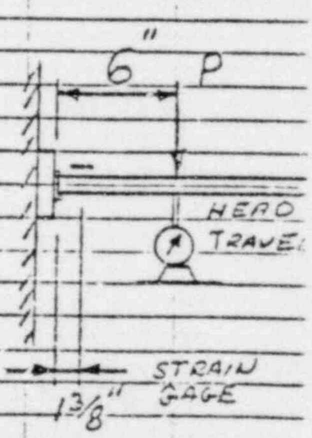
BEND TEST

SPECIMEN B4

PLATE EPS11 A11-42 Rod #10

LOAD (lbs.)	HEAD TRAVEL READING	HEAD TRAVEL DIFF.	ANGLE (degrees)	STRAIN DATA READING	REMARKS
0		—		0	
100		0.000		160	
200		0.008		295	
400		0.023		660	
600		0.041		935	
800		0.056		1270	
1000		0.072		1595	
1200		0.098		2050	
1300		0.121		2790	
1400		0.236		7940	
1500		0.412		14525	
1600		0.522		26310	
1700		0.681		34150	
1800		0.902		43850	
1900		1.100		out.	
2010		1.350			
2090	0.400	1.500			
2200	0.600	1.700			
2240	0.800	1.900			
2290	1.000	2.100	slip		
2290	1.200	2.300			
2340	1.400	2.500			
2320	1.500	2.600	32° measured		
0			30°		

Don Hinkle 8/6/80
Roy Vientel 8/6/80
K. Parikh 8/6/80



Testing Machine: 300,000 lb. Capacity Baldwin Serial No. 39460

Test by: "Detailed Procedure for Test Program to Evaluate Welds of Anchor Rods and Studs to Embedded Plates" Prepared by K. Parikh Bechtel Power Corporation Revised 7-11-80

BEND TEST

SPECIMEN B5
PLATE EP611 D24-1 Rod #5

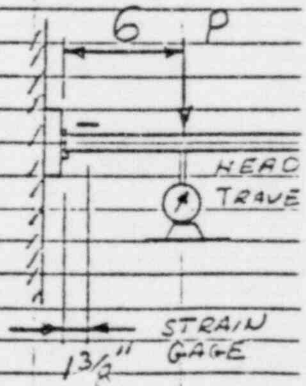
FRITZ ENGINEERING LABORATORY #13
LEHIGH UNIVERSITY
BETHLEHEM, PENNSYLVANIA 18015

200.80.240.1

SHEET 5 OF 12

LOAD (lbs.)	HEAD TRAVEL READING	HEAD TRAVEL DIFF.	ANGLE (degrees)		STRAIN DATA READING		REMARKS
0		–			1000	0	
100		0.000			1160 ~~1243~~	~~243~~ 160	
200		0.006			1310	310	
400		0.024			1610	610	
600		0.040			1905	905	
800		0.056			2185	1185	
1000		0.072			2485	1485	
1200		0.091			2965	1965	
1300		0.115			4050	3050	
1400		0.157			6510	5510	
1500		0.228			12085	11085	
1600		0.331			19920	18920	
1700		0.410			28225	27225	
1800		0.546			35825	34825	
1900		0.769			44875	43875	
2000		0.960			–		
2080		1.100					
2180	Reset	1.300					
2240	0.200	1.500					
2330	0.400	1.700					
2370	0.600	1.900					
2420	0.800	2.100					
2440	1.000	2.300					
2420	1.200	2.500					
2400	1.400	2.700	34°	measured			
0			32°	measured			

Don [illegible] 8/6/80
Roy Veatel 8/6/80
K Parikh 8/6/80



Testing Machine: 300,000 lb. Capacity Baldwin Serial No. 39460

Test by: "Detailed Procedure for Test Program to Evaluate Welds of Anchor Rods and Studs to Embedded Plates" Prepared by K. Parikh Bechtel Power Corporation, Revised 7-11-80

