SSC L-SR-1133

GR74

PRESSUREMETER TESTING AND ANALYSIS FOR SUPERCONDUCTING SUPERCOLLIDER

Combined Report Prepared by

STS Consultants, Ltd.
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and

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for

Southwestern Laboratories
2575 Lonestar Drive
Dalls, TX 75212

April, 1990

April 16. 1990

Mr. Bruce Bailey
Southwestern Laboratories
2575 Lonestar Drive
Dallas. TX 75212

RE: Pressuremeter Testing and Analysis - Waxahachie Texas -- STS Project No. 26189

Dear Mr. Bailey:

This report summarizes the pressuremeter testing and analysis for the superconducting - supercollider to be located in Waxahachie. Texas. Twenty-two (22) pressuremeter tests were performed in two borings using two types of weak rock pressuremeters.

The results of all these tests are included in the Appendix of this report. The interpretation of the test results is included in the main body.

If there are any questions with regard to this report, or if we can be of further service in any way, feel free to contact us.

Respectfully,

STS CONSULTANTS LTD.

Robert G. Lukas, P.E.
Senior Principal Engineer

Norman H. Seiler
Instrumentation Engineer

RGL/nt

cc: Briaud Engineers
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PURPOSE AND SCOPE

Pressuremeter tests were performed in two (2) borings near Waxahachie, Texas for the purposes of determining some of the properties of the bedrock in which the super conducting supercollider tunnel will be constructed. The pressuremeter tests were performed during the time interval of December 14 to 30, 1989. Eleven pressuremeter tests were performed within the Taylor Marl, eight tests were performed within the Austin Chalk, and three tests within the Eagle Ford Shale. For each of these pressuremeter tests, the initial pressuremeter modulus and reload modulus were calculated. Where possible, the horizontal pressure at rest, the yield pressure, and the limit pressure were estimated.

GEOTECHNICAL TEAM

The geotechnical team that was assembled to conduct the pressuremeter tests consisted of three members; i.e., Southwestern Labs, STS Consultants, Ltd. and Professor Jean-Louis Briaud. The contribution of each of these members is described below.

1. Southwestern Labs provided two drill rigs, plus the associated crews and field geologists for coring and logging the bedrock and for preparing the boreholes for pressuremeter testing. Bruce Bailey of Southwestern Labs was the leader of the team, and directed the field operations.

   Two borings were completed at opposite sides of the proposed tunnel and these borings are labeled BE-2 and BF-6. The logs of these borings, along with the location diagram are included in Appendix A of this report. A detailed discussion of the drilling methods that were used to advance the boreholes is included in Appendix B.

2. STS Consultants, Ltd. conducted the pressuremeter tests (PMT) in the field. Mr. Norman Seiler of STS Consultants performed the tests and recorded the data. In addition, Mr. Seiler conducted all of the calibration tests at ground surface prior to insertion of the pressuremeter into the corehole for the actual performance of the tests within the bedrock. The pressuremeter data is included in Appendix C. Mr. Seiler's observations of the pressuremeter testing and borehole preparation procedures are included in Appendix B. Mr. Robert Lukas assisted Professor Briaud in the pressuremeter interpretation and prepared this final report.

3. Professor Jean-Louis Briaud was responsible for plotting of the test data gathered by STS Consultants. From this data, the pressuremeter modulus and reload modulus were calculated. Estimates were also made of the horizontal pressure at rest, the yield pressure and the limit pressure. All of the pressuremeter field data, plus the graphical plots of pressure versus diameter change are included Appendix C. Professor Briaud provided the pressuremeter interpretation and assisted in the report preparation.

PRESSUREMETER DESCRIPTIONS

Two pressuremeters were used at this site; an Elastmeter 100, manufactured by Oyo Corporation and the Probex 1, manufactured by Roctest, Inc. The control leads for the Oyo pressuremeter were only 300 feet long, which limited this unit to the testing at depths of 300 feet or less. The Probex 1 was available in longer control leads, and this unit was used to conduct three pressuremeter tests at depths on the order 300 to 360 feet below grade. A brief description of each of the pressuremeters follows.

Oyo Elastmeter 100 - This is a monocell pressuremeter, inflated pneumatically with radius measurement by two feeler arms at the center of the probe. The probe is 72 mm (2.83 in) in diameter and 700 mm (2.76 in) in length. This unit has lateral testing capabilities up to 200 tsf (2,778 psi). Diameter readings are taken to the nearest .01 mm. This pressuremeter was used for nineteen of the pressuremeter tests.

Probex 1 - This is a monocell pressuremeter, inflated hydraulically with volume measurements to indicate displacement. The probe is 74 mm (2.91 in) in diameter and 470 mm (18.5 in) in length. The limitation of this unit for lateral pressure testing is 300 tsf (4,167 psi). Three pressuremeter tests were performed with the Probex 1 unit.

All of the pressuremeter tests were pressure controlled tests. In general, the tests were performed with one unload-reload cycle to obtain a reloading modulus. At four pressuremeter test locations, the probe was deflated after the unload-reload cycle and then the probe rotated through various degrees of azimuth and another cycle was performed to detect if there was anisotropy in the rock.

DATA REDUCTION

The raw data obtained in the field was corrected for membrane resistance and system compressibility to obtain the final corrected pressuremeter curves. These curves are presented in the Appendix C as P versus $\Delta R/R_o$ curves where P is the pressure against the borehole wall, R_o is the radius of the deflated probe and ΔR is the increase in probe radius.

For each test, where possible, a first loading modulus E_o, a first reload modulus E_r, were calculated and the horizontal at-rest pressure, P_o, the yield pressure, P_y, and the limit pressures, p_L, were estimated. These terms are illustrated on a typical

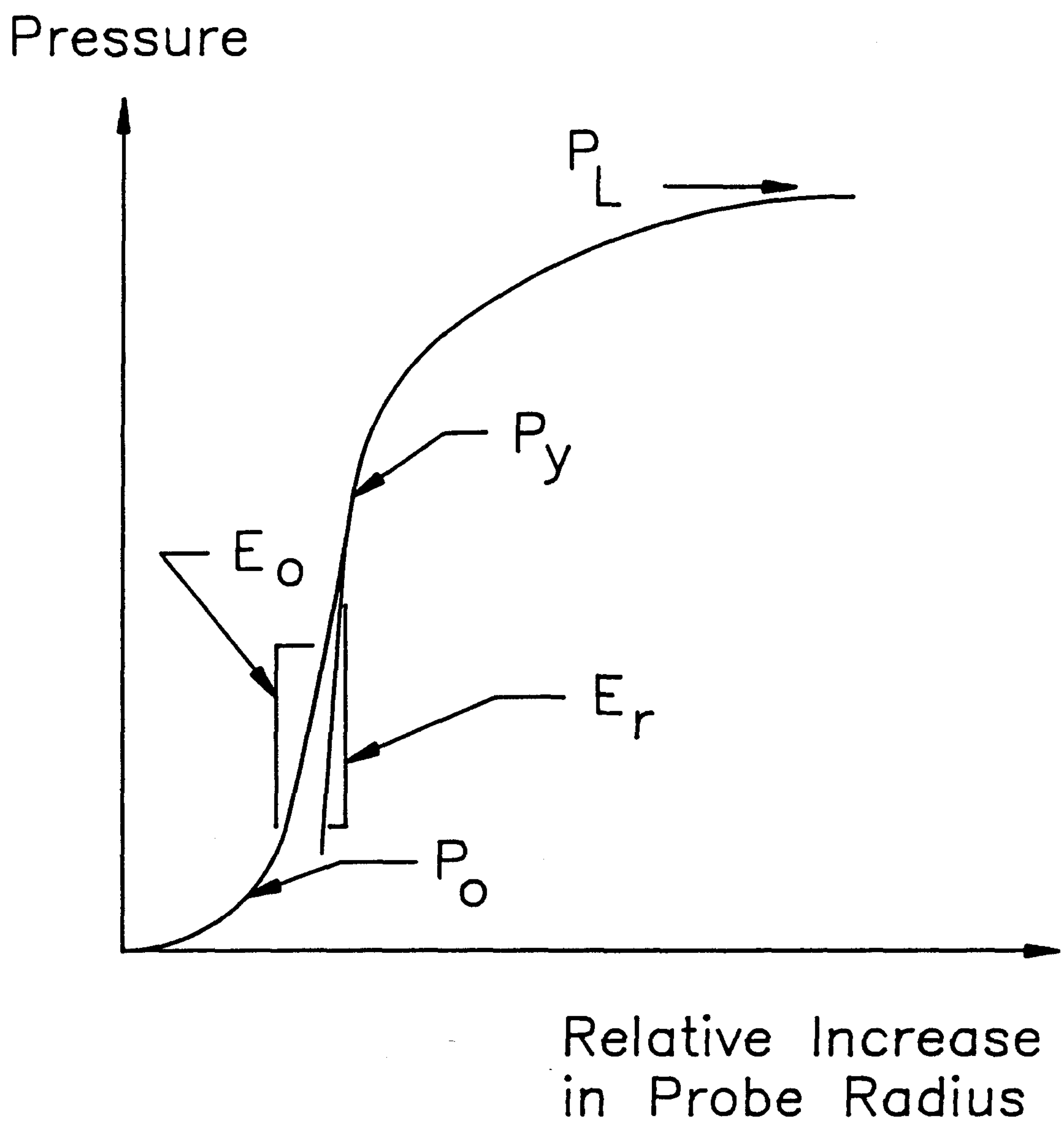


Figure 1. Typical Test and Parameter Definition

pressuremeter curve in Figure 1. The modulus was obtained from the straight part of the PMT curve upon loading and is actually a shear modulus, G. The modulus was then converted to an equivalent E value by assuming a Poisson's ratio of 0.33. Other values of Poisson's ratio could be used but unless site specific values are known, a value of 0.33 is customary for pressuremeter modulus conversion from G to E.

$$A = 1 + \frac{\Delta R_1}{R_o}^2 \qquad B = 1 + \frac{\Delta R_2}{R_o}^2$$

$$E = (1 + \nu)\,\Delta P \frac{A + B}{B - A}$$

where ν is Poisson's ratio, ΔP is the increase in pressure over the straight part of the PMT curve, ΔR_1 and ΔR_2 are the relative increase in probe radius corresponding to the beginning and ending points of this straight part, respectively. The at-rest horizontal stress, P_o, was estimated to be at the maximum curvature of the initial portion of the PMT curve. Some consider the at-rest horizontal stress to be as high as the beginning of the straight line portion of the PMT curve. The actual value may lie somewhere in between. The yield pressure, P_y, is the pressure at which the creep begins to increase, and corresponds to the end of the straight line portion of the PMT curve. The limit pressure, P_L, is defined as the pressures corresponding to the point on the PMT curve where the initial volume of the cavity is doubled.

PRESSUREMETER TEST RESULTS

The pressuremeter test results are summarized in Table 1. The initial in-place horizontal stress P_o, is shown, but should be used with caution. The method of estimating P_o by inspection of the pressuremeter curve is prone to considerable error. At the present time, there is no accepted method for determining P_o from the shape of the pressuremeter curve.

Both the limit pressure, P_L, and the yield pressure, P_y are shown in Table 1. Unfortunately, both the Austin Chalk and Taylor Marl deposits were so stiff that the limitations of the pressuremeter equipment were reached before the limit pressure was obtained. Even the creep pressure had not yet been reached in the Austin Chalk before the limitation of the pressuremeter testing equipment was reached. Thus, it is not possible to compare the various formations on the basis of either the limit pressure or the creep pressure.

Perhaps, the most reliable measurement of the three rock formations that could be used for comparison purposes is the initial loading modulus. All of the pressuremeter tests were able to be extended upward into the elastic range of deformation within the rock from which the initial modulus values could be obtained. The reload modulus could also be used for comparison, but because of the high value of reload modulus, some of the values given are at the limit of the pressuremeter measurements. The variation in initial and reload modulus values with depth is shown in Figures 2 and 3.

Based upon a comparison of the initial modulus values, certain conclusions regarding the properties of these three rock formations can be reached.

1. The stiffest deposit at the site is the Austin Chalk and the weakest deposit at the site is the Eagle Ford Shale. The Taylor Marl is intermediate in stiffness between these two. The average initial modulus for the Austin Chalk, Taylor Marl and Eagle Ford Shale is 950 ksi, 474 ksi, and 153 ksi, respectively. In calculating the average initial modulus within the marl, the tests above a depth of 90 feet were excluded for reasons outlined in item 2 below. On a relative

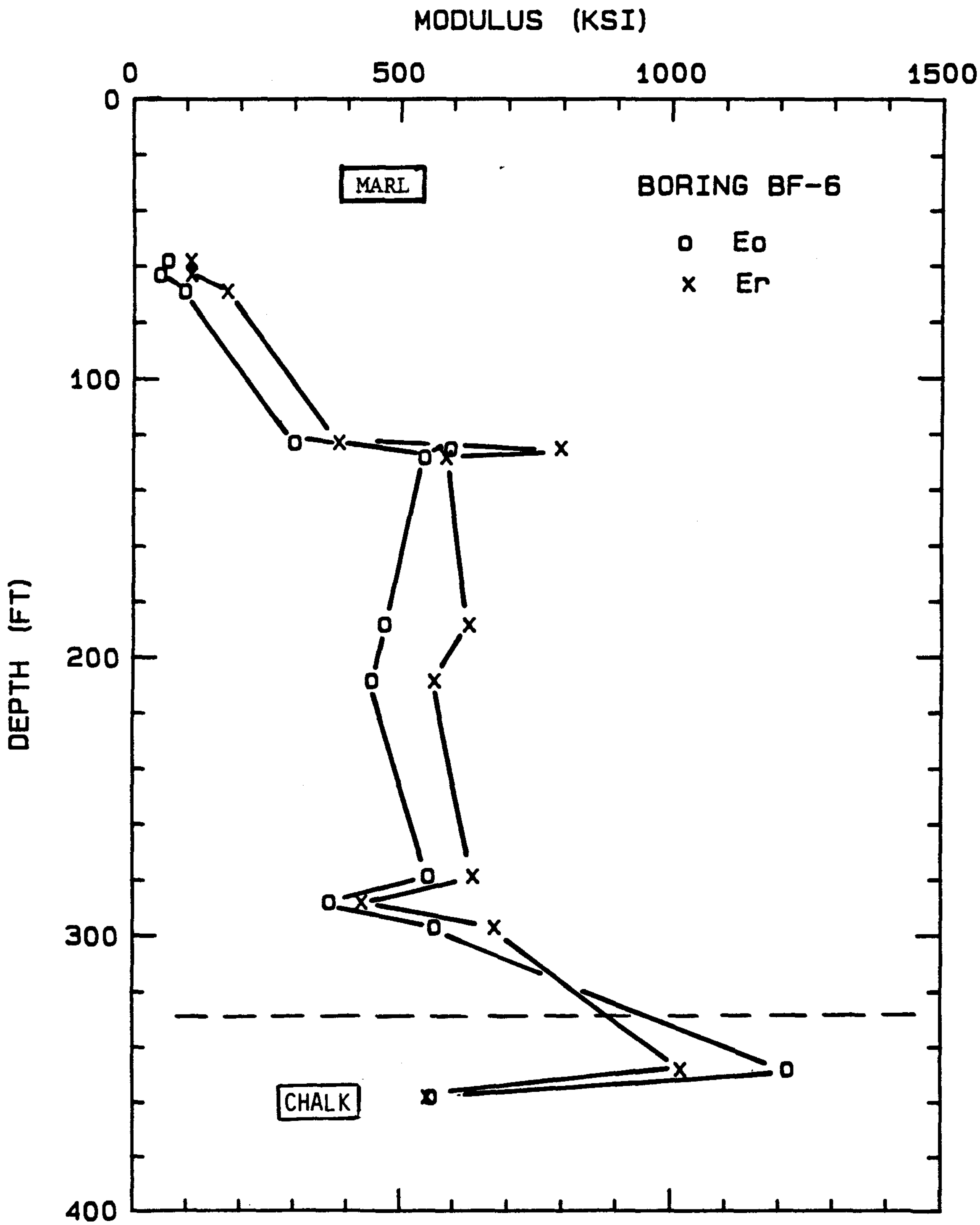


Figure 2. Modulus Profile - Boring BF-6

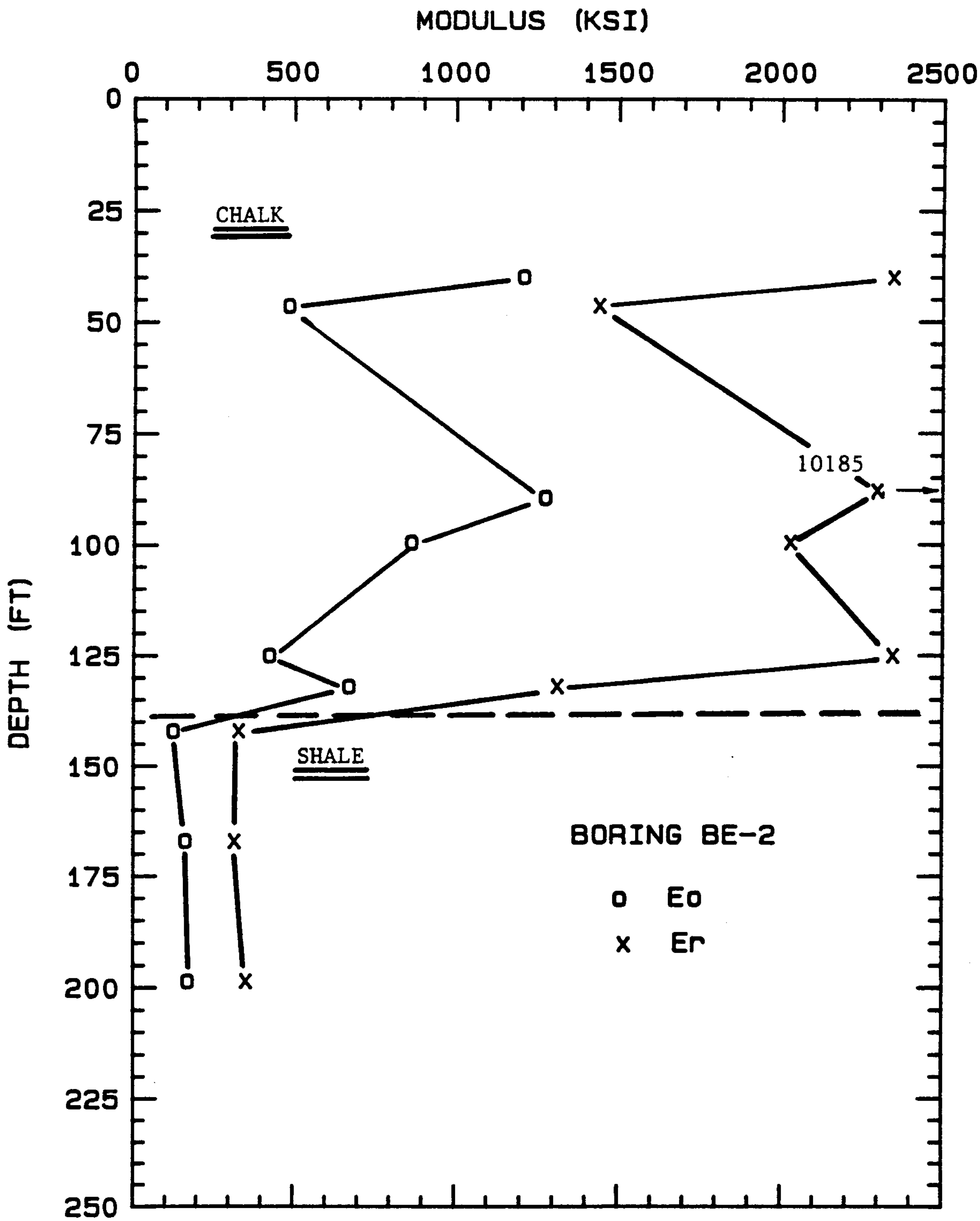


Figure 3. Modulus Profile - Boring BE-2

TABLE 1. PRESSUREMETER TEST RESULTS

Boring	Depth (ft)	P_o (psi)	P_y (psi)	P_L (psi)	E_o * (ksi)	E_r (ksi)	PMT Type	Rock Type
BF-6	58	55	800	1350	65	108	OYO	Marl
	63	50	250	1250	50	109	"	"
	69	30	800	1450	96	175	"	"
	123	20	1000	>2100	301	384	"	"
	125.5	35	1000	>2300	595	796	"	"
	128.5	50	1000	>1900	(546)0 (425)90	587	"	"
	188.5	50	1000	>2300	470	629	"	"
	208.5	60	1600	>2300	446	565	"	"
	278.5	40	1300	>2400	553	636	"	"
	288	-	1500	>3000	365	428	Probex	"
	297	40	1600	>2500	564	675	OYO	"
	348	-	3500	>4500	1217	1019	Probex	Chalk
	358	-	2500	>4000	559	552	Probex	"
BE-2	40	50	> 1150	>1150	(1207)280 (1207)340 (1207)40 (1785)280	2347	OYO	Chalk
	46.5	50	> 1350	>1350	482	1439	"	"
	89.5	15	> 1950	>1950	(1275)280 (1939)340 (1937)40 (1939)280	10185	"	"
	99.5	30	> 2300	>2300	864	2027	"	"
	125	65	> 1950	>1950	(425)280 (375)340 (451)40 (388)280	2345	"	"
	132	30	> 2250	>2250	672	1312	"	"
	142	80	800	1350	126	328	"	Shale
	167	100	1200	>1950	163	316	"	"
	198.5	140	800	1950	171	353	"	"

* For tests where the probe was deflated and rotated, the number in parentheses is the modulus, the number after the parentheses is the azimuth of the direction of the PMT feeler arms.

? This value is outside the accuracy of this instrument and is therefore questionable.

scale, the marl is 3.1 times stiffer than the shale, and the chalk is 6.2 times stiffer than the shale.

2. Below a depth of about 90 feet, the initial modulus within the marl ranges from 300 to 595 ksi with an average of 474 ksi. Above a depth of 90 feet, the initial modulus within the marl is only on the order of 65 to 96 ksi, and this is attributed to weathering or unloading of this deposit over a period of time, thereby reducing its stiffness. Within each zone (above 70 feet and below 100 feet), the modulus values are grouped within narrow bands indicating consistent pressuremeter test results, thereby ruling out testing errors.

3. At the four locations where pressuremeter tests were performed at varying degrees of azimuth, similar initial modulus values were obtained and this would be indicative of a relatively homogeneous property in different horizontal directions.

CORRELATIONS WITH PUBLISHED DATA

Articles pertaining to pressuremeter testing in weak rocks were reviewed to see what pressuremeter parameters were obtained in similar types of formations. In addition, some of the published articles contained correlations between modulus values obtained by the pressuremeter plate load tests, and laboratory tests.

Table 2 summarizes some of the published information pertaining to modulus values. The black shale from Reference 1 was found to have an initial modulus of 10 to 125 ksi, with an average of 52 ksi. This is significantly less than the modulus determined for the Eagle Ford Shale, which ranged from 125 to 170 ksi with an average of 153 ksi. The testing on the black shale was performed in 1970 using a conventional soil pressuremeter which has limitations on the lateral stresses that can be transmitted to the ground. so it is possible that the pressuremeter tests on the Black Shale are not truly representative.

Table 2

Pressuremeter Tests in Weak Rock

Rock	Water Content		Initial Modulus ksi		Reload Modulus ksi		
Type	Range	Avg.	Range	Avg.	Range	Avg.	Source
Black Shale	9.5-12.0	10.5	10-125	52	--	--	1
Keuper Marl	12-20	--	29-73	61	44-174	90	2
Mudstone	5-15	--	58-217	145	102-544	303	3
Clay Shale	13-20	19	60-237	132			4

Reference:

1. Compressibility Characteristics of Shales Measured by Laboratory and In-situ Tests - A.J. Hendron, Jr., G. Mesri, J.C. Gamble and G. Way, ASTM STP477, 1970

2. Pressuremeter Testing, Methods and Interpretation - R.J. Mair and D.M. Wood. Butterworths. 1987, Chapter 5

3. The Triassic Rocks with Particular Reference to Predicted and Observed Performance of Some Major Foundations, A.C. Meigh, Geotechnique 26, No. 3, p 391-452. 1976.

