SSCL-SR-1093

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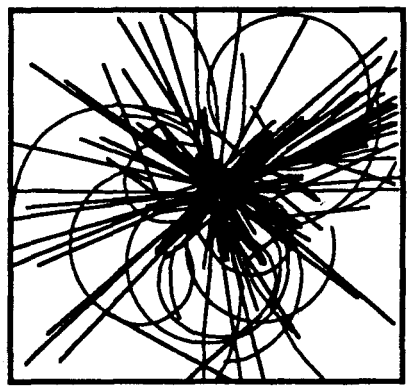
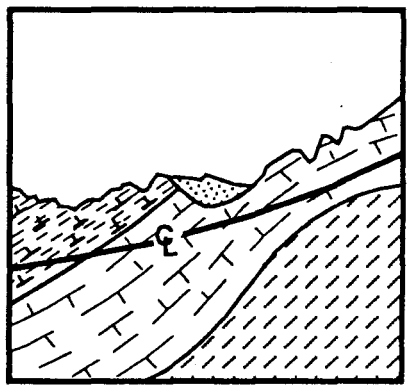
Project No. 87-888-0015
Report No. SSC-GR-34
August 1990

Data Report for Interaction Region 4 and Coreholes BIR 41, BIR 42, BIR 43, BIR 44 and BIR 45





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FOREWORD

The goal of the geotechnical studies at the Texas Superconducting Super Collider (SSC) site is to allow the geologist and engineer to build their level of knowledge and confidence about the geologic structures and geotechnical properties of the site materials to the point at which there remains only a realistically small risk of encountering geotechnical conditions during construction that would significantly increase construction costs or delay construction schedules. To do this, a characterization program has been designed to meet the following objectives:

- To confirm the site's suitability and optimize the ring location (the "footprint") and hall positions on the ring
- To provide data for a preliminary structural design
- To provide a rational framework within which construction contracts and schedules can be formulated
- To maximize the use of the site-specific data already gathered by the proposer.

The geotechnical program to meet these objectives has been divided into the following three phases of study:

- Footprint location data
- Structure-specific data
- Global data

This is one in a series of data reports prepared for the structure-specific phase of geotechnical characterization at the SSC site. Data collection for this study phase focused on drillhole-based geological, geohydrological, geophysical, and geotechnical tests at the locations of experimental halls and the injector. In combination with data from the other phases, these data will allow conceptual designs of construction methods and structural supports for key underground structures. Each data report includes the results of both field and laboratory tests for specific drilling and sampling site(s).

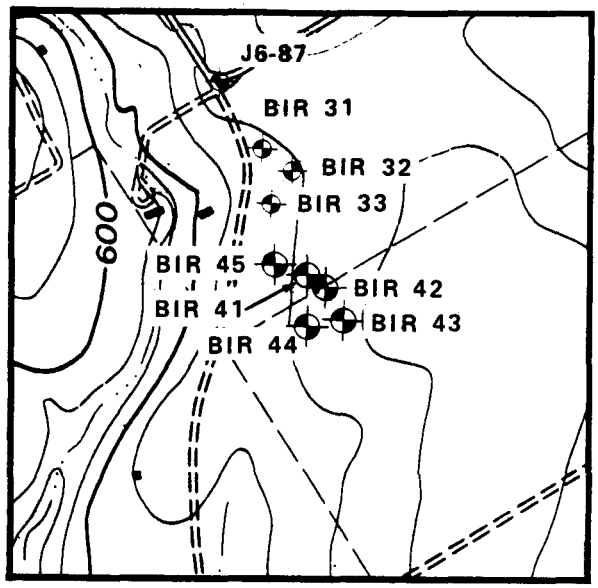
DATA REPORT

Site Designator: Interaction Region (IR) 4

Objective: Characterization of subsurface conditions at the Interaction Region 4. Drill five coreholes, four vertical and one inclined ,and obtain samples for mineralogical and geomechanical testing; perform in-situ hydrological and geophysical testing; excavate one trench and perform geologic mapping.

Interaction Region 4 is located on the western side of the ring, approximately 0.7 mile southeast of Boz, Texas.

BIR 41, 43, 44 and 45 are vertical coreholes. **BIR 42** is an angled boring with a bearing of approximately N75°W, angled 45° from horizontal at the surface.



SCALE 1:12,000

0 500 1000 1500 2000 Feet

CONTOUR INTERVAL 10 FEET

Boring Locations:

Boring	Northing (feet)	Easting (feet)	Surface Elevation (feet)
BIR 41	231,388	2,178,618	618.7
BIR 42	231,357	2,178,714	620.0
BIR 43	231,237	2,178,839	623.3
BIR 44	231,160	2,178,664	617.9
BIR 45	231,515	2,178,508	616.3

Scope and Schedule:

- Borings

Boring	Coring (full depth)	Wire-Line Logging	Hydrologic Testing	Laboratory Testing	Well Construction or Plugging
BIR 41	Sept.21 to 23, 1989	Sept. 23, 1989	Sept. 25, 1989	Sept. 21 to Oct. 6, 1989	Sept. 29, 1989 (Well*)
BIR 42	Sept. 20 to 23, 1989	Sept. 23, 1989	Sept. 25, 1989	Sept. 20 to Oct. 23, 1989	Sept. 25, 1989 (Plugging)
BIR 43	Mar. 5 to 12, 1990	Mar. 16, 1990	Not done	Mar. 17 to Apr. 10, 1990	Mar. 17, 1990 (Plugging)
BIR 44	Mar. 5 to 13, 1990	Mar. 15, 1990	Not done	Mar. 20 to Apr. 4, 1990	Mar. 15, 1990 (Plugging)
BIR 45	Apr. 3 to 9, 1990	Apr. 10, 1990	Not done	Apr. 17 to Apr. 27, 1990	Apr. 11, 1990 (Plugging)

* Water level was measured at 595.1 feet above MSL (23.6 feet below ground surface) on June 27, 1990.

- Geologic mapping and trenching - September 29 to October 4, 1989
- Downhole velocity surveys (in boring BIR 41 only) - November 29, 1989
- Seismic Reflection Survey - February 6, 1990

Conditions Encountered: (see Lithologic Logs, Appendix A)

Boring No.	Total Depth (feet)	Soil (feet)	Weathered Austin Chalk (feet)	Fresh Austin Chalk (feet)	Eagle Ford Shale (feet)
BIR 41	226.0	0.0 to 4.0	4.0 to 16.0	16.0 to 175.0	175.0 to 226.0
BIR 42 (Angle Hole)	282.5 (inclined)	0.0 to 1.5	1.5 to 12.1	12.1 to 245.2	245.2 to 282.5
	203.3 (vertical)	0.0 to 1.2	1.2 to 9.5	9.5 to 177.3	177.3 to 203.3
BIR 43	320.0	0.0 to 0.5	0.5 to 5.3	5.3 to 182.2	182.2 to 320.0
BIR 44	315.0	0.0 to 2.0	2.0 to 7.8	7.8 to 177.3	177.3 to 315.0
BIR 45	312.0	0.0 to 1.0	1.0 to 13.8	13.8 to 171.6	171.6 to 312.0

Geophysical Logging: (see wire-line Logs, Appendix B)

Boring No.	Spontaneous Potential (SP)	Normal Resistivity (Short and Long)	Guard Resistivity	Point Resistance	Natural Gamma	Short and Long Gamma	Compensated Density (Caliper)	Sonic Velocity (Full Wave)	Other
BIR 41	X	X	X	X	X	X	X	X	Neutron
BIR 42	X	X	X	X	X	X	X	X	Deviation
BIR 43	X	X	X	X	X	X	X	Note	
BIR 44	X	X	X	X	X	X	X	Note	
BIR 45	X	X	X	X	X	X	X	X	

Note: Not done due to equipment malfunction.

Geologic Mapping Results Summary: (see also Appendix C)

Field mapping identified exposed bedrock approximately 600 feet east of the IR. The exposure was large enough to provide representative fracture data in the area of the IR. Analyses of boring logs for BIR 41 through BIR 45, as well as logs of adjacent borings, indicate that no major faults cross IR 4. See Appendix C and Drawings GP-2C and GS-6 (in pocket).

Hydrologic Test Results Summary: Borings BIR 41 and BIR 42 were hydrotested on September 25, 1989 (see Hydrologic Test Results, Appendix D).

Boring	Vertical Test Depth (ft)	Packer Pressure (psi)	Gauge Pressure (psi)	Formation/Lithology	Hydraulic Conductivity (cm/sec)
BIR 41	125.0-145.0	150	20	Austin Chalk	1.6×10^{-6}
BIR 41	165.0-185.0	160	20	Austin Chalk/Eagle Ford Shale Contact	1.1×10^{-6}
BIR 42	182.9-198.1	150	30	Fractured Eagle Ford Shale	1.0×10^{-5}

* Vertical depths extrapolated from Deviation Wire-line Log.

Bulk and Clay Mineralogy Test Results Summary: (see also Appendix E)

Formation: Austin Chalk

Whole Rock Composition:		Relative Clay Abundance:	
Mineral	Percent	Mineral	Percent
quartz	1-3	Not Analyzed	
calcite	96-98		
pyrite	0-1		
total clay	0-1		

Formation: Eagle Ford Shale

Whole Rock Composition:		Relative Clay Abundance:	
Mineral	Percent	Mineral	Percent
clay	52-100	montmorillonite	0-40
non-clay*	0-48	illite	17-49
		kaolinite	12-27
		Fe-chlorite	0-4
		mixed layer (illite/smectite)	0-69

*Specific composition not analyzed.

Laboratory Geomechanical Test Results Summary: (see also Appendix E)

Vertical Depth (ft)	Formation/ Lithology	Moisture Content (%)	Dry Density (pcf)	Unconfined Compressive Strength (psi)	Tangent Young's Modulus E_{50} (psi x 10^5)	Brazil Tensile Strength (psi)
2-4	Austin Chalk	12-14	121-125	1135-2268	2.86-12.00	
6-11	Austin Chalk	13-15	118-120	1484-1979	2.30-7.94	204-232
16	Austin Chalk	8-9	131			183
19-21	Austin Chalk	12	122-126	1703	1.22-10.50	
25-30	Austin Chalk	11-13	124-125	2733-2975	5.00	331
37-42	Austin Chalk	12-15	114-124	2415	3.38	179-242
47-51	Austin Chalk	13-19	110-117	2233-2766	4.40-8.40	210-229
66-71	Austin Chalk	11-16	116-127	487-2252	0.29-14.40	175-294
76-82	Austin Chalk	11-19	111-123	390-2025	0.29-9.78	289
84-85	Austin Chalk	11-14	121-143		0.17-2.08	
95	Austin Chalk	14	116			
102-105	Austin Chalk	13-21	111-122			245
105-106	Bentonite	40-42	77-82			
108-112	Austin Chalk	12-16	119-127	1614-3015	2.04-8.00	166-236
116	Austin Chalk	13-14	124-126	1286	2.31	
123-132	Austin Chalk	10-16	116-131	1698-2904	2.06-5.70	268
141	Austin Chalk	17	115			
145-151	Austin Chalk	10-14	120-128	1941-2699	4.50-9.55	
156-163	Austin Chalk	11-16	119-128	3300	6.60	242-286
166-179	Austin Chalk	9-16	116-141	2184-2379	3.21-8.42	116-285
180-184	Eagle Ford Shale	16-18	115-118	99-360	0.61	
186	Eagle Ford Shale	15-16	120	332	0.60	
189-195	Eagle Ford Shale	14-17	113-129	143-277	0.54-1.20	
196-201	Eagle Ford Shale	14-18	105-122	111-157	0.66-0.72	
204-207	Eagle Ford Shale	16-17	118-119	288		
211-219	Eagle Ford Shale	13-16	117-126	357-432	0.80-1.11	
224-225	Eagle Ford Shale	12-14	125	445	0.87	
230-233	Eagle Ford Shale	11-15	118-127	346	0.49-1.54	
255-261	Eagle Ford Shale	15-18	112-120	146-380	0.31-1.05	
275	Eagle Ford Shale	16	116-118		0.55-1.00	
286-296	Eagle Ford Shale	10-14	121-127	133-309	0.03-1.21	
307-308	Eagle Ford Shale	9-10	131	120	0.08	336
315	Eagle Ford Shale	10-13	125	335	0.28	

Downhole Velocity Survey Summary: in boring BIR 41 (see also Appendix F)

Depth (feet)	Compressional Wave Velocity (feet/second)	Shear Wave Velocity (feet/second)	Poisson's Ratio	Shear Modulus (x 10^5 psi)	Constrained Modulus (x 10^5 psi)
Austin Chalk					
0-23	3,000	1,000	0.44	0.30	2.72
23-184	9,600	3,400	0.43	3.49	27.80
Eagle Ford Shale					
184-220	7,000	1,400	0.48	0.58	14.46

Hole Status: An observation well was installed in Boring BIR 41. Borings BIR 42 through BIR 45 were plugged with cement grout (see also Appendix G).

APPENDIX A

LITHOLOGIC LOGS

LITHOLOGIC LOG

BIR 41

LOG OF BORING

BORING NO: BIR 41 PG 1 OF 6

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

LOCATION: N 231,388 feet
E 2,178,618 feet

GROUND EL: 618.7 feet

DATE: 9/21-9/23/89 TYPE: Nx Core CASED TO: N/A CONTRACTOR: SWL (89-192)

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
									CLAY, silty, traces of roots, mottled, brown and gray 4.0
5									LIMESTONE (Austin Chalk) soft to medium, moderately weathered, tan with occasional clay layers and fossil partings
		C1	6.0	10.0	0	0			
10									-fossil partings at 11.8' and 12.1'
		C2	10.0	15.0	76	24			
15									16.0
		C3	15.0	20.0	100 100	80 100			LIMESTONE (Austin Chalk), moderately to medium hard, fresh, light gray to dark gray with 0.2' to 1' thick slightly, moderately, extremely argillaceous to shaly limestone interbeds 2' to 4' apart. Also fossil partings.
20									-shaly layers, soft, dark gray, at 17.9'-18.4' and 20.3'-21.2' -fossil partings at 18.9' and 21.9'-23.6'
25		C4	20.0	30.0	100	100			-shaly layer, soft, dark gray at 25.4'-25.9' -fossil parting at 26.8' -shaly layer, soft, dark gray at 28.1'-29.2'
30									-shaly layer, soft, fossiliferous, dark gray at 30.0' -fossil parting at 30.8'
35		C5	30.0	40.0	100	100			-shaly layer, soft, fossiliferous, dark gray at 33.4'-34.3' -fossil parting at 36.6' and 39.6' -shaly layer, soft, dark gray at 37.3'-37.5'
40			40.0						-shaly layer, soft, dark gray at 40.0'-40.5'

SAMPLE LEGEND

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

WATER INFORMATION

Began drilling with water at surface

DRILLING GEOLOGIST S. Wood ASSISTANT J. Lu CHECKED BY C. Bommarito

Shawn Wood
(2-1-90)

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 41 PG 2 OF 6

LOCATION: N 231,388 feet
E 2,178,618 feet

GROUND EL: 618.7 feet

DATE: 9/21-9/23/89 TYPE: Nx Core CASED TO: N/A 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
45		C6		50.0	100	100				LIMESTONE (Austin Chalk), moderately to medium hard, fresh, light gray to dark gray with 0.2' to 6' thick shaly limestone interbeds 2' to 6' apart. Also shale layers 0.6' thick, fossil partings, and bentonite layer. -shaly layer, soft, dark gray at 44.9'-46.1'
50		C7	50.0	60.0	100	100				-shaly layer, soft, dark gray at 54.5'-60.3' -fossil partings at 54.4'-55.0' -shaly layer, soft, dark gray at 56.1'-56.3' -shaly layer, soft, fossiliferous, dark gray at 59.0'-59.5'
55		C8	60.0	70.0	100	100				-fossil parting at 61.2' -shaly layer, soft, fossiliferous, dark gray at 61.4'-61.9' -fossil parting at 63.0' -bentonite layer, soft, gray at 64.4'-64.6' -shaly layer, soft, dark at 66.6'-67.3'
60		C9	70.0	80.0	97	97				-shale layer, soft, dark gray at 71.1'-71.7' -shaly layer, soft, fossiliferous, dark gray at 73.3'-73.6' and 76.1'-76.8' -fossil partings at 73.6'-76.2'
65			80.0							
70										
75										
80										

DRILLING GEOLOGIST S. Wood ASSISTANT J. Lu CHECKED BY C. Bommarito

Shawn Wood
(2-1-90)