BEND TEST

SPECIMEN B6

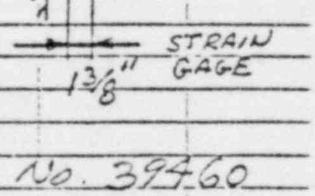
PLATE EP611 A24-2 Rod #1

FRITZ ENGINEERING LABORATORY #13
LEHIGH UNIVERSITY
BETHLEHEM, PENNSYLVANIA 18015

200.80.240.1

LOAD (lbs.)	HEAD TRAVEL READING	HEAD TRAVEL DIFF.	ANGLE (degrees)	STRAIN DATA READING		REMARKS
0				1000	0	
100		0.000		1160	160	
200		0.009		1280	280	
400		0.026		1525	475	
600		0.041		1835	735	
800		0.058		2150	1150	
1000		0.074		2375	1375	
1200		0.096		2815	1715	
1300		0.228		7810	6810	
1400		0.354		16160	15160	
1500		0.526		26935	25935	
1600		0.800		36310	35310	
1700		0.860		43245	42245	
1800		1.122		—	—	
1820	Reset	1.300				
2000	0.400	1.500				
2040	0.600	1.700				
2080	0.800	1.900				
2130	1.000	2.100				
2170	1.200	2.300				
2210	1.400	2.500				
2180	1.600	2.700	31½° measured			
0			30° measured			

[signature] 8/6/80
Roy Vealel 8/6/80
K. Parikh 8/6/80



Testing Machine: 300,000 lb. Capacity Baldwin Serial No. 39460
Stro 020148

Test by: "Detailed Procedure for Test Program to Evaluate Welds of Anchor Rods and Studs to Embedded Plates" Prepared by K. Parikh Bechtel Power Corporation Revised 7-11-80

TENSION TEST

SPECIMEN T1

PLATE EP412 A16-19 Left Rod #5

LOAD (lbs.)	HEAD TRAVEL READING	HEAD TRAVEL DIFF		
1000	0.500	0.000		Gage Length 14 13/16"
2000	0.515	0.015		
4000	0.563	0.063		
6000	0.594	0.094		
8000	0.617	0.117		
10000	0.637	0.137		
12000	0.653	0.153		
14000	0.668	0.168		
16000	0.683	0.183		
18000	0.696	0.196		
20000	0.710	0.210		
22000	0.722	0.222		
24000	0.732	0.232		
26000	0.745	0.245		
28000	0.756	0.256		
30,000	0.771	0.271		30,400 yield
30,000	0.871	0.371		load dropped 29,600
32000	1.074	0.574		
34000	1.163	0.663		
36000	1.262	0.762		
38,000	1.378	0.878		
38,000	0.600	0.878	Reset	
40,000	0.744	1.022		
42,000	0.816	1.194		
44,000	1.164	1.442		
46,000	1.482	1.760		
46,000	0.400		Reset	
47,000	0.642	2.002		Gge Length = 16 5/8"
48,000	0.959	2.319		
48,500	1.285	2.645		
49,000	1.559			
49,000	0.200	2.919	Reset	
49,900	1.632			
49,900	0.100	4.351	Reset	
50,000	0.460	4.711		Ultimate Load

Gage length = 19 1/2" after fracture

Failure in bar

D. Sterko 8/6/80
Roy Vealch 8/6/80
Parikh 8/6/80

Testing Machine: 300,000 lb. Capacity Baldwin Serial No. 39460

Test by: "Detailed Procedure for Test Programs to Evaluate Welds of Anchor Rods and Studs to Embedded Plates" Prepared by K. Parikh
Bechtel Power Corporation Revised 7-11-80

LEHIGH UNIVERSITY
BETHLEHEM, PENNSYLVANIA 18015

200.80.240.1

SHEET 8 OF 12

TENSION TEST

SPECIMEN T2

PLATE EP711 A7-155 Rod #5

Gage Length = 4"