4. Predicted and Measured Performance of a Foundation - J.L. Briaud. C.F. Roba. W.T. Johnson, R. Halverson, Drilled Piers and Caissons II, ASCE, p 43-56. 1985.

Pressuremeter tests within the Keuper Marl indicate an initial modulus ranging from 29 to 73 ksi, with an average of 61 ksi. These tests correlate very well with the pressuremeter tests within the upper 100 feet from ground surface at the SSC site on the Taylor Marl, where the initial pressuremeter modulus ranged from 50 to 96 ksi, with an average of 70 ksi. However, the lower Taylor Marl had a significantly higher initial tangent modulus indicating a less degree of weathering.

Tests on the Mudstone from Reference 3 indicates an initial tangent modulus range of 58 to 217 ksi, with an average of 145 ksi. The mudstones are described in Reference 3 as a Marl that is only slightly calcareous. Thus, comparison of this deposit could be made with the Taylor Marl at the SSC site. It appears that the Mudstone has an initial tangent modulus somewhere between the weathered and the unweathered Taylor Marl.

Meigh(3) compared elastic moduli obtained from pressuremeter tests, plate loading tests, laboratory triaxial and consolidation tests for the Keuper Marl. Figures 77 and 78 shown on the attached sheet are from this reference and indicate the variation in the modulus with the method of testing. In both of these figures, the pressuremeter modulus is typically higher than the modulus measured from either the triaxial or the plate loading test. This trend was also observed by Meigh(3) for tests performed on other weak rock such as the siltstones and mudstones. Other authors have found a similar result with the pressuremeter moduli being greater than the moduli determined from plate loading tests or other laboratory tests. The lower moduli from the laboratory tests is attributed to sample disturbance. There appears to be a closer correlation between the moduli from plate loading tests and from pressuremeter tests.

The results from reference 4 obtained in shale at San Antonio closely match the data for the Eagle Ford Shale at the SSC site. In the San Antonio project, 80 feet deep drilled shafts with 13 feet diameter bells were supporting 2,000 ton column loads. No measurable settlement was recorded.

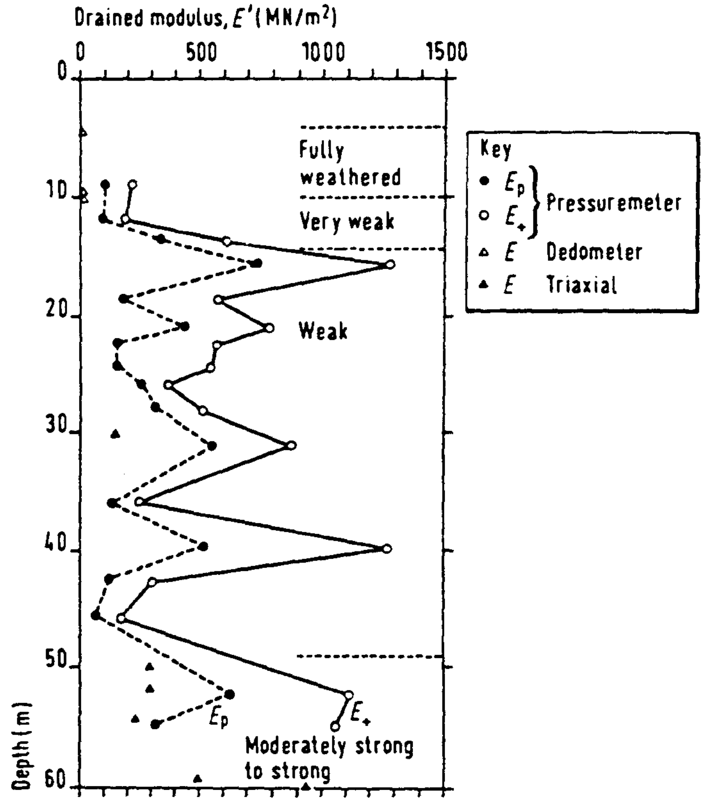


Figure 77 Elastic moduli determined from pressuremeter, laboratory triaxial and oedometer tests on Keuper Marl (from Meigh, 1976)

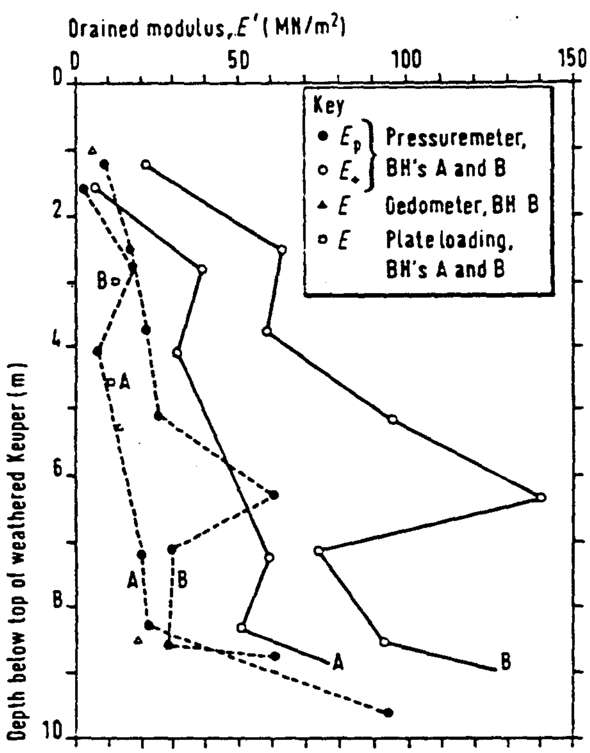


Figure 78 Elastic moduli determined from pressuremeter, plate-loading, and oedometer tests on weathered Keuper Marl (from Meigh, 1976)

On the basis of the comparison of the tests at the SSC site with the published literature, it is concluded that the pressuremeter modulus values are similar, although higher at the SSC site. This may be due to less weathering of the rock at the SSC site, because the tests were performed at relatively great depths below grade, and the use of rock pressuremeter testing equipment which can test the rock to higher lateral stresses.

SIGNIFICANCE OF TEST RESULTS

- The most significant test value obtained from the pressuremeter testing is considered to be the initial and reload modulus. These modulus values can be used to predict deformations within the rock mass from either tunneling operations, excavations, or from loading, such as with new foundations. For the tunnel and excavations, it will probably be necessary to use a finite element program incorporating the modulus values in order to predict deformations.

- Another value of the pressuremeter testing was to show the relative stiffness of the various rock deposits. Using the the stiffness of the Eagle Ford Shale as a value of 1, the stiffness of the Taylor Marl is 3.1 times greater than the Shale, and the stiffness of the Austin Chalk is 6.2 times stiffer than the Shale. Thus, to limit deformations during tunneling or from loading, the most favorable deposits at this site would be the Austin Chalk and the Taylor Marl. The least favorable would be the Eagle Ford Shale.

- The limited amount of pressuremeter testing at various degrees of azimuth indicates that the rock formations are relatively homogeneous in a horizontal direction, although more testing along these lines is warranted.

- In-situ horizontal stresses were predicted from the pressuremeter, but the accepted procedure for interpretation of the horizontal stress from pressuremeter testing is still lacking, so these values should be used with caution.

- The yield pressures obtained from the pressuremeter tests indicate the stress level above which creep of the rock becomes a serious problem.

- The compressive strength of the rock can be estimated by a correlation to the limit pressure. Also, the residual undrained shear strength can be calculated from the large strain portion of the pressuremeter curve. These values may be useful in slope stability calculations.

RECOMMENDATIONS FOR FUTURE TESTING

The pressuremeter testing that has been done to date has been undertaken in only two boreholes. Some variation in test parameters will probably be experienced in other portions of the site, and additional pressuremeter testing is recommended. It is our understanding that an instrumented test shaft will be installed in the near future to provide additional property information regarding the various rock formations. As part of this test shaft installation, it is recommended that additional pressuremeter tests be performed. These tests could include:

- Pressuremeter tests prior to shaft construction within the various rock formations through which the instrumented shaft will be installed, with tests being performed at various degrees of azimuth to obtain more information regarding the horizontal anisotropy. The pressuremeter tests should focus on the determination of the rock properties, including creep properties, at the pressure levels anticipated during construction and the duration of the SSC structural elements. These tests should model construction sequence and the associated stress path.

- Within the test shaft, a horizontal hole could be bored for a distance of 4 to 5 feet beyond the extent of the shaft from which a horizontal pressuremeter test can be performed to compare with vertical pressuremeter tests to determine what variation in moduli there might be from horizontal to vertical positioning of the pressuremeter.

- Tests should be performed at the bottom of the test shaft to be compared with tests prior to excavation to document the change in pressuremeter parameters due to overburden removal.

- Pressuremeter tests can be performed within each rock formation for an extended period of time while holding the pressure constant to see if there is any creep in the rock during this time interval. These tests could be done during loading or unloading to obtain the unloading creep response of the rock. This would be especially important for the Eagle Ford Shale.

- Both the Oyo Elastmeter and the Roctest Probex 1 worked well at the site and are recommended for future use. The stress range imposed on the rock mass by new construction, including unloading or loading, are anticipated to be well below the highest stress imposed by the Elastmeter and Probex 1.

- Within the stiffer formations such as the Austin Chalk, high capacity rock pressure tests could be performed. There is a device called the Goodman Jack which exerts horizontal pressures up to 9,000 psi, or approximately 3 times higher than the upper limit of the Oyo 100 Elastmeter. By having a higher lateral stress capability, the pressuremeter curve can be extended much further and perhaps even to the limit pressure in these stiffer formations.

GENERAL QUALIFICATIONS

The pressuremeter testing that was undertaken as part of this study is limited in extent and should be considered appropriate only for the locations at which the tests were made. Additional testing has been suggested and we would welcome the opportunity to perform this additional testing for you if so desired.

The pressuremeter test parameters have been calculated in accordance with Standard Pressuremeter Procedures as outlined by ASTM Standard D-4719. The prediction of movements or performance of various facets of the SSC project are beyond the scope of this report. We welcome the opportunity to use the pressuremeter data in conjunction with a finite element program to predict movements if provided with information on construction sequence and loading.

APPENDIX A

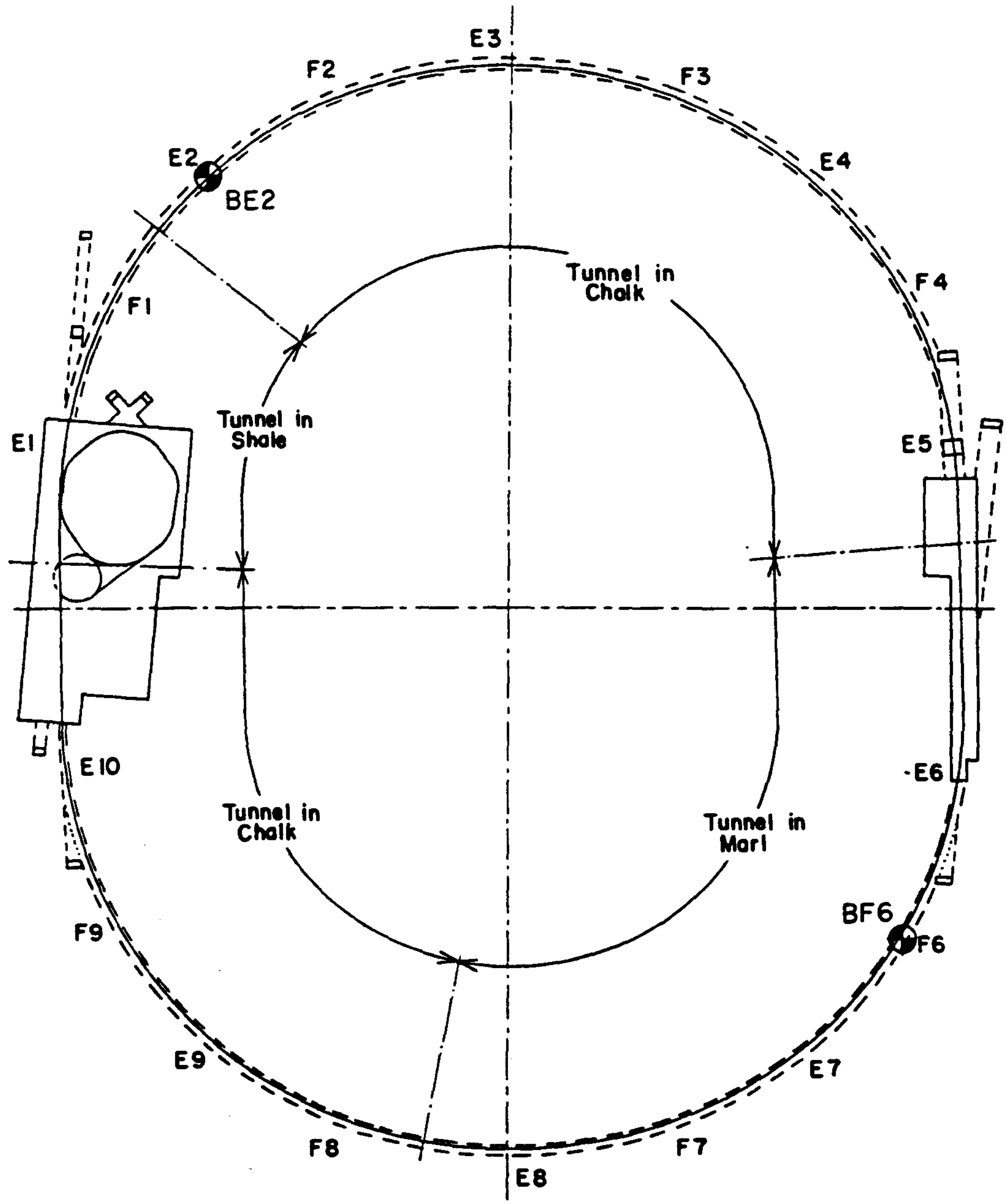


FIGURE A1

BORING LOCATION PLAN

LOG OF BORING

BORING NO: BE 2 PG 1 OF 6

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 17

LOCATION: N 281,050 feet E 2,175,700 feet

GROUND EL: 674.0 feet

DATE: 12-13/12-21-90 TYPE: NX Core CASED TO: 30.0' CONTRACTOR: SwL (89-192)

SAMPLE LEGEND: S= SPLIT SPOON; T= 2" THIN WALL TUBE; U= 3" THIN WALL TUBE; C= NX ROCK CORE

WATER INFORMATION: Begin using air rotary at ground surface. Seepage encountered at 134.0'. Begin using water at 150.0'.

SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT ROD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
							CLAY silty, traces of roots, organic debris and weathered limestone fragments, dark brown (0.5)
C-1		2.0 / 11.0	88	31			LIMESTONE (Austin Chalk) soft, severely weathered, moderately fractured, tan (9.7)
C-2	11.0	21.0	97	84			LIMESTONE (Austin Chalk) soft to medium, fresh, sound, light gray with occasional tan weathered seams and trace fossils. -tan weathered seams at 12.5', 14.1', 15.5' and 20.9' (21.0)
C-3	21.0	30.0	94	94			LIMESTONE (Austin Chalk) medium, fresh, sound, light gray with occasional argillaceous layers, soft shale seams and fossil partings. -60° rough, open, calcite filled (5/8"), fracture at 30.4'
C-4	30.0	40.0	94	88			-shale layer, soft, dark gray, sharp contact at 32.4' to gradational contact at 32.6' -soft shale seam (¼"), dark gray at 34.4' -slightly argillaceous layer, medium gray, gradational contacts at 35.0'-36.3' -fossil parting at 38.5'
	40.0						

DRILLING GEOLOGIST Mike Granger ASSISTANT Jim Lu CHECKED BY Clem Bommarito

Shawn Wood
(3-7-90)

LOG OF BORING

PROJECT: Superconducting_Supercollider
CLIENT: The Earth Technology Corporation
TASK NO.: 17

BORING NO: BE 2 PG 2 OF 6
LOCATION: N 281,056 feet E 2,175,700 feet
GROUND EL: 674.0 feet

DATE: 12-13/12-21-90 TYPE: NX Core CASED TO: 30.0' CONTRACTOR: SwL

SAMPLE LEGEND
S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION

See p. 1. of 6

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.
45		C-5	40.0	50.0	100	96		
50, 55		C-6	50.0	60.0	100	97		
60, 65		C-7	60.0	70.0	94	90		
70, 75		C-8	70.0	80.0	97	96		
80			80.0					

DESCRIPTION OF STRATUM

LIMESTONE (Austin Chalk) medium, fresh, sound, light gray with occasional slightly argillaceous layers, soft shale seams, bentonite layers, fossil partings, and trace pyrite

- -slightly argillaceous layer, medium gray, gradational contact at 41.6' to sharp contact at 42.5'
- -slightly argillaceous layer, medium gray gradational contacts at 43.4'-44.8'
- -slightly argillaceous layer, medium gray, gradational contacts at 46.1'-46.8'
- -slightly argillaceous layer, medium gray gradational contacts at 47.6'-49.9'
- -slightly argillaceous layer, medium gray, gradational contacts at 51.5'-52.7'
- -slightly argillaceous layer, medium gray gradational contact at 53.6' to sharp contact at 55.2'
- -slightly argillaceous layer, medium gray, gradational contacts at 56.8'-57.6'
- -slightly argillaceous layer, medium gray, gradational contacts at 59.3'-60.0'
- -fossil parting at 56.6'
- -bentonite layer, bluish gray, sharp contacts at 60.8'-61.0'
- -fossil partings at 62.9' and 63.5'
- -slightly argillaceous layer, medium gray, gradational contacts at 68.6'-69.2'
- -fossil partings at 71.3' and 74.2'
- -shale seam (½") soft, dark gray with trace pyrite at 77.2'

DRILLING GEOLOGIST Mike Granger ASSISTANT Jim Lu CHECKED BY Clem Bommarito

Shawn Wood
(3-7-90)

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 17

BORING NO: BE 2 PG 3 OF 6

LOCATION: N 281,050 feet
E 2,175,700 feet

GROUND EL: 674.0 feet

DATE: 12/13-21/90 TYPE: NX Core CASED TO: 30.0' CONTRACTOR: SwL -(89-192)

SAMPLE LEGEND: S= SPLIT SPOON; T= 2" THIN WALL TUBE; U= 3" THIN WALL TUBE; C= NX ROCK CORE

WATER INFORMATION: See p. 1 of 6

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
		C-9	80.0	90.0	91	91			LIMESTONE (Austin Chalk) medium, fresh, sound, light gray with occasional argillaceous layers and fossil partings.
85									
90		C-10	90.0	100.0	100	95			
95									-moderately argillaceous layer, medium gray, at 98.2'-99.1'
100		C-11	100.0	110.0	99	96			12-15-90 / 12-16-90 -moderately argillaceous layer, medium gray, gradational contact at 103.1' to sharp contact at 103.5' -very argillaceous layer, dark gray, sharp contact at 105.5' to gradational contact at 105.7' -slightly argillaceous layer, medium gray, gradational contacts at 108.2'-109.9'
105									
110		C-12	110.0	120.0	100	95			-80° open, rough, calcite filled (1"), fracture at 110.5' -moderately argillaceous layer, medium gray, gradational contacts at 112.6'-113.3' -fossil parting at 114.6'
115									-moderately argillaceous layer, medium gray, sharp contact at 117.5' to gradational contact at 118.3'
120			120.0						

DRILLING GEOLOGIST Mike Granger ASSISTANT Jim Lu CHECKED BY Clem Bommarito

Shawn Wood
3-7-90

LOG OF BORING

PROJECT: Superconducting Supercollider
CLIENT: The Earth Technology Corporation
TASK NO.: 17

BORING NO: BE 2 PG 4 OF 6
LOCATION: N 281,050 feet E 2,175,700 feet
GROUND EL: 674.0 feet

DATE: 12-13/12-21-90 TYPE: NX Core CASED TO: 30.0' CONTRACTOR: SwL

SAMPLE LEGEND: S= SPLIT SPOON; T= 2" THIN WALL TUBE; U= 3" THIN WALL TUBE; C= NX ROCK CORE

WATER INFORMATION: See p. 1 of 6

DEPTH IN FEET	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
125	C-13		120.0 / 130.0	84	84			LIMESTONE (Austin Chalk) medium, fresh, sound, light gray with occasional argillaceous layers and trace pyrite -trace pyrite at 124.2' and 124.6' -slightly argillaceous layer, medium gray, gradational contacts at 125.3'-127.0'
130	C-14	130.0	136.0	70	70			131.4 -gradational contact- SHALEY LIMESTONE (Transition) medium, fresh, sound, extremely argillaceous, dark gray with abundant fragments of fish bones, teeth and other fossil debris 132.1 -sharp contact-
140	C-15	136.0	143.0	0	0			SHALE (Eagle Ford) soft, fresh, sound, fissile, dark gray with occasional septarian concretions and trace pyrite
145	C-16	143.0	150.0	49	49			
150–160	C-17	150.0	160.0	100	97			-15° smooth, open, fracture with trace pyrite at 152.9' -septarian concretions (¼") at 153.1 and 153.6' -septarian concretion (½") at 156.8' -trace pyrite at 158.0'
		160.0						

DRILLING GEOLOGIST Mike Granger ASSISTANT Jim Lu CHECKED BY Clem Bommarito

Shawn Wood
3-7-90

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 17

LOCATION: N 281,050 feet E 2,175,700 feet

GROUND EL: 674.0 feet

DATE: 12-13/ ~~12-21-90~~ TYPE: NX Core CASED TO: 30.0' CONTRACTOR: SwL (89-192)

SAMPLE LEGEND: S= SPLIT SPOON; T= 2" THIN WALL TUBE; U= 3" THIN WALL TUBE; C= NX ROCK CORE

WATER INFORMATION: See p. 1 of 6

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
160–170		C-18	160.0	170.0	20	20			SHALE (Eagle Ford) soft, fresh, sound, fissile, dark gray with occasional limestone and shaley limestone layers, calcite veins, septarian concretions, fossil partings, and traces of pyrite; -pyrite nodules (¼"-1") from 170.3'-171.0'
170–180		C-19	170.0	180.0	100	100			-fossil partings at 172.0', 173.2' and 175.0'; -trace pyrite at 177.1'
180–190		C-20	180.0	190.0	100	98			-septarian concretions at 180.6'-182.6'; -limestone layer (5"), with numerous (¼"-1") radial calcite veins and trace pyrite, sharp contact at 185.2'-185.7'; -pyrite nodules (½") at 185.9'
190–200		C-21	190.0	200.0	59	59			-shaley limestone, light gray, sharp contacts at 194.3'-195.2'; -fossil parting at 194.9'
200–			200.0						

DRILLING GEOLOGIST Mike Granger ASSISTANT Jim Lu CHECKED BY Clem Bommarito

Shawn Wood
3-7-90

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 17

BORING NO: BE 2 PG 6 OF 6

LOCATION: N 281,050 feet E 2,175,700 feet

GROUND EL: 674.0 feet

DATE: 12-13/12-21-90 TYPE: NX Core CASED TO: 30.0' CONTRACTOR: SwL (89-192)

SAMPLE LEGEND: S= SPLIT SPOON; T= 2" THIN WALL TUBE; U= 3" THIN WALL TUBE; C= NX ROCK CORE

WATER INFORMATION: See p. 1 of 6

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
200–210		C-22	200.0	210.0	85	85			SHALE (Eagle Ford) soft, fresh, sound, fissile, dark gray with occasional fossil partings -fossil parting at 208.0'
210–211		C-23	210.0	211.0	92	92			
211–242									Bottom of exploration at 211.0'

DRILLING GEOLOGIST Mike Granger ASSISTANT Jim Lu CHECKED BY Clem Bommarito

Shawn Wood
3-7-90

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 17

BORING NO: BF-6 PG 1 OF 10

LOCATION: N 238,075 feet
E 2,255,063 feet

GROUND EL: 456.3 feet

DATE: 12-11-89/1-2-90 TYPE: Nx/NxB Core CASED TO: 40.0' CONTRACTOR: SwL (89-192)

SAMPLE LEGEND

S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION

Begin drilling with water from ground surface. Unable to determine parameters of subsurface water table.