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 41 PG 3 OF 6

LOCATION: N 231, 388 feet
E 2,178,618 feet

GROUND EL: 618.7 feet

DATE: 9/21-9/23/89 TYPE: Nx Core CASED TO: N/A 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
85		C10	80.0	90.0	96	96			LIMESTONE (Austin Chalk), moderately to medium hard, fresh, light gray to dark gray with 0.2' to 3' thick shaly limestone interbeds 1' to 4' apart. Also shale layers 0.3' thick, fossil partings, bentonite and bentonitic shale layer, low to medium angle fractures and traces of lignite. -shale layer, soft, dark gray at 82.9'-83.1' -fossil parting at 84.4' -bentonitic shale seam, soft, dark gray at 84.8' -shaly layer, soft, dark gray at 84.1'-87.0' and 89.5'-89.7'
90									
95		C11	90.0	100.0	98	98			-fossil partings at 90.9', 91.8', and 98.8' -shaly layers, soft, dark gray at 91.2'-92.0'; 93.4'-94.1' and 97.5'-99.0'
100									
105		C12	100.0	110.0	100	100			-fossil partings at 101.3', 101.4' and 109.7' -shaly layer, soft, dark gray at 101.4'-102.6' and 106.5'-107.3' and 109.0'-109.4' -lignite parting at 107.3'
110									
115		C13	110.0	120.0	55	55			-bentonite layer, soft, gray at 110.4'-111.1' -20° smooth, tight slickensided fracture at 110.8', 110.9' and 111.1' -40° smooth, tight slickensided fracture at 111.6'
120			120.0						

DRILLING GEOLOGIST S. Wood ASSISTANT J. Lu CHECKED BY C. Bommarito

Shawn Wood
(2-1-90)

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 41PG 4 OF 6

LOCATION: N 231,388 feet
E 2,178,618 feet

GROUND EL: 618.7 feet

DATE: 9/21-9/23/89 TYPE: Nx Core CASED TO: N/A 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
125		C14		130.0	90	90				LIMESTONE (Austin Chalk), moderately to medium hard, fresh, light gray to dark gray with 1' thick shaly limestone interbeds 1' to 24' apart and shale layers 0.1' thick. -shaly layer, soft, dark gray at 125.0'-126.1' and 127.6'-128.5'
130		C15	130.0	140.0	0	0				
135										
140		C16	140.0	150.0	100	100				-shale partings, soft, dark gray at 142.5', 147.1' and 148.2', traces of pyrite
145										
150		C17	150.0	160.0	100	100				-shaly layer, soft, dark gray at 152.8'-153.5' and 156.0'-156.7'
155										
160			160.0							

DRILLING GEOLOGIST S. Wood ASSISTANT J. Lu CHECKED BY C. Bommarito

Shawn Wood
(2-1-90)

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 41 PG 5 OF 6

LOCATION: N 231,388 feet
E 2,178,618 feet

GROUND EL: 618.7 feet

DATE: 9/21-9/23/89 TYPE: Nx Core CASED TO: N/A 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
165		C18	160.0	170.0	100	100			LIMESTONE (Austin Chalk), moderately to medium hard, fresh, light gray to dark gray with 0.3' to 2' thick shaly limestone interbeds 3' to 7' apart. -shaly layer, soft, dark gray at 160.3'-160.7' and168.0'-170.0'
170		C19	170.0	180.0	87	87			-shaly layer, soft, dark gray at 173.4'-174.5' 174.5' SHALY LIMESTONE (Transition) medium hard, fresh, dark gray with abundant fragments of fish bones, teeth and other fossil debris -15° smooth, tight at 176.1', 176.2' and 176.4'
175									
180		C20	180.0	190.0	72	72			SHALE (Eagle Ford), soft, fresh, fissile, dark gray with occasional harder carbonate layers 0.2' thick and low to medium angle fractures. -15° smooth, tight slickensided fractures at 176.1', 176.2' and 176.4' -20° smooth, tight slickensided fractures at 179.9' -carbonate nodule at 184.3'-184.5'
185									
190		C21	190.0	200.0	100	100			-65° smooth, tight slickensided fracture at 190.8' and 193.0' -carbonate nodules at 193.1' and 194.4'
195									-45° smooth, tight slickensided fracture at 199.0'
200			200.0						-30° smooth, tight slickensided fracture at 203.9'

DRILLING GEOLOGIST S. Wood ASSISTANT J. Lu CHECKED BY C. Bommarito

Shawn Wood
(2-1-90)

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 41 PG 6 OF 6

LOCATION: N 231,388 feet
E 2,178,618 feet

GROUND EL: 618.7 feet

DATE: 9/21-9/23/89 TYPE: Nx Core CASED TO: N/A 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
		C22	200.0	210.0	82	82				SHALE (Eagle Ford) soft, fresh, slightly fossiliferous, fissile, dark gray
205										
210		C23	210.0	220.0	85	85				
215										
220		C24	220.0		0	0				
225										
230										Bottom of Exploration at 226.0'
										NOTE: Monitor well installed upon completion
235										
240										

DRILLING GEOLOGIST S. Wood ASSISTANT J. Lu CHECKED BY C. Bommarito

Shawn Wood
(2-1-90)

LITHOLOGIC LOG

BIR 42

LOG OF BORING

PROJECT: SSC - Texas Site

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 42 PG 1 OF 8

LOCATION: N 231,357 feet
E 2,178,714 feet

GROUND EL: 620.0 feet

DATE: 9/20/89 TYPE: Nx Angle Core(1) CASED TO: 14.0' CONTRACTOR: MJA

SAMPLE LEGEND

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

WATER INFORMATION

Wet Rotary Core Hole
Water level not determinable

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
										CLAY (Residual Soil), silty, dk. brown 1.5g
										LIMESTONE (Austin Chalk), med. hard, highly to mod. weathered, tan with very close to closely spaced iron stained fractures and with 0.1 to 1.3 ft. thick mod. argill. interbeds 3.2 to 6.4 ft. apart
5		C1	4.0	8.5	85	13				7.9g-8.0g Very thin soft mod. argill. bed, brown
10		C2	8.5	13.5	100	56				11.2g-12.5g Med. thick mod. argill. bed, brown to dark gray 12.1g
										LIMESTONE (Austin Chalk), fresh, mod. hard, sli. fossil., lt. gray with 0.5 to 2.1 ft. thick sli. to mod. argill. beds 2.4 to 5.0 ft. apart
15		C3	14.0	16.0	100	100				
20		C4	16.0	26.0	100	100				16.4g-18.0g Med. thick sli.-mod. argill. bed, med. - dk. gray 21.0g-22.5g Med. thick mod. argill. bed, dk. gray 24.9g-26.7g Med. thick sli.-mod. argill. bed, med. - dk. gray
25										
30		C5	26.0	36.0	100	100				29.3g-29.8g Thin sli. argill. bed, med. gray 32.9g-35.0g Med. thick sli.-mod. argill. bed, med. - dk. gray
35										
40		C6	36.0		95	95				

DRILLING GEOLOGIST Scott E. Lesikar ASSISTANT Beth Flowers CHECKED BY W. D. Flanigan

LOG OF BORING

BORING NO: BIR 42 PG 2 OF 8

PROJECT: SSC - Texas Site

CLIENT: The Earth Technology Corporation

TASK NO.: 15

LOCATION: N 231,357 feet
E 2,178,714 feet

GROUND EL: 620.0 feet

DATE: 9/20/89 TYPE: Nx Angle Core(1) CASED TO: 14.0' CONTRACTOR: MJA

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
		C6		46.0	95	95				LIMESTONE (Austin Chalk), fresh, mod. hard, sli. fossiliferous, lt. gray with 0.4 to 1.6 ft. thick sli. to very argill. interbeds 0.5 to 8.6 ft. apart 43.5g-45.0g Med. thick mod. argill. bed, dk. gray 45.0g-46.0g Med. thick sli. argill. bed, med. gray
45										46.5g-47.7g Med. thick sli. argill. bed, med. gray
		C7	46.0	56.0	100	100				50.0g-50.4g Thin very argill sli. bentonitic bed, dk. gray
50										
55										
		C8	56.0	66.0	100	100				59.0g-59.6g Thin sli. argill. bed, med. gray 59.6g-61.1g Thin very argill. bed, dk. gray
60										
65										67.0g-68.6g Med. thick mod. argill. - very argill. bed, dk. gray
		C9	66.0	76.0	99	99	Stopped 9/20/89	Drilling		
70										71.0g-72.6g Med. thick very argill. bed, dk. gray
75										74.8g-76.0g Med. thick mod. argill. - very argill. bed, dk. gray
		C10	76.0		99	99	Started 9/21/89	Drilling		
80										

SAMPLE LEGEND

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

WATER INFORMATION

Wet Rotary Core Hole
Water level not determinable

DRILLING GEOLOGIST Scott E. Lesikar ASSISTANT Beth Flowers CHECKED BY W. D. Flanigan

LOG OF BORING

PROJECT: SSC - Texas Site

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 42 PG 3 OF 8

LOCATION: N 231,357 feet
E 2,178,714 feet

GROUND EL: 620.0 feet

DATE: 9/21/89 TYPE: Nx Angle Core (1) CASED TO: 14.0' CONTRACTOR: MJA

SAMPLE LEGEND

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

WATER INFORMATION

Wet Rotary Core Hole
Water level not determinable

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
85		C10		86.0	99	99				LIMESTONE (Austin Chalk), fresh, mod. hard, sli. fossiliferous, lt. gray with 0.5 to 2.2 ft. thick sli. argill. to shaly and bentonitic interbeds 0.7 to 7.0 ft. apart 80.0g-81.3g Med. thick very argill. bed, dk. gray 82.2g-82.7g Thin mod. argill. bed, dk. gray
90 95		C11	86.0	96.0	99	99				86.6g-87.3g Thin very argill. bed, dk. gray 89.0g-89.6g Thin sli. argill. bed, med. gray 89.6g-90.6g Med. thick mod. argill. bed, dk. gray 93.7g-94.3g Thin shaly bed with 2" soft bentonitic clay layer, dk. gray
100 105		C12	96.0	106.0	100	100				97.0g-97.6g Thin very argill. bed, dk. gray 101.5g-102.1g Thin sli. argill. bed, med. gray 105.9g-107.0g Med. thick mod. argill. bed, dk. gray
110 115		C13	106.0	116.0	100	100				109.3g-111.5g Med. thick sli. argill. bed, med. gray
120		C14	116.0		100	100				118.5g-119.3g Thin very argill. bed, dk. gray

DRILLING GEOLOGIST Scott E. Lesikar ASSISTANT Beth Flowers CHECKED BY W. D. Flanigan

LOG OF BORING

BORING NO: BIR 42 PG 4 OF 8

PROJECT: SSC - Texas Site

CLIENT: The Earth Technology Corporation

TASK NO.: 15

LOCATION: N 231,357 feet
E 2,178,714 feet

GROUND EL: 620.0 feet

DATE: 9/21/89 TYPE: Nx Angle Core(1) CASED TO: 14.0' CONTRACTOR: MJA

SAMPLE LEGEND	WATER INFORMATION
S= SPLIT SPOON T= 2" THIN WALL TUBE U= 3" THIN WALL TUBE C= NX ROCK CORE	Wet Rotary Core Hole Water level not determinable

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
		C14			100	100				LIMESTONE (Austin Chalk), fresh, mod. hard, sli. fossiliferous, lt. gray with 0.3 to 3.5 ft. thick sli. argill. to shaly and bentonitic interbeds 0.3 to 3.5 ft. apart
125				126.0						120.9g-121.2g Thin shaly bed, soft-med. hd., dk. gray 121.2g-123.8g Med. thick sli. argill.-mod. argill. bed, dk. gray
		C15	126.0		100	100				127.3g-128.9g Med. thick mod. argill. bed, dk. gray 128.9g-130.7g Med. thick sli. argill. bed, med. gray
130										130.7g-131.6g Med. thick mod. argill. bed, dk. gray 131.6g-132.9g Med. thick sli. argill. bed, med. gray 132.9g-134.2g Med. thick mod. argill. bed, dk. gray
135				136.0						136.1g-137.2g Med. thick mod. argill. bed, dk. gray
		C16	136.0		100	100				138.0g-140.7g Med. thick sli. argill.-mod. argill. bed, dk. gray
140										141.0g-141.6g Thin sli. argill. bed, med. gray 143.7g-145.3g Med. thick mod. argill. bed, dk. gray
145				146.0						146.5g-148.6s Med. thick mod. argill. bed, dk. gray
		C17	146.0		100	100				
150										150.5g-151.6g Med. thick mod. argill.-very argill. bed, dk. gray 153.8g-154.2g Thin mod. argill. bed, dk. gray 154.2g-155.3g Med. thick mod. argill.-very argill. bed, dark gray
155				156.0						155.3g-156.65g Med. thick bentonitic clay bed, very soft, waxy, non-laminated, sli. pyritic, bulish-gray
		C18	156.0		91	91				157.7g-159.5g Med. thick sli. argill.-mod. argill. bed, dk. gray
160										

DRILLING GEOLOGIST Scott E. Lesikar ASSISTANT Beth Flowers CHECKED BY W. D. Flanigan

LOG OF BORING

PROJECT: SSC - Texas Site

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 42 PG 5 OF 8

LOCATION: N 231,357 feet
E 2,178,714 feet

GROUND EL: 620.0 feet

DATE: 9/21/89 TYPE: Nx Angle Core(1) CASED TO: 14.0' CONTRACTOR: MJA

SAMPLE LEGEND

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

WATER INFORMATION

Wet Rotary Core Hole
Water level not determinable

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
165		C18		165.5	91	91			LIMESTONE (Austin Chalk), fresh, mod. hard, sli. fossiliferous, lt. gray with pyrite nodules and with 0.4 to 5.6 ft. thick sli. argill. to shaly interbeds 0.7 to 4.8 ft. apart 161.9g-165.6g Thick sli. argill.-mod. argill. bed, dk. gray
170		C19	165.5	175.0	100	100	Stopped Drilling 9/21/89		166.6g-167.4g Med. thick sli. argill. bed, med. gray 169.2g-174.8g Thick sli. argill. bed, med. gray
175		C20	175.0	185.3	100	100	Started Drilling 9/22/89		176.4g-177.1g Med. thick very argill. to sli. shaly bed, dk. gray 178.5g-181.0g Med. thick mod. argill. bed, dk. gray 183.0g-183.7g Thin sli. argill. bed, med. gray
190		C21	185.3	195.6	100	100			187.7g-188.1g Thin shaly bed with large pyrite nodule, dk. gray 192.9g-193.6g Thin very argill. bed, dk. gray
200		C22	195.6		100	100			196.5g-196.9g Thin sli. argill. bed, med. gray

DRILLING GEOLOGIST Scott E. Lesikar ASSISTANT Beth Flowers CHECKED BY W. D. Flanigan

LOG OF BORING

PROJECT: SSC - Texas Site

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 42 PG 6 OF 8

LOCATION: N 231,357 feet
E 2,178,714 feet

GROUND EL: 620.0 feet

DATE: 9/22/89 TYPE: Nx Angle Core(1) CASED TO: 14.0' CONTRACTOR: MJA

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.
		C22			100	100			
205				205.9					
		C23	205.9		100	100			
210									
215				216.2					
		C24	216.2		100	100			
220									
225				225.3					
		C25	225.3		100	100			
230									
235				235.5					
		C26	235.5		100	100			
240									

SAMPLE LEGEND

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

WATER INFORMATION

Wet Rotary Core Hole
Water level not determinable

DESCRIPTION OF STRATUM

LIMESTONE (Austin Chalk), fresh, mod. hard, sli. fossiliferous, lt. gray with 0.3 to 7.3 ft. thick sli. to mod. argill. interbeds 0.2 to 5.0 ft. apart

203.9g-205.3g Med. thick sli. argill. bed, med. gray

206.5g-206.9g Thin mod. argill. bed, dk. gray

208.5g-208.8g Thin mod. argill. bed, dk. gray

209.0g-209.3g Thin mod. argill. bed, dk. gray

211.8g-212.1g Thin mod. argill. bed, dk. gray

215.3g-216.4g Med. thick mod. argill. bed, dk. gray

219.7g-220.8g Med. thick mod. argill. bed, dk. gray

225.8g-226.8s Med. thick mod. argill. bed, dk. gray

228.5g-229.6g Med. thick mod. argill. bed, dk. gray

234.4g-241.7g Thick sli. argill.-mod. argill. bed, dk. gray

DRILLING GEOLOGIST Scott E. Lesikar ASSISTANT Beth Flowers CHECKED BY W. D. Flanigan