LOAD (lbs.)	HEAD TRAVEL READING	HEAD TRAVEL DIFF	
1000	0.000	0.000	
2000		0.051	
~~3000~~			
4000		0.119	
~~5000~~			
6000		0.148	
~~7000~~			
8000		0.170	
~~9000~~			
10000		0.188	
12000		0.204	
14000		0.219	
16000		0.232	
18000		0.243	
20000		0.253	
22000		0.265	
24000		0.276	
26000		0.287	
28000		0.299	
30000		0.315	30,700 yield
32000		0.421	
34000		0.463	
36000		0.512	
38000		0.565	
40,000		0.625	
42,000		0.695	
44,000		0.781	
46,000		0.900	
47,000		0.972	
48,000		1.059	
49,000		1.185	
50,000		1.318	
50,100		1.490	Failure in weld

[signature] 8/6/80
Roy [signature] 8/6/80
[signature] 8/6/80

Testing Machine: 300,000 lb. Capacity Baldwin Serial No. 39460

Test by: "Detailed Procedure for Test Programs to Evaluate Welds at Anchor Rods and Studs to Embedded Plates" Prepared by K. Parikh
Bechtel Power Corporation Revised 7-11-80

TENSION TEST

SPECIMEN T3

PLATE EP511 A11-1 Rod #5

LEHIGH UNIVERSITY
BETHLEHEM, PENNSYLVANIA 18015
200.80.240.1
SHEET 9 OF 17

Gage Length $4\frac{3}{8}$"

LOAD (lbs.)	HEAD TRAVEL READING	HEAD TRAVEL DIFF	
1000		0.000	
2000		0.011	
4000		0.054	
6000		0.082	
8000		0.101	
10,000		0.117	
12000		0.131	
14000		0.143	
16000		0.154	
18000		0.165	
20,000		0.174	
22,000		0.184	
24000		0.194	
26000		0.205	
28000		0.216	
30000		0.241	Yield 30,100 lbs.
32000		0.351	
34000		0.402	
36000		0.456	
38000		0.575	
40000		0.586	
42000		0.670	
44000		0.776	
46000		0.920	
47000		1.030	
48000		1.155	
49000	Reset	1.328	
49500	0.000	1.500	
50,000	0.163	1.663	
50,500	0.430	1.930	
50,750	1.050	2.550	50,750 ultimate
	1.597	3.097	

Failure in bar

Dan [signature] 8/6/80
Roy Vreeland 8/6/80
K Parikh 8/6/80

Testing Machine: 300,000 lb. Capacity Baldwin Serial No. 39460

Test by: "Detailed Procedure for Test Programs to Evaluate Welds of Anchor Rods and Studs to Embedded Plates" Prepared by K. Parikh
Bechtel Power Corporation Revised 7-11-80

TENSION TEST

SPECIMEN T4

PLATE EP412 A16-18 Bot. Rod #12

Gage Length = 14 9/16"

LOAD (lbs.)	HEAD TRAVEL READING	HEAD TRAVEL DIFF	
1000	0.100	0.000	
2000	0.137	0.037	
4000	0.178	0.078	
6000	0.207	0.107	
8000	0.226	0.126	
10000	0.242	0.142	
12000	0.257	0.157	
14000	0.269	0.169	
16000	0.281	0.181	
18000	0.293	0.193	
20000	0.304	0.204	
22000	0.314	0.214	
24000	0.324	0.224	
26000	0.334	0.234	
28000	0.347	0.247	yield 0.319 → 0.29: 29,600 lbs.
30000	0.455	0.355	
32000	0.601	0.501	
34000	0.685	0.585	
36000	0.771	0.671	
38000	0.873	0.773	
40000	0.992	0.892	
42000	1.135	1.035	
44000	1.320	1.220	
46000	1.550	1.450	
47000	1.721	1.621	
48000	1.891	1.791	
49000	2.141	2.041	
50000	3.520	3.420	
51000	4.000	3.900	
51500	5.100	5.000	Ultimate load Failure in weld.