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
0–3.0									CLAY, sandy, traces of rounded gravel fragments, roots, tan and brown
3.0–7.0									CLAY, silty with embedded medium to coarse gravel, traces of sand, brown to dark brown
7.0–35.0									CLAY, shaly, jointed, mottled, tan and gray
35.0–									CALCAREOUS SHALE (Taylor Marl) soft, fresh, fissile, slightly calcareous, dark gray with occasional thin carbonate seams
		C1	38.0	40.0	100	100			
			40.0						

DRILLING GEOLOGIST Shawn Wood ASSISTANT Dale Brown CHECKED BY Clem Bommarito
Shawn Wood

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 17

BORING NO: BF-6 PG 2 OF 10

LOCATION: N 238,075 feet
E 2,255,063 feet

GROUND EL: 456.3 feet

DATE: 12-11-89/1-02-90 TYPE: Nx/NxB Core CASED TO: 40.0 CONTRACTOR: SwL (89-192)

SAMPLE LEGEND
S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION
See page 1 of 10

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
45		C2	40.0	50.0	89	89			CALCAREOUS SHALE (Taylor Marl) soft, fresh, fissile, slightly calcareous, dark gray with occasional thin carbonate seams and fossil partings
50, 55, 60		C3	50.0	60.0	98	98			-fossil parting at 59.6'
		C4	60.0	64.0	75	75			
65, 70		C5	64.0	70.0	79	79			
75, 80		C6	70.0	80.0	75	75			-very calcareous shale, light gray from 72.6'-77.5' -fossil parting at 74.6'
			80.0						

DRILLING GEOLOGIST Shawn Wood ASSISTANT Dale Brown CHECKED BY Clem Bommarito

Shawn Wood

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 17

BORING NO: BF-6 PG 3 OF 10

LOCATION: N 238,075 feet
E 2,255,063 feet

GROUND EL: 456.3 feet

DATE: 12-11-89/ 1-02-90 TYPE: Nx/NxB Core CASED TO: 40.0' CONTRACTOR: SwL (89-192)

SAMPLE LEGEND
S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION
See page 1 of 10

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
80–90		C7	80.0	90.0	92	92			CALCAREOUS SHALE (Taylor Marl) soft, fresh, fissile, slightly calcareous, dark gray with occasional thin carbonate seams and fossil partings -fossil parting at 86.9'
90–100		C8	90.0	100.0	93	93			-fossil partings at 92.1' and 93.0'
100–108		C9	100.0	108.0	91	91			-fossil parting at 107.9'
108–110		C10	108.0	110.0	75	75			
110–120		C11	110.0	120.0	97	97			-fossil partings at 114.4', 115.3', 116.8' and 119.4'
120–			120.0						

DRILLING GEOLOGIST Shawn Wood ASSISTANT Dale Brown CHECKED BY Clem Bommarito
Shawn Wood

LOG OF BORING

PROJECT: Superconducting Supercollider	BORING NO: BF-6 PG 4 OF 10
CLIENT: The Earth Technology Corporation	LOCATION: N 238,075 feet E 2,255,063 feet
TASK NO.: 17	GROUND EL: 456.3 feet

DATE: 12-11-89/ 1-02-90 TYPE: Nx/NxB Core CASED TO: 40.0' CONTRACTOR: SwL (89-192)

SAMPLE LEGEND: S= SPLIT SPOON; T= 2" THIN WALL TUBE; U= 3" THIN WALL TUBE; C= NX ROCK CORE

WATER INFORMATION: See page 1 of 10

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
120–130		C12	120.0	130.0	95	95			CALCAREOUS SHALE (Taylor Marl) soft, fresh, fissile, slightly calcareous, dark gray with occasional carbonate seams and fossil partings
130–140		C13	130.0	140.0	83	83			
140–150		C14	140.0	150.0	99	99			-fossil partings at 140.4', 140.7', 141.9', 144.2', 145.4', 146.7', 147.5', and 147.7'
150–160		C15	150.0	160.0	100	100			-fossil partings at 150.5', 154.2', 154.8', 155.5', 157.7' and 159.6'
160–			160.0						

DRILLING GEOLOGIST Shawn Wood ASSISTANT Dale Brown CHECKED BY Clem Bommarito

Shawn Wood

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 17

BORING NO: BF-6 PG 5 OF10

LOCATION: N 238,075 feet
E 2,255,063 feet

GROUND EL: 456.3 feet

DATE: 12-11-89/1-02-90 TYPE: Nx/NxB Core CASED TO: 40.0' CONTRACTOR: SwL (89-192)

SAMPLE LEGEND: S= SPLIT SPOON; T= 2" THIN WALL TUBE; U= 3" THIN WALL TUBE; C= NX ROCK CORE

WATER INFORMATION: See page 1 of 10

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
160–170 (165)		C16	160.0	170.0	97	97			CALCAREOUS SHALE (Taylor Marl) soft, fresh, fissile, slightly calcareous, dark gray with occasional thin carbonate seams and fossil partings
170–180 (175)		C17	170.0	180.0	100	100			-fossil partings at 170.5', 174.6' and 176.2'
180–190 (185)		C18	180.0	190.0	89	89			
190–200 (195)		C19	190.0	200.0	98	98			-fossil partings at 190.5' and 191.8' -carbonate seam at 194.1'
200–			200.0						

DRILLING GEOLOGIST Shawn Wood ASSISTANT Dale Brown CHECKED BY Clem Bommarito
Shawn Wood

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 17

BORING NO: BF-6 PG 6 OF 10

LOCATION: N 238,075 feet
E 2,255,063 feet

GROUND EL: 456.3 feet

DATE: 12-11-89/1-02-90 TYPE: Nx/NxB Core CASED TO: 40.0' CONTRACTOR: SwL (89-192)

SAMPLE LEGEND: S= SPLIT SPOON; T= 2" THIN WALL TUBE; U= 3" THIN WALL TUBE; C= NX ROCK CORE

WATER INFORMATION: See page 1 of 10

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
200–210		C20	200.0	210.0	96	96			CALCAREOUS SHALE (Taylor Marl) soft, fresh, fissile, slightly calcareous, dark gray with occasional thin carbonate seams and fossil partings
210–220		C21	210.0	220.0	98	98			
220–230		C22	220.0	230.0	98	98			-thin carbonate seams, chalky white at 227.7' and 228.1'
230–240		C23	230.0	240.0	99	99			-thin carbonate seams, chalky white at 230.7', 233.2', 235.6', 237.4' and 238.4'
240–			240.0						

DRILLING GEOLOGIST Shawn Wood ASSISTANT Dale Brown CHECKED BY Clem Bommarito

Shawn Wood

LOG OF BORING

BORING NO: BF-6 PG 7 OF 10

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 17

LOCATION: N 238,075 feet
E 2,255,063 feet

GROUND EL: 456.3 feet

DATE: 12-11-89/1-02-90 TYPE: Nx/NxB Core CASED TO: 40.0' CONTRACTOR: SwL (89-192)

SAMPLE LEGEND

S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION

See page 1 of 10

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
240–250 (245)		C24	240.0	250.0	99	99			CALCAREOUS SHALE (Taylor Marl) soft, fresh, fissile, slightly to moderately calcareous, dark gray to gray with occasional thin carbonate seams and fossil partings -thin carbonate seams, chalky white at 241.0', 240.3', 247.0' and 248.5'
250–260 (255)		C25	250.0	260.0	100	100			-thin carbonate seams, chalky white at 250.6', 252,8', 254.5', 255.2', 258.9' and 259.7'
260–270 (265)		C26	260.0	270.0	97	97			-thin carbonate seams, chalky white at 260.2', 263.9', 264.0', 265.5' and 268.6' -fossil partings at 264.5' and 267.9' -slightly calcareous layer at 270.5'-271.4'
270–280 (275)		C27	270.0	280.0	94	94			-thin carbonate seams at 272.0' and 272.8' -fossil parting at 273.1' -carbonate parting at 277.0'
280			280.0						

DRILLING GEOLOGIST Shawn Wood ASSISTANT Dale Brown CHECKED BY Clem Bommarito
Shawn Wood

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 17

BORING NO: BF-6 PG 8 OF 10

LOCATION: N 238,075 feet, E 2,235,063 feet

GROUND EL: 456.3 feet

DATE: 12-11-89/1-02-90 TYPE: Nx/NxB Core CASED TO: 40.0' CONTRACTOR: SwL (89-192)

SAMPLE LEGEND: S= SPLIT SPOON; T= 2" THIN WALL TUBE; U= 3" THIN WALL TUBE; C= NX ROCK CORE

WATER INFORMATION: See page 1 of 10

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
280–290		C28	280.0	290.0	88	88			CALCAREOUS SHALE (Taylor Marl) soft, fresh, fissile, slightly to moderately calcareous, dark gray to gray with occasional thin carbonate seams and fossil partings -fossil partings at 280.1', 280.7', and 282.9' -fossil parting at 290.7'
290–300		C29	290.0	300.0	91	91			-thin carbonate seams at 282.5' and 286.9' -thin carbonate seams at 292.3' and 298.9'
300–310		C30	300.0	310.0	99	99			-thin carbonate seams at 300.4', 304.2', 306.6' and 309.4' -fossil parting at 303.2' -thin carbonate seam at 305.2' -fossil parting at 310.6', 310.9' and 304.4'
310–320		C31	310.0	320.0	99	99			

DRILLING GEOLOGIST Shawn Wood ASSISTANT Dale Brown CHECKED BY Clem Bommarito, Shawn Wood

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 17

BORING NO: BF-6 PG 9 OF10

LOCATION: N 238,075 feet
E 2,255,063 feet

GROUND EL: 456.3 feet

DATE: 12-11-89/1-02-90 TYPE: Nx/NxB Core CASED TO: 40.0' CONTRACTOR: SwL (89-192)

SAMPLE LEGEND: S= SPLIT SPOON; T= 2" THIN WALL TUBE; U= 3" THIN WALL TUBE; C= NX ROCK CORE

WATER INFORMATION: See page 1 of 10

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
325		C32	320.0	330.0	100	100			CALCAREOUS SHALE (Taylor Marl) soft, fresh, fissile, slightly to moderately calcareous, dark gray to gray with occasional thin carbonate seams -thin carbonate seam at 324.3' -slightly calcareous layer at 325.0'-325.6' -thin, carbonate seams at 325.8', 326.1', 326.4', 327.6' and 328.8' -possible slickensided fractures at 326.4' 327.6' and 328.8' -fossil parting at 329.6' -thin carbonate seam at 330.3'
330		C33	330.0	340.0	100	100			333.9 -sharp contact- LIMESTONE (Austin Chalk) medium, fresh, sound, light gray to dark gray with occasional argillaceous layers, soft shale layers and fossil partings
335									
340		C34	340.0	350.0	100	100			
345									
350		C35	350.0	360.0	100	100			-fossil partings at 354.9', 357.4', and 358.5' -calcareous shaley limestone layer at 357.0'-357.4'
355									
360									

DRILLING GEOLOGIST Shawn Wood ASSISTANT Dale Brown CHECKED BY Clem Bommarito / Shawn Wood

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 17

BORING NO: BF-6 PG 10 OF 10

LOCATION: N 238,075 feet
E 2,255,063 feet

GROUND EL: 456.3 feet

DATE: 12-11-89/1-02-90 TYPE: Nx/NxB Core CASED TO: 40.0' CONTRACTOR: SwL (89-192)

SAMPLE LEGEND
S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION
See page 1 of 10

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES		HAND PEN. TSF.	DESCRIPTION OF STRATUM
360–370		C36	360.0	370.0	98	98				LIMESTONE (Austin Chalk) medium, fresh, sound, slightly to moderately argillaceous, light gray to dark gray with occasional argillaceous layers, soft shale layers and fossil partings
370–380		C37	370.0	380.0	100	100				-slightly fossiliferous limestone from 374.3'-374.8' -fossil partings at 373.4', 373.6', 374.3', 376.4', 379.0', and 379.8' -45° smooth, tight, slickensided fracture at 380.0' 380.0
380–400										Bottom of Exploration at 380.0' Monitor well installed upon completion

DRILLING GEOLOGIST Shawn Wood ASSISTANT Dale Brown CHECKED BY Clem Bommarito

Shawn Wood

APPENDIX B

APPENDIX B: DRILLING METHODS

The pressuremeter tests were conducted in shaft Borings BE2 and BF6, roughly on opposite sides of the ring. Specified intervals of 20 and 30 feet were designated for pressuremeter tests in each of these borings as shown in Figure B1. Both borings were specified to be N-cored full depth with air-rotary used in the designated test intervals to avoid wetting the penetrated rock test depths.

Wide face core bits are typically used for local soft rock coring to provide sufficient space for circulation of drilling fluids. For NX core, these bits typically result in an outside borehole diameter of 4.0 to 4.75 inches, depending on the bit used and the formation being used. The pressuremeter used (OYO, Probex-1 required a snug fit in a nominal 3-inch outside diameter test hole. The pressuremeter test results are very sensitive to the quality (smoothness and diameter) of the borehole in the test intervals.

For both borings, a 6-inch inside diameter PVC surface casing, seated into the top of the unweathered rock, was grouted in place to minimize the potential for groundwater infiltration from shallow depths (particularly near the bedrock surface). The coring was then advanced with wide-faced bits using air or water rotary methods to the top of the designated test interval. If drilling water or mud was utilized, this was evacuated with air circulation after reaching this depth.

In Boring BF6, an accumulation of water was noted at the bottom of the borehole each morning as the hole was advanced. This was estimated to be 6 to 12 inches deep and was evacuated by air circulation prior to coring when air was used. The borehole was then reamed to 5-inches outside diameter with a tapered bit using air rotary circulation to the top of the test interval to provide adequate space for removal of drill cuttings in the test intervals. The tapered bit provided a conical hole bottom at the top of the test interval to help center the smaller-diameter core barrels, with narrow-faced bits used in the test intervals (Figure B2).

The stinger holes in the test intervals were cored with Christensen Geoset bits with outside diameters of 2.98 and 3.03 inches. The smaller bit was used in the

Austin Chalk and the larger bit in the Eagle Ford Shale and Taylor Marl. Both bits enabled an N-size core sample to be obtained. The rate of coring in the stinger holes was very slow, ranging from 1 to 2 hours per 10-foot run in the shale and marl. In these formations, attempts to penetrate more than 10 feet at a time was discouraging. Faster coring rates and greater overall penetrations could be obtained in the Austin Chalk.

Except for the Eagle Ford Shale, it was possible to maintain high bore recoveries. However, the core quality was limited owing to numerous mechanical fractures and this limited the usefulness of the core samples for laboratory testing purposes. In the Eagle Ford Shale, no core was recovered in the first 10-foot stinger hole, 20 percent was recovered in the second interval and 50 percent in the third and final attempt. Slight changes in the drilling procedures and rates were believed to have contributed to the increases in recovery.

The stinger holes were caliper logged with multiple passes of a single feeler arm tool to verify the hole condition and to help select suitable test depths, thus minimizing the potential for rupturing the pressuremeter membrane. The roughest borehole wall conditions occurred in the Eagle Ford Shale and the only ruptured membrane occurred in one of the Eagle Ford test depths. On inspection, it was concluded that the rupture was probably a result of membrane wear in combination with the general hole roughness at this depth. In general, the quality of the borehole in the test intervals were regarded as very good to excellent.

For many of the OYO tests, it was attempted to orient the two feeler arms (diametrically opposed arms in one plane) by marking the drill rods used to position the instrument and recording the bearing of the markings at the ground surface using a Brunton compass. In the first attempt, hexagonal pinned drilling rods were used to maintain the rod alignment. However, the pressuremeter instrument was noted to have a tendency to "bond" to the sides of the borehole after deflation (tight fit in Taylor Marl) and during attempts to jerk the unit free, a pin was loosened and some delay was necessitated to "fish" the tool from the boring. Subsequently, threaded round rods were used and these were first marked at the joints by tightening the rod string on the ground prior to lowering the instrument and re-tightening the rods to the marks as the tool was lowered in the borehole. Although judged as less accurate in orienting than the hex-rod method, the changes in rotation within a given test interval were judged to be satisfactorily accurate for tool orientation.

The drilling procedures used were regarded as satisfactory for high-quality pressuremeter test results for the Austin Chalk and the Taylor Marl. For future attempts in the Eagle Ford Shale, a shorter "stinger" hole length, say 5 to 7 feet might be considered. The use of a tri-cone or wing-bit might also be tried for drilling the stinger holes in this formation.

If higher quality core samples are required for the test intervals, it is recommended that these be obtained from an auxiliary borehole located at least 5 to 10 feet away from the pressuremeter test hole. The auxiliary hole could be advanced by air or water rotary methods to the test/core depth with the core obtained using water or air rotary methods and a wide faced core bit. In general, the water rotary methods result in a higher quality core sample, in SwL's experience.

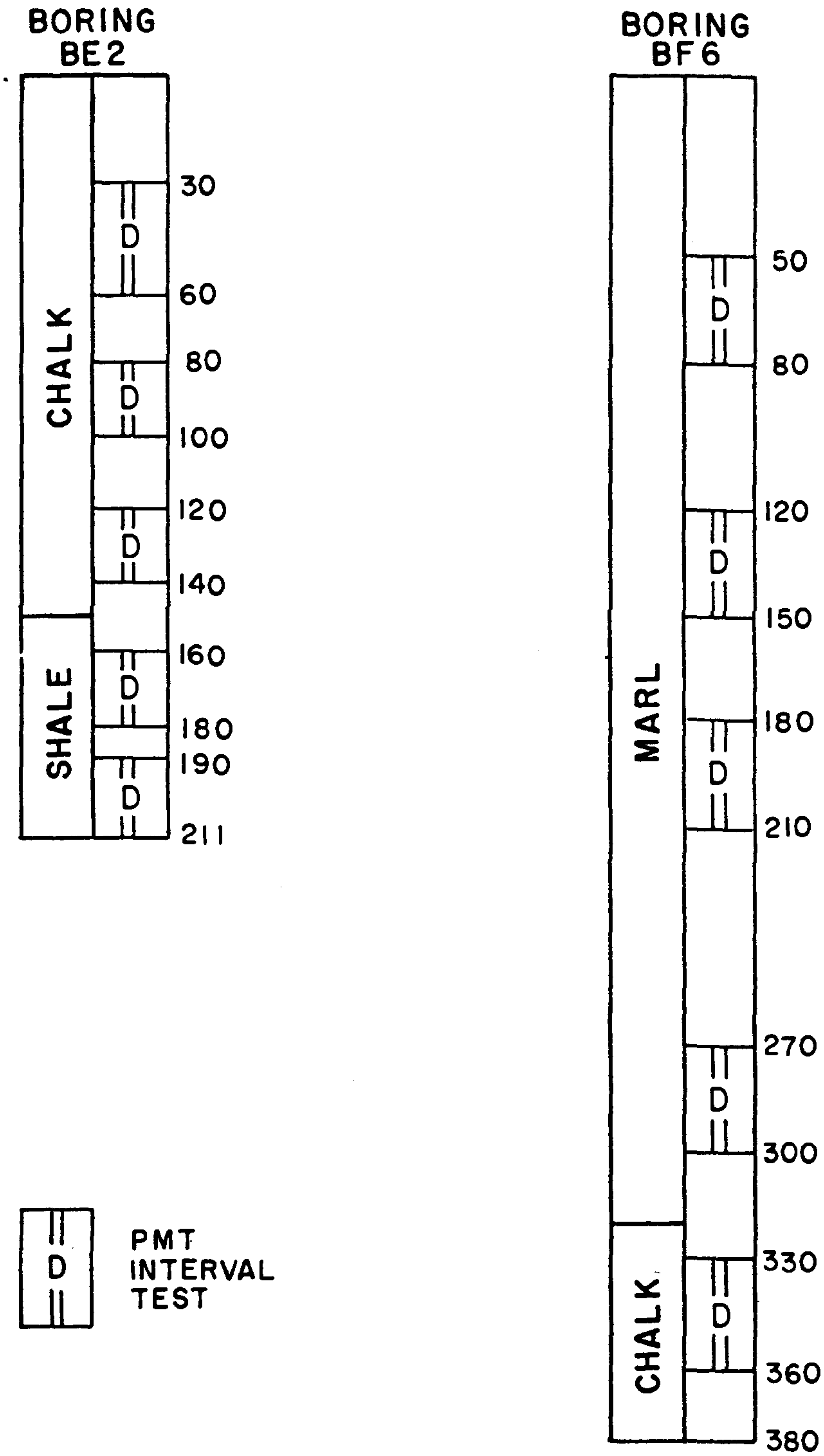


FIGURE B1

PMT TEST INTERVALS

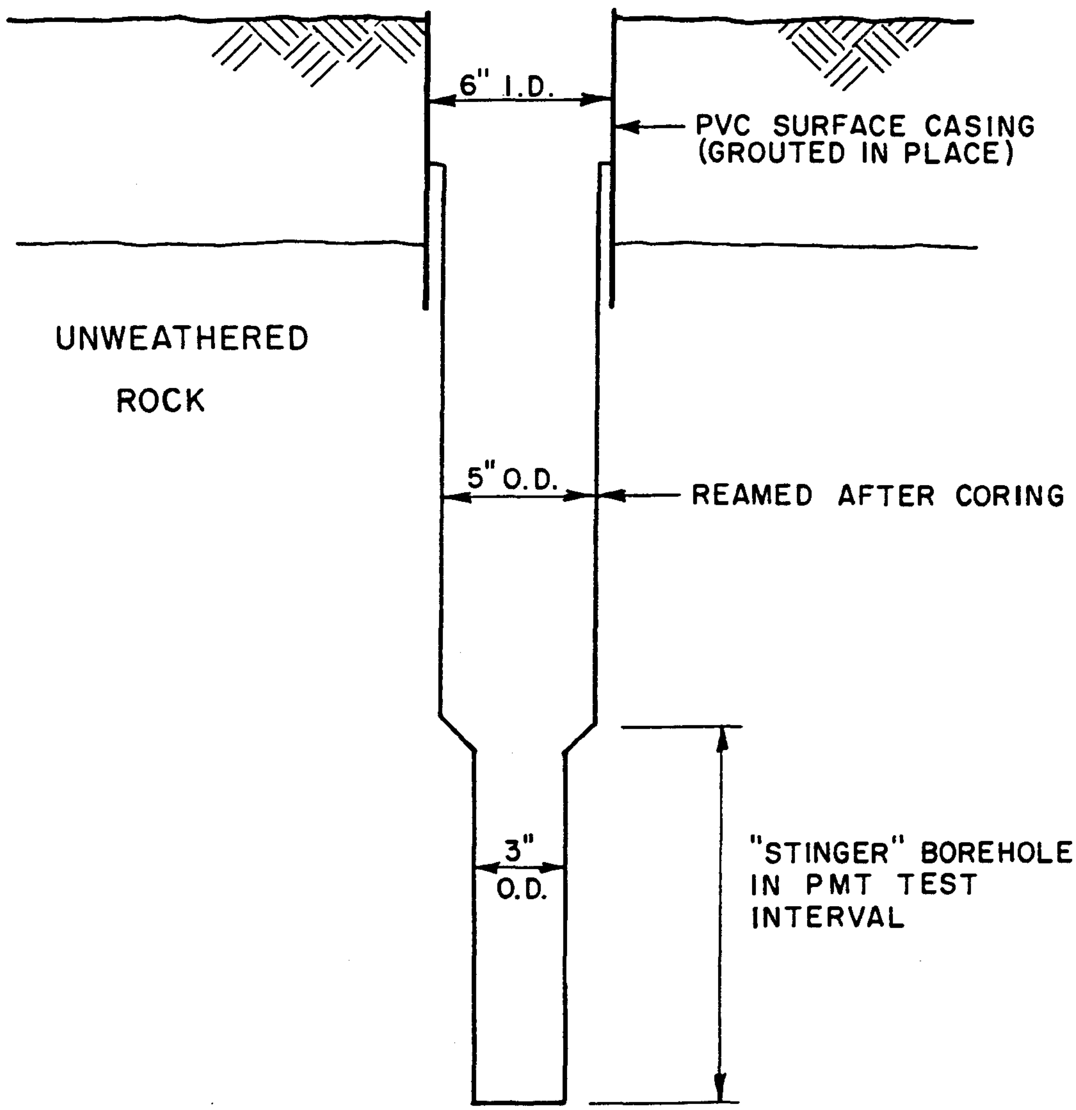


FIGURE B2

BOREHOLE DIMENSIONS
FOR PMT TESTS

OBSERVATIONS OF THE PRESSUREMETER ENGINEER

Mr. Norman Seiler of STS Consultants performed the pressuremeter tests at the SSC project in Waxahachie, Texas. During the course of this time, Mr. Seiler observed the drilling process and noted the condition of the borehole prior to testing. These observations are as follows:

- All of the boreholes were well prepared. Some experimentation was undertaken with slightly different size core bits so as to prepare the proper size hole for pressuremeter testing. There was a good fit of the pressuremeter probe into the borehole which is important since a borehole too large or small in diameter would result in a disturbed test.