LOG OF BORING

PROJECT: SSC - Texas Site

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 42 PG 7 OF 8

LOCATION: N 231,357 feet
E 2,178,714 feet

GROUND EL: 620.0 feet

DATE: 9/22/89 TYPE: Nx Angle Core(1) CASED TO: 14.0' CONTRACTOR: MJA

SAMPLE LEGEND	WATER INFORMATION
S= SPLIT SPOON T= 2" THIN WALL TUBE U= 3" THIN WALL TUBE C= NX ROCK CORE	Wet Rotary Core Hole Water level not determinable

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
		C26		242.9	100	100			LIMESTONE (Austin Chalk), fresh, mod. hard, sli. fossiliferous, lt. gray 242.3-244.0 Becoming arenaceous, argillaceous, increasingly fossiliferous, dk. gray 244.0g Transition zone, argill., arenaceous, fossil., (bio-clastics), med.-mod. hd., med.-dk. gray
245		C27	242.9	246.0	100	100			245.2s SHALE (Eagle Ford), soft to med. hard, very thinly bedded, very fine grained, fresh, sli. to noncalcareous with 0.1 ft. thick siltstone lenses and occasional siltstone inclusions and calcareous concretions
250		C28	246.0	256.0	100	100	Stopped Drilling 9/22/89		
		C29	256.0	266.0	100	100	Started Drilling 9/23/89		260.0 Shale is mainly non-calcareous below this depth 262.1s-262.2s Very thin siltstone, mod. hd., non-calc. bed, lt. brown 263.3s-263.4s Very thin siltstone, mod. hd., non-calc. bed, lt. brown 265.0 Increasing amount of small siltstone inclusions, mod. hard, non-calc. below this depth, lt. brown
270		C30	266.0	276.0	100	67			269.6-272.1 Fracture zone, smooth to sli. rough, clean surfaces, very closely spaced, various orientations and angles, closed (approx. 10 fractures/foot) 273.5-274.3 Fracture zone, smooth to sli. rough, clean surfaces, very closely spaced, various orientations and angles, closed 276.3s Siltstone inclusion, non-calcareous, lt. brown 276.3s-276.4s Siltstone, mod. hard, non-calc. bed, lt. brown
280		C31	276.0		100	100			277.9-278.1 Calcareous concretion, hard to v. hard, w/calcite crystals inside, dk. gray and lt. gray

DRILLING GEOLOGIST Scott E. Lesikar ASSISTANT Beth Flowers CHECKED BY W. D. Flanigan

LOG OF BORING

BORING NO: BIR 42 PG 8 OF 8

PROJECT: SSC - Texas Site

CLIENT: The Earth Technology Corporation

TASK NO.: 15

LOCATION: N 231,357 feet
E 2,178,714 feet

GROUND EL: 620.0 feet

DATE: 9/23/89 TYPE: Nx Angle Core(1) CASED TO: 14.0' CONTRACTOR: MJA

SAMPLE LEGEND	WATER INFORMATION
S= SPLIT SPOON T= 2" THIN WALL TUBE U= 3" THIN WALL TUBE C= NX ROCK CORE	Wet Rotary Core Hole Water level not determinable

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
		C31		282.5	100	100				SHALE (Eagle Ford), fresh, soft to med. hd., v. thinly bedded, v. fine grained, dk. gray
285										Total Depth: 282.5' 9/23/89
										(1) Angle Hole Field Azimuth: ~N75°W Plunge: ~45°
										(2) Fractures: First angle is measured normal to core axis. Strike and dip trends are approximated from field azimuth and dip.
290										(3) Wireline Logged 9/23/89 (4) Hydrotested 9/25/89 (5) Boring Plugged 9/25/89
295										Log Revised 1/22/90
300										
305										
310										
315										
320										

DRILLING GEOLOGIST Scott E. Lesikar ASSISTANT Beth Flowers CHECKED BY W. D. Flanigan

LITHOLOGIC LOG

BIR 43

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 43 PG 1 OF 8

LOCATION: N 231,237 ft.
E 2,178,839 ft.

GROUND EL: 623.3 ft.

DATE: 3-5/12-90 TYPE: NX Core CASED TO: N/A 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

Air Rotary to 61.0', water rotary 61.0' to T.D.
Seepage at 55.2'

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
		S-1							CLAY, silty, dark brown with weathered, limestone fragments and organic debris.
		C1	2.0	11.0	85 / 100	55 / 100			0.5 -Sharp Contact- LIMESTONE (Austin Chalk) soft, severely weathered, moderately fractured, tan.
5									
10									
		C2	11.0	21.0	100	100			5.3 -Sharp Contact- LIMESTONE (Austin Chalk), moderately to medium hard, fresh, light to dark gray with 0.2' to 1' thick moderately argillaceous to shaly limestone interbeds 1' to 5' apart. Also shale layers 0.2' thick, and fossil partings. -fossil parting at 6.4' -moderately argillaceous layer , medium gray, sharp contacts at 9.0'-9.8' -moderately weathered layer , tan, sharp contacts at 11.0'-12.1'
15									
20									
		C3	21.0	31.0	100	100			-moderately argillaceous layer , medium gray, sharp contacts at 12.1'-12.9' -moderately argillaceous layer , medium gray, sharp contact at 15.9' to gradational contact at 16.3' -moderately argillaceous layer , medium gray, gradational contacts at 19.1'-19.8' -fossil partings at 25.0', 26.3', 26.9', and 30.1' -shaly limestone layer , dark gray, sharp contacts at 25.0'-25.4'
25									
30									
		C4	31.0	41.0	100	100			-shaly limestone layer , dark gray, sharp contacts at 27.6'-29.0' -fossil partings at 31.9', 33.6', 34.5', and 38.6' -moderately argillaceous layer , medium gray, gradational contacts at 32.6'-33.2' -shaly limestone layer , dark gray, gradational contacts at 35.3'-36.1' -shale layer , soft, dark gray, sharp contacts at 39.7'-39.9'
35									
40									

DRILLING GEOLOGIST M. Granger ASSISTANT R. Grimstead CHECKED BY Shawn Wood

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 43 PG 2 OF 8

LOCATION: N 231,237 ft. E 2,178,839 ft.

GROUND EL: 623.3 ft.

DATE: 3-5/12-90 TYPE: NX Core CASED TO: N/A 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 8

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, 50		C5	41.0	51.0	99	99			LIMESTONE (Austin Chalk), moderately to medium hard, fresh, light to dark gray with 0.4' to 1' thick moderately argillaceous to shaly limestone interbeds 1' to 4' apart. Also shale layers up to 0.5' thick, fossil partings, low angle fractures. -shaly limestone layer, dark gray, gradational contact at 42.9' to sharp contact at 44.1' -shaly limestone layer, dark gray, sharp contacts at 46.9'-48.0' -fossil partings at 43.5', 46.7', and 49.0'
55, 60		C6	51.0	61.0	100	100			-shaly limestone layer, dark gray, gradational contacts at 52.4'-53.8' -shaly limestone layer, dark gray, sharp contacts at 55.7'-56.7' -fossil partings at 52.5', 59.1' and 59.4' -tan water stained parting at 55.2' -moderately argillaceous layer, medium gray, gradational contact at 58.5' to sharp contact at 59.0'
65, 70		C7	61.0	71.0	94	92			-shaly limestone layer, dark gray, sharp contact at 62.1' to gradational contact at 63.1' -fossil partings at 62.5', 62.6', 65.2', 66.8', 68.1' and 69.8' -shale layer, soft, dark gray, sharp contacts at 63.7'-64.1' -shaly limestone layer, dark gray, sharp contacts at 66.8'-67.3' -moderately argillaceous layer, medium gray, sharp contacts at 68.2'-69.8'
75, 80		C8	71.0	81.0	100	100			-fossil partings at 71.2', 73.0', 73.4', 73.8' and 74.2' -shale layer, soft, dark gray, sharp contacts at 71.8'-72.1' -30°, smooth, open, slickensided fracture at 72.0' -shale layer, soft, dark gray, sharp contacts at 74.2'-74.6' -fossil partings at 76.6', 77.8', 79.3' and 80.0' -shale layer, soft, dark gray, gradational contacts at 79.0'-79.5'

DRILLING GEOLOGIST M. Granger ASSISTANT R. Grimstead CHECKED BY Shawn Wood

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 43 PG 3 OF 8

LOCATION: N 231,237 ft. E 2,178,839 ft.

GROUND EL: 623.3 ft.

DATE: 3-5/12-90 TYPE: NX Core CASED TO: N/A 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 8

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
		C9	81.0	91.0	100	100			LIMESTONE (Austin Chalk), moderately to medium hard, fresh, light to dark gray with 0.4' to 1' thick moderately argillaceous to shaly limestone interbeds 1' to 4' apart. Also shale layers 0.2' thick, fossil partings, bentonite layers. -shaly limestone layer, dark gray, gradational contacts at 80.8'-81.5' and 83.6'-84.4' -fossil partings at 83.8, 83.9' and 88.0' -moderately argillaceous layer, medium gray, gradational contacts at 87.5'-88.0'
		C10	91.0	101.0	99	99			-shale layer, soft, dark gray, gradational contacts at 90.1'-90.5' -1/16" bentonite seam, soft, bluish-gray at 90.3' -shale layer, soft, dark gray, gradational contacts at 91.9'-92.1' -shaly limestone layer, dark gray, gradational contact at 92.8' to sharp contact at 94.0' -shale layer, soft, dark gray, sharp contacts at 96.4'-96.6' -shaly limestone layer, dark gray, sharp contacts at 96.6'-97.6' -shaly limestone layer, dark gray, gradational contacts at 98.6'-99.6'
		C11	101.0	111.0	100	100			-shaly limestone layer, dark gray, sharp contact at 100.7' to gradational contact at 101.6' -fossil partings at 101.0', 102.8', 103.9', 104.5' and 108.2' -shaly limestone layer, dark gray, sharp contacts at 104.9'-105.3' -shaly limestone layer, dark gray, sharp contacts at 108.4'-109.8' -shaly limestone layer, dark gray, sharp contacts at 110.7'-111.9'
		C12	111.0	121.0	99	99			-shaly limestone layer, dark gray, sharp contacts at 112.3'-113.0' -bentonitic shale layer, light gray, sharp contacts at 114.7'-114.9' -shaly limestone layer, dark gray, gradational contacts at 115.7'-117.1' -bentonite layer, soft, bluish-gray, sharp contacts at 117.1'-117.8' -shaly limestone layer, dark gray, sharp contacts at 118.3'-119.8' -fossil parting at 119.7'

DRILLING GEOLOGIST M. Granger ASSISTANT R. Grimstead CHECKED BY Shawn Wood

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 43 PG 4 OF 8

LOCATION: N 231,237 ft.
E 2,178,839 ft.

GROUND EL: 623.3 ft.

DATE: 3-5/12-90 TYPE: NX Core CASED TO: N/A 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 8

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
		C13	121.0	131.0	100	100			LIMESTONE (Austin Chalk), moderately to medium hard, fresh, light to dark gray with 0.2' to 1' thick moderately argillaceous to shaly limestone interbeds 1' to 2' apart. Also shale layers 0.4' thick, fossil partings. -moderately argillaceous layer , medium gray, sharp contacts at 121.7'-122.7' -shaly limestone layer , dark gray, gradational contacts at 123.1-124.1' -shaly limestone layer , dark gray, sharp contact at 125.0' to gradational contact at 125.7' -moderately argillaceous layer , medium gray, gradational contacts at 126.8'-131.2' -fossil partings at 127.2' and 129.6' -½" pyrite nodule at 129.5' -shale layer , soft, dark gray, sharp contacts at 132.5'-132.9' -shaly limestone layer , dark gray, gradational contacts at 133.2'-134.3' -¼" pyrite nodules at 134.4' and 135.1' -1" pyrite nodule at 137.8' -shale layer , soft, dark gray, sharp contacts at 140.8'-141.0' -fossil partings at 144.3' and 149.2' -shaly limestone layer , dark gray, sharp contacts at 144.3'-144.8' -moderately argillaceous layer , medium gray, gradational contacts at 147.0'-147.3' -moderately argillaceous layer , medium gray, gradational contacts at 148.0'-148.2' -shaly limestone layer , dark gray, gradational contact at 151.1' to sharp contact at 151.6' -shaly limestone layer, dark gray, sharp contacts at 153.4'-153.7' -shaly limestone layer , dark gray, sharp contacts at 154.3'-154.6' -shaly limestone layers, dark gray, gradational contacts at 155.7'-155.9' -shaly limestone layer , dark gray, sharp contacts at 158.0'-158.3'
125									
130									
		C14	131.0	141.0	100	100			
135									
140									
		C15	141.0	151.0	100	100			
145									
150									
		C16	151.0	161.0	100	100			
155									
160									-shaly limestone layer , dark gray, sharp contact at 160.6' to gradational contact at 161.5'

DRILLING GEOLOGIST M. Granger ASSISTANT R. Grimstead CHECKED BY Shawn Wood

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 43 PG 5 OF 8

LOCATION: N 231,237 ft.
E 2,178,839 ft.

GROUND EL: 623.3 ft.

DATE: 3-5/12-90 TYPE: NX Core CASED TO: N/A CONTRACTOR: SwL (89192)

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 8

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
		C17	161.0	171.0	100	100			LIMESTONE (Austin Chalk), moderately to medium hard, fresh, light to dark gray with 1' to 2' thick shaly limestone interbeds 2' to 4' apart. Also shale layers 0.6' thick and pyrite nodules. -shale layer , soft, dark gray, sharp contacts at 163.9'-164.5' -shaly limestone layer , dark gray, gradational contacts at 168.8'-169.2' -trace pyrite at 171.0'
165 170									
		C18	171.0	179.0	73	73			-2" pyrite nodule at 171.0' -traces of slickensided fracture at 171.1', unable to determine size or orientation from recovered core. -shaly limestone layer , dark gray, gradational contacts at 175.0'-177.1'
175									
180		C19	179.0	189.0	69	68			180.2 -Gradational Contact- SHALY LIMESTONE (Transition) medium hard, fresh, extremely argillaceous, medium gray with abundant fragments of fish bones, teeth, and other fossil debris. 182.2 -Sharp Contact- SHALE (Eagle Ford), soft, fresh, fissile, dark gray with occasional harder limestone layers 0.1' thick, medium angle fractures septarian concretions and pyrite nodules.
185									
190		C20	189.0	196.0	67	65			-1" pyrite nodules at 183.2'-183.4' -1" limestone layer , with fossil parting at 185.5' -60° , smooth, open, slickensided fracture at 190.1' -limestone layer with multiple intersecting 1/8" to 1/2" calcite veins, sharp contacts at 190.4'-191.0' -septarian concretions at 193.3', 196.6', 198.5' and 199.7' -1" pyrite nodule at 197.6'
195									
200		C21	196.0		100	100			

DRILLING GEOLOGIST Mike Granger ASSISTANT R. Grimstead CHECKED BY Shawn Wood

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO. 115

BORING NO: BIR 43 PG 6 OF 8

LOCATION: N 231,237 ft. E 2,178,839 ft.

GROUND EL: 623.3 ft.

DATE: 3-5/12-90 TYPE: NX Core CASED TO: N/A 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 8

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
									SHALE (Eagle Ford) soft, fresh, fissile, dark gray with occasional harder carbonate layers 0.6' thick, medium angle fractures, fossil partings, septarian concretions and pyrite nodules.
205									-45°, smooth, open, slickensided fractures at 200.3'
		C22	206.0	216.0	58	58			-45°, closed tight, fractures at 200.2', 200.4', 200.6', 200.9' and 202.2' -limestone layer, with ¼" to ½" intersecting calcite and pyrite veins, sharp contacts at 201.2-201.3' -septarian concretions at 201.8' and 204.0' -40°, closed, tight, fracture at 203.4' -septarian concretions at 206.0', 207.1', and 207.5' -pyrite parting, 1" nodule at 219.0'
210									
215									
		C23	216.0	226.0	87	87			-1" pyrite nodule at 220.8' -¼" pyrite seam at 221.1' -limestone layer, light gray, sharp contacts at 221.8' to gradational contact at 222.4'
220									
225									
		C24	226.0	236.0	90	90			-septarian concretion at 230.5'
230									
235									
		C25	236.0	241.0	99	99			-fossil partings at 238.1' and 239.3' -limestone layer, light gray, sharp contacts at 240.1'-240.5'
240									

DRILLING GEOLOGIST M. Granger ASSISTANT R. Grimstead CHECKED BY Shawn Wood

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 43 PG 7 OF 8

LOCATION: N 231,237 ft. E 2,178,839 ft.