Don Sluka 8/6/80
Roy Veatch 8/6/80
K Parikh 8/6/80

Testing Machine: 300,000 lb. Capacity Baldwin Serial No. 39460

Test by: "Detailed Procedure for Test Programs to Evaluate Welds of Anchor Rods and Studs to Embedded Plates" Prepared by K. Parikh
Bechtel Power Corporation Revised 7-11-80

FRITZ ENGINEERING LABORATORY #13
LEHIGH UNIVERSITY
BETHLEHEM, PENNSYLVANIA 18015
200.80.240.1
SHEET 11 OF 12

TENSION TEST

SPECIMEN TS

PLATE EPA12 A16-18 Top Rod #10

Gage Length = $14\frac{7}{8}$"

LOAD (lbs.)	HEAD TRAVEL READING	HEAD TRAVEL DIFF	
1000	0.400	0.000	
2000	0.448	0.048	
4000	0.495	0.095	
6000	0.524	0.124	
8000	0.539	0.139	
10 000	0.555	0.155	
12000	0.571	0.171	
14000	0.583	0.183	
16000	0.595	0.195	
18000	0.606	0.206	
20000	0.617	0.217	
22 000	0.626	0.226	
24000	0.635	0.235	
26000	0.646	0.246	
28000	0.659	0.259	
30 000	0.679	0.279	yield = 30,000 lbs
32000	0.917	0.517	
34000	0.994	0.594	
36000	1.070	0.670	
38000	1.175	0.775	
40 000	1.282	0.882	
42000	1.419	1.019	
44000	1.591	1.191	
46000	1.842	1.442	
47000	1.987	1.587	
48000	2.174	1.774	
49000	2.437	2.037	
50,000	2.808	2.408	
51000	3.770	3.370	
51300	4.450	4.050	Ultimate load
Failure	5.075	4.675	Failure in Bar.

Don B. Stecko
Roy Uzalch
K Parikh 5/6/80

Testing Machine: 300,000 lb. Capacity Baldwin Serial No. 39460

Test by: " Detailed Procedure for Test Programs to Evaluate Welds of Anchor Rods and Studs to Embedded Plates" Prepared by K. Parikh Bechtel Power Corporation Revised 7-11-80