- In Boring BF-6, the borehole was completely dry and there was no water in the borehole even after 24 hours delay in testing. At Boring BE-2, some water seepage was encountered at the transition between the chalk and the shale at a depth of 135 feet. The shale cores at Boring BE-2 were observed to be wet in some places. but the tests appeared normal. The boreholes did not squeeze even though the shale was wet.

- There was at least a three hour delay between drilling a formation and pressuremeter testing. This delay was due borehole diameter logging that was necessary in order to allow the pressuremeter to be inserted into the borehole at the most favorable diameter location. At a few locations, there was up to 12 hours delay when the hole was cored late in the evening and then the diameter logged early in the morning.

- The difference in modulus values for pressuremeter tests run within the same formation is most likely due to differences in consistency of the deposit that was cored. All of the pressuremeter tests were run using the same procedure, and all but three tests were undertaken using the OYO pressuremeter. The outer membrane did not rupture, so all the tests were run with the same membrane. Before performing each pressuremeter test, the system stiffness was calibrated and found to be approximately the same.

. The only unexplainable difference that was observed in the field at the time of pressuremeter testing was the different modulus calculated for the OYO and the Probex-1 tests which were performed at approximately the same elevation in borehole BG-6. Since the pressuremeter units are constructed differently, the difference in modulus may be due to instrument variations. The OYO is inflated with nitrogen and the change in diameter is measured with two feelers, whereas the Probex-1 is inflated with water and volumetric readings are taken.

. In the very stiff formation such as the marl or the chalk, it was observed that the amount of diameter change was only slightly greater than the diameter change during the calibration in the steel cylinder, so the calculation of modulus is very sensitive to minor changes in diameter or volume. Thus, whenever the calculated modulus values are over 500,000 to 750,000 psi, the accuracy of the modulus calculation is not as precise as for the lower modulus material such as the shale.

APPENDIX C

APPENDIX

PRESSUREMETER TEST RESULTS

SSC BORING BF-6 TEST 4 58 FT

POINT NUMBER	D.I.R. (mm)	PRESSURE (psi)	CORRECTED RADIUS (mm)	Δ R/Ro (%)	CORRECTED PRESSURE (psi)
1	-0.78	0	36.06	0.00	0
2	0.85	40	37.10	2.89	-0
3	2.64	60	38.30	6.21	-4
4	3.48	80	38.87	7.80	8
5	3.62	100	38.97	8.06	27
6	3.70	120	39.02	8.21	46
7	3.75	140	39.05	8.30	66
8	3.83	200	39.10	8.43	125
9	3.94	300	39.16	8.60	224
10	4.08	400	39.24	8.83	323
11	4.21	500	39.32	9.05	422
12	4.34	600	39.40	9.26	521
13	4.50	700	39.50	9.53	620
14	4.64	800	39.58	9.76	719
15	4.83	900	39.70	10.10	818
16	5.04	1000	39.83	10.47	917
17	4.43	200	39.53	9.62	119
18	5.10	1000	39.92	10.71	916
19	5.53	1100	40.22	11.53	1014
20	6.19	1200	40.68	12.82	1111
21	7.62	1300	41.72	15.70	1203
22	9.79	1400	43.34	20.20	1289
23	11.86	1450	44.94	24.62	1326
24	11.20	800	44.50	23.40	680
25	9.40	200	43.18	19.75	91

Po = 55.0 psi   Pl = 1350.0 psi   Pl* = 1295.0 psi
Eo = 64592 psi   Er = 107661 psi   Eo/Pl* = 49.9

SSC BORING BF-6 TEST 3 63 FT

POINT NUMBER	D.I.R. (mm)	PRESSURE (psi)	CORRECTED RADIUS (mm)	ΔR/Ro (%)	CORRECTED PRESSURE (psi)
1	-1.28	0	35.75	0.00	0
2	-1.01	20	35.91	0.46	11
3	0.00	60	36.55	2.24	27
4	0.12	80	36.62	2.45	45
5	0.19	100	36.66	2.57	63
6	0.25	120	36.70	2.67	82
7	0.46	200	36.83	3.02	159
8	0.63	300	36.92	3.29	257
9	0.91	400	37.09	3.77	353
10	1.17	500	37.25	4.21	450
11	1.05	200	37.22	4.12	151
12	1.30	500	37.35	4.50	448
13	1.61	600	37.55	5.05	544
14	1.99	700	37.79	5.73	639
15	2.54	800	38.16	6.75	734
16	3.40	900	38.74	8.37	826
17	4.58	1000	39.55	10.64	917
18	6.34	1100	40.80	14.14	1007
19	8.70	1200	42.54	19.00	1093
20	11.97	1300	45.04	26.00	1172
21	11.22	700	44.52	24.56	577
22	9.31	200	43.11	20.61	89

Po = 50.0 psi　Pl = 1250.0 psi　Pl* = 1200.0 psi
Eo = 49492 psi　Er = 108571 psi　Eo/Pl* = 41.2

SSC BORING BF-6 TEST 11 69 FT

POINT NUMBER	D.I.R. (mm)	PRESSURE (psi)	CORRECTED RADIUS (mm)	Δ R/Ro (%)	CORRECTED PRESSURE (psi)
1	-0.49	0	36.24	0.00	0
2	0.75	40	37.04	2.19	7
3	2.07	60	37.91	4.60	7
4	3.73	80	39.05	7.74	8
5	3.83	100	39.11	7.92	27
6	3.86	120	39.13	7.97	47
7	3.89	140	39.15	8.02	67
8	3.95	200	39.18	8.11	126
9	4.03	300	39.22	8.23	226
10	4.13	400	39.28	8.38	325
11	4.23	500	39.33	8.53	424
12	4.34	600	39.40	8.71	523
13	4.46	700	39.47	8.90	622
14	4.59	800	39.54	9.11	721
15	4.75	900	39.64	9.38	820
16	4.40	200	39.51	9.01	122
17	4.80	900	39.72	9.59	819
18	4.99	1000	39.84	9.93	918
19	5.55	1100	40.23	11.00	1015
20	5.95	1200	40.51	11.77	1113
21	6.79	1300	41.11	13.43	1209
22	8.09	1400	42.06	16.05	1301
23	9.40	1500	43.03	18.74	1393
24	11.00	1550	44.25	22.11	1433
25	10.28	800	43.78	20.81	687
26	8.41	200	42.43	17.08	98

Po = 30.0 psi   Pl = 1450.0 psi   Pl* = 1420.0 psi
Eo = 96409 psi   Er = 175387 psi   Eo/Pl* = 67.9

SSC BORING BF-6 TEST 25 123 FT

POINT NUMBER	D.I.R. (mm)	PRESSURE (psi)	CORRECTED RADIUS (mm)	$\Delta R/Ro$ (%)	CORRECTED PRESSURE (psi)
1	-0.15	0	36.46	0.00	0
2	1.11	40	37.27	2.23	7
3	2.52	60	38.22	4.82	5
4	3.67	80	39.00	6.98	12
5	3.70	100	39.02	7.03	32
6	3.71	120	39.03	7.04	52
7	3.74	200	39.04	7.07	132
8	3.86	500	39.08	7.18	431
9	3.99	800	39.12	7.31	730
10	4.15	1100	39.19	7.49	1029
11	4.36	1400	39.29	7.78	1328
12	4.25	800	39.34	7.90	727
13	4.01	200	39.23	7.61	129
14	4.13	800	39.25	7.67	728
15	4.42	1400	39.40	8.05	1326
16	4.69	1700	39.55	8.49	1624
17	5.11	2000	39.82	9.22	1920
18	5.53	2150	40.10	10.00	2068
19	5.52	1950	40.12	10.04	1868
20	5.16	1100	39.95	9.58	1019
21	4.55	200	39.61	8.65	123

Po = 20.0 psi Pl = psi Pl* = psi
Eo = 300509 psi Er = 384361 psi Eo/Pl* =

SSC BORING BF-6 TEST 24 125.5 FT

POINT NUMBER	D.I.R. (mm)	PRESSURE (psi)	CORRECTED RADIUS (mm)	ΔR/Ro (%)	CORRECTED PRESSURE (psi)
1	-0.25	0	36.39	0.00	0
2	0.89	40	37.13	2.01	9
3	2.33	60	38.09	4.65	6
4	3.80	80	39.09	7.42	10
5	3.83	100	39.11	7.47	30
6	3.85	120	39.12	7.50	49
7	3.90	200	39.15	7.56	129
8	3.97	500	39.15	7.58	429
9	4.09	800	39.19	7.69	728
10	4.20	1100	39.23	7.78	1028
11	4.35	1400	39.29	7.95	1327
12	4.28	800	39.36	8.15	726
13	4.10	200	39.30	7.97	127
14	4.17	800	39.28	7.93	727
15	4.39	1400	39.37	8.19	1326
16	4.54	1700	39.45	8.39	1625
17	4.76	2000	39.57	8.73	1923
18	5.16	2300	39.82	9.42	2220
19	5.33	2350	39.94	9.74	2269
20	5.32	2100	39.96	9.79	2019
21	5.08	1300	39.87	9.56	1219
22	4.47	200	39.56	8.69	123

Po = 35.0 psi Pl = psi Pl* = psi
Eo = 594801 psi Er = 796484 psi Eo/Pl* =

SSC BORING BF-6 TEST 23 128.5 FT

POINT NUMBER	D.I.R. (mm)	PRESSURE (psi)	CORRECTED RADIUS (mm)	dR/Ro (%)	CORRECTED PRESSURE (psi)
1	-0.49	0	36.24	0.00	0
2	0.88	40	37.12	2.43	5
3	2.45	60	38.17	5.31	1
4	3.84	80	39.12	7.95	7
5	3.91	100	39.17	8.08	27
6	3.94	120	39.19	8.13	46
7	3.95	140	39.19	8.14	66
8	3.98	200	39.20	8.17	126
9	4.06	500	39.22	8.20	426
10	4.16	800	39.24	8.28	726
11	4.29	1100	39.29	8.41	1025
12	4.46	1400	39.36	8.62	1324
13	4.37	800	39.42	8.78	723
14	4.18	200	39.35	8.58	124
15	4.26	800	39.35	8.56	724
16	4.51	1400	39.46	8.88	1323
17	3.99	200	39.21	8.19	126
18	4.19	800	39.26	8.33	725
19	4.45	1400	39.36	8.60	1324
20	4.68	1700	39.55	9.12	1621
21	4.97	1900	39.73	9.63	1819
22	5.07	1950	39.80	9.81	1869
23	5.03	1550	39.81	9.85	1469
24	4.87	1100	39.74	9.67	1019
25	4.39	200	39.50	8.99	122

Po = 50.0 psi Pl = 0 psi Pl* = 0 psi
Eo = 546188 psi Er = 586840 psi Eo/Pl* =

SSC BORING BF-6 TEST 30 188.5 FT

POINT NUMBER	D.I.R. (mm)	PRESSURE (psi)	CORRECTED RADIUS (mm)	ΔR/Ro (%)	CORRECTED PRESSURE (psi)
1	-1.09	0	35.86	0.00	0
2	-0.13	40	36.47	1.68	13
3	0.94	60	37.16	3.61	14
4	2.53	80	38.22	6.57	15
5	3.89	100	39.15	9.18	21
6	3.98	120	39.21	9.34	41
7	4.00	140	39.23	9.37	60
8	4.04	200	39.24	9.43	120
9	4.14	500	39.27	9.50	420
10	4.24	800	39.30	9.57	720
11	4.37	1100	39.34	9.71	1019
12	4.53	1400	39.41	9.90	1319
13	4.42	800	39.46	10.02	718
14	4.25	200	39.40	9.86	119
15	4.33	800	39.39	9.84	719
16	4.57	1400	39.50	10.14	1318
17	4.72	1700	39.58	10.35	1618
18	4.95	2000	39.71	10.72	1917
19	5.38	2300	39.98	11.48	2214
20	5.53	2350	40.08	11.76	2264
21	5.52	2150	40.10	11.80	2064
22	5.16	1200	39.94	11.37	1115
23	4.56	200	39.62	10.47	117

Po =	50.0 psi	Pl =	psi	Pl* =	psi
Eo =	469745 psi	Er =	628517 psi	Eo/Pl* =	

SSC BORING BF-6 TEST 33 208.5 FT

POINT NUMBER	D.I.R. (mm)	PRESSURE (psi)	CORRECTED RADIUS (mm)	ΔR/Ro (%)	CORRECTED PRESSURE (psi)
1	-1.02	0	35.91	0.00	0
2	-0.04	40	36.52	1.72	13
3	1.08	60	37.25	3.74	13
4	2.48	80	38.19	6.34	16
5	3.92	100	39.18	9.10	22
6	3.99	120	39.22	9.23	41
7	4.01	140	39.23	9.26	61
8	4.03	200	39.24	9.27	121
9	4.12	500	39.26	9.33	421
10	4.23	800	39.29	9.42	720
11	4.35	1100	39.33	9.53	1020
12	4.48	1400	39.38	9.67	1319
13	4.64	1700	39.45	9.86	1619
14	4.50	950	39.50	10.00	868
15	4.24	200	39.39	9.71	119
16	4.36	950	39.40	9.73	869
17	4.66	1700	39.53	10.10	1618
18	4.89	2000	39.66	10.46	1917
19	5.29	2300	39.92	11.17	2215
20	5.47	2400	40.03	11.49	2314
21	5.44	2100	40.05	11.52	2014
22	5.13	1300	39.91	11.14	1215
23	4.54	200	39.61	10.30	118

Po =	60.0 psi	Pl =	psi	Pl* =	psi
Eo =	446135 psi	Er =	564881 psi	Eo/Pl* =	

SSC BORING BF-6 TEST 38 278.5 FT

POINT NUMBER	D.I.R. (mm)	PRESSURE (psi)	CORRECTED RADIUS (mm)	Δ R/Ro (%)	CORRECTED PRESSURE (psi)
1	-1.25	0	35.76	0.00	0
2	-0.25	40	36.39	1.75	12
3	0.84	60	37.09	3.71	14
4	2.57	80	38.25	6.94	13
5	4.15	100	39.34	9.99	19
6	4.19	120	39.36	10.06	38
7	4.20	140	39.37	10.07	58
8	4.23	200	39.38	10.11	118
9	4.33	500	39.40	10.18	418
10	4.43	800	39.43	10.25	718
11	4.54	1100	39.46	10.34	1018
12	4.67	1400	39.51	10.48	1317
13	4.58	800	39.57	10.64	717
14	4.38	200	39.49	10.42	117
15	4.48	800	39.50	10.44	717
16	4.58	1100	39.54	10.55	1017
17	4.70	1400	39.59	10.70	1317
18	4.83	1700	39.65	10.87	1616
19	4.99	2000	39.73	11.10	1916
20	5.25	2300	39.89	11.53	2214
21	5.53	2525	40.06	12.02	2438
22	5.51	2300	40.07	12.04	2213
23	5.15	1300	39.92	11.62	1214
24	4.59	200	39.64	10.84	116

Po = 40.0 psi Pl = 0.0 psi Pl* = 0.0 psi
Eo = 552499 psi Er = 636529 psi Eo/Pl* =

SSC BORING BF-6 TEST 41 288 FT

POINT NUMBER	VOLUME MEASUREMENT	PRESSURE MEASUREMENT	CORR. VOL. INCREASE (cm^3)	dR/Ro (%)	CORRECTED PRESSURE (psi)
1	18129	0.0	0.00	0.00	76.03
2	16950	100.0	20.64	0.51	152.78
3	14800	150.0	59.86	1.47	168.41
4	11000	200.0	129.63	3.16	181.68
5	8000	250.0	184.60	4.47	209.15
6	7754	300.0	188.55	4.56	255.72
7	7627	350.0	190.31	4.60	302.87
8	7250	590.0	194.41	4.70	530.27
9	6932	800.0	197.79	4.78	729.30
10	6564	1100.0	201.77	4.87	1014.04
11	6187	1400.0	206.23	4.98	1298.74
12	5786	1700.0	211.01	5.09	1582.79
13	6418	1000.0	203.28	4.91	917.84
14	7335	300.0	192.81	4.66	253.72
15	6555	1000.0	202.88	4.90	918.50
16	5777	1700.0	211.18	5.09	1582.74
17	5293	2000.0	217.47	5.24	1866.16
18	4680	2300.0	226.38	5.45	2148.76
19	3880	2600.0	238.70	5.74	2430.17
20	2620	2900.0	259.74	6.23	2709.45
21	982	3200.0	287.66	6.88	2988.13
22	1041	2900.0	288.14	6.89	2701.91
23	2776	1500.0	264.14	6.33	1373.19
24	5225	300.0	229.58	5.53	242.22

Po = 0 psi Pl = 0 psi Pl* = 0 psi

Eo = 365376 psi Er = 427857 psi Eo/Pl* =

SSC BORING BF-6 TEST 42 297 FT

POINT NUMBER	D.I.R. (mm)	PRESSURE (psi)	CORRECTED RADIUS (mm)	ΔR/Ro (%)	CORRECTED PRESSURE (psi)
1	-1.43	0	35.65	0.00	0
2	-0.42	40	36.28	1.76	12
3	0.71	60	37.01	3.80	13
4	2.44	80	38.16	7.03	13
5	3.96	100	39.20	9.96	19
6	4.04	120	39.26	10.11	38
7	4.06	140	39.27	10.14	58
8	4.10	200	39.29	10.19	118
9	4.21	500	39.32	10.29	418
10	4.29	800	39.33	10.32	718
11	4.40	1100	39.36	10.41	1018
12	4.51	1400	39.40	10.51	1317
13	4.63	1700	39.44	10.62	1617
14	4.52	1000	39.51	10.81	916
15	4.26	200	39.41	10.53	117
16	4.41	1000	39.43	10.59	917
17	4.65	1700	39.52	10.86	1616
18	4.79	2000	39.59	11.05	1916
19	5.01	2300	39.72	11.40	2215
20	5.30	2575	39.89	11.89	2489
21	5.28	2350	39.90	11.92	2263
22	5.02	1400	39.82	11.68	1314
23	4.50	200	39.58	11.01	116

Po = 40.0 psi Pl = 0.0 psi Pl* = 0.0 psi
Eo = 564159 psi Er = 675037 psi Eo/Pl* =

SSC BORING BF-6 TEST 48 348 FT

POINT NUMBER	VOLUME MEASUREMENT	PRESSURE MEASUREMENT	CORR. VOL. INCREASE (cm^3)	dR/Ro (%)	CORRECTED PRESSURE (psi)
1	17369	0.0	0.00	0.00	91.87
2	13905	25.0	63.87	1.57	63.59
3	12625	50.0	87.29	2.14	75.25
4	11370	75.0	110.25	2.69	87.14
5	11089	100.0	115.18	2.81	108.78
6	10908	150.0	117.96	2.88	155.09
7	10798	200.0	119.44	2.91	201.96
8	10653	300.0	120.99	2.95	296.31
9	10430	500.0	122.86	2.99	485.54
10	10079	900.0	124.84	3.04	864.74
11	9766	1300.0	126.47	3.08	1244.26
12	9474	1700.0	128.04	3.12	1623.93
13	9178	2100.0	129.99	3.17	2003.58
14	9687	1200.0	126.01	3.07	1148.13
15	10435	300.0	120.52	2.94	294.58
16	9781	1200.0	127.20	3.10	1148.87
17	9172	2100.0	130.10	3.17	2003.53
18	8882	2500.0	132.20	3.22	2383.22
19	8595	2900.0	134.71	3.28	2762.94
20	8271	3300.0	138.04	3.36	3142.66
21	7920	3700.0	142.02	3.45	3522.98
22	7489	4100.0	148.18	3.60	3902.93
23	7243	4300.0	152.73	3.71	4092.75
24	7076	4400.0	155.83	3.78	4187.45
25	6930	4500.0	158.53	3.85	4282.26
26	7067	4160.0	155.99	3.79	3958.21
27	8310	2300.0	140.42	3.41	2187.84
28	10087	300.0	123.09	3.00	291.81

Po = 0 psi Pl = 0 psi Pl* = 0 psi
Eo = 1216922 psi Er = 1019076 psi Eo/Pl* =

SSC BORING BF-6 TEST 47 358 FT

POINT NUMBER	VOLUME MEASUREMENT	PRESSURE MEASUREMENT	CORR. VOL. INCREASE (cm^3)	dR/Ro (%)	CORRECTED PRESSURE (psi)
1	17175	0.0	0.00	0.00	94.51
2	14943	25.0	41.05	1.01	82.88
3	12532	35.0	85.59	2.10	64.53
4	11662	100.0	100.97	2.47	118.30
5	11574	150.0	102.04	2.49	165.21
6	11483	200.0	103.16	2.52	212.09
7	11082	500.0	107.19	2.62	494.90
8	10644	1000.0	109.66	2.68	968.92
9	10196	1500.0	112.88	2.75	1442.86
10	9620	2000.0	119.03	2.90	1915.78
11	8998	2500.0	126.45	3.08	2388.33
12	9940	1400.0	115.27	2.81	1345.32
13	11015	300.0	105.33	2.57	303.37
14	10102	1400.0	115.64	2.82	1346.61
15	8980	2500.0	126.79	3.09	2388.19
16	8568	2800.0	132.32	3.22	2671.41
17	8000	3100.0	140.78	3.42	2953.93
18	7330	3400.0	151.22	3.67	3237.23
19	6490	3600.0	165.52	4.01	3424.22
20	5700	3700.0	179.54	4.35	3515.95
21	4900	3800.0	193.75	4.68	3607.21
22	4280	3850.0	204.93	4.95	3651.01
23	4465	3500.0	202.88	4.90	3317.94
24	6775	2250.0	166.32	4.03	2136.33
25	9390	300.0	132.78	3.23	290.45

Po = 0 psi Pl = 0 psi Pl* = 0 psi
Eo = 559127 psi Er = 552296 psi Eo/Pl* =

SSC BORING BE-2 TEST 8 40 FT

POINT NUMBER	D.I.R. (mm)	PRESSURE (psi)	CORRECTED RADIUS (mm)	dR/Ro (%)	CORRECTED PRESSURE (psi)
1	-0.47	0	36.25	0.00	0
2	1.02	40	37.21	2.64	2
3	2.58	60	38.26	5.52	-0
4	2.93	80	38.49	6.17	16
5	3.00	100	38.54	6.30	36
6	3.02	120	38.55	6.33	56
7	3.07	200	38.57	6.39	135
8	3.11	400	38.57	6.39	335
9	3.17	600	38.58	6.42	535
10	3.23	800	38.60	6.46	735
11	3.29	1000	38.61	6.49	935
12	3.34	1200	38.61	6.51	1135
13	3.19	200	38.66	6.64	134
14	3.37	1200	38.68	6.70	1134
15	3.05	200	38.56	6.35	135
16	3.32	1200	38.60	6.47	1135
17	3.05	200	38.56	6.35	135
18	3.32	1200	38.60	6.47	1135
19	3.10	200	38.59	6.45	135
20	3.35	1200	38.62	6.53	1135

Po = 50.0 psi   Pl = 0.0 psi   Pl* = 0.0 psi
Eo = 1206935 psi   Er = 2346987 psi   Eo/Pl* =

SSC BORING BE-2 TEST 7 46.5 FT

POINT NUMBER	D.I.R. (mm)	PRESSURE (psi)	CORRECTED RADIUS (mm)	ΔR/Ro (%)	CORRECTED PRESSURE (psi)
1	-0.56	0	36.20	0.00	0
2	0.75	40	37.04	2.32	6
3	2.36	60	38.11	5.27	2
4	3.37	80	38.80	7.18	11
5	3.44	100	38.84	7.30	31
6	3.48	120	38.87	7.37	50
7	3.52	200	38.88	7.42	130
8	3.60	400	38.91	7.49	330
9	3.68	600	38.94	7.56	529
10	3.76	800	38.96	7.64	729
11	3.81	1000	38.97	7.65	929
12	3.88	1200	38.99	7.71	1129
13	3.96	1400	39.01	7.78	1328
14	3.75	200	39.05	7.88	128
15	3.99	1400	39.09	8.00	1327
16	4.00	1450	39.10	8.01	1377
17	3.90	700	39.10	8.03	627
18	3.78	200	39.07	7.94	127