GROUND EL: 623.3 ft.

DATE: 3-5/12-90 TYPE: NX Core CASED TO: N/A 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 8

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
		C26	241.0	251.0	13	13			SHALE (Eagle Ford) soft, fresh, fissile dark gray with occasional harder carbonate layers 0.3' thick, medium angle fractures, fossil partings and pyrite nodules. -calcareous layer , sharp contacts at 241.0-241.3' -limestone layer , light gray with ¼" calcite veins, sharp contacts at 242.0'-242.3' -½" pyrite nodule at 251.9'
245									
250									
		C27	251.0	261.0	91	91			-45° , smooth, open, slickensided fracture with traces of pyrite at 253.3' -limestone layer , light gray, sharp contacts at 258.0'-258.2' -fossil parting with traces of pyrite at 258.1'
255									
260									
		C28	261.0	271.0	100	100			-1" pyrite nodule at 265.4' -fossil parting at 266.4' -½" pyrite nodule at 271.1'
265									
270									
		C29	271.0	281.0	100	100			-fossil partings at 272.1' and 277.5'
275									
280									

DRILLING GEOLOGIST M. Granger ASSISTANT R. Grimstead CHECKED BY Shawn Wood

LOG OF BORING

BORING NO: BIR 43 PG 8 OF 8

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

LOCATION: N 231,237 ft. E 2,178,839 ft.

GROUND EL: 623.3 ft.

DATE: 3-5/12-90 TYPE: NX Core CASED TO: N/A 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 8

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
		C30	281.0	288.0	97	97				SHALE (Eagle Ford), soft, fresh, fissile, dark gray with occasional harder carbonate layers 3' thick, fossil partings and traces of pyrite.
285										
290		C31	288.0	298.0	46	46				-trace pyrite at 291.3'
295										
300		C32	298.0	300.0	100	100				
		C33	300.0	310.0	90	90				-fossil partings at 307.0' and 311.5'
305										
310		C34	310.0	320.0	73	73				-¼" limestone seam, light gray at 310.6'
315										-calcareous layer, gradational contacts at 314.4'-317.3'
										-interbedded limestone layers, (1" to 2") light gray, gradational contacts at 315.8'-317.2'
320										Bottom of Exploration 320.0'

DRILLING GEOLOGIST M. Granger ASSISTANT R. Grimstead CHECKED BY Shawn Wood

LITHOLOGIC LOG

BIR 44

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 44 PG 1 OF 8

LOCATION: N 231,160 ft.
E 2,178,664 ft.

GROUND EL: 617.9 ft.

DATE: 3/5-13/90 TYPE: NX Core CASED TO: 5.0' 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

Drilled with air to 32.0', switched to water at 32.0'. Unable to determine groundwater parameters below 32.0'

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	1.5	100				CLAY, soft, silty, dark brown to gray, traces of organics. (2.0)
		C1	2.0	4.5	92	88			LIMESTONE (Austin Chalk), soft to medium, moderately weathered, moderately fractured, tan. -slightly argillaceous layers, soft, moderately weathered, tan, sharp contact at 4.5' to gradational contact at 5.2' (7.8)
5		C2	4.5	7.0	68	66			
		C3	7.0	12.0	92	90			LIMESTONE (Austin Chalk), moderately to medium hard, fresh, light gray to dark gray with 0.1' to 1' thick slightly, moderately, extremely argillaceous to shaly limestone interbeds 1' to 4' apart. Also fossiliferous layers 1' thick, fossil partings. -slightly argillaceous layer, soft to medium hard, gradational conacts at 10.9'-11.7' -fossil parting at 10.5' -fossil partings at 12.2', 15.6', and 18.7' -slightly argillaceous layers, gray, gradational contacts at 14.1'-15.0', gradational contacts at 16.8'-17.5' and gradational contacts at 20.0'-20.3'
10									
15		C4	12.0	22.0	100	100			-fossil partings at 22.5' and 24.8'
20									
25		C5	22.0	32.0	97	97			-moderately argillaceous layers, soft, gray, gradational contacts at 22.5'-22.8', gradational contacts at 23.8'-23.9' and gradational contacts at 30.0'-30.2' -slightly argillaceous layers, medium hard, light gray, gradational contacts at 22.8'-23.8', gradational contacts at 27.2'-27.8', gradational contacts at 30.2'-30.7', fossiliferous at 25.2'-26.1'
30									
35		C6	32.0	42.0	100	98			-moderately argillaceous layer, dark gray, gradational contacts at 34.6'-34.8' -very argillaceous layer, dark gray, soft, at 41.8'-42.0' -fossil parting at 36.1' and 38.0' -slightly argillaceous layer, gradational contacts at 37.8'-38.8' -shaly limestone layer, dark gray, gradational contact at 38.8' to sharp contact at 39.3'
40									

DRILLING GEOLOGIST Dale Brown ASSISTANT Gary White CHECKED BY Shawn Wood

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 44 PG 2 OF 8

LOCATION: N 231,160 ft.
E 2,178,664 ft.

GROUND EL: 617.9 ft.

DATE: 3/5-13/90 TYPE: NX Core CASED TO: 5.0' CONTRACTOR: SwL (89-192)

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
									LIMESTONE (Austin Chalk), moderately to medium hard, fresh, light gray to dark gray with 0.5' to 1' thick slightly, moderately, extremely argillaceous to shaly limestone interbeds 0.3' to 5' apart. Also fossil partings, bentonite layer, medium, angle fractures.
45		C7	42.0	52.0	99	99			-moderately argillaceous layers, soft, dark gray, gradational contact at 42.0' to sharp contact at 42.5', sharp contacts at 46.7'-48.2' -very argillaceous layer, soft, dark gray, gradational contact at 50.0' to sharp contact at 51.0' -fossil partings at 45.5' and 50.8'
50									
55		C8	52.0	62.0	100	1000			-slightly argillaceous layer, gradational contacts at 52.8'-53.3' -moderately argillaceous layer, dark gray, gradational contacts at 56.5'-57.5' -shaly limestone layers, gray, soft, fissile, gradational contacts at 58.2'-58.5', and dark gray, gradational contacts at 61.2'-61.8' -fossil partings at 58.6', 59.5', 61.2', and 61.8'
60									
65		C9	62.0	72.0	100	100			-slightly argillaceous layer, light gray to gray, gradational contacts at 63.0'-64.1' -bentonitic shale layer, dark gray, gradational contacts at 66.2'-66.5' -moderately argillaceous layer, dark gray, gradational contacts at 68.7'-69.2' -shaly limestone, dark gray, fissile, at 69.8' -40°, smooth, tight, slickensided fracture at 66.4' -fossil partings at 63.9', 64.8', 67.6', 67.8' and 68.9'
70									
75		C10	72.0	82.0	100	100			-fossil partings at 72.8', 75.1', 75.4', 76.2', 78.4' and 79.7' -slightly argillaceous layers, gray, gradational contacts at 73.0'-73.4', gradational contacts at 73.7'-75.0' and gradational contacts at 80.0'-81.5' -moderately argillaceous layers, gray to dark gray, gradational contacts at 77.8'-78.7', gradational contacts at 79.4'-80.0' and gradational contact at 81.5' to sharp contact at 81.8' -shaly limestone layers, soft, gray to dark gray, gradational contacts at 73.4'-73.7', 75.0'-76.0' and 78.7'-79.4'
80									

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 8

DRILLING GEOLOGIST Dale Brown ASSISTANT Gary White CHECKED BY Shawn Wood

LOG OF BORING

PROJECT: Superconducting Supercollider
CLIENT: The Earth Technology Corporation
TASK NO.: 15

BORING NO: BIR 44 PG 3 OF 8
LOCATION: N 231,160 ft. E 2,178,664 ft.
GROUND EL: 617.9 ft.

DATE: 3/5-13-90 TYPE: NX Core CASED TO: 5.0' 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 8

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
									LIMESTONE (Austin Chalk), moderately to medium hard, fresh, light gray to dark gray with 0.2' to 2' thick moderately to extremely argillaceous to shaly limestone interbeds 0.2' to 3' apart. Also fossil partings, bentonite layer.
85		C11	87.0	92.0	100	100			-moderately argillaceous layers, dark gray, sharp contact at 82.1' to gradational contact at 82.3', gradational contacts at 82.5'-84.2', 86.3'-87.9', and gradational contact at 90.9' to sharp contact at 92.0' -shaly limestone layer, dark gray, fissile, gradational contacts at 82.3'-82.5', gradational contacts at 84.2'-84.5', gradational contacts at 87. 9'-88.1' and gradational contacts at 90.7'-90.9'
90									
95		C12	92.0	102.0	100	100			-bentontic shale layer, dark gray, soft, gradational contacts at 86.1'-86.3' -fossil parting at 89.9' -moderately argillaceous layer, dark gray, gradational contacts at 93.1'-93.9' -very argillaceous layers, dark gray, gradational contacts at 95.0'-95.8', 97.1'-98.0', and 99.0'-100.3'
100									
105		C13	102.0	112.0	93	93			-fossil partings at 108.1 and 110.9' -moderately argillaceous layers, dark gray, gradational contacts at 102.5'-103.7', gray, gradational contacts at 104.7'-105.3', dark gray, gradational contacts at 105.3'-105.9', gradational contacts at 107.6'-108.4', and gradational contacts at 110.2'-111.1 ' -shaly limestone layers, gray, fissile, soft, gradational contacts at 105.9'-106.2', gradational contacts at 109.2'-109.4', and gradational contact at 111.1' to sharp contact at 111.4'
110									
115		C14	112.0	122.0	98	98			-moderately argillaceous layers, dark gray, gradational contacts at 112.6'-113.9', gradational contacts at 115.8'-116.6', gradational contacts at 117.8'-118.3', gradational contacts at 119.0'-119.7', and gradational contact at 121.0' to sharp contact at 121.7' -very argillaceous layer , dark gray, gradational contacts at 117.4'-117.8' -fossil partings at 113.2', 114.5', and 121.2'
120									

DRILLING GEOLOGIST Dale Brown ASSISTANT Gary White CHECKED BY Shawn Wood

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 44 PG 4 OF 8

LOCATION: N 231,160 ft.
E 2,178,664 ft.

GROUND EL: 617.9 ft.

DATE: 3/5-13/90 TYPE: NX Core CASED TO: 5.0' 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 8

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
									LIMESTONE Austin Chalk), moderately to medium hard, fresh, light to dark gray with 0.2' to 1' thick slightly, moderately, extremely argillaceous to shaly limestone interbeds 0.1' to 4' apart. Also fossil partings, medium angle fractures and traces of pyrite.
125		C15	122.0	132.0	100	100			-35° smooth, tight, slickensided fracture at 127.0' -shaly limestone layer, soft, medium gray, gradational contact at 126.7' to sharp contact at 127.0' -pyrite nodule at 127.1' -moderately argillaceous layer, soft, medium gray, gradational contacts at 128.0'-129.5' -moderately argillaceous layer, soft, medium gray, gradational contacts at 129.6'-130.0'
130									
135		C16	132.0	142.0	100	100			-moderately argillaceous layer, medium gray, gradational contacts at 133.6'-134.3' -shaly limestone layer, soft, dark gray, gradational contact at 134.8' to sharp contact at 135.0' -pyrite nodule at 134.9' -shaly limestone layer, soft, dark gray, sharp contacts at 138.6'-139.1' -slightly argillaceous layer, light gray, gradational contacts at 141.2'-141.5'
140									
145		C17	142.0	152.0	100	100			-shaly limestone layers, dark gray, sharp contact at 144.1' to gradational contact at 144.4', sharp contacts at 144.8'-145.0' -pyrite nodule at 144.2' -moderately argillaceous layers, medium gray, gradational contacts at 147.2'-148.5', gradational contacts at 150.2'-151.4' -moderately argillaceous layer, dark gray sharp contact at 149.1' to gradational contact at 149.4' -fossil parting at 152.9'
150									
155		C18	152.0	162.0	100	100			-very argillaceous layers, soft, dark gray, sharp contact 152.7' to gradational contact at 152.9', gradational contacts at 155.4'-155.9' and gradational contacts at 158.5'-159.1' -pyrite nodule at 155.2 and 155.4'
160									

DRILLING GEOLOGIST Dale Brown ASSISTANT Gary White CHECKED BY Shawn Wood

LOG OF BORING

PROJECT: Superconducting Supercollider
CLIENT: The Earth Technology Corporation
TASK NO.: 15

BORING NO: BIR 44 PG 5 OF 8
LOCATION: N 231,160 ft. E 2,178,664 ft.
GROUND EL: 617.9 ft.

DATE: 3/5-13/90 TYPE: NX Core CASED TO: 5.0' 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 8

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
									LIMESTONE (Austin Chalk), moderately to medium hard, fresh, light gray to dark gray with 0.3' to 1' thick slightly, moderately argillaceous interbeds 1' to 5' apart. Also fossiliferous layers 0.3' thick, traces of pyrite.
			162.0						-fossiliferous limestone gradational contacts at 162.7'-163.0'
165		C19			100	100			-moderately argillaceous layers, dark gray, gradational contacts 163.4'-163.7', gradational contacts at 165.3'-165.6', gradational contacts at 170.6'-171.3', and gradational contact at 172.0' to sharp contact at 173.0'
170				172.0					-slightly argillaceous layers, gray to dark gray, gradational contacts at 165.0'-165.3', gradational contacts at 171.3'-172.0'
			172.0						-pyrite nodule at 163.5'
									-moderately argillaceous layers, fossiliferous, dark gray, gradational contacts at 175.4'-176.1'
175									
									176.1 -Gradational Contact-
		C20			75	75			SHALY LIMESTONE (Transition), medium hard, fresh, extremely argillaceous, medium gray with abundant fragments of fish bones, and other fossil debris.
180									177.3 -Sharp Contact-
				182.0					SHALE (Eagle Ford), soft, fresh, fissile, dark gray with occasional low, medium angle fractures, fossil partings, septarian concretions, traces of pyrite.
			182.0						-40°, smooth, tight, slickensided fracture at 179.2'
185									-45°, smooth, tight, slickensided fracture at 189.9'
		C21			100	100			-25°, smooth, tight, slickensided fracture at 182.6'
									-limestone layers (½"), dark tan, medium hard at 189.3' (1½"), tan to gray, medium hard at 188.6'-188.7'
190									-very fossiliferous, dark gray at 187.2'-187.4'
				192.0					-10°, smooth, tight, slickensided fracture at 185.7'
			192.0						-limestone layer (½"), gray, medium hard at 184.9'
									-fossil partings at 184.9' and 187.3'
195									-pyrite nodules at 192.6' and 197.2'
									-50°, smooth, slickensided fracture at 195.7'
		C22			99	99			-40°, smooth, tight, slickensided fracture at 196.1'
									-limestone layer (3/4"), gray, medium hard at 195.2'
									-20°, healed, pyrite filled, fracture at 198.5'
200									-septarian concretions, gray at 199.0', 199.4' 200.1, 200.3', and 200.7'
				202.0					-30°, smooth, tight, slickensided fracture at 200.9'
									-limestone layer (3/4"), gray at 201.6'

DRILLING GEOLOGIST Dale Brown ASSISTANT Alan Dover, Gary White CHECKED BY Shawn Wood

LOG OF BORING

PROJECT: Superconducting Supercollider
CLIENT: The Earth Technology Corporation
TASK NO.: 15

BORING NO: BIR 44 PG 6 OF 8
LOCATION: N 231,160 ft. E 2,178,664 ft.
GROUND EL: 617.9 ft.