TENSION TEST
SPECIMEN T6
PLATE EP711 A7-223 Rod#6

LEHIGH UNIVERSITY
BETHLEHEM, PENNSYLVANIA 18015
200.80.240.1
SHEET 12 OF 12

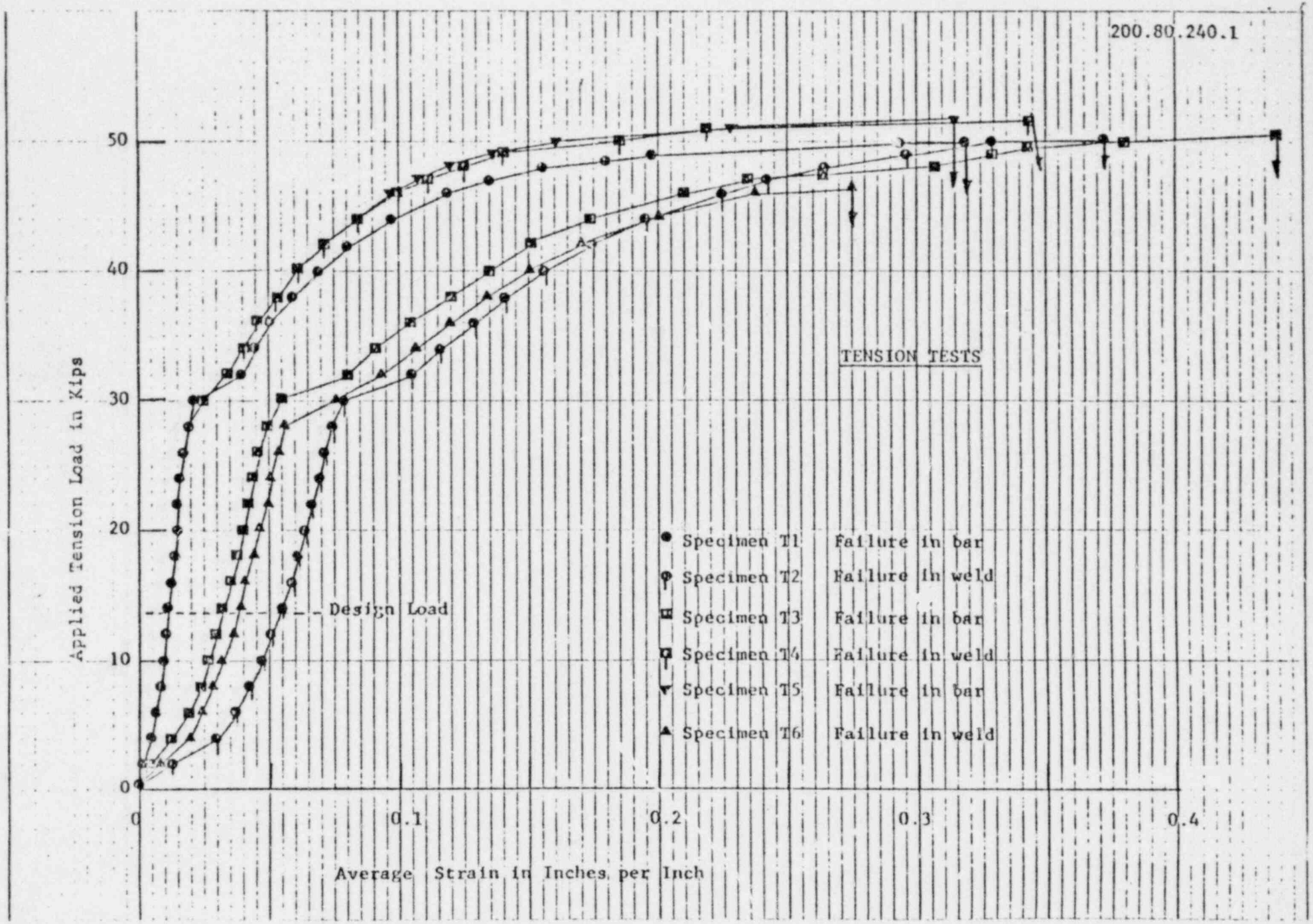
Gage Length = 4"