Po = 50.0 psi	Pl = 0.0 psi	Pl* = 0.0 psi
Eo = 482355 psi	Er = 1438786 psi	Eo/Pl* =

SSC BORING BE-2 TEST 13 89.5 FT

POINT NUMBER	D.I.R. (mm)	PRESSURE (psi)	CORRECTED RADIUS (mm)	dR/Ro (%)	CORRECTED PRESSURE (psi)
1	-0.44	0	36.27	0.00	0
2	1.04	40	37.23	2.63	2
3	2.59	60	38.26	5.48	-0
4	3.32	80	38.76	6.86	13
5	3.34	100	38.77	6.89	33
6	3.36	120	38.78	6.92	53
7	3.39	200	38.79	6.94	132
8	3.46	500	38.80	6.96	432
9	3.53	800	38.80	6.97	732
10	3.61	1100	38.81	7.01	1032
11	3.69	1400	38.83	7.04	1332
12	3.77	1700	38.84	7.07	1632
13	3.87	2000	38.87	7.14	1931
14	3.59	200	38.94	7.35	130
15	3.87	2000	38.95	7.37	1930
16	3.37	200	38.78	6.91	133
17	3.74	1700	38.82	7.02	1632
18	3.41	200	38.81	6.98	132
19	3.78	1700	38.85	7.09	1632
20	3.42	200	38.81	7.00	132
21	3.79	1700	38.85	7.11	1632

Po = 15.0 psi Pl = 0.0 psi Pl* = 0.0 psi
Eo = 1275049 psi Er = 10185390? psi Eo/Pl* =

SSC BORING BE-2 TEST 12 99.5 FT

POINT NUMBER	D.I.R. (mm)	PRESSURE (psi)	CORRECTED RADIUS (mm)	Δ R/Ro (%)	CORRECTED PRESSURE (psi)
1	-0.64	0	36.15	0.00	0
2	0.85	40	37.10	2.64	2
3	2.35	60	38.10	5.40	1
4	3.06	80	38.58	6.74	14
5	3.10	100	38.61	6.80	33
6	3.11	120	38.61	6.82	53
7	3.12	140	38.61	6.83	73
8	3.15	200	38.63	6.86	133
9	3.20	400	38.63	6.88	333
10	3.25	600	38.64	6.89	533
11	3.31	800	38.65	6.93	733
12	3.39	1000	38.68	7.00	932
13	3.42	1200	38.67	6.98	1132
14	3.49	1400	38.69	7.03	1332
15	3.56	1600	38.71	7.09	1532
16	3.62	1800	38.72	7.12	1732
17	3.68	2000	38.73	7.16	1931
18	3.76	2200	38.76	7.23	2131
19	3.82	2350	38.78	7.29	2281
20	3.42	200	38.82	7.40	130
21	3.79	2200	38.87	7.54	2129

Po = 30.0 psi Pl = 0.0 psi Pl* = 0.0 psi
Eo = 864269 psi Er = 2026869 psi Eo/Pl* =

SSC BORING BE-2 TEST 17 125 FT

POINT NUMBER	D.I.R. (mm)	PRESSURE (psi)	CORRECTED RADIUS (mm)	dR/Ro (%)	CORRECTED PRESSURE (psi)
1	-0.38	0	36.31	0.00	0
2	0.68	40	36.99	1.87	11
3	2.60	60	38.27	5.39	0
4	3.48	80	38.87	7.05	12
5	3.56	100	38.92	7.20	31
6	3.61	120	38.96	7.28	51
7	3.64	140	38.97	7.33	70
8	3.69	200	39.00	7.40	130
9	3.81	500	39.04	7.52	429
10	3.98	800	39.12	7.72	728
11	4.08	1100	39.14	7.79	1028
12	4.17	1400	39.16	7.85	1328
13	4.27	1700	39.19	7.92	1627
14	4.38	2000	39.22	8.01	1927
15	4.26	1100	39.31	8.27	1026
16	4.04	200	39.25	8.10	126
17	4.15	1100	39.24	8.06	1027
18	4.31	1700	39.29	8.19	1626
19	3.75	200	39.04	7.52	129
20	4.36	1700	39.25	8.09	1626
21	3.76	200	39.05	7.54	129
22	4.32	1700	39.22	8.02	1627
23	3.69	200	39.00	7.40	130
24	4.29	1700	39.20	7.96	1627

Po = 65.0 psi   Pl = 0.0 psi   Pl* = 0.0 psi
Eo = 424771 psi   Er = 2344905 psi   Eo/Pl* =

SSC BORING BE-2 TEST 16 132 FT

POINT NUMBER	D.I.R. (mm)	PRESSURE (psi)	CORRECTED RADIUS (mm)	ΔR/Ro (%)	CORRECTED PRESSURE (psi)
1	-0.45	0	36.27	0.00	0
2	0.63	40	36.96	1.90	10
3	1.97	60	37.84	4.34	9
4	3.30	80	38.75	6.84	13
5	3.34	100	38.77	6.91	33
6	3.37	120	38.79	6.96	52
7	3.43	200	38.82	7.04	132
8	3.53	500	38.85	7.11	432
9	3.63	800	38.87	7.18	731
10	3.72	1100	38.89	7.23	1031
11	3.82	1400	38.92	7.31	1331
12	3.92	1700	38.94	7.38	1630
13	4.01	2000	38.96	7.43	1930
14	4.10	2300	38.98	7.48	2230
15	4.09	2100	39.09	7.79	2028
16	3.95	1200	39.09	7.77	1128
17	3.66	200	38.99	7.50	130
18	3.80	1200	38.98	7.49	1130
19	4.07	2200	39.07	7.72	2128
20	4.06	1750	39.11	7.83	1678
21	3.92	1100	39.08	7.75	1028
22	3.66	200	38.99	7.50	130

Po = 30.0 psi Pl = 0.0 psi Pl* = 0.0 psi
Eo = 671865 psi Er = 1312021 psi Eo/Pl* =

SSC BORING BE-2 TEST 20 142 FT

POINT NUMBER	D.I.R. (mm)	PRESSURE (psi)	CORRECTED RADIUS (mm)	ΔR/Ro (%)	CORRECTED PRESSURE (psi)
1	-0.56	0	36.20	0.00	0
2	0.97	40	37.18	2.72	1
3	2.48	60	38.19	5.50	-0
4	4.41	80	39.52	9.19	1
5	4.65	100	39.69	9.65	19
6	4.74	120	39.75	9.82	39
7	4.81	140	39.80	9.94	58
8	4.93	200	39.87	10.16	118
9	5.04	300	39.94	10.33	217
10	5.19	500	40.01	10.55	417
11	5.35	700	40.10	10.78	616
12	5.52	900	40.19	11.03	815
13	5.85	1100	40.40	11.61	1014
14	5.74	600	40.42	11.67	514
15	5.52	200	40.30	11.35	115
16	5.59	600	40.31	11.37	514
17	5.82	1000	40.44	11.71	914
18	6.29	1200	40.75	12.59	1111
19	7.26	1300	41.45	14.52	1206
20	10.15	1400	43.62	20.50	1288
21	10.12	1100	43.63	20.53	988
22	9.89	800	43.49	20.13	689
23	8.53	200	42.52	17.47	97

Po = 80.0 psi   Pl = 1350.0 psi   Pl* = 1270.0 psi
Eo = 125492 psi   Er = 328277 psi   Eo/Pl* = 98.8

SSC BORING BE-2 TEST 27 167 FT

POINT NUMBER	D.I.R. (mm)	PRESSURE (psi)	CORRECTED RADIUS (mm)	ΔR/Ro (%)	CORRECTED PRESSURE (psi)
1	-0.47	0	36.25	0.00	0
2	0.69	40	37.00	2.05	9
3	2.08	60	37.92	4.59	7
4	3.77	80	39.07	7.78	8
5	4.01	100	39.24	8.23	26
6	4.11	120	39.31	8.42	45
7	4.18	140	39.35	8.54	64
8	4.30	200	39.43	8.75	123
9	4.50	400	39.54	9.06	322
10	4.67	600	39.63	9.31	520
11	4.80	800	39.69	9.48	720
12	4.93	1000	39.76	9.66	919
13	5.03	1200	39.80	9.77	1119
14	5.20	1400	39.89	10.02	1318
15	5.07	800	39.92	10.11	718
16	4.70	200	39.72	9.56	119
17	4.91	800	39.80	9.79	719
18	5.16	1400	39.92	10.11	1318
19	5.34	1600	40.03	10.40	1517
20	5.65	1800	40.23	10.96	1716
21	6.01	2000	40.47	11.61	1914

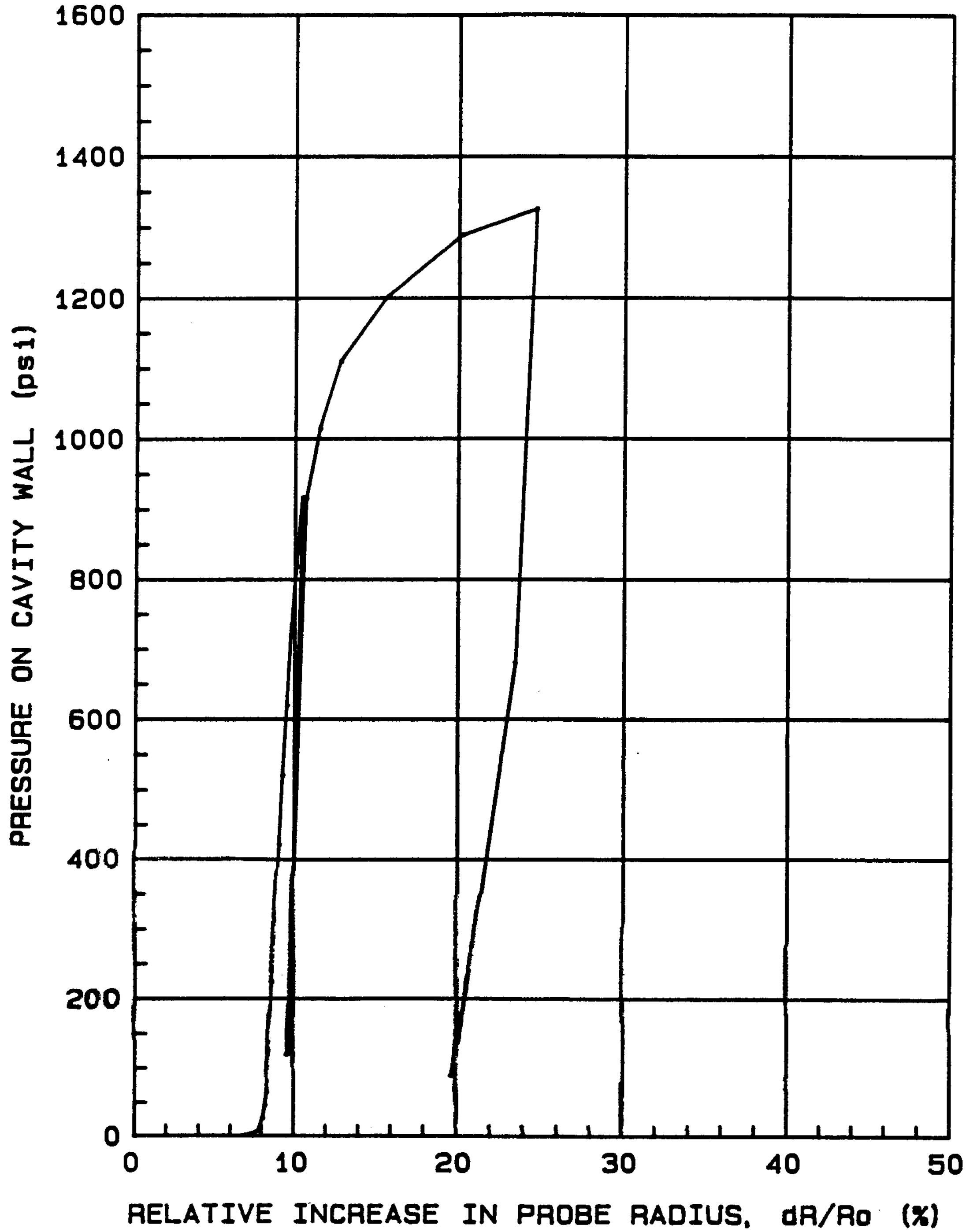
Po = 100.0 psi P1 = 0.0 psi P1* = 0.0 psi
Eo = 163413 psi Er = 316431 psi Eo/P1* =

SSC BORING BE-2 TEST 34 198.5 FT

POINT NUMBER	D.I.R. (mm)	PRESSURE (psi)	CORRECTED RADIUS (mm)	Δ R/Ro (%)	CORRECTED PRESSURE (psi)
1	-1.59	0	35.55	0.00	0
2	-1.44	40	35.64	0.25	35
3	-1.37	60	35.68	0.36	53
4	-1.28	80	35.73	0.51	70
5	-1.13	100	35.83	0.77	86
6	-1.06	120	35.87	0.88	104
7	-0.98	140	35.91	1.01	121
8	-0.91	200	35.95	1.12	179
9	-0.80	400	35.99	1.24	378
10	-0.66	600	36.06	1.41	576
11	-0.52	800	36.12	1.59	774
12	-0.33	1000	36.21	1.85	971
13	-0.38	600	36.26	1.97	570
14	-0.54	200	36.19	1.79	172
15	-0.48	600	36.19	1.79	572
16	-0.25	1000	36.30	2.10	969
17	0.00	1200	36.44	2.50	1164
18	0.46	1400	36.72	3.27	1357
19	1.27	1600	37.23	4.71	1546
20	3.02	1800	38.38	7.96	1728
21	8.59	2000	42.37	19.16	1893
22	8.57	1800	42.37	19.18	1693
23	8.23	1100	42.20	18.68	995
24	6.55	200	41.05	15.46	104

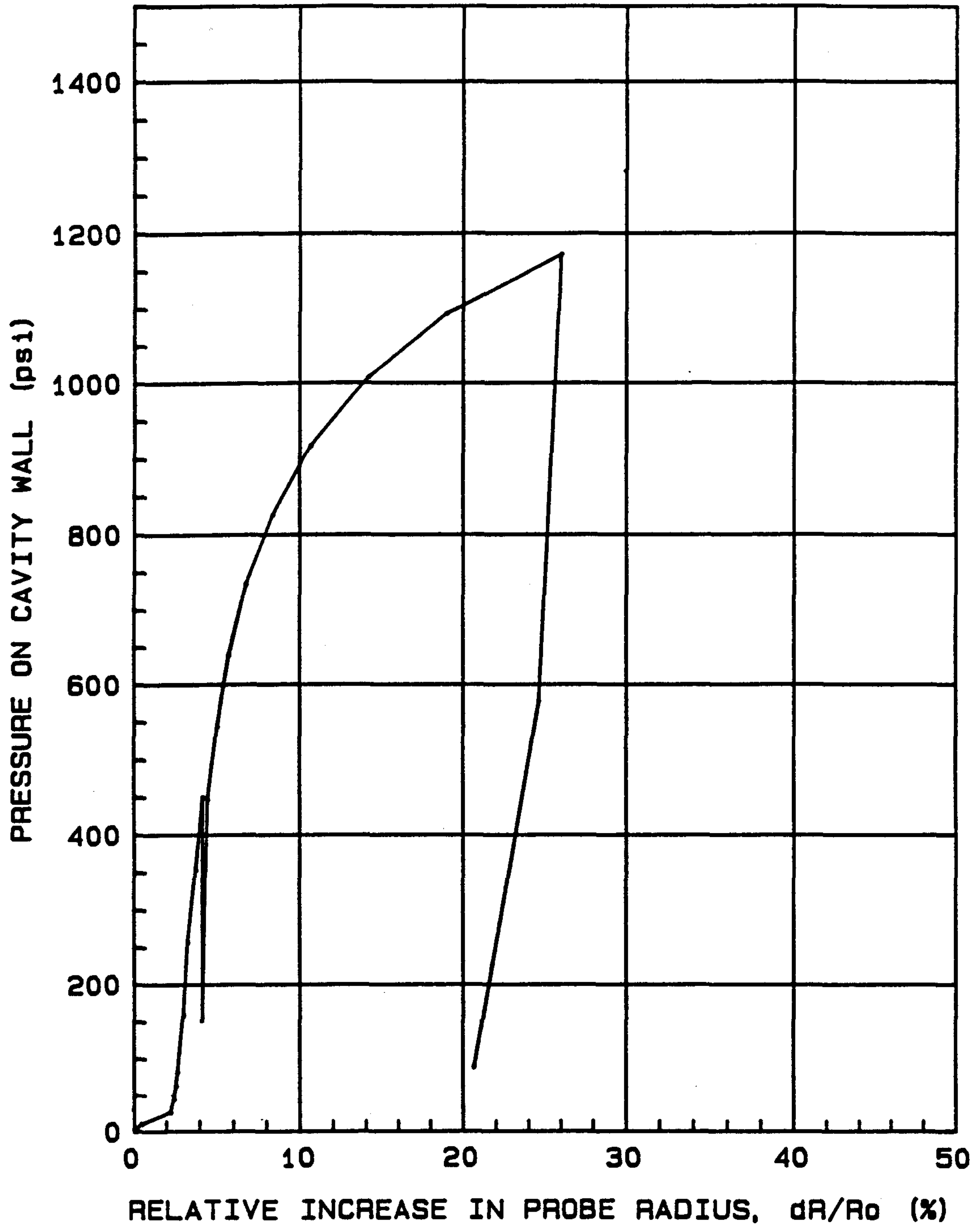
Po = 140.0 psi   Pl = 1950.0 psi   Pl* = 1810.0 psi
Eo = 170874 psi   Er = 352820 psi   Eo/Pl* = 94.4

Po = 55 psi
Eo = 64592 psi
Pl = 1350 psi
Er = 107661 psi
Pl* = 1295 psi
Eo/Pl* = 49.8

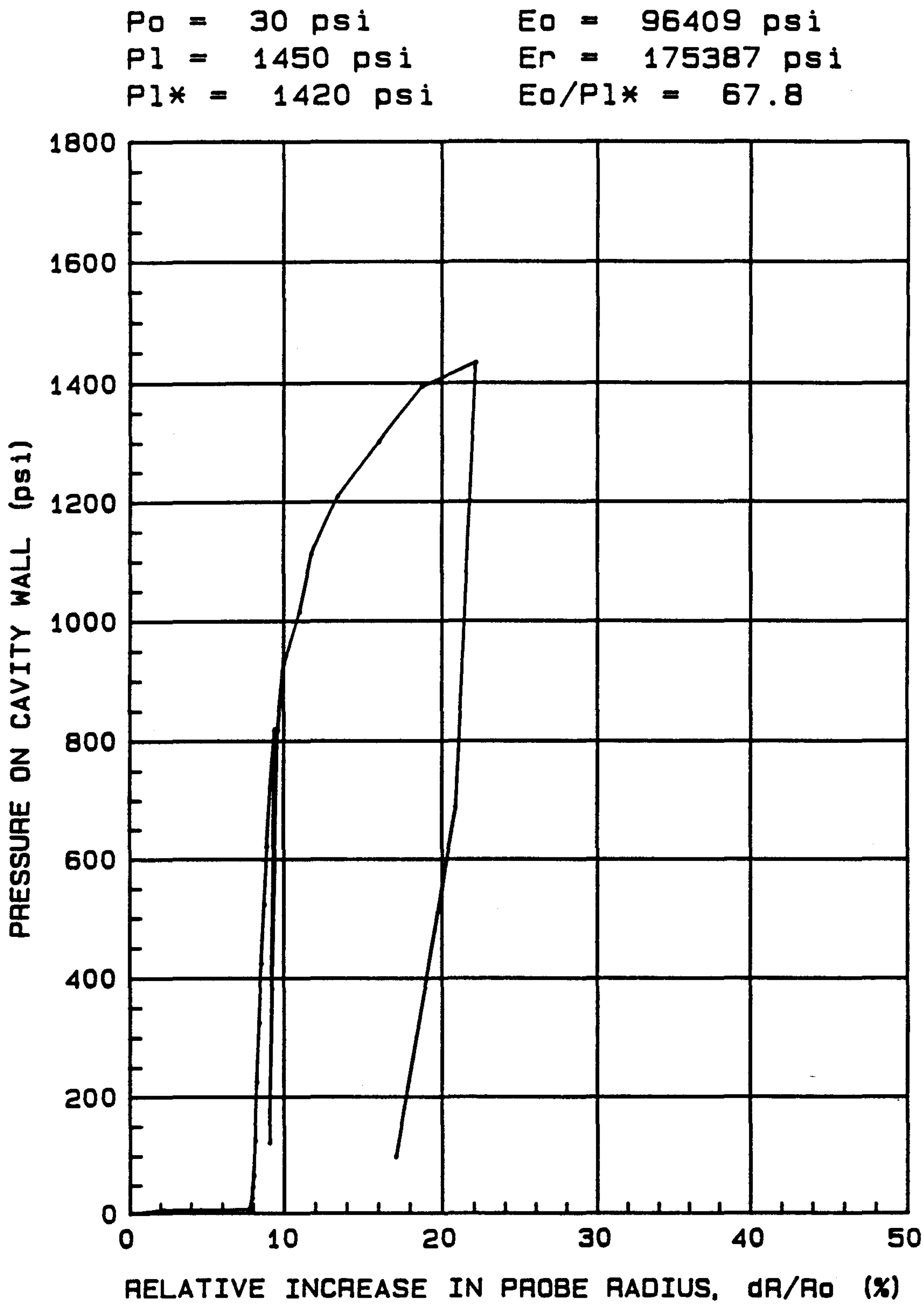


SSC BORING BF-6 TEST 4 58 FT

Po = 50 psi   Eo = 49492 psi
Pl = 1250 psi   Er = 108571 psi
Pl* = 1200 psi   Eo/Pl* = 41.2