DATE: 3/5-13/90 TYPE: NX Core CASED TO: 5.0' CONTRACTOR: SwL (89-192)

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
			202.0	212.0	100	100			SHALE (Eagle Ford), soft, fresh, fissile, dark with occasional harder carbonate layers 1' thick, low to medium angle fractures, fossil partings and septarian concretions, traces of pyrite. -40°, smooth, tight, fracture at 202.0' -25°, smooth, tight, slickensided fracture at 202.9' -45°, healed, tight, fracture at 203.7' -30°, smooth, tight, slickensided fracture at 204.3' -55°, smooth, tight, slickensided fracture at 207.2' -65°, smooth, tight, slickensided fracture at 207.6' -50°, smooth, tight, slickensided fracture at 208.0' -severely fractured, healed, at 208.2'-208.6' -30°, smooth, tight, slickensided fracture at 210.1' -septarian concretions, gray, at 203.6' and 207.0' -pyrite nodule at 208.2' -pyrite nodules at 214.3', 216.1', 218.0' and 217.6' -limestone layer, medium hard, gray, sharp contacts at 217.1'-217.4' -fossiliferous, calcareous, shale layer, dark gray sharp contacts at 217.4'-217.7' -fossil parting at 221.5' -fossil parting, pyrite at 223.3' -calcareous shale, fossiliferous, gradational contacts at 224.9'-225.7' -fossil partings at 225.5' and 227.0' -60°, smooth, tight, slickensided fracture at 229.8' -60°, healed, planar, fracture at 230.2' -55°, smooth, tight, slickensided fracture at 230.9' -pyrite seam at 231.4' -septarian concretions at 234.3',234.7', 238.1' and 238.4' -calcareous shale, fossiliferous, sharp contacts at 234.8'-235.9' and gradational contacts at 236.7'-237.1' -pyrite nodule at 239.1' -45°, smooth, tight, slickensided fracture at 238.2'
205		C23							
210									
			212.0	222.0	100	100			
215		C24							
220									
			222.0	232.0	100	100			
225		C25							
230									
			232.0	240.0	100	100			
235		C26							
240									

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 8

DRILLING GEOLOGIST Dale Brown ASSISTANT Alan Dover CHECKED BY Shawn Wood

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 44 PG 7 OF 8

LOCATION: N 231,160 ft.
E 2,178,664 ft.

GROUND EL: 617.9 ft.

DATE: 3/5-13/90 TYPE: NX Core CASED TO: 5.0' 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 8

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
			240.0						SHALE (Eagle Ford), soft, fresh, fissile, dark gray with occasional harder carbonate layers 0.5' thick, medium angle fractures, fossil partings and traces of pyrite and calcite.
245		C27			100	100			-fossil parting at 240.2' -pyrite seam (½") at 243.2' -pyrite nodule at 246.3', 249.7', and 249.9'
250				250.0					
			250.0						-limestone layers, gray, calcite filled, some pyrite, sharp contacts at 251.1'-251.4' -pyrite nodules at 251.4', 251.6', 251.7' and 256.7' -limestone layer, gray, fractured, calcite filled, some pyrite, sharp contacts at 255.0'-255.5' -60°, smooth, tight, slickensided fracture at 255.6' -pyrite layer (3/4") at 255.5' -55°, healed, calcite filled, fracture at 254.8' -40°, smooth, tight, slickensided fracture at 265.6' -60°, smooth, planar, transverse slickensided fracture at 255.8' -fossil parting at 256.8'
255		C28			86	86			
260				260.0					
			260.0						
265		C29			98	98			
270				270.0					
			270.0						
275		C30			90	90			-fossil partings at 275.0' and 276.0'
280				280.0					

DRILLING GEOLOGIST Dale Brown ASSISTANT Alan Dover CHECKED BY Shawn Wood

LOG OF BORING

PROJECT: Superconducting Supercollider
CLIENT: The Earth Technology Corporation
TASK NO.: 15

BORING NO: BIR 44 PG 8 OF 8
LOCATION: N 231,160 ft. E 2,178,664 ft.
GROUND EL: 617.9 ft.

DATE: 3/5-13/90 TYPE: NX Core CASED TO: 5.0' 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 8

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
		C31	280.0	290.0	89	89				SHALE (Eagle Ford), soft, fresh, fissile, dark gray with occasional harder carbonate layers 2' thick, fossiliferous layer, fossil partings and septarian concretions. -septarian concretion at 286.7'
285										
290		C32	290.0	300.0	100	100				-fossil partings at 290.1', 291.4', 251.9'. 293.3', 295.0', 295.5', 299.5' and 300.0' -fossiliferous shale, very soft, very fissile, sharp transition at 293.0' to gradational transition at 296.9'
295										
300		C33	300.0	310.0	99	99				-fossil partings at 302.1', 302.6', 303.3', 304.8', 305.1', 305.2', 305.4', 305.8', 306.4' and 306.9' -calcareous shale transition sharp contact at 307.4' to gradational contact at 309.4' -limestone layers, soft, broken, argillaceous gradational contact at 309.4' to sharp contact at 310.0'
305										
310		C34	310.0	315.0	0	0				
315										Bottom of Exploration at 315.0 feet
320										

DRILLING GEOLOGIST Dale Brown ASSISTANT Gary White CHECKED BY Shawn Wood

LITHOLOGIC LOG

BIR 45

LOG OF BORING

PROJECT: The Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 45PG 1 OF 8

LOCATION: N 231,515 ft.
E 2,178,508 ft.

GROUND EL: 616.3 ft.

DATE: 4/3-9/90 TYPE: NX Core CASED TO: 5' 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

Began drilling with air to 61.0' switched to water, no seepage. Unable to determine parameters at groundwater 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
									CLAY, soft, fine organics, dark brownish gray with occasional severely weathered limestone fragments
			2.0						1.0
5		C1			93	93			LIMESTONE (Austin Chalk), soft to medium, moist severely weathered, tan with weathered moderately argillaceous layers 1' thick.
									-moderately argillaceous tan layers, sharp contacts at 6.7'-8.0'
10				11.0					
			11.0						13.8
15		C2			96	90			LIMESTONE (Austin Chalk), moderately to medium hard, fresh, light gray to dark gray with 1' to 2' thick slightly, moderately argillaceous limestone interbeds 2' to 4' apart. Also fossil partings.
									-fossil partings at 14.4', 14.5', 14.6', 15.3', 16.0', 16.6', and 17.0'
20				21.0					
			21.0						
25		C3			100	100			-fossil partings at 23.9' and 27.2'
									-slightly argillaceous layer, gradational contacts at 26.0'-27.3'
30				31.0					-moderately argillaceous layer, gradational contact at 29.3' to sharp contact at 30.3'
			31.0						-slightly argillaceous layers, gradational contact at 33.0' to sharp contact at 34.2'; gradational contacts at 38.5'-40.0'
35		C4			100	100			-fossil partings at 33.2' and 35.7'
40				41.0					

DRILLING GEOLOGIST D. Brown ASSISTANT G. White CHECKED BY Shawn Wood

LOG OF BORING

BORING NO: BIR 45PG 2 OF 8

PROJECT: The Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

LOCATION: N 231,515 ft. E 2,178,508 ft.

GROUND EL: 616.3 ft.

DATE: 4/3-9/90 TYPE: NX Core CASED TO: 5' 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 8

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, 50		C5	41.0	51.0	100	100			LIMESTONE (Austin Chalk), moderately to medium hard, fresh, light gray to dark gray with 1' to 3' thick slightly, moderately, extremely argillaceous limestone interbeds 1' to 18' apart. Also fossil partings. -fossil partings at 41.6', 45.5' and 50.2' -slightly argillaceous layers, gradational contacts at 41.5'-42.7'; gradational contacts at 48.5'-49.5'
55, 60		C6	51.0	61.0	100	100			
65, 70		C7	61.0	71.0	100	100			-moderately argillaceous layers, dark gray, gradational contacts at 67.2'-68.1'; sharp contacts at 70.1'-71.0', and gradational contact at 65.8' to sharp contact at 66.1' -fossil partings at 61.4', 61.8', 63.3', 64.8', 70.1' and 70.5'
75, 80		C8	71.0	81.0	100	100			-moderately argillaceous layers, dark gray, sharp contact at 71.0' to gradational contact at 72.3'; gradational contacts at 74.0'-76.0'; and gradational contacts at 79.0'-80.8' -very argillaceous layers, dark gray, fissile, gradational contacts at 76.8'-77.1'; gradational contacts at 78.6'-79.0' -fossil partings at 72.3' and 78.2'

DRILLING GEOLOGIST D. Brown ASSISTANT G. White CHECKED BY Shawn Wood

LOG OF BORING

PROJECT: The Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 45PG 3 OF 8

LOCATION: N 231,515 ft.
E 2,178,508 ft.

GROUND EL: 616.3 ft.

DATE: 4/3-9/90 TYPE: NX Core CASED TO: 5' 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 8

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
85, 90		C9	81.0	91.0	100	100			LIMESTONE (Austin Chalk), moderately to medium hard, fresh, light gray to dark gray with 0.5' to 2' thick slightly moderately argillaceous limestone interbeds 2' to 4' apart. Also fossil partings, bentonite layer, and medium angle fractures. -fossil partings at 82.9', 83.7', 87.5', 88.6', and 89.0' -moderately argillaceous layers, dark gray, gradational contacts at 83.5'-84.6'; gradational contacts at 86.1'-86.6'; and gradational contacts at 88.0'-88.7'
95, 100		C10	91.0	101.0	100	100			-slightly argillaceous layer, gradational contact at 90.1' to sharp contact at 91.0' -moderately argillaceous layers, dark gray, gradational contacts at 92.2'-93.6'; gradational contacts at 95.8'-97.0'; and gradational contact at 98.8' to sharp contact at 99.6' -fossil parting at 96.2'
105, 110		C11	101.0	111.0	100	100			-fossil partings at 101.9', 102.0', and 108.4' -bentonitic shale layer, soft, gray, sharp contact at 104.5' to gradational contact at 105.0' -bentonite layer, soft, bluish-gray, gradational contact at 105.0' to sharp contact at 105.8' -45°, smooth, tight, planar, healed slickensided fracture at 106.2' -50°, smooth, tight, planar, slickensided fracture at 107.3'
115, 120		C12	111.0	121.0	100	100			-fossil partings at 115.1' and 115.5'

DRILLING GEOLOGIST D. Brown ASSISTANT B. Morgan CHECKED BY Shawn Wood

LOG OF BORING

PROJECT: The Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 45PG 4 OF 8

LOCATION: N 231,515 ft.
E 2,178,508 ft.

GROUND EL: 616.3 ft.

DATE: 4/3-9/90 TYPE: NX Core CASED TO: 5' 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 8

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
		C13	121.0	131.0	100	100			LIMESTONE (Austin Chalk), moderately to medium hard, fresh, light gray to dark gray with 0.1' to 1' thick moderately, extremely argillaceous limestone interbeds 2' to 6' apart. Also pyrite nodules. -pyrite nodules at 122.9', 123.7', and 124.4'
125									
130									-very argillaceous layers, dark gray, sharp contacts at 132.3'-132.8', sharp contacts at 138.4'-138.5'
		C14	131.0	141.0	100	100			
135									
140									-moderately argillaceous layers, dark gray, sharp contacts at 142.9'-143.1',sharp contacts at 146.6'-146.8', and gradational contacts at 149.3'-150.0'
		C15	141.0	151.0	100	100			
145									
150									-very argillaceous layer, dark gray, sharp contacts at 152.6'-153.1'
		C16	151.0	161.0	67	67			
155									-moderately argillaceous layer, dark gray, gradational contacts at 156.7'-157.0'
160									

DRILLING GEOLOGIST D. Brown ASSISTANT B. Morgan CHECKED BY Shawn Wood

LOG OF BORING

PROJECT: The Superconducting Supercollider
CLIENT: The Earth Technology Corporation
TASK NO.: 15

BORING NO: BIR 45PG 5 OF 8
LOCATION: N 231,515 ft. E 2,178,508 ft.
GROUND EL: 616.3 ft.

DATE: 4/3-9/90 TYPE: NX-Core CASED TO: 5' 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 8

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
-165, -170		C17	161.0	171.0	99	99			LIMESTONE (Austin Chalk), moderately to medium hard, fresh, light gray to dark gray with 1' to 2' thick slightly, moderately argillaceous limestone interbeds. -slightly argillaceous layers, gradational contacts at 163.6'-165.3'; gradational contacts at 167.0'-169.5' -moderately argillaceous layers, dark gray, gradational contacts at 165.3'-167.0' and 169.5'-170.9' 171.0 -Sharp Contact-
-175, -180		C18	171.0	181.0	96	96			SHALEY LIMESTONE (Transition) medium, fresh, extremely argillaceous, medium gray with abundant fragments of fish bones, sharks teeth, and other fossil debris. 171.6 -Sharp Contact-
-185, -190		C19	181.0	190.0	100	100			SHALE (Eagle Ford) soft, fresh, fissile, dark gray with occasional layers of limestone, calcareous shale and septarian concretions. -limestone layer, medium, fresh, gray, sharp contacts at 181.4'-181.6' -calcareous shale, soft, dark tan at 183.8', 184.7', 186.9' and sharp contacts at 189.8'-190.0'
-195, -200		C20	190.0	200.0	92	92			-limestone layers, medium, fresh, gray, sharp contacts at 190.2'-190.3'; 193.3', and sharp contacts at 195.3'-195.4' -calcareous shale layer, soft, dark tan, at 191.8', 192.4' and 194.9' -septarian concretions at 194.3', 195.1', 196.9' and 197.2'

DRILLING GEOLOGIST D. Brown ASSISTANT G. White CHECKED BY Shawn Wood

LOG OF BORING

PROJECT: The Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 45 PG 6 OF 8

LOCATION: N 231,515 ft.
E 2,178,508 ft.

GROUND EL: 616.3 ft.

DATE: 4/3-9/90 TYPE: NX Core CASED TO: 5' 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 8

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
			200.0						SHALE (Eagle Ford), soft, fresh, fissile, dark gray with occasional fossil partings, septarian concretions, pyrite nodules, limestone and calcareous shale layers 0.1' to 4' thick. -pyrite nodule (1") at 203.3' -pyrite layer (½"), at 207.7'
205		C21			100	100			
				210.0					
210			210.0						-limestone layer, medium, fresh, gray, sharp contacts at 213.0'-213.1' -pyrite layer, fine grained, sharp contacts at 213.1'-213.5'
215		C22			100	100			
220				220.0					
			220.0						-limestone layer, medium, fresh, gray, sharp contacts at 221.4'-221.5' -calcareous shale layer, soft, brownish gray, gradational contacts at 222.0'-222.4'
225		C23			100	100			
230				230.0					
			230.0						-pyrite layer, fine grained, gradational contacts at 233.5'-233.9' -septarian concretions at 233.9', 234.8, and 238.8'
235		C24			89	89			
240				240.0					

DRILLING GEOLOGIST D. Brown ASSISTANT G. White CHECKED BY Shawn Wood

LOG OF BORING

PROJECT: The Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 45PG 7 OF 8

LOCATION: N 231,515 ft.
E 2,178,508 ft.

GROUND EL: 616.3 ft.

DATE: 4/3-9/90 TYPE: NX Core CASED TO: 5' 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 8

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
		C25	240.0	250.0	100	100			SHALE (Eagle Ford), soft, fresh, fissile, dark gray.
245									
250		C26	250.0	260.0	40	40			
255									
260		C27	260.0	270.0	19	19			
265									
270		C28	270.0	280.0	100	100			
275									
280									

DRILLING GEOLOGIST D. Brown ASSISTANT G. White CHECKED BY Shawn Wood

LOG OF BORING

PROJECT: The Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 15

BORING NO: BIR 45 PG 8 OF 8

LOCATION: N 231,515 ft.
E 2,178,508 ft.

GROUND EL: 616.3 ft.