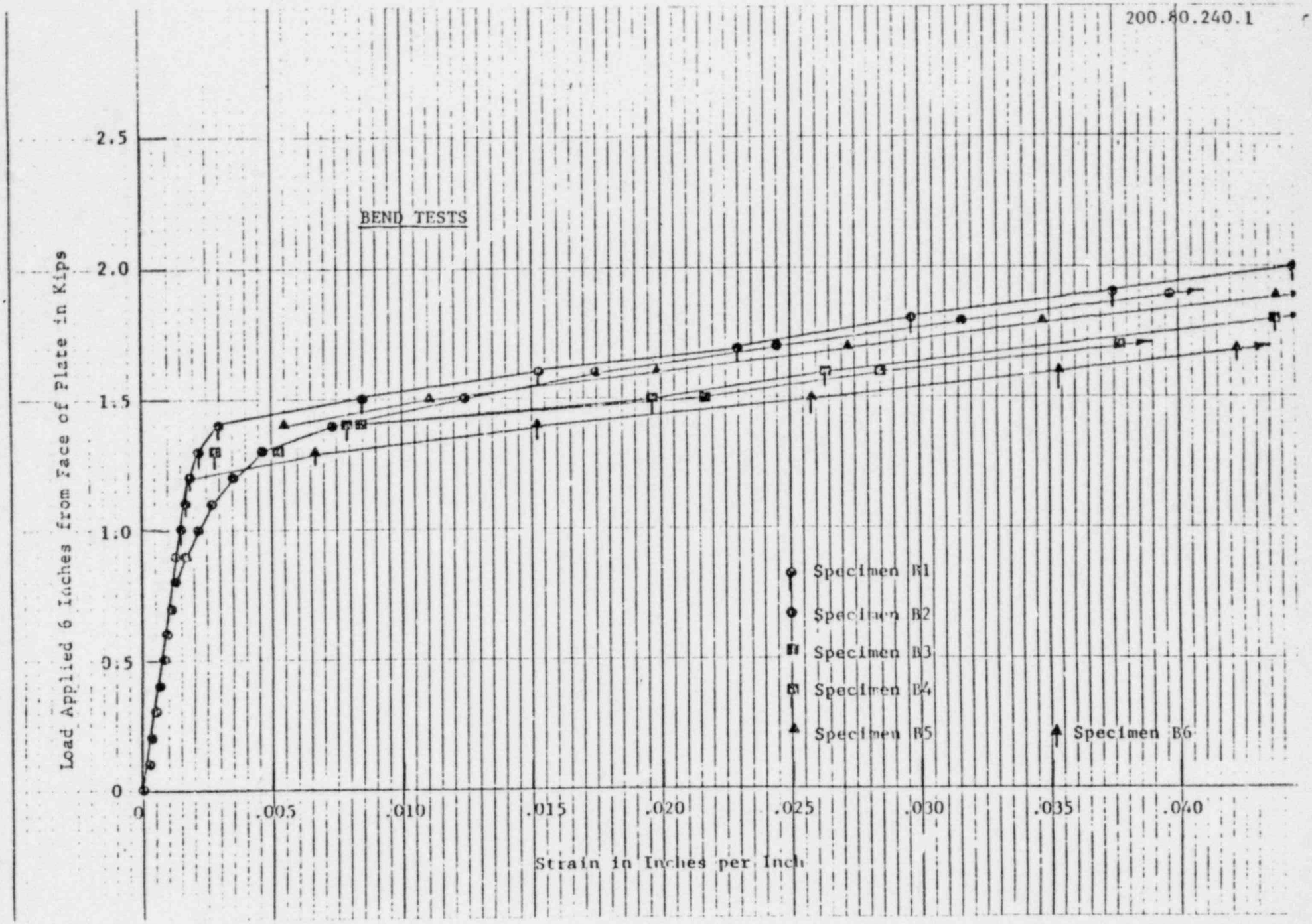
LOAD (lbs.)	HEAD TRAVEL READING	HEAD TRAVEL DIFF	
1000	0.4000	0.000	
2000	0.431	0.031	
4000	0.480	0.080*	
6000	0.496	0.096	
8000	0.512	0.112	
10000	0.528	0.128	
12000	0.542	0.142	
14000	0.554	0.154	
16000	0.566	0.166	
18000	0.578	0.178	
20000	0.588	0.188	
22000	0.598	0.198	
24000	0.607	0.207	
26000	0.617	0.217	
28000	0.626	0.226	Yield 29,700 @ 0.645
30000	0.727	0.327	
32,000	0.776	0.376	
34,000	0.823	0.423	
36,000	0.877	0.477	
38,000	0.936	0.536	
40,000	1.004	0.604	
42,000	1.088	0.688	
44,000	1.198	0.798	
46,000	1.351	0.951	
46,200	1.502	1.102	Failure in weld

Don Stauka 8/6/80
Roy Vieulet 8/6/80
Kparikh 8/6/80

Testing Machine: 300,000 lb. Capacity Baldwin Serial No. 39460

Test by: "Detailed Procedure for Test Programs to Evaluate Welds of Anchor Rods and Studs to Embedded Plates" Prepared by K. Parikh Bechtel Power Corporation Revised 7-11-80




200.80.240.1
BEND TESTS
Load Applied 6 Inches from Face of Plate in Kips
2.5
2.0
1.5
1.0
0.5
0
0
.005
.010
.015
.020
.025
.030
.035
.040
Strain in Inches per Inch
Specimen B1
Specimen B2
Specimen B3
Specimen B4
Specimen B5
Specimen B6