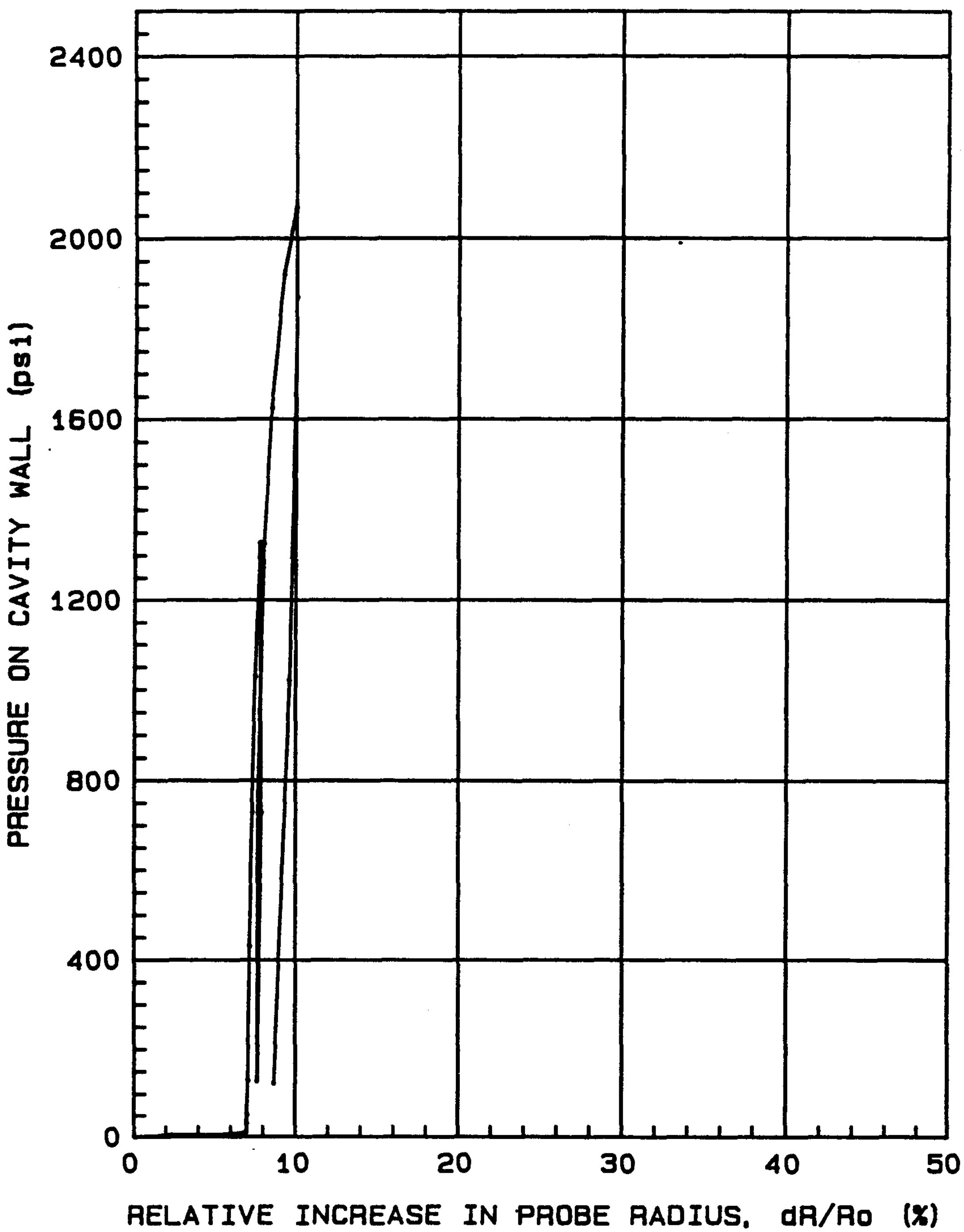


SSC BORING BF-6 TEST 3 63 FT



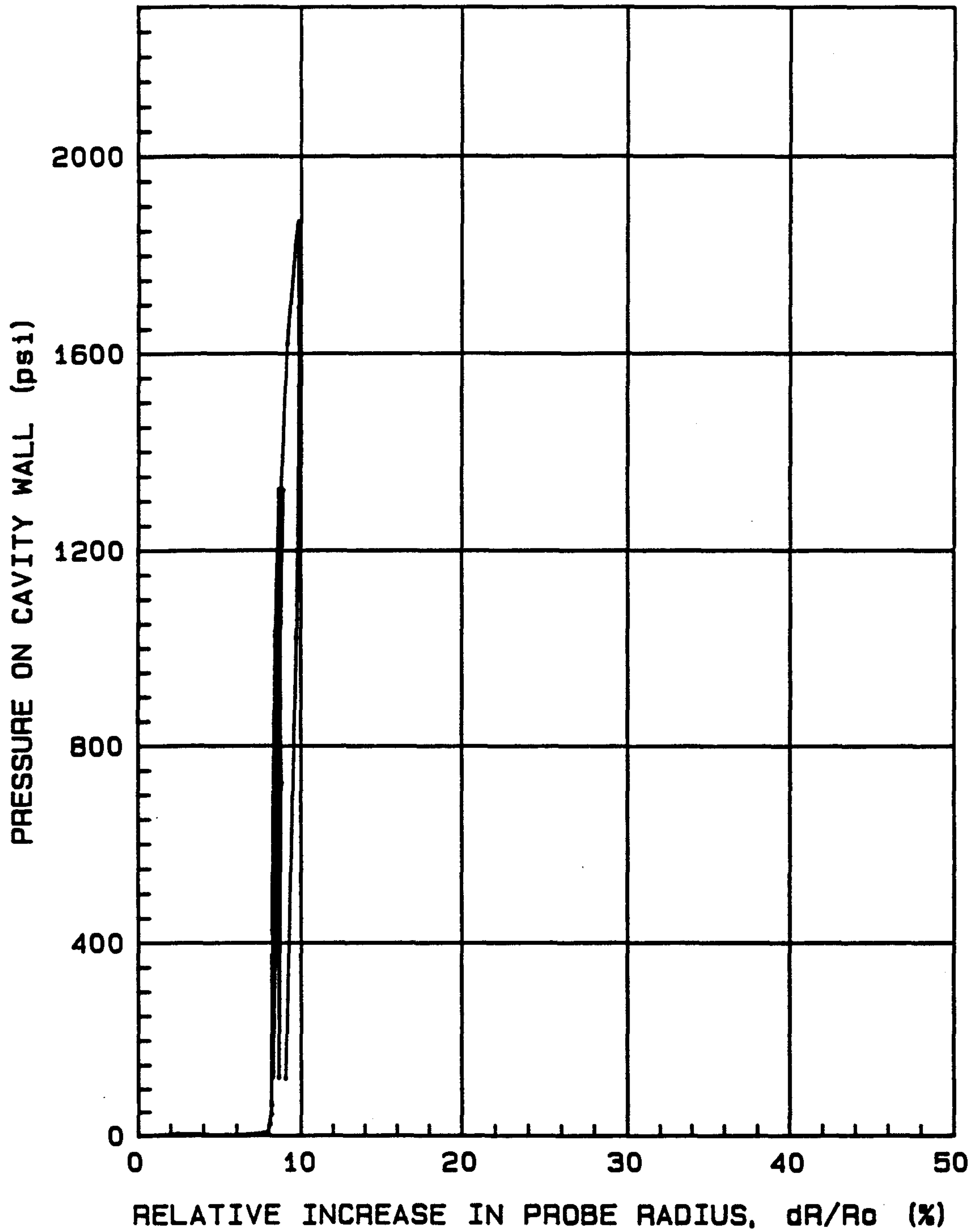
SSC BORING BF-6 TEST 11 69 FT

Po = 20 psi   Eo = 300509 psi
Pl = psi   Er = 384361 psi
Pl* = psi   Eo/Pl* =

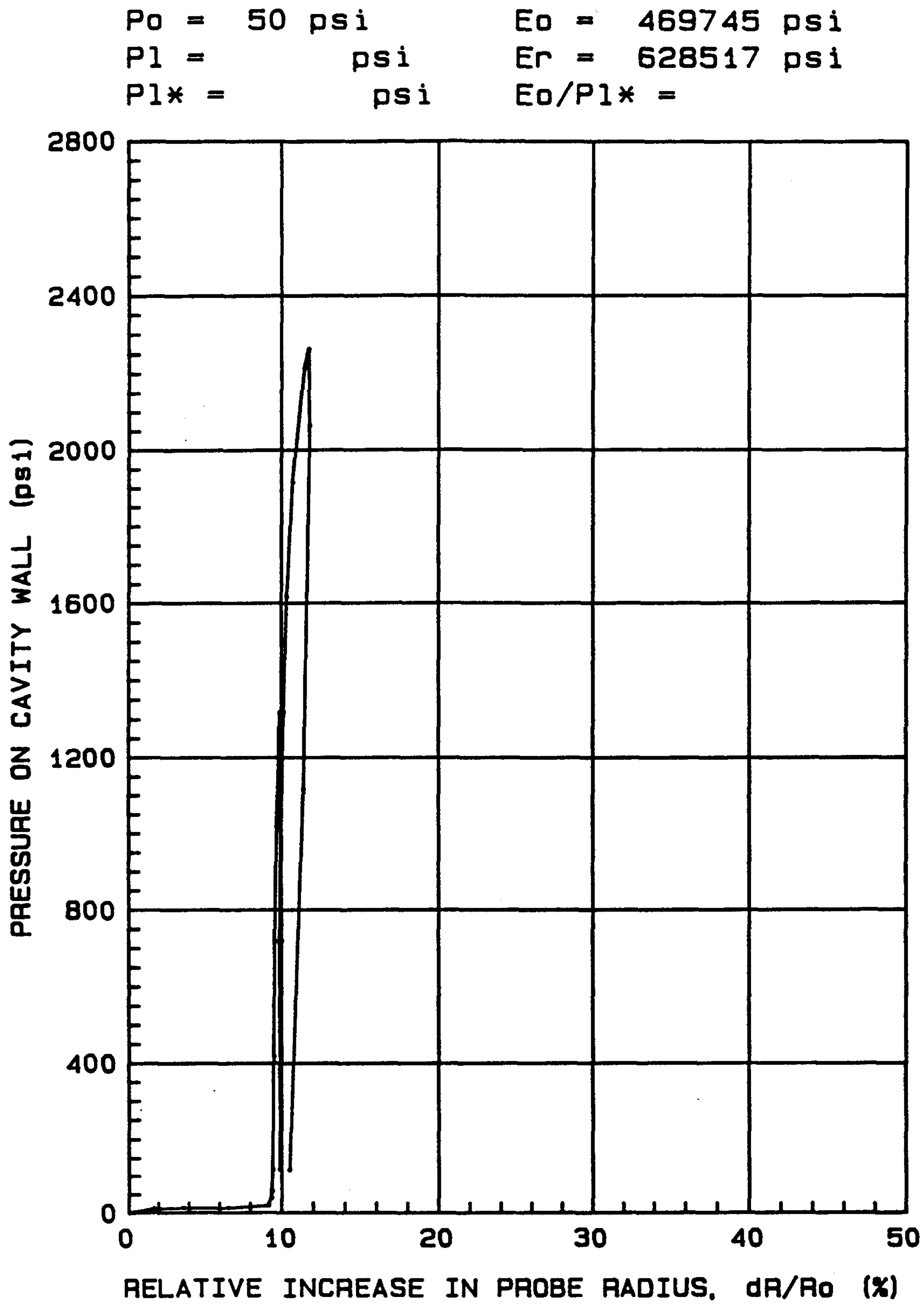


SSC BORING BF-6 TEST 25 123 FT

Po = 50 psi Eo = 546188 psi
Pl = psi Er = 586840 psi
Pl* = psi Eo/Pl* =

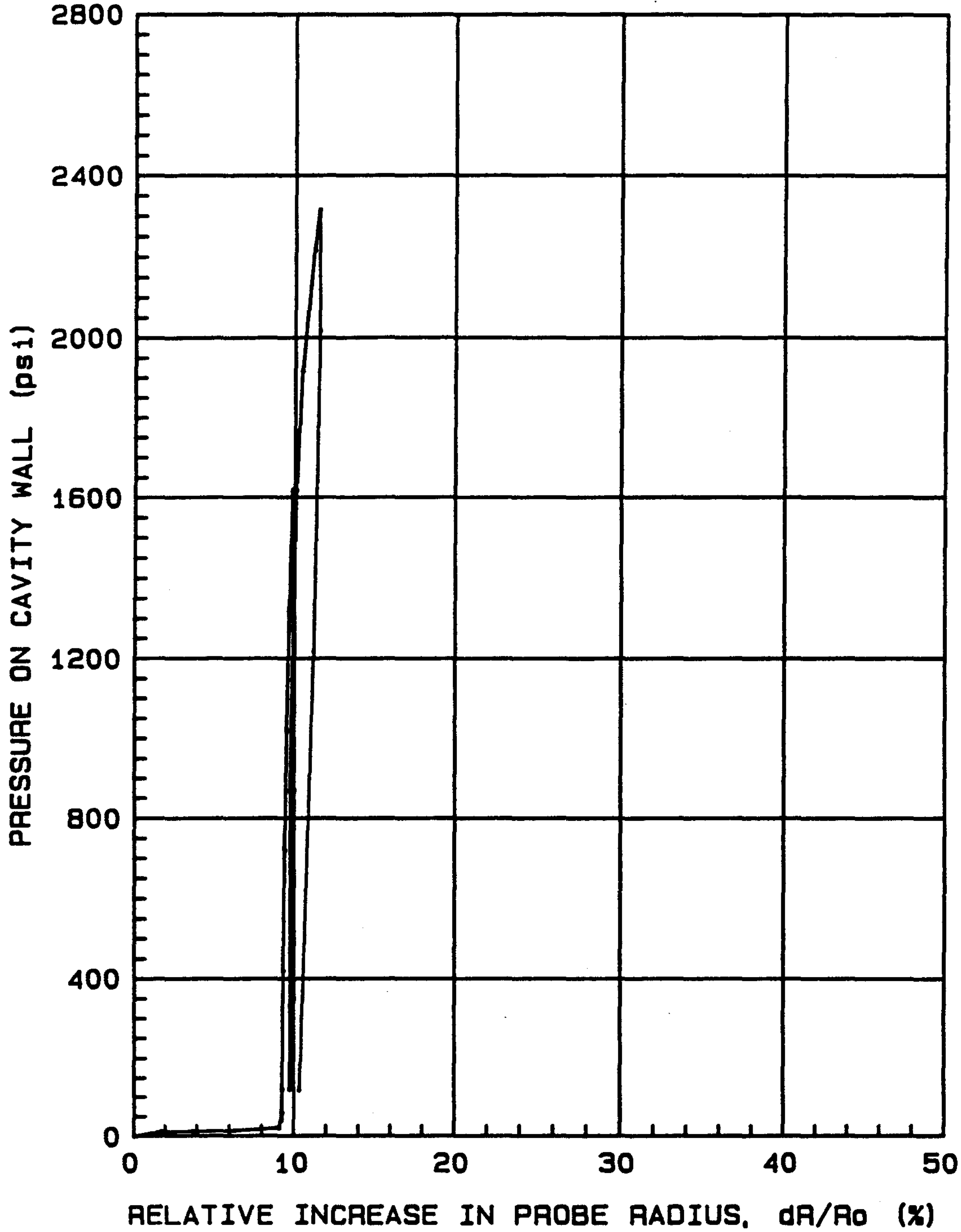


SSC BORING BF-6 TEST 23 128.5 FT



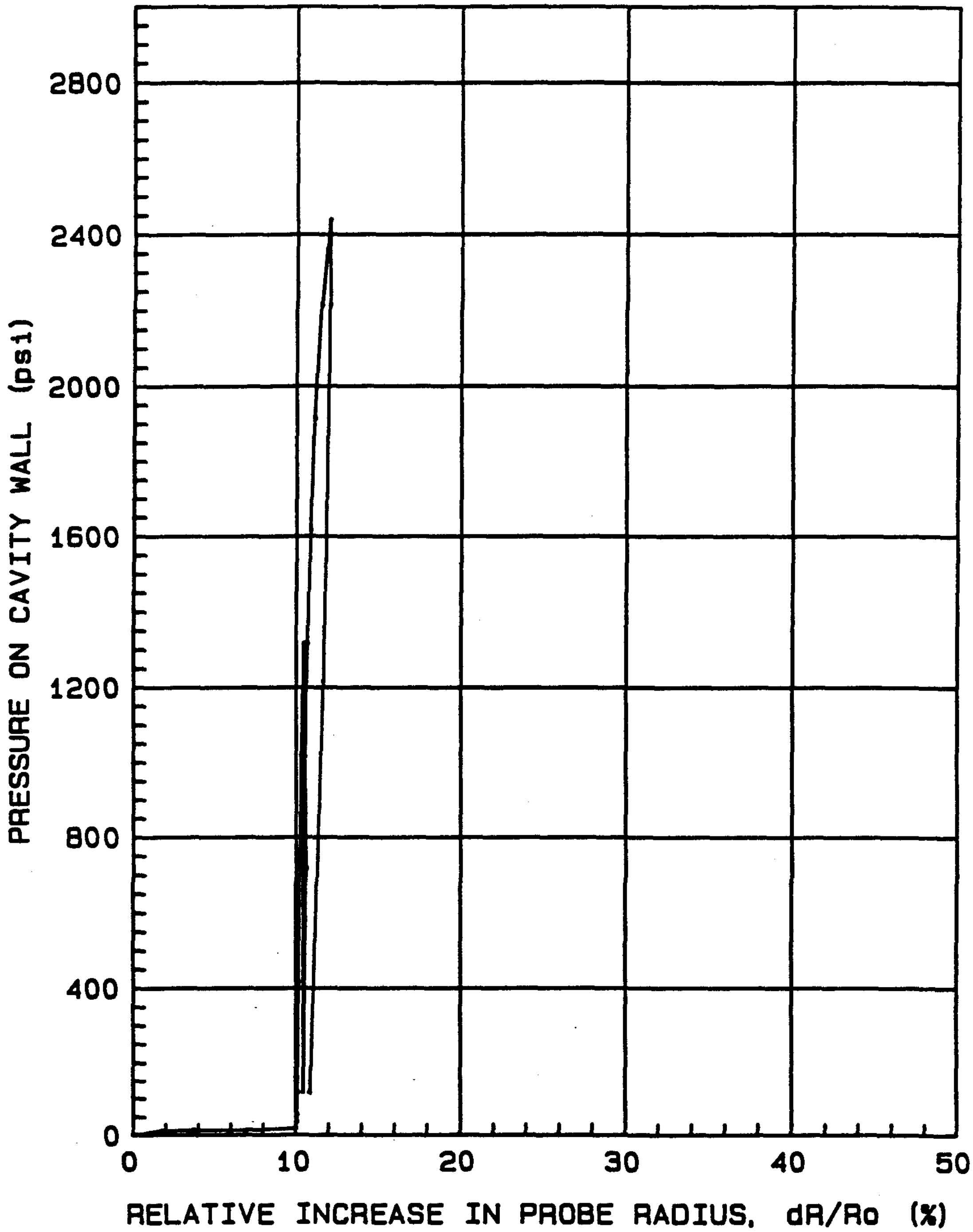
SSC BORING BF-6 TEST 30 188.5 FT

Po = 60 psi Eo = 446135 psi
Pl = psi Er = 564881 psi
Pl* = psi Eo/Pl* =



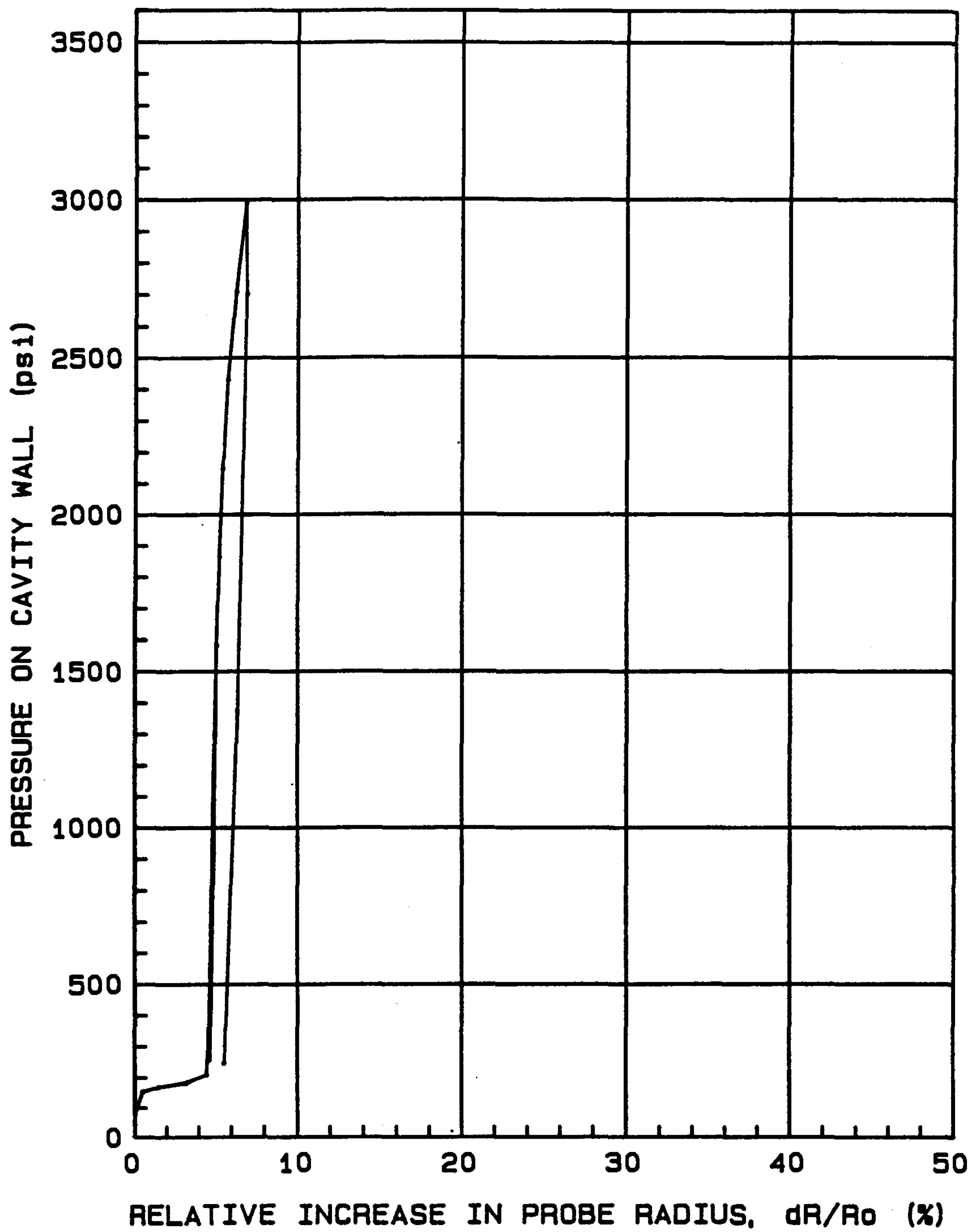
SSC BORING BF-6 TEST 33 208.5 FT

Po = 40 psi Eo = 552499 psi
Pl = psi Er = 636529 psi
Pl* = psi Eo/Pl* =



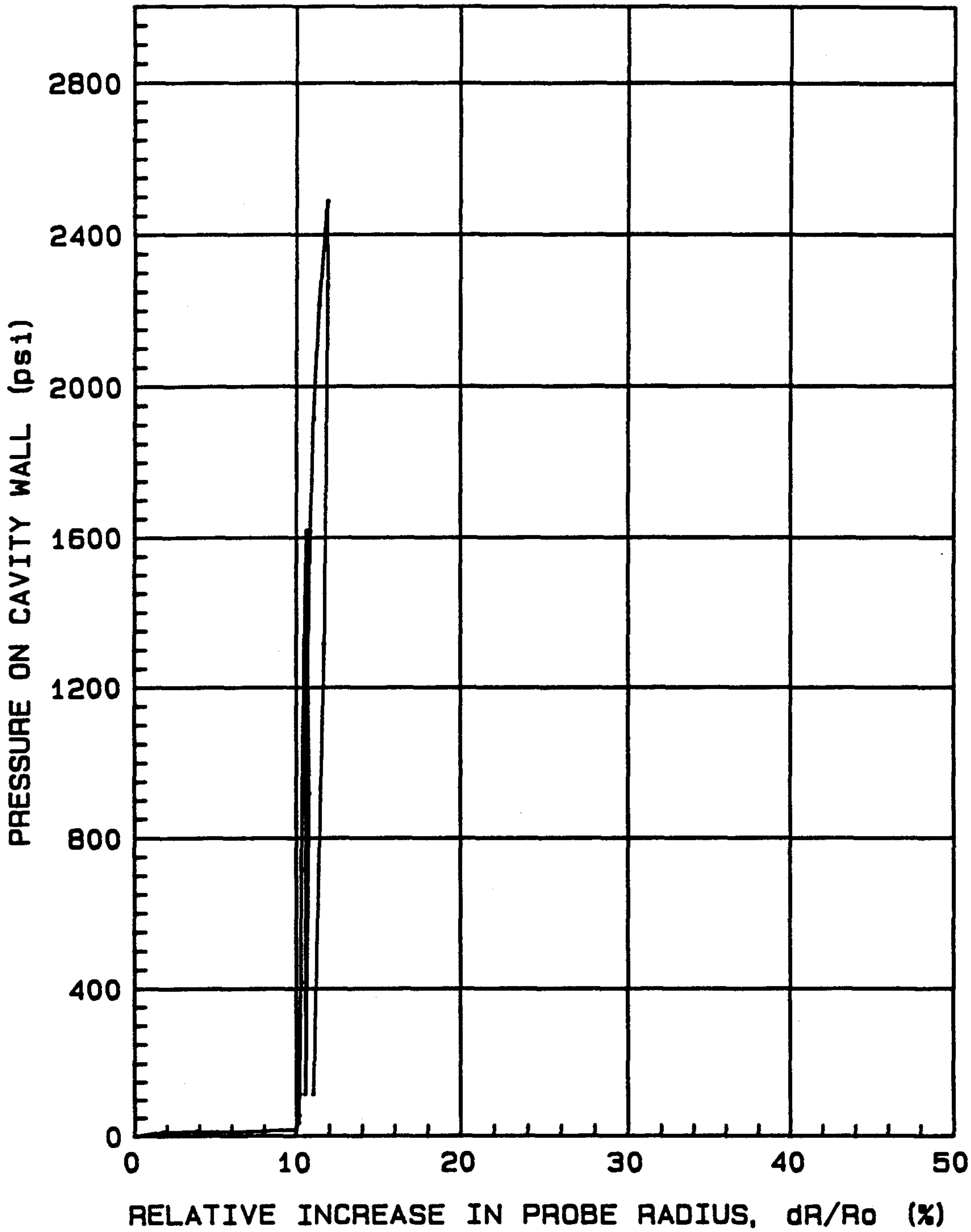