DATE: 4/3-9/90 TYPE: NX Core CASED TO: 5' 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 8

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
		C27	280.0	290.0	100	100				SHALE (Eagle Ford), soft, fresh, fissile, calcareous, dark gray with occasional fossil partings, with very fossiliferous layers 4' thick and shaly limestone layers 0.3' to 0.6' thick.
285										
290		C30	290.0	300.0	100	100				
295										
300		C31	300.0	310.0	92	92				-fossil parting at 304.0' -very fossiliferous calcareous shale layers, soft to medium, gray to dark gray, gradational contact at 305.5' to sharp contact at 309.2' -shaly limestone layers, medium gray at 308.0'-308.3' and 308.6'-309.2'
305										
310		C32	310.0	312.0	0	0				
315										Bottom of Exploration at 312.0 feet.
320										

DRILLING GEOLOGIST D. Brown ASSISTANT G. White CHECKED BY Shawn Wood

APPENDIX B

WIRE-LINE LOGS

WIRE-LINE LOGGING PARAMETERS

Hole No. BIR 41 **Log Measured From:** Ground Level

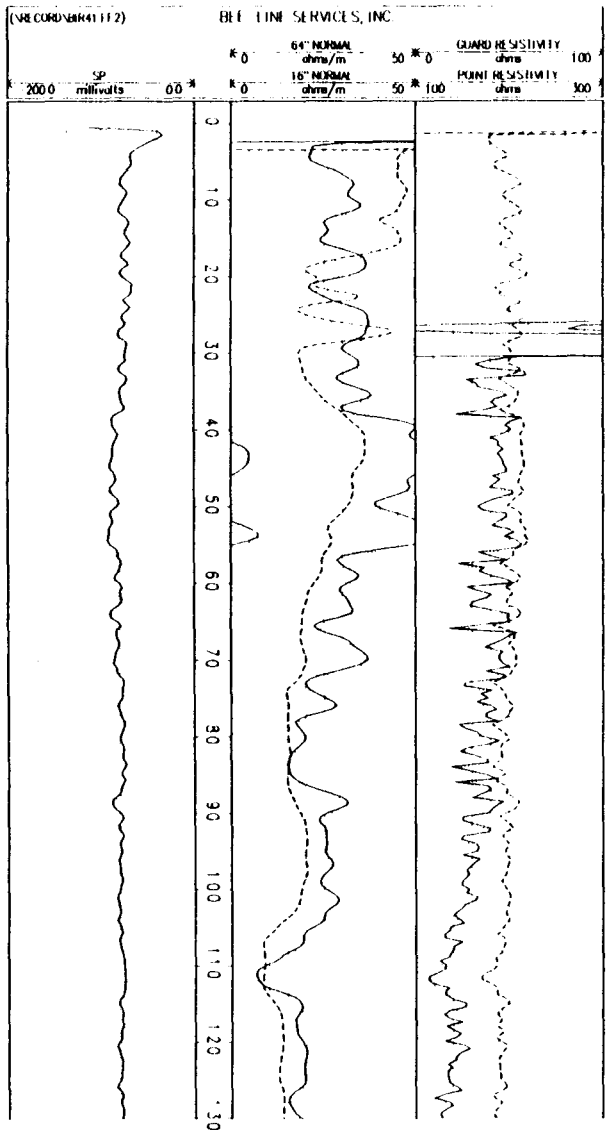
Drilling Parameters
Depth 266.0 feet
Bit Diameter 4.75 inches

Logging Parameters	Electrical Log	Gamma and Neutron Logs	Sonic Log
Date	September 23, 1989	September 23, 1989	September 23, 1989
Bottom Log Interval	222.5 feet	220.5 feet	216.1 feet
Top Log Interval	surface	surface	surface
Type of Fluid in Hole	drilling mud	drilling mud	drilling mud
Time Since Circulation Stop	30 minutes	30 minutes	30 minutes
Probe Type/S.N.	ALP-4979	XAP-4383	CLP-4877A
Module Type/S.N.	ALM-4979	XAM-4383	CLM-4877A
Logging Speed	40 feet/min.	20 feet/min.	20 feet/min.
Sample Interval	0.5 foot	0.5 foot	0.5 foot

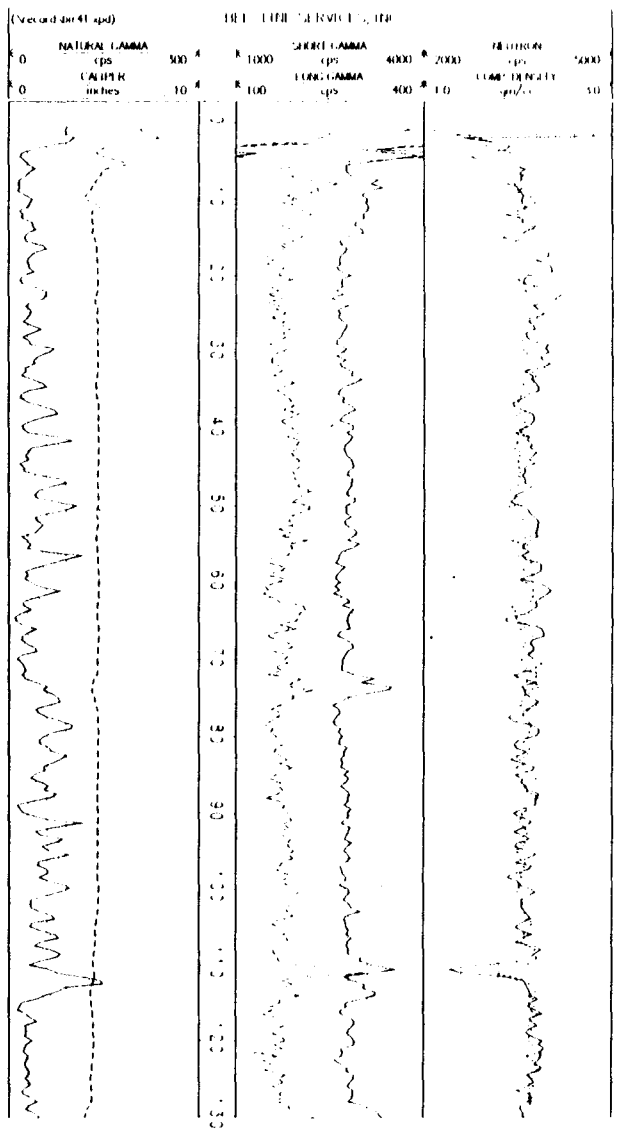
Logged by: BEE-LINE SERVICES, INC.
P. O. Box 2096
Corsicana, TX 75151

BIR 41 Wire-line logs run September 23, 1989. Surface elevation 618.7 feet.

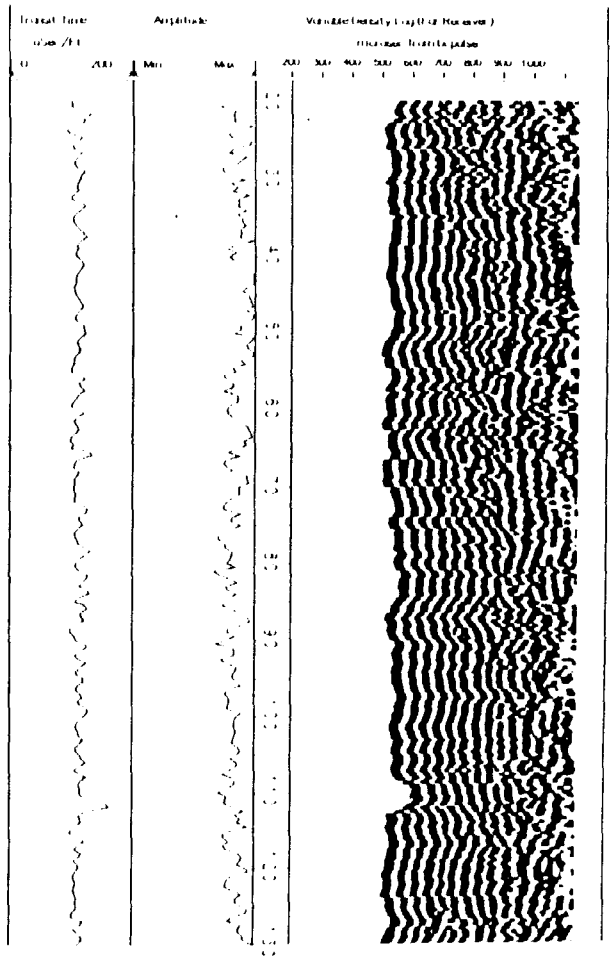
ELECTRICAL LOG



GAMMA AND NEUTRON LOGS

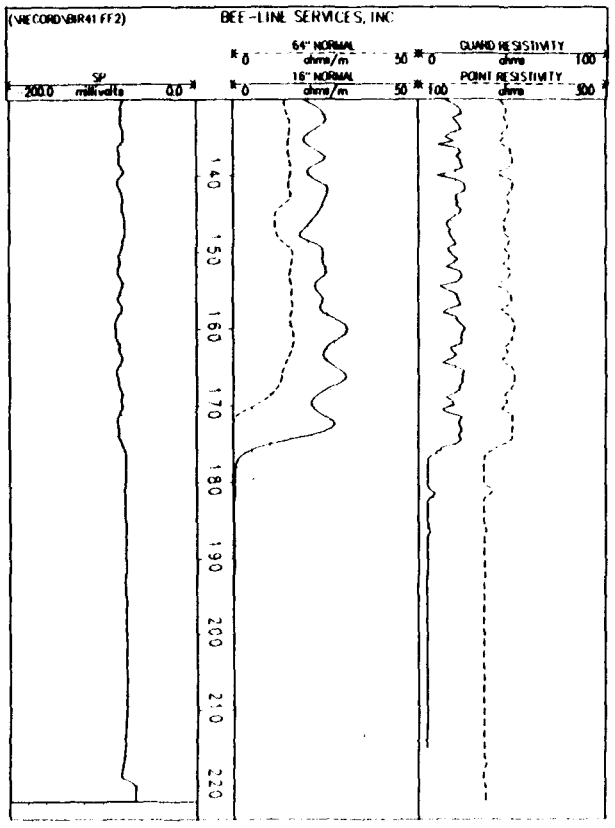


SONIC LOG

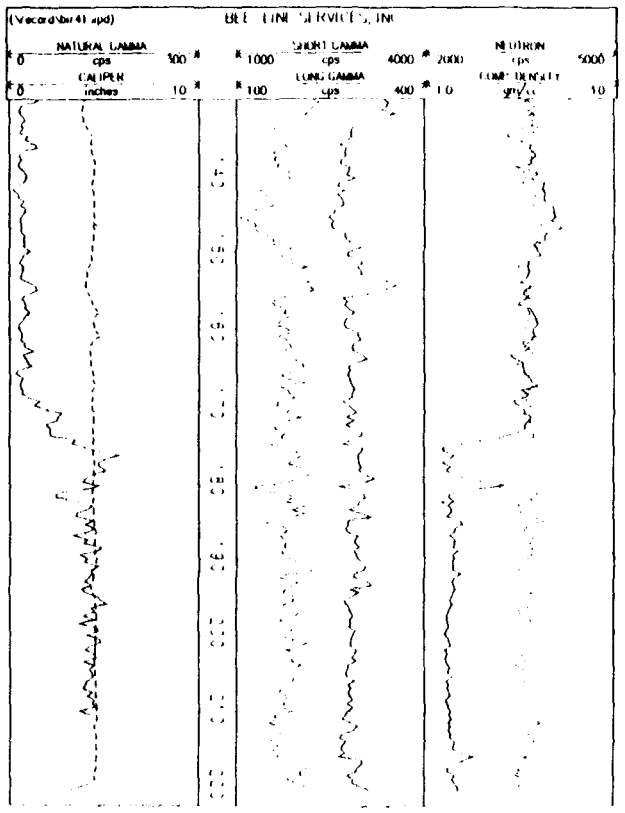


BIR 41 Wire-line logs run September 23, 1989 (Continued). Surface elevation 618.7 feet.

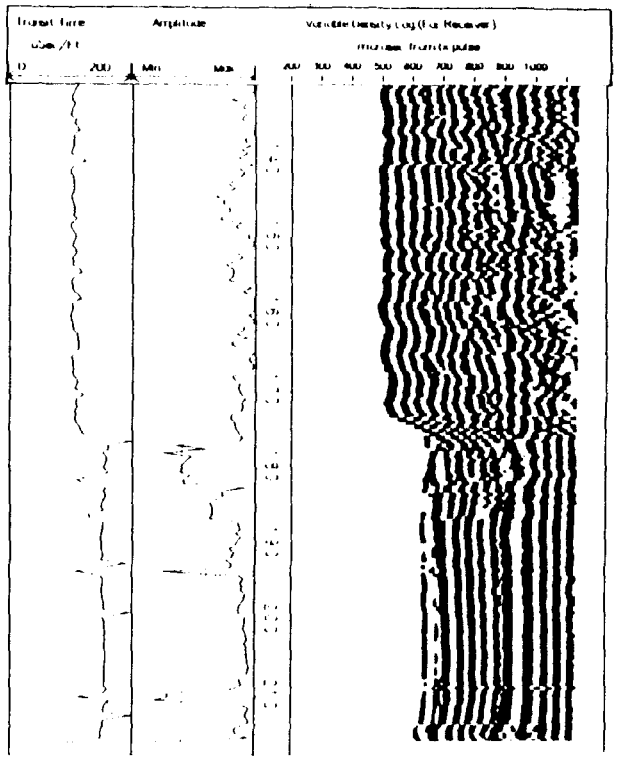
ELECTRICAL LOG CONTINUED



GAMMA AND NEUTRON LOGS CONTINUED



SONIC LOG CONTINUED



WIRE-LINE LOGGING PARAMETERS

Hole No. BIR 42 **Log Measured From:** Ground Level

Drilling Parameters

Depth 282.5 feet

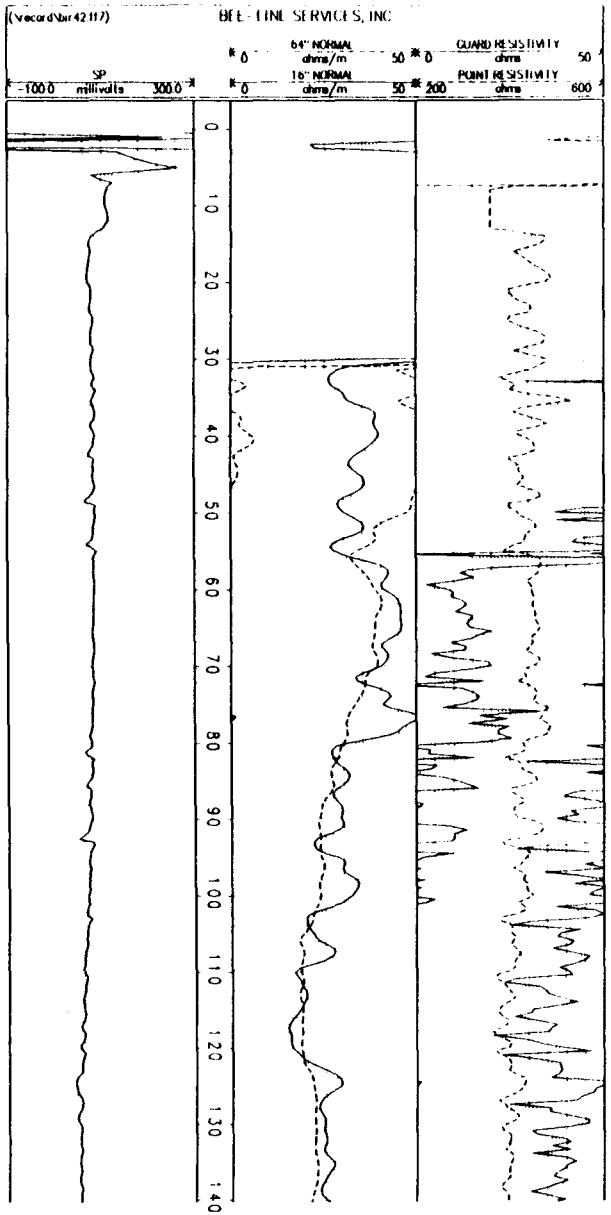
Bit Diameter 3.125 inches

Logging Parameters	Electrical Log	Gamma Log	Sonic Log	Deviation Log
Date	September 23, 1989	September 23, 1989	September 23, 1989	September 23, 1989
Bottom Log Interval	279.5 feet	279.5 feet	275.5 feet	281.3 feet
Top Log Interval	surface	surface	surface	surface
Type of Fluid in Hole	drilling fluid	drilling fluid	drilling fluid	drilling fluid
Time Since Circulation Stop	45 minutes	45 minutes	45 minutes	45 minutes
Probe Type/S.N.	ALP-4979	XAP-4383	CLP-4877A	9055A/135
Module Type/S.N.	ALM-4979	XAM-4383	CLM-4877A	COMPU-LOG
Logging Speed	40 feet/min.	20 feet/min.	20 feet/min.	60 feet/min.
Sample Interval	0.5 foot	0.5 foot	0.5 foot	0.1 foot

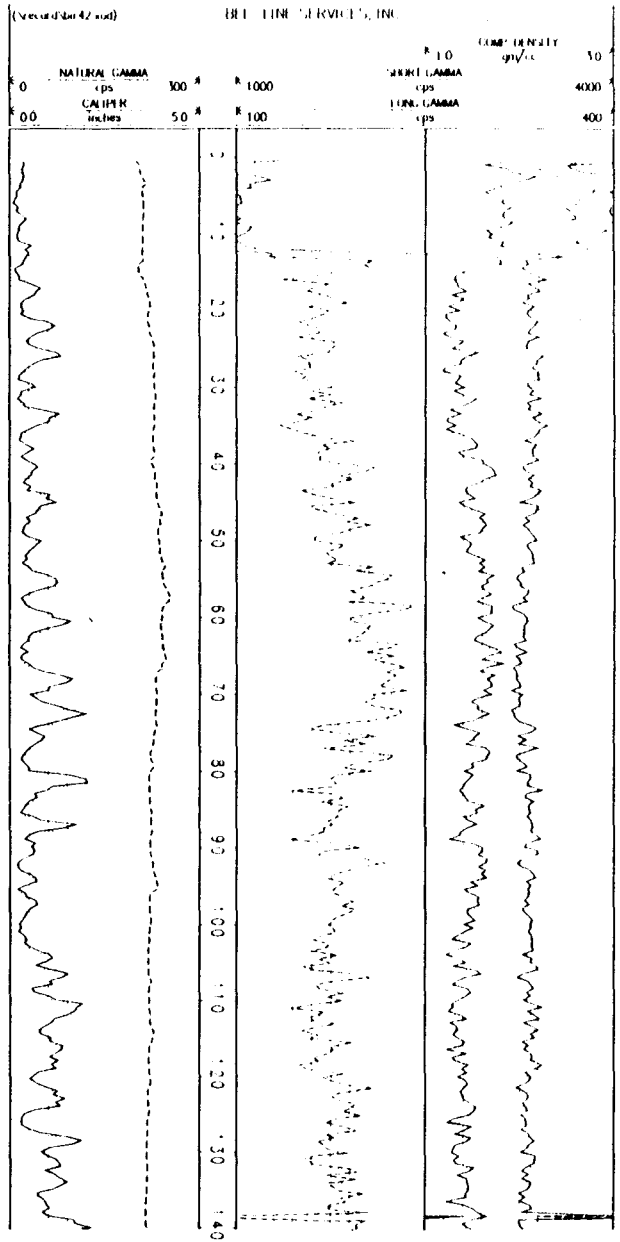
Logged by: BEE-LINE SERVICES, INC.
P. O. Box 2096
Corsicana, TX 75151

BIR 42 Wire-line logs run September 23, 1989. Surface elevation 620 feet.

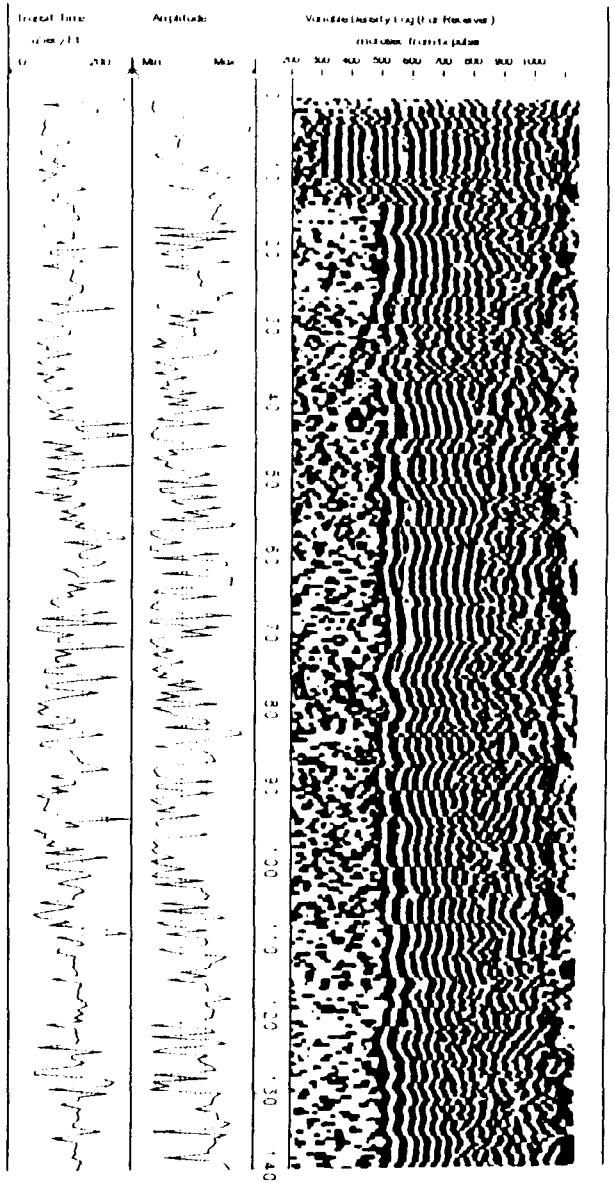
ELECTRICAL LOG



GAMMA LOG

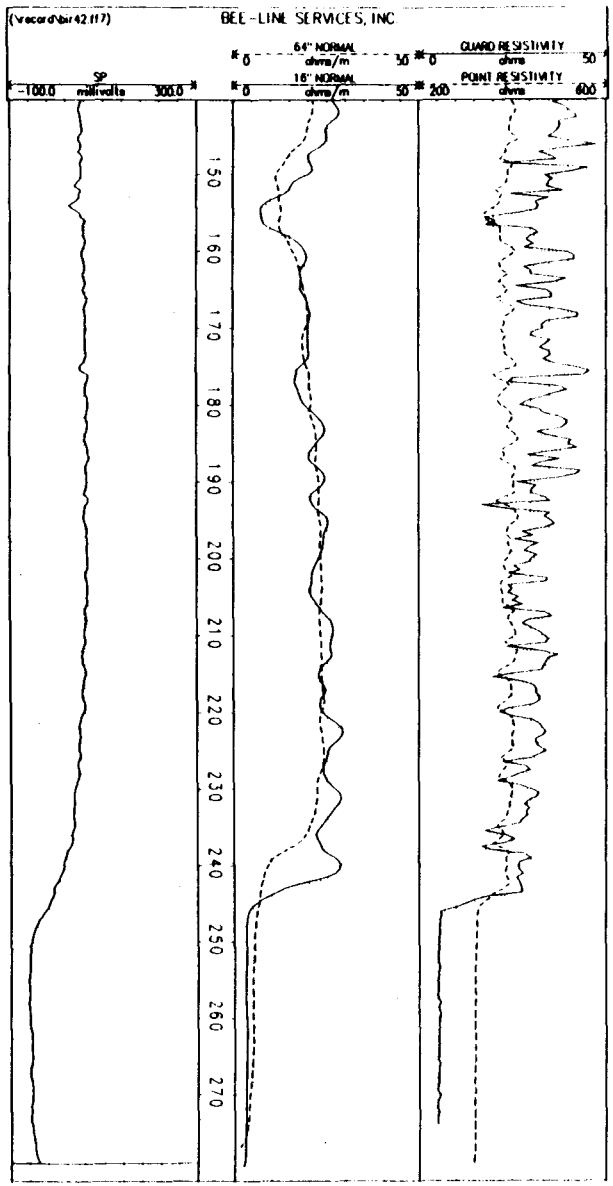


SONIC LOG

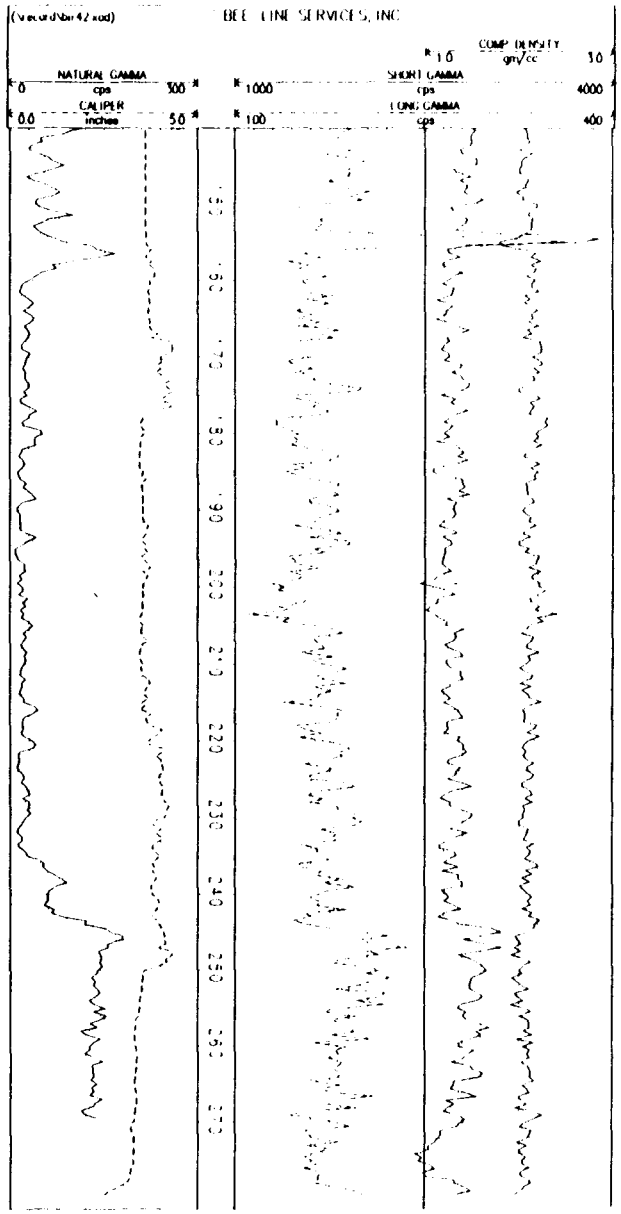


BIR 42 Wire-line logs run September 23, 1989 (Continued). Surface elevation 620 feet.