SSC BORING BF-6 TEST 38 278.5 FT

Po = psi   Eo = 365376 psi
Pl = psi   Er = 427857 psi
Pl* = psi   Eo/Pl* =



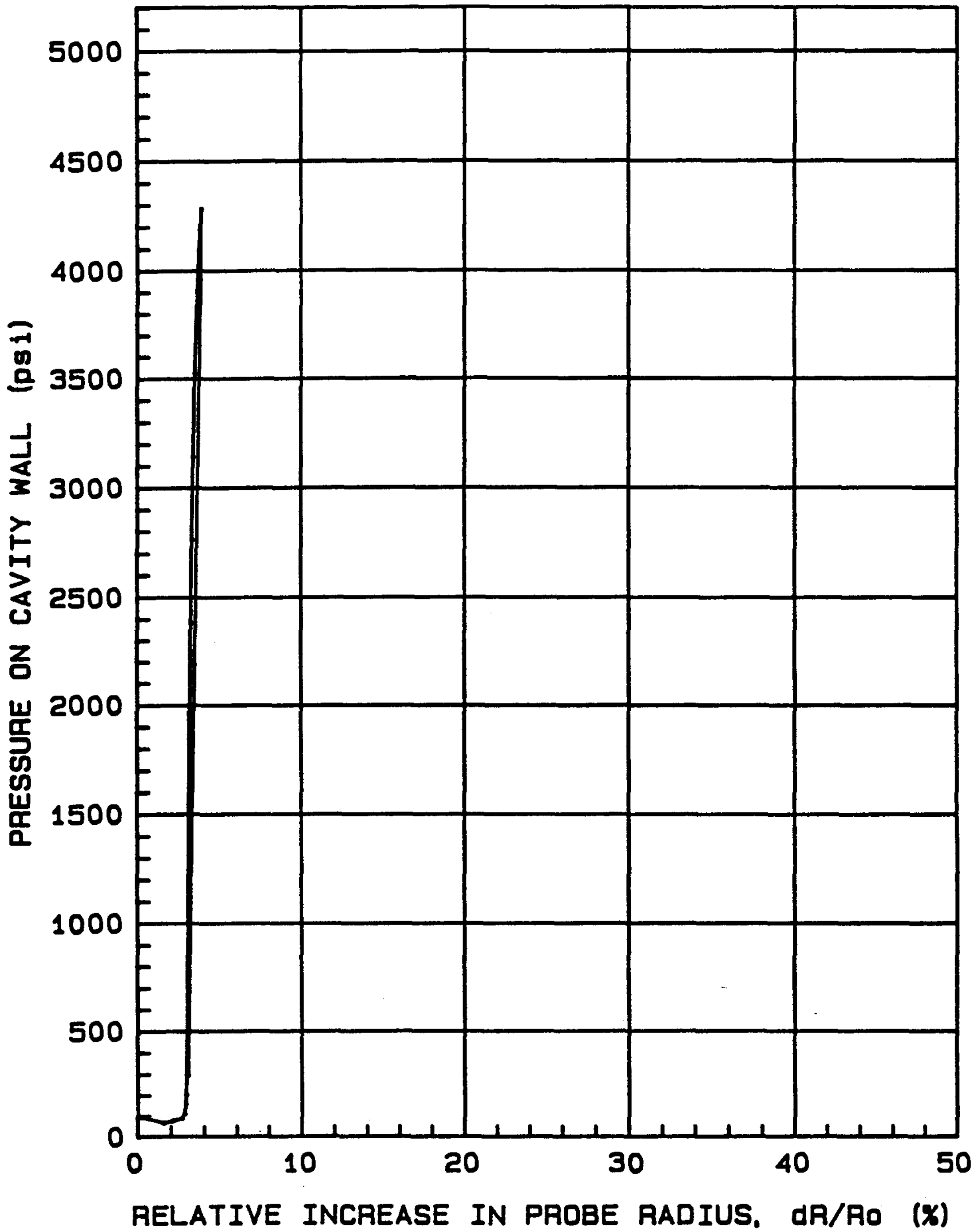
SSC BORING BF-6 TEST 41 288 FT

Po = 40 psi Eo = 564159 psi
Pl = psi Er = 675037 psi
Pl* = psi Eo/Pl* =



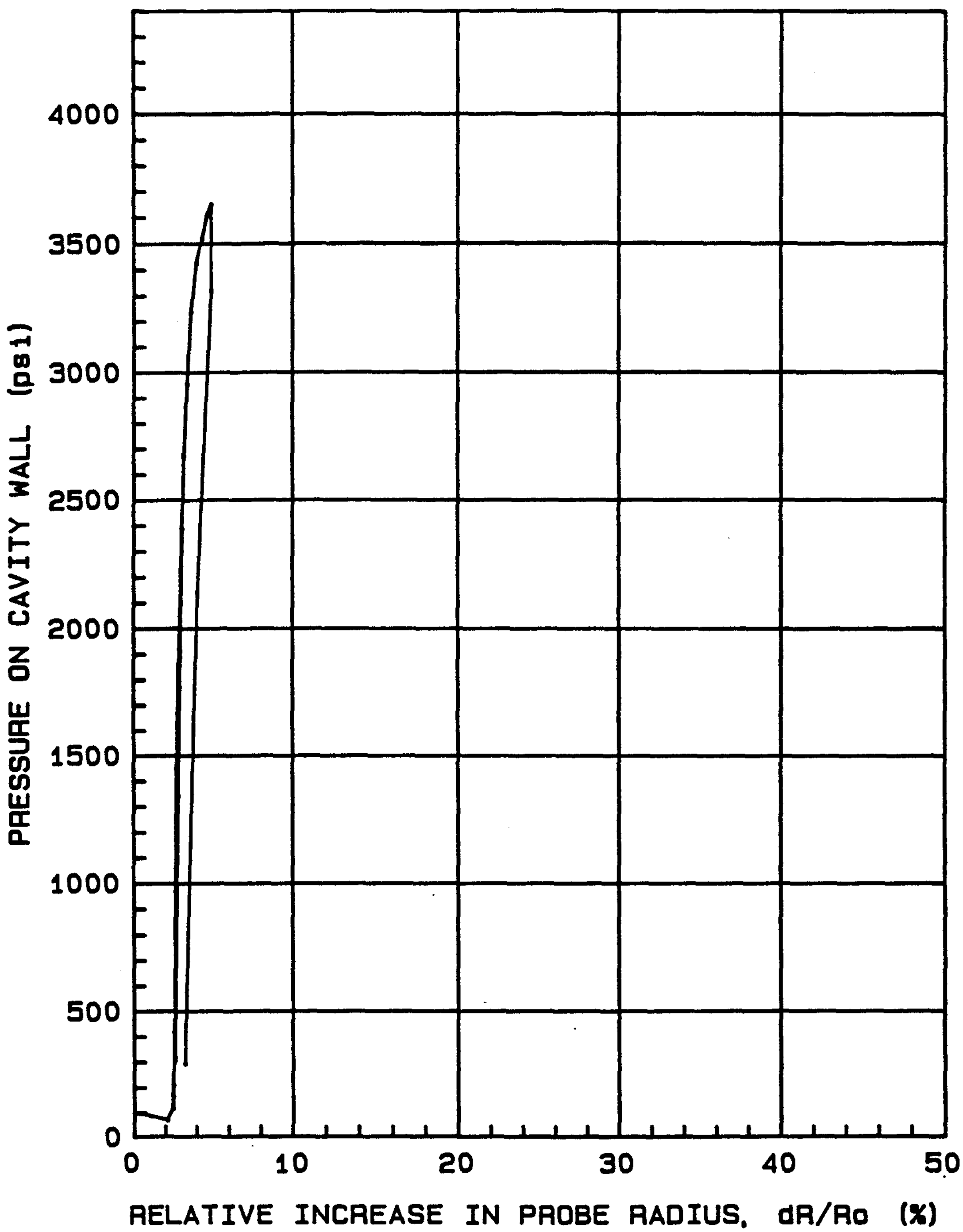
SSC BORING BF-6 TEST 42 297 FT

Po = psi Eo = 1216922 psi
Pl = . psi Er = 1019076 psi
Pl* = psi Eo/Pl* =

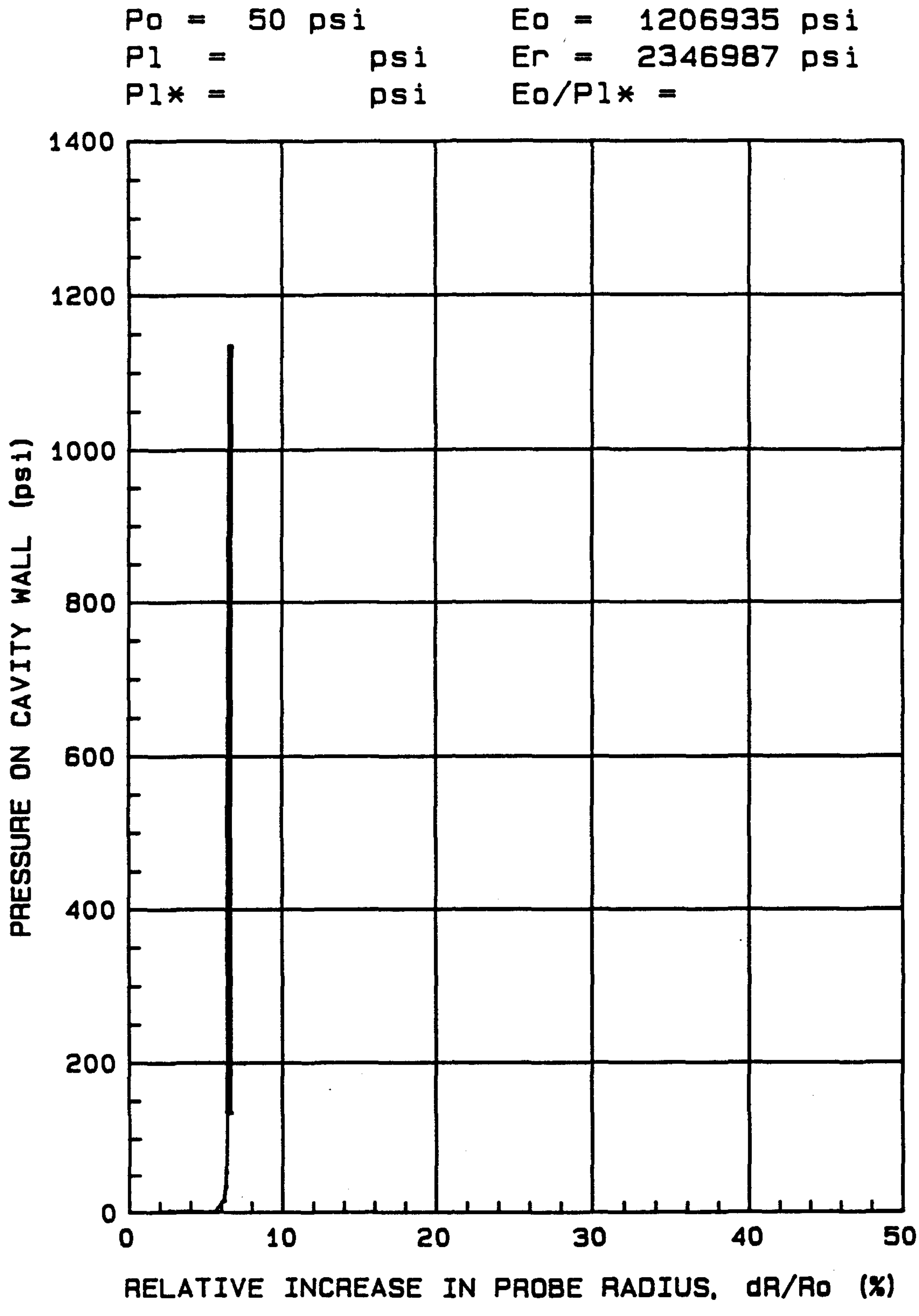


SSC BORING BF-6 TEST 48 348 FT

Po = psi Eo = 559127 psi
Pl = psi Er = 552296 psi
Pl* = psi Eo/Pl* =

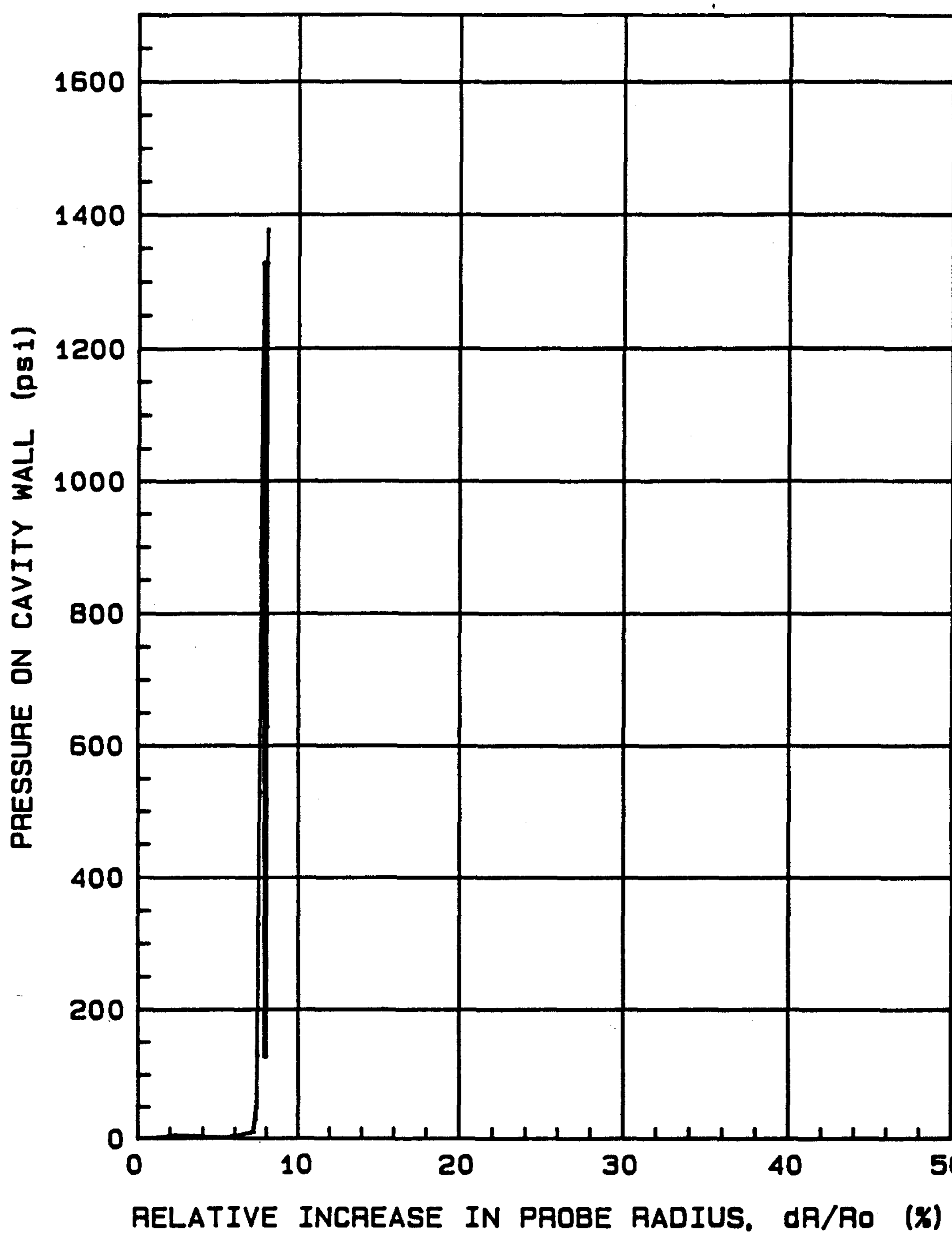


SSC BORING BF-6 TEST 47 358 FT

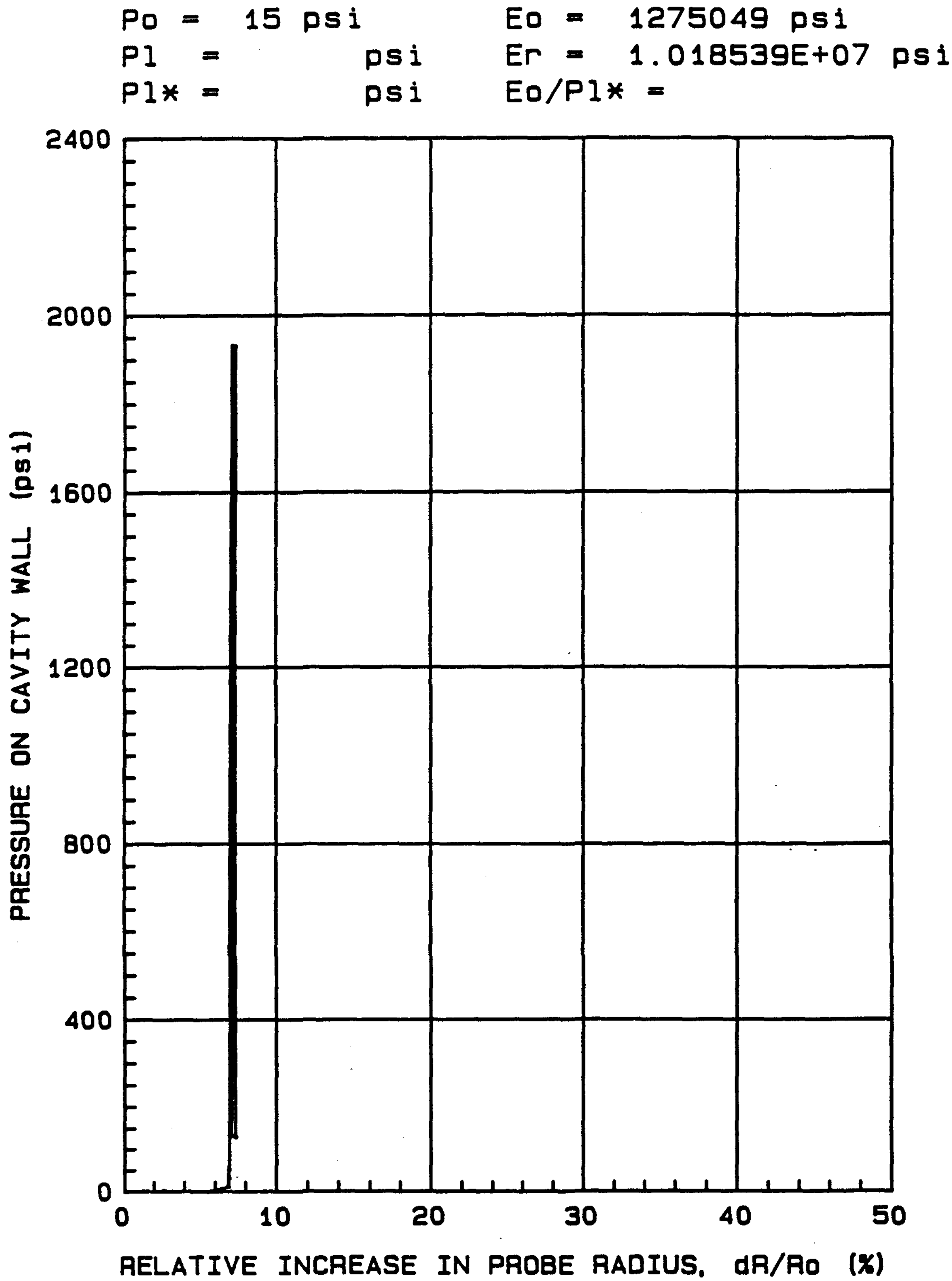


SSC BORING BE-2 TEST 8 40 FT

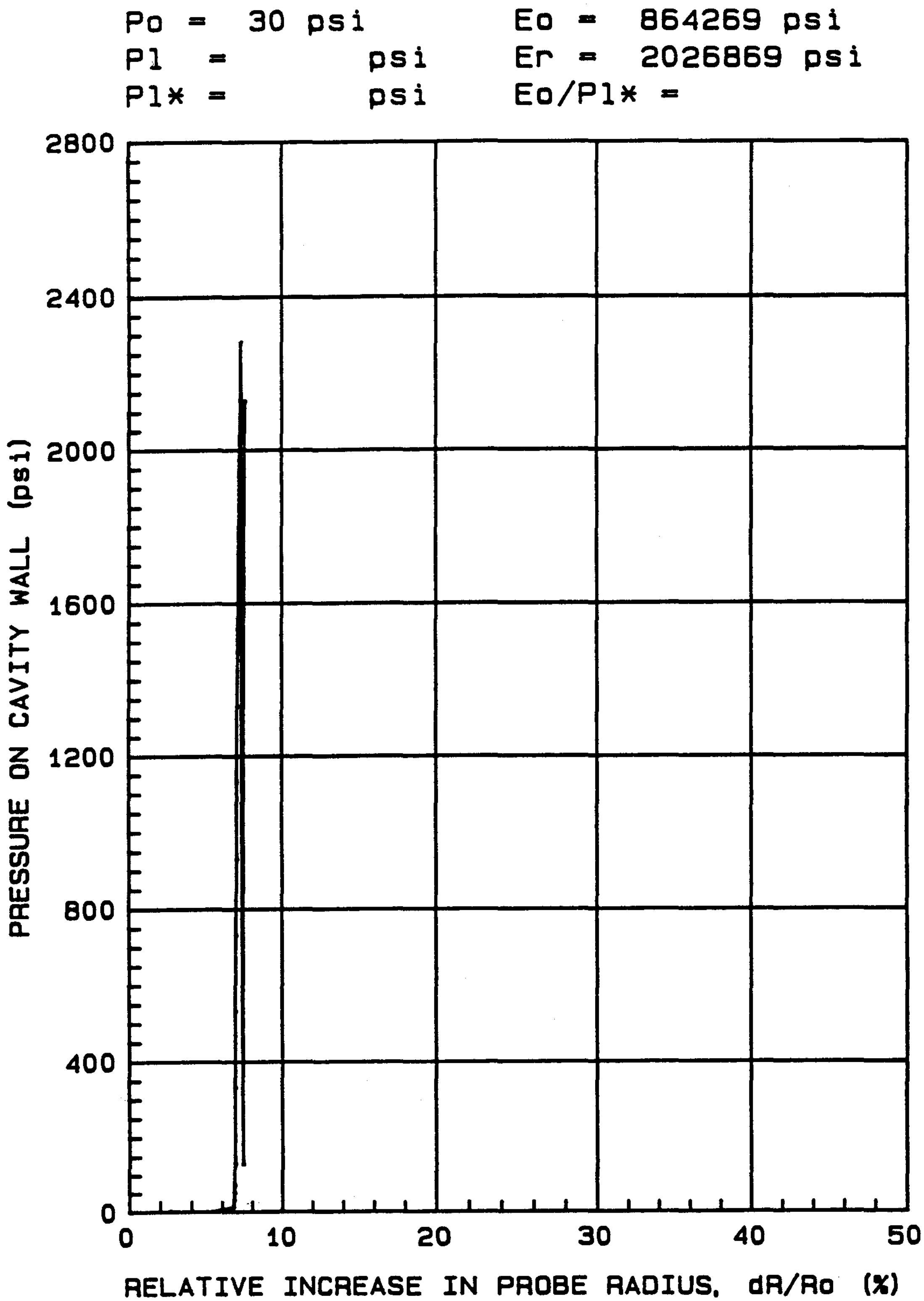
Po = 50 psi Eo = 482355 psi
Pl = psi Er = 1438786 psi
Pl* = psi Eo/Pl* =



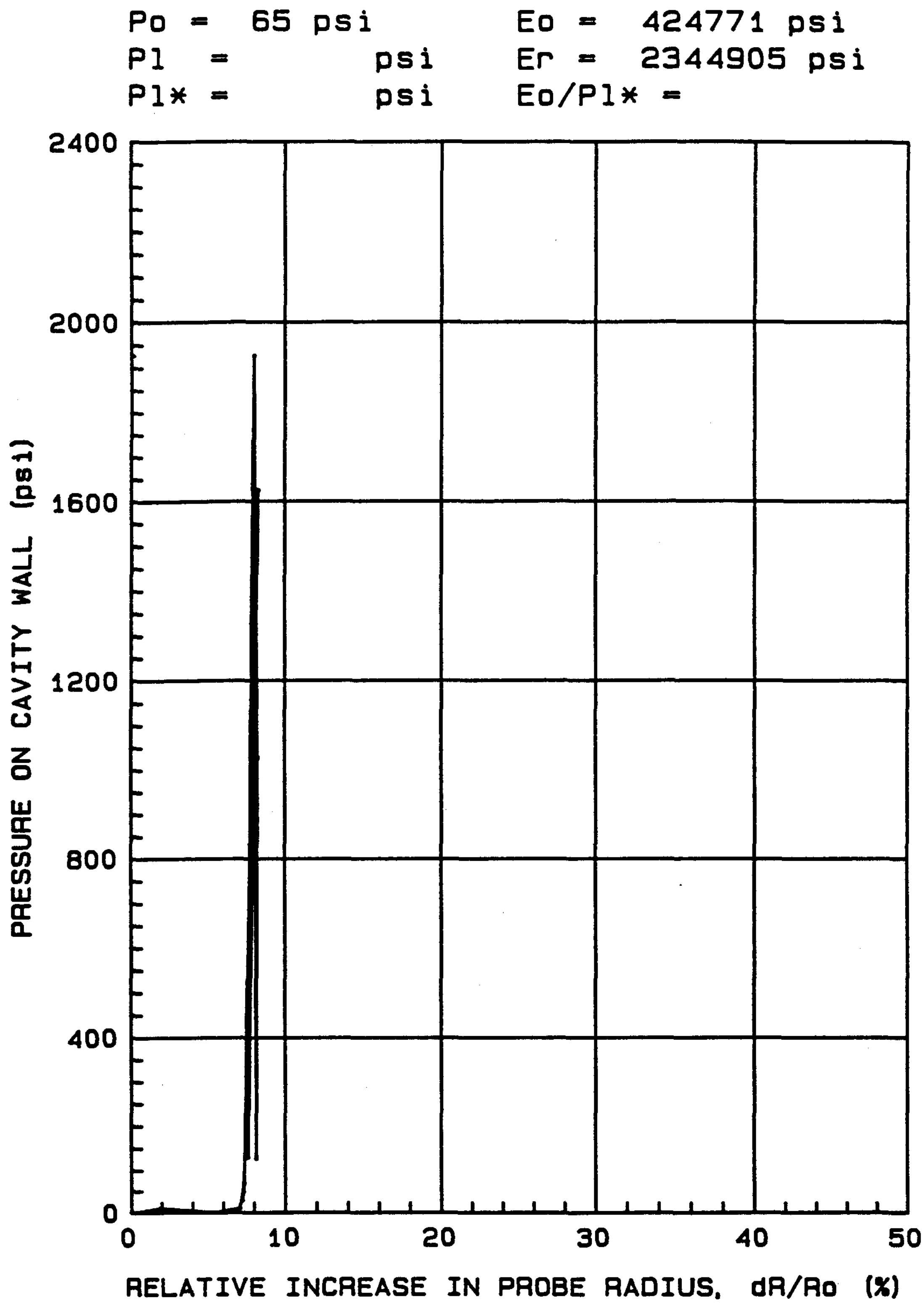
SSC BORING BE-2 TEST 7 46.5 FT



SSC BORING BE-2 TEST 13 89.5 FT

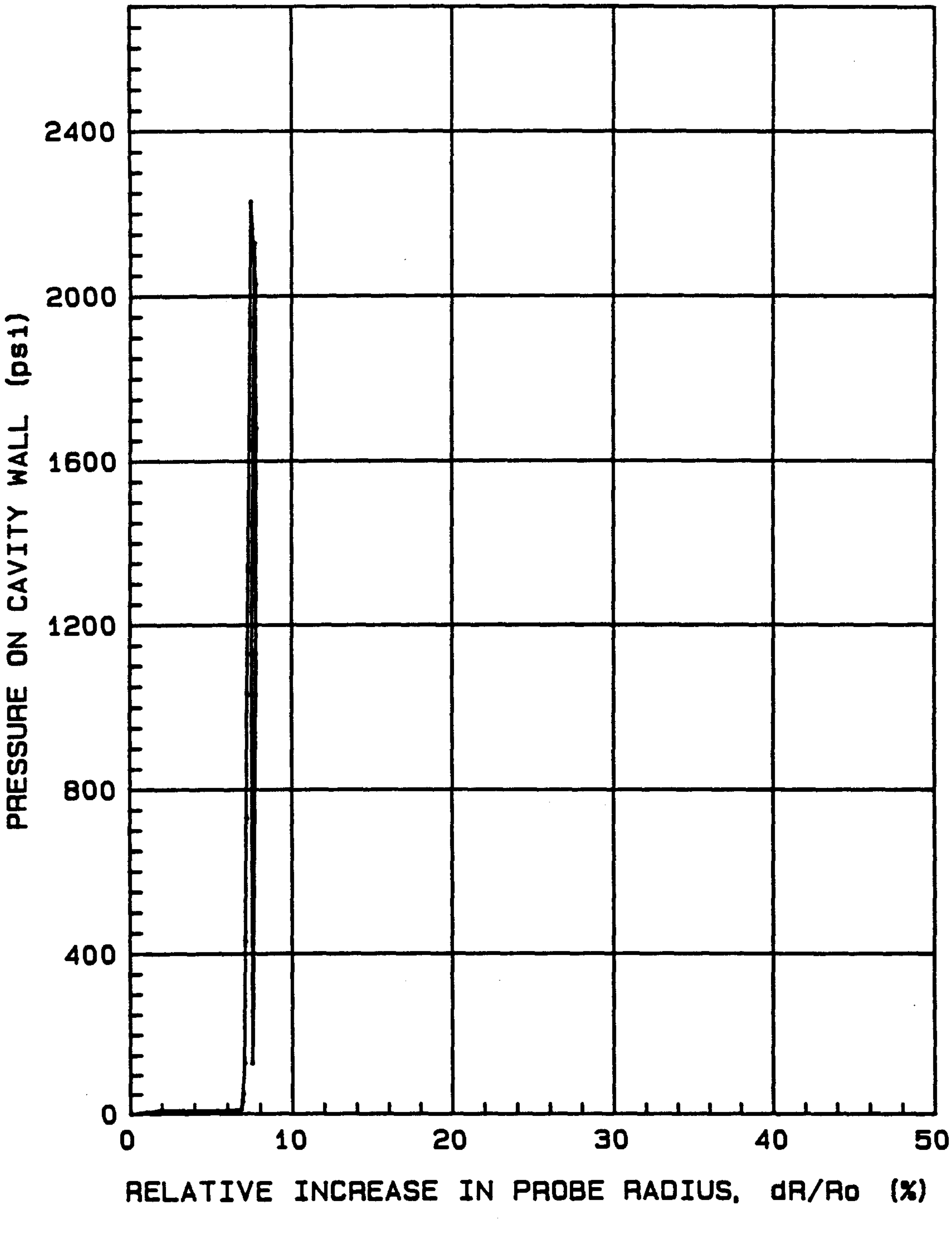


SSC BORING BE-2 TEST 12 99.5 FT



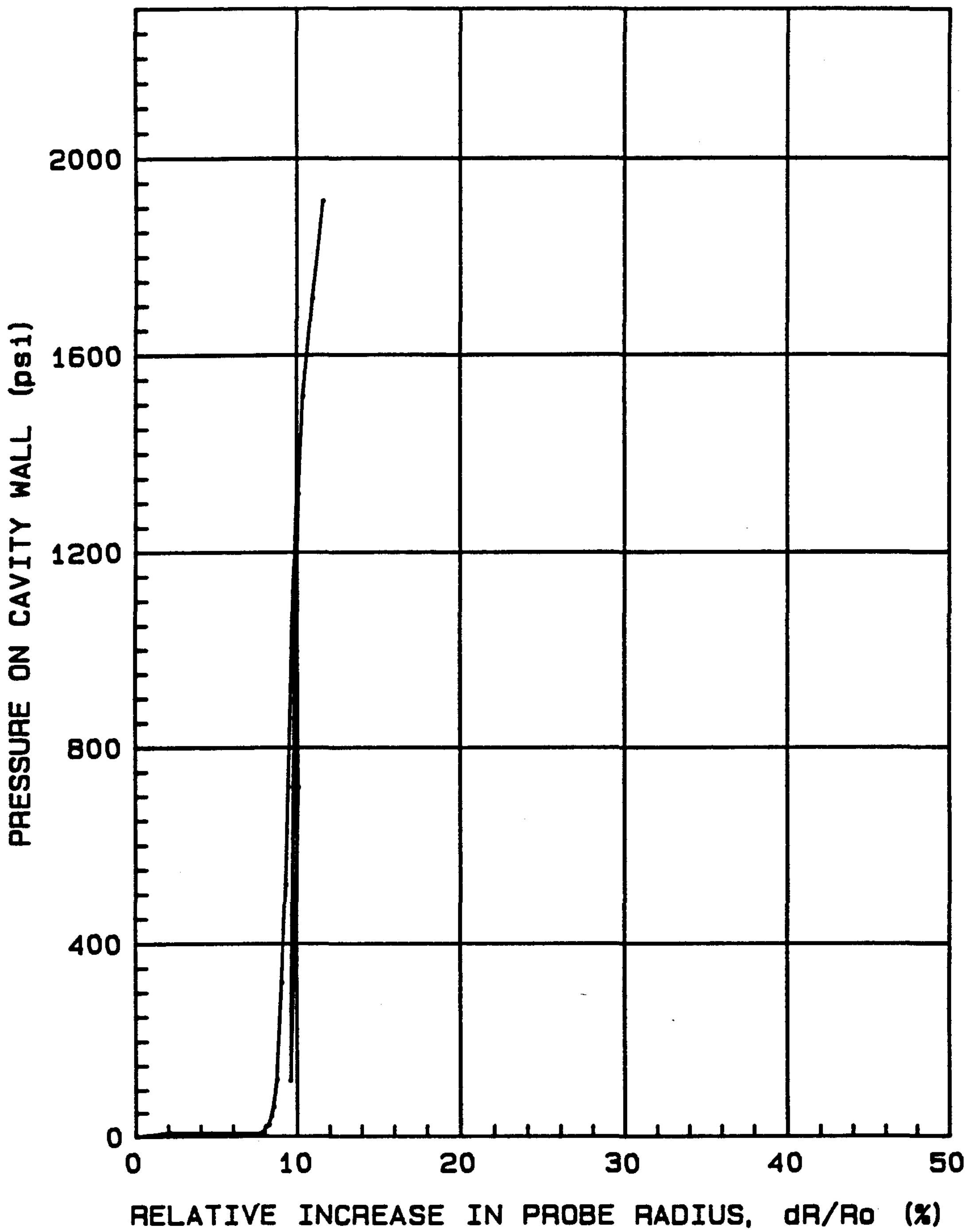
SSC BORING BE-2 TEST 17 125 FT

Po = 30 psi Eo = 671865 psi
Pl = psi Er = 1312021 psi
Pl* = psi Eo/Pl* =



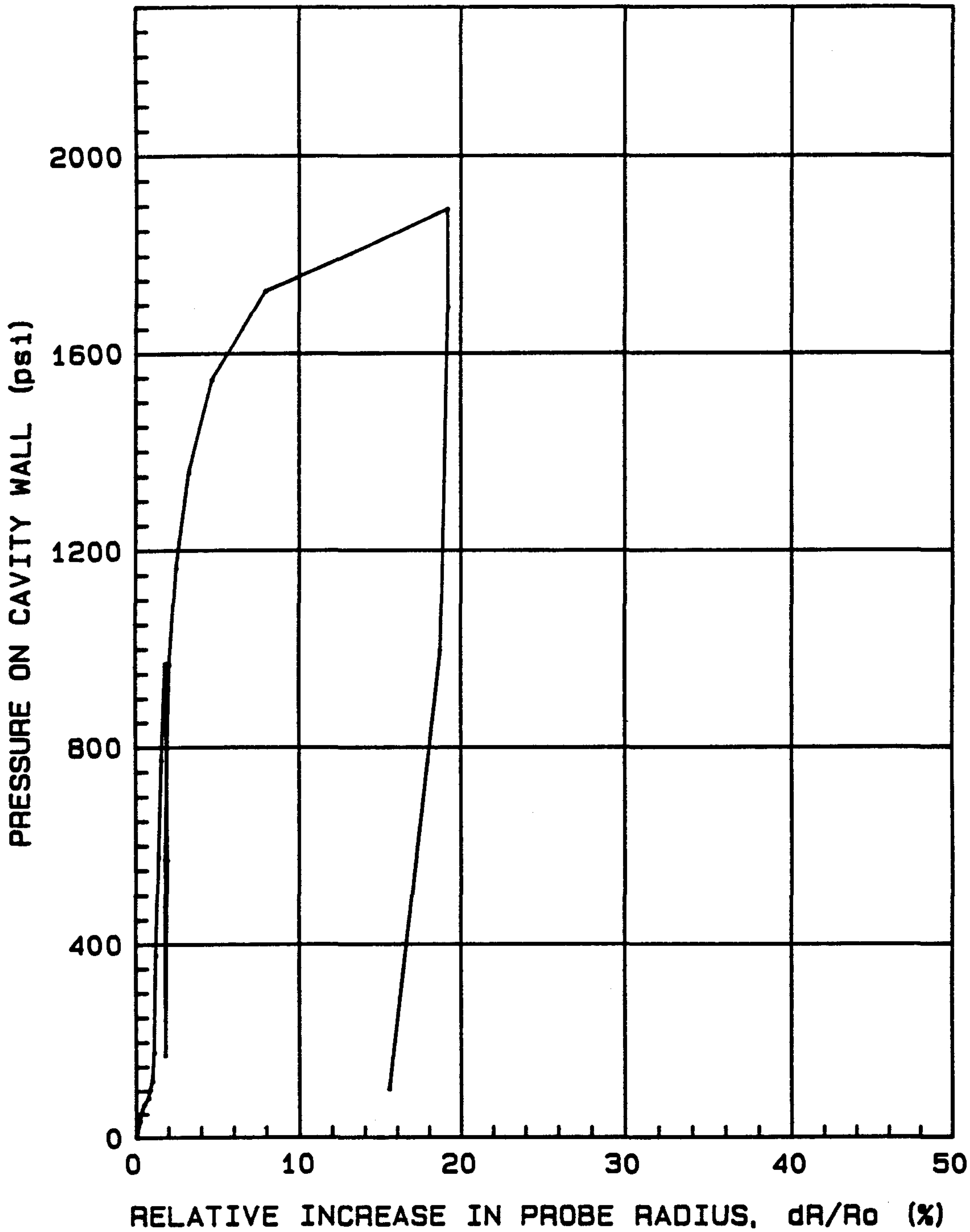
SSC BORING BE-2 TEST 16 132 FT

Po = 100 psi Eo = 163413 psi
Pl = psi Er = 316431 psi
Pl* = psi Eo/Pl* =



SSC BORING BE-2 TEST 27 167 FT

Po = 140 psi　　Eo = 170874 psi
Pl = 1950 psi　　Er = 352820 psi
Pl* = 1810 psi　　Eo/Pl* = 94.4



SSC　BORING BE-2　TEST 34　198.5 FT

APPENDIX D

LABORATORY GEOMECHANICAL DATA FOR BORING :BE-2

REVISION :2.0

DRILLING CONTRACTOR: SWL

DATE :'3/5/90

	GENERAL LITHOLOGY	VERTICAL DEPTH (ft)	INCLINED DEPTH (ft)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SPECIFIC GRAVITY	LIQUID LIMIT	PLASTICITY INDEX	CARBONATE CONTENT (%)	SAMPLE DIMENSION RATIO L/D	SAMPLE FAILURE MODE/ANGLE	UNCONFINED COMPRESSIVE STRENGTH (psi)	FAILURE STRAIN (%)	DIRECT SHEAR NORMAL STRESS (psi)	DIRECT SHEAR PEAK STRENGTH (psi)	DIRECT SHEAR RESIDUAL STRENGTH (psi)	BRAZIL STRENGTH (psi)	2ND CYCLE SLAKE DURABILITY INDEX (%)	TABER ABRASION HARDNESS INDEX	SWELL PRESSURE INDEX (psi)	COMMENTS
	AUSTIN	18.0		16.6																	
	AUSTIN	18.2		16.3	116.0					2.23	B-2	1416	0.9								
	AUSTIN	47.5		10.2	133.0																
	AUSTIN	47.6		10.4													450				
	AUSTIN	103.1		10.9	127.0					2.26	E	1313	0.8								
	AUSTIN	103.8		9.5																	
	EAGLE FD.	151.1																	*		* TEST PENDING
178	EAGLE FD.	151.7		15.9	119.2																
	EAGLE FD.	154.2		17.5																	
	EAGLE FD.	154.8							11.2												
145	EAGLE FD.	154.9		9.8	132.0		*	*		2.24	B-1/30	2099	1.0								LS LAYER/* TEST PEND.
	EAGLE FD.	160.8		14.7																	
	EAGLE FD.	160.9		14.3			92	57													DRY METHOD
	EAGLE FD.	161.1																		*	* TEST PENDING
	EAGLE FD.	185.2		3.8	*																* SAMPLE UNSUITABLE
	EAGLE FD.	185.3																	*		* TEST PENDING
	EAGLE FD.	193.2		15.7																	
	EAGLE FD.	193.3		15.3			83	52													DRY METH./UNUSED SD
	EAGLE FD.	193.3																33.1			
	EAGLE FD.	193.4							7.1												
157	EAGLE FD.	194.2		6.2																	SHALY LS. LAYER
	EAGLE FD.	194.3		7.7	139.3	*			45.7	2.40	B-1	844	1.0								SHALY LS./* TEST PEND.
	AUSTIN	69.7		18.2																	DELETED
	EAGLE FD.	151.1																	*		* TEST PENDING

LABORATORY GEOMECHNICAL DATA FOR BORING :BE-2

REVISION :2.0

DRILLING CONTRACTOR: SWL

DATE :'3/5/90

GENERAL LITHOLOGY	VERTICAL DEPTH (ft)	INCLINED DEPTH (ft)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SPECIFIC GRAVITY	LIQUID LIMIT	PLASTICITY INDEX	CARBONATE CONTENT (%)	SAMPLE DIMENSION RATIO L/D	SAMPLE FAILURE MODE/ANGLE	UNCONFINED COMPRESSIVE STRENGTH (psi)	FAILURE STRAIN (%)	DIRECT SHEAR NORMAL STRESS (psi)	DIRECT SHEAR PEAK STRENGTH (psi)	DIRECT SHEAR RESIDUAL STRENGTH (psi)	BRAZIL STRENGTH (psi)	2ND CYCLE SLAKE DURABILITY INDEX (%)	TABER ABRASION HARDNESS INDEX	SWELL PRESSURE INDEX (psi)	COMMENTS
EAGLE FD.	154.9		9.8	132.0		*	*		2.24	B-1/30	2099	1.0								LS LAYER/*TEST PEND.
	161.0																		*	*TEST PENDING
	185.2			*																SAMPLE UNSUITABLE
EAGLE FD.	185.3																	*		* TEST PENDING
	194.3				*			*												SHALY LS/*TEST PEND
EAGLE FD.	202.4		16.3			112	75													DELETED
EAGLE FD.	203.0		17.0	115.4															43.3	DELETED
EAGLE FD.	203.3		17.0	113.0															29.0	DELETED

LABORATORY GEOMECHNICAL DATA FOR BORING :BF-6

REVISION :2.0

DRILLING CONTRACTOR: SWL

DATE :3/12/90

GENERAL LITHOLOGY	VERTICAL DEPTH (ft)	INCLINED DEPTH (ft)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SPECIFIC GRAVITY	LIQUID LIMIT	PLASTICITY INDEX	CARBONATE CONTENT (%)	SAMPLE DIMENSION RATIO L/D	SAMPLE FAILURE MODE/ANGLE	UNCONFINED COMPRESSIVE STRENGTH (psi)	FAILURE STRAIN (%)	DIRECT SHEAR NORMAL STRESS (psi)	DIRECT SHEAR PEAK STRENGTH (psi)	DIRECT SHEAR RESIDUAL STRENGTH (psi)	BRAZIL STRENGTH (psi)	2ND CYCLE SLAKE DURABILITY INDEX (%)	TABER ABRASION HARDNESS INDEX	SWELL PRESSURE INDEX (psi)	COMMENTS
TAYLOR	54.0		15.6	*																* SAMPLE UNSUITABLE
TAYLOR	54.1		15.9		2.71	72	41	19.6												DRY METHOD
TAYLOR	121.8		13.4	122.2																
TAYLOR	121.9		13.3		2.69	77	44	27.2												DRY METHOD
TAYLOR	138.8		14.0	120.6					*	*	*	*								* SAMPLE UNSUITABLE
TAYLOR	138.9		13.7			86	53	27.2												DRY METHOD
TAYLOR	180.9		14.3			95	59													DRY METHOD
TAYLOR	181.1		14.1	120.2																
TAYLOR	183.2		14.1	*																* SAMPLE UNSUITABLE
TAYLOR	183.4		14.5			93	56													DRY METHOD
TAYLOR	201.3		13.6	119.7																
TAYLOR	201.4		14.4													121				
TAYLOR	201.5		13.5		2.73	94	58	26.4												DRY METHOD
TAYLOR	202.4		13.9	*																* SAMPLE UNSUITABLE
TAYLOR	202.5		14.2			95	60													DRY METHOD
TAYLOR	274.4				2.73			33.0												
TAYLOR	274.7		13.6	117.9																
TAYLOR	274.8		14.2													140				
TAYLOR	274.9		13.8			109	73													
TAYLOR	291.1		13.3	*																* SAMPLE UNSUITABLE
TAYLOR	291.2		13.3			101	65	30.0												
TAYLOR	291.3																48.0			
TAYLOR	325.2		10.5	129.2																
TAYLOR	325.3		12.3													117				
TAYLOR	325.4							31.5												
TAYLOR	332.2		12.1	*									*	*	*					* TEST PENDING
AUSTIN	342.7		9.2																	
AUSTIN	342.9		7.6	138.4					2.62	B-1\30	2444	1.0								
AUSTIN	343.2		8.2													366				
AUSTIN	354.1		9.2																	

LABORATORY GEOMECHNICAL DATA FOR BORING :BF-6

REVISION :2.0

DRILLING CONTRACTOR: SWL

DATE :3/12/90

GENERAL LITHOLOGY	VERTICAL DEPTH (ft)	INCLINED DEPTH (ft)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SPECIFIC GRAVITY	LIQUID LIMIT	PLASTICITY INDEX	CARBONATE CONTENT (%)	SAMPLE DIMENSION RATIO L/D	SAMPLE FAILURE MODE/ANGLE	UNCONFINED COMPRESSIVE STRENGTH (psi)	FAILURE STRAIN (%)	DIRECT SHEAR NORMAL STRESS (psi)	DIRECT SHEAR PEAK STRENGTH (psi)	DIRECT SHEAR RESIDUAL STRENGTH (psi)	BRAZIL STRENGTH (psi)	2ND CYCLE SLAKE DURABILITY INDEX (%)	TABER ABRASION HARDNESS INDEX	SWELL PRESSURE INDEX (psi)	COMMENTS
AUSTIN	354.3		9.5	131.8					2.53	E	3819	1.2								
AUSTIN	356.3		9.2																	
AUSTIN	356.5		9.4	132.9					2.47	E	2295	1.3								
	54.0																			* SAMPLE UNSUITABLE
	138.8																			* SAMPLE UNSUITABLE
	183.2																			* SAMPLE UNSUITABLE
	202.4																			* SAMPLE UNSUITABLE
	274.7			117.9																
TAYLOR	274.9		13.8			109	73													
	291.1																			* SAMPLE UNSUITABLE
TAYLOR	291.2		13.3			101	65													
	332.2																			* SAMPLE UNSUITABLE