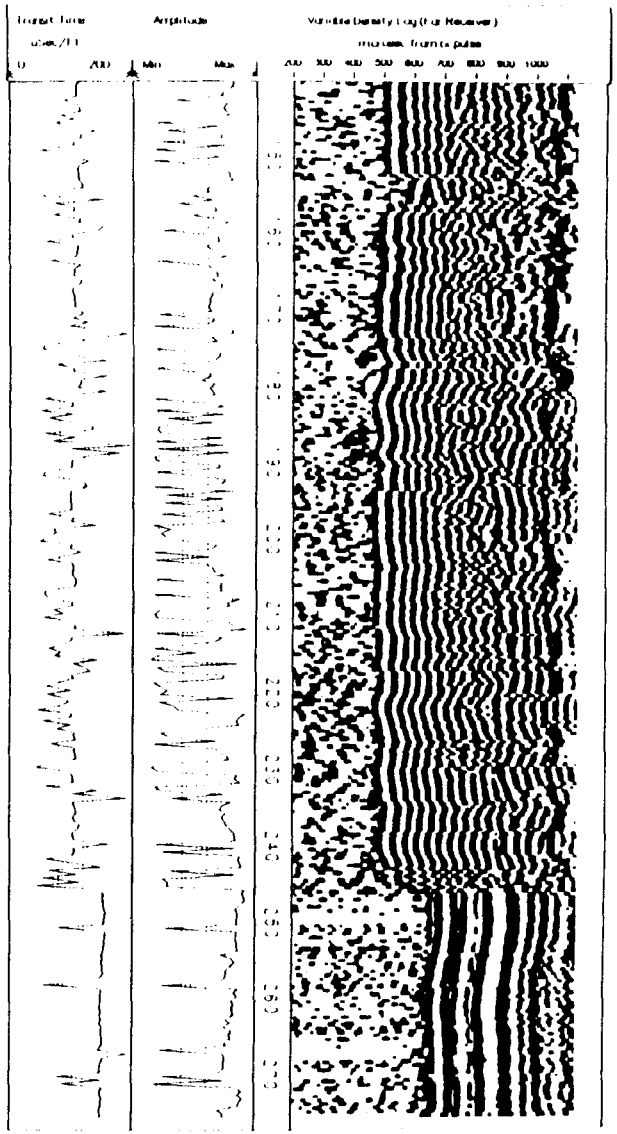
ELECTRICAL LOG CONTINUED



GAMMA LOG CONTINUED



SONIC LOG CONTINUED



DEVIATION SURVEY RESULTS

BORING BIR 42

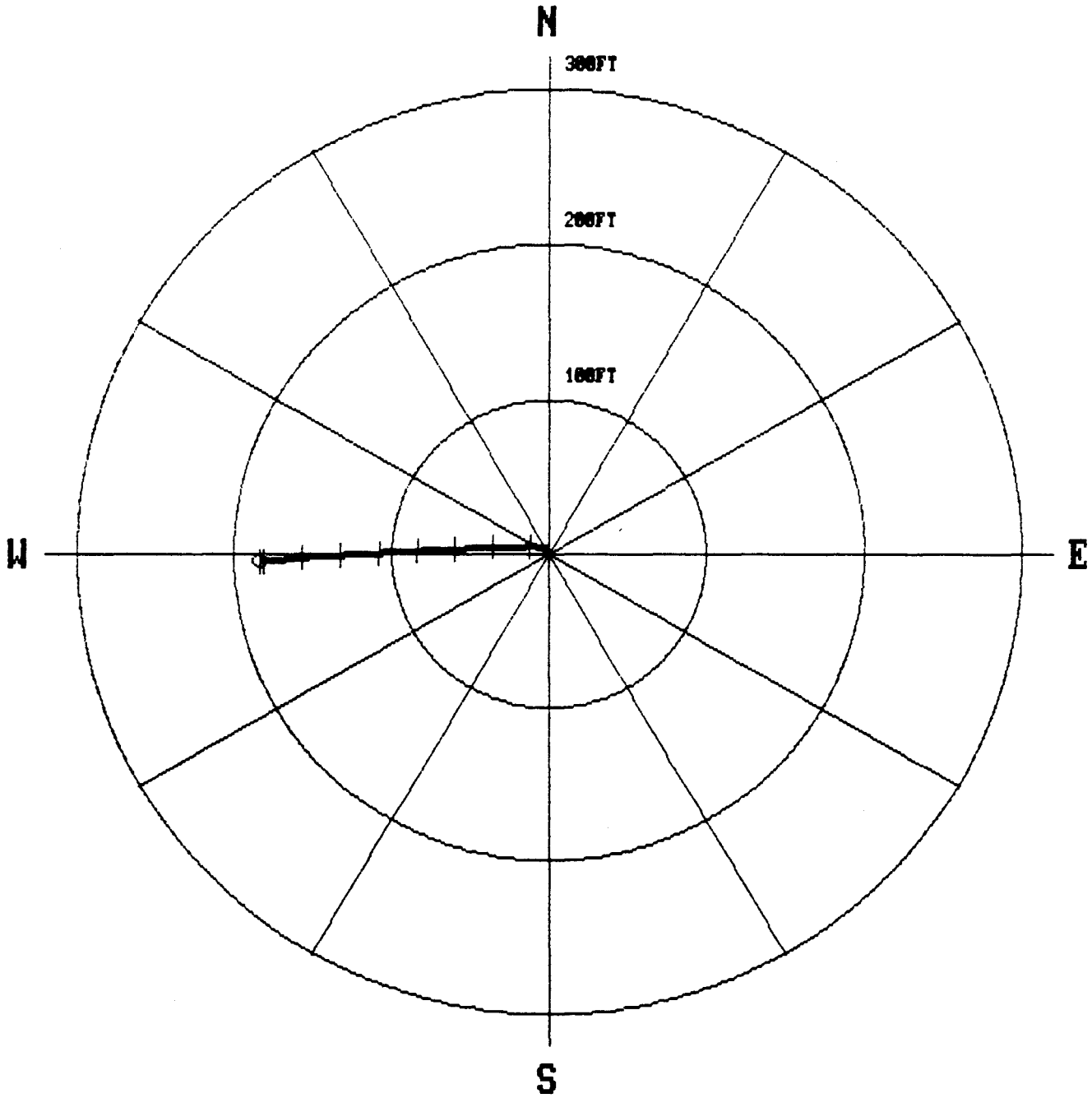
PLAN VIEW

COMPU-LOG DEVIATION

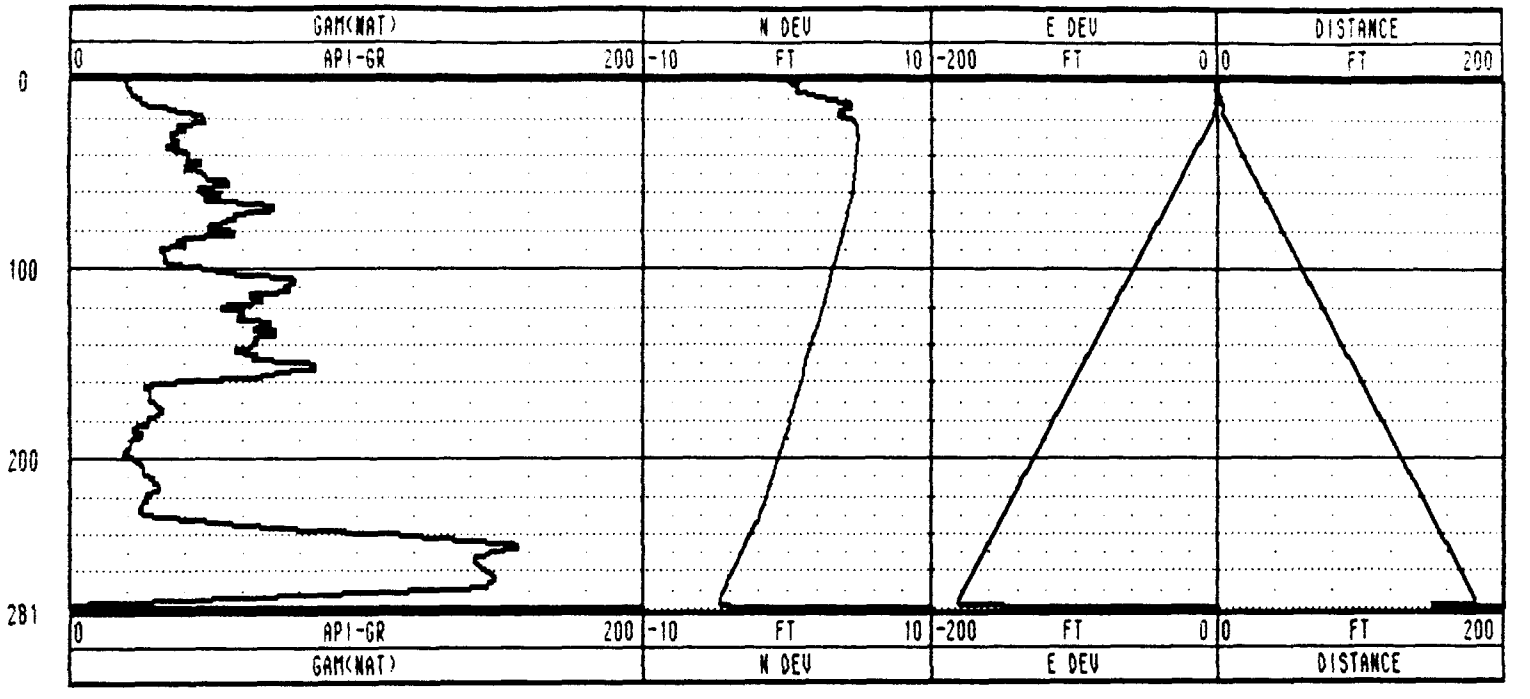
CLIENT: TEXAS SSC SITE
LOCATION: 87-888 TASK #15
HOLE ID: BIR 42
DATE OF LOG: 09/23/89
PROBE: 9055A 135

MAG DECL: 7.0

SCALE: 100 FT/IN
TRUE DEPTH: 202.97 FT
AZIMUTH: 268.5
DISTANCE: 182.8 FT
+ = 25 FT INCR
○ = BOTTOM OF HOLE



PROFILE VIEW
Compu-Log-Deviation
BIR 42



* * * * * * * COMPU-LOG - VERTICAL DEVIATION * * * * * * *

CLIENT : TEXAS SSC SITE
FIELD OFFICE : CORSICANA
DATA FROM :
MAG. DECL. : 7.000

HOLE ID. : BIR 42
DATE OF LOG : 09/23/89
PROBE : 9055A , 135
DEPTH UNITS : FEET LOG 9

CABLE DEPTH	TRUE DEPTH	NORTH DEV.	EAST DEV.	DISTANCE	AZIMUTH	SANG	SANGB
0.0	-0.00	0.00	0.00	0.0	0.0	0.0	0.0
1.0	1.00	0.00	0.00	0.0	0.0	0.0	0.0
2.0	2.00	0.00	0.00	0.0	0.0	0.0	0.0
3.0	2.91	0.04	-0.21	0.2	280.0	45.3	282.2
4.0	3.62	0.24	-0.88	0.9	285.3	44.5	295.2
5.0	4.34	0.71	-1.37	1.5	297.4	44.7	343.5
6.0	5.05	0.98	-1.33	1.7	306.3	44.4	173.9
7.0	5.76	0.30	-1.17	1.2	284.5	44.5	154.0
8.0	6.47	0.56	-0.68	0.9	309.2	44.6	36.4
9.0	7.18	1.17	-0.35	1.2	343.5	44.7	31.4
10.0	7.89	1.82	-0.59	1.9	342.0	44.9	349.7
11.0	8.60	1.97	-0.92	2.2	335.0	44.2	12.5
12.0	9.31	2.56	-1.22	2.8	334.5	44.9	328.9
13.0	10.02	3.15	-1.27	3.4	338.0	44.6	30.7
14.0	10.73	3.79	-0.97	3.9	345.6	44.6	18.0
15.0	11.44	4.44	-0.72	4.5	350.7	44.5	0.6
16.0	12.16	4.61	-1.02	4.7	347.5	44.2	248.6
17.0	12.87	4.32	-1.63	4.6	339.3	44.2	221.1
18.0	13.59	3.80	-1.45	4.1	339.1	43.7	126.7
19.0	14.32	3.65	-2.04	4.2	330.9	44.1	263.3
20.0	15.05	3.41	-2.66	4.3	322.0	44.1	258.1
21.0	15.77	3.61	-3.21	4.8	318.3	43.6	315.6
22.0	16.50	4.11	-3.67	5.5	318.3	41.0	319.3
23.0	17.23	4.47	-4.24	6.2	316.5	43.5	293.8
24.0	17.96	4.64	-4.90	6.7	313.4	43.4	281.9
25.0	18.68	4.73	-5.58	7.3	310.3	43.7	278.5
26.0	19.41	4.80	-6.27	7.9	307.4	43.8	275.0
27.0	20.13	4.83	-6.95	8.5	304.8	43.7	276.9
28.0	20.86	4.86	-7.64	9.1	302.5	43.6	271.6
29.0	21.58	4.89	-8.33	9.7	300.4	43.8	270.8
30.0	22.31	4.90	-9.02	10.3	298.5	43.7	270.1
31.0	23.03	4.90	-9.70	10.9	296.8	43.9	271.1
32.0	23.75	4.91	-10.39	11.5	295.3	43.7	270.4
33.0	24.48	4.91	-11.08	12.1	293.9	43.5	270.3
34.0	25.20	4.91	-11.77	12.8	292.6	43.3	269.4
35.0	25.93	4.90	-12.46	13.4	291.5	43.1	268.1
36.0	26.66	4.88	-13.15	14.0	290.4	43.1	267.1
37.0	27.38	4.87	-13.83	14.7	289.4	43.0	267.1
38.0	28.11	4.85	-14.52	15.3	288.5	42.9	267.1
39.0	28.84	4.83	-15.20	16.0	287.6	43.2	268.9
40.0	29.57	4.82	-15.88	16.6	286.9	42.7	270.9
41.0	30.30	4.81	-16.57	17.3	286.2	43.0	268.3
42.0	31.03	4.79	-17.25	17.9	285.5	41.8	267.4
43.0	31.75	4.81	-17.94	18.6	285.0	42.4	268.7
44.0	32.48	4.81	-18.63	19.2	284.5	43.2	269.4
45.0	33.21	4.80	-19.31	19.9	284.0	43.7	271.4
46.0	33.93	4.80	-20.00	20.6	283.5	43.4	269.0
47.0	34.66	4.78	-20.68	21.2	283.0	43.3	268.7
48.0	35.39	4.76	-21.37	21.9	282.6	43.3	268.8
49.0	36.12	4.75	-22.05	22.6	282.1	43.5	269.2
50.0	36.85	4.72	-22.74	23.2	281.7	43.3	268.6
51.0	37.57	4.70	-23.43	23.9	281.4	43.3	268.1

* * * * * * * COMPU-LOG - VERTICAL DEVIATION * * * * * * *

CLIENT : TEXAS SSC SITE
FIELD OFFICE : CORSICANA
DATA FROM :
MAG. DECL. : 7.000

HOLE ID. : BIR 42
DATE OF LOG : 09/23/89
PROBE : 9055A , 135
DEPTH UNITS : FEET LOG 9

CABLE DEPTH	TRUE DEPTH	NORTH DEV.	EAST DEV.	DISTANCE	AZIMUTH	SANG	SANGB
52.0	38.30	4.69	-24.11	24.6	281.0	43.3	268.4
53.0	39.03	4.67	-24.80	25.2	280.7	43.0	268.0
54.0	39.76	4.65	-25.48	25.9	280.3	43.4	268.4
55.0	40.49	4.62	-26.17	26.6	280.0	43.6	270.8
56.0	41.21	4.61	-26.85	27.2	279.7	43.6	268.6
57.0	41.94	4.59	-27.54	27.9	279.5	43.7	269.0
58.0	42.66	4.57	-28.23	28.6	279.2	43.6	269.1
59.0	43.39	4.55	-28.92	29.3	278.9	43.6	268.5
60.0	44.11	4.53	-29.61	30.0	278.7	43.5	268.5
61.0	44.84	4.52	-30.30	30.6	278.5	43.6	268.4
62.0	45.56	4.49	-30.99	31.3	278.2	43.6	267.9
63.0	46.28	4.47	-31.67	32.0	278.0	43.6	267.8
64.0	47.01	4.43	-32.36	32.7	277.8	43.5	267.7
65.0	47.73	4.40	-33.05	33.3	277.6	43.7	267.7
66.0	48.46	4.37	-33.74	34.0	277.4	43.6	267.8
67.0	49.18	4.35	-34.43	34.7	277.2	43.6	268.1
68.0	49.91	4.32	-35.12	35.4	277.0	43.6	267.1
69.0	50.63	4.29	-35.81	36.1	276.8	43.6	267.7
70.0	51.35	4.26	-36.50	36.7	276.7	43.6	267.3
71.0	52.08	4.23	-37.19	37.4	276.5	43.6	268.2
72.0	52.80	4.21	-37.88	38.1	276.3	43.8	268.6
73.0	53.52	4.19	-38.57	38.8	276.2	43.8	266.6
74.0	54.24	4.16	-39.26	39.5	276.1	43.9	268.1
75.0	54.96	4.14	-39.95	40.2	275.9	44.0	268.9
76.0	55.68	4.12	-40.65	40.9	275.8	43.5	269.2
77.0	56.41	4.08	-41.34	41.5	275.6	43.4	266.9
78.0	57.12	4.04	-42.03	42.2	275.5	44.9	269.4
79.0	57.84	4.02	-42.73	42.9	275.4	44.2	266.5
80.0	58.55	3.98	-43.43	43.6	275.2	44.1	266.1
81.0	59.27	3.96	-44.13	44.3	275.1	44.4	268.9
82.0	59.98	3.94	-44.82	45.0	275.0	44.2	267.8
83.0	60.70	3.90	-45.52	45.7	274.9	44.4	268.3
84.0	61.42	3.84	-46.21	46.4	274.7	44.0	266.3
85.0	62.15	3.79	-46.90	47.1	274.6	44.1	267.9
86.0	62.87	3.76	-47.59	47.7	274.5	44.2	267.8
87.0	63.58	3.73	-48.29	48.4	274.4	43.7	267.1
88.0	64.31	3.67	-48.98	49.1	274.3	43.8	265.0
89.0	65.03	3.64	-49.67	49.8	274.2	43.8	267.2
90.0	65.75	3.60	-50.36	50.5	274.1	44.2	267.2
91.0	66.47	3.55	-51.05	51.2	274.0	43.8	267.2
92.0	67.19	3.51	-51.74	51.9	273.9	43.9	266.7
93.0	67.91	3.48	-52.44	52.6	273.8	44.3	267.5
94.0	68.63	3.45	-53.14	53.2	273.7	44.0	267.7
95.0	69.35	3.42	-53.83	53.9	273.6	43.8	267.5
96.0	70.07	3.37	-54.52	54.6	273.5	43.8	267.8
97.0	70.78	3.34	-55.22	55.3	273.5	44.0	271.2
98.0	71.50	3.32	-55.91	56.0	273.4	44.1	266.5
99.0	72.22	3.29	-56.60	56.7	273.3	44.2	268.0
100.0	72.94	3.24	-57.30	57.4	273.2	44.7	265.1
101.0	73.66	3.19	-57.98	58.1	273.1	43.4	265.4
102.0	74.39	3.15	-58.67	58.8	273.1	43.7	266.1
103.0	75.10	3.12	-59.37	59.4	273.0	44.1	266.2

* * * * * * * COMPU-LOG - VERTICAL DEVIATION * * * * * * *

CLIENT : TEXAS SSC SITE
FIELD OFFICE : CORSICANA
DATA FROM :
MAG. DECL. : 7.000

HOLE ID. : BIR 42
DATE OF LOG : 09/23/89
PROBE : 9055A , 135
DEPTH UNITS : FEET LOG 9

CABLE DEPTH	TRUE DEPTH	NORTH DEV.	EAST DEV.	DISTANCE	AZIMUTH	SANG	SANGB
104.0	75.82	3.09	-60.06	60.1	272.9	43.9	266.3
105.0	76.54	3.05	-60.75	60.8	272.9	44.1	267.7
106.0	77.26	3.02	-61.45	61.5	272.8	44.1	267.5
107.0	77.98	2.98	-62.15	62.2	272.7	45.4	267.9
108.0	78.68	2.98	-62.86	62.9	272.7	44.7	269.5
109.0	79.40	2.95	-63.55	63.6	272.7	44.4	266.6
110.0	80.12	2.91	-64.25	64.3	272.6	43.5	265.4
111.0	80.84	2.87	-64.94	65.0	272.5	43.8	266.3
112.0	81.56	2.84	-65.63	65.7	272.5	45.0	270.1
113.0	82.28	2.82	-66.32	66.4	272.4	42.8	264.7
114.0	82.99	2.79	-67.02	67.1	272.4	43.8	267.5
115.0	83.71	2.75	-67.71	67.8	272.3	44.0	266.9
116.0	84.44	2.72	-68.41	68.5	272.3	43.4	267.0
117.0	85.16	2.67	-69.10	69.1	272.2	44.2	266.2
118.0	85.88	2.64	-69.79	69.8	272.2	43.9	267.4
119.0	86.60	2.60	-70.48	70.5	272.1	44.2	267.7
120.0	87.32	2.56	-71.18	71.2	272.1	43.8	266.1
121.0	88.04	2.52	-71.87	71.9	272.0	44.6	268.6
122.0	88.75	2.49	-72.56	72.6	272.0	43.7	266.8
123.0	89.48	2.45	-73.26	73.3	271.9	44.3	265.8
124.0	90.20	2.42	-73.95	74.0	271.9	43.1	267.4
125.0	90.92	2.38	-74.64	74.7	271.8	44.1	266.8
126.0	91.64	2.34	-75.33	75.4	271.8	43.6	266.6
127.0	92.36	2.31	-76.02	76.1	271.7	43.8	267.8
128.0	93.09	2.27	-76.71	76.7	271.7	43.8	265.8
129.0	93.80	2.23	-77.41	77.4	271.7	44.3	267.7
130.0	94.52	2.19	-78.10	78.1	271.6	43.7	265.8
131.0	95.24	2.17	-78.80	78.8	271.6	43.6	266.7
132.0	95.96	2.12	-79.49	79.5	271.5	44.1	267.1
133.0	96.68	2.08	-80.18	80.2	271.5	43.9	265.6
134.0	97.41	2.03	-80.86	80.9	271.4	43.4	265.4
135.0	98.13	1.98	-81.55	81.6	271.4	44.0	267.5
136.0	98.85	1.95	-82.25	82.3	271.4	43.8	267.4
137.0	99.57	1.90	-82.94	83.0	271.3	43.6	265.8
138.0	100.29	1.83	-83.63	83.6	271.3	44.0	264.8
139.0	101.01	1.78	-84.32	84.3	271.2	43.9	267.1
140.0	101.73	1.74	-85.01	85.0	271.2	44.0	267.6
141.0	102.45	1.71	-85.71	85.7	271.1	44.1	267.5
142.0	103.17	1.68	-86.40	86.4	271.1	43.7	267.0
143.0	103.89	1.64	-87.09	87.1	271.1	43.9	267.6
144.0	104.61	1.61	-87.78	87.8	271.1	43.8	266.7
145.0	105.34	1.56	-88.47	88.5	271.0	43.7	265.3
146.0	106.06	1.51	-89.16	89.2	271.0	44.5	265.7
147.0	106.78	1.46	-89.85	89.9	270.9	44.1	265.5
148.0	107.50	1.41	-90.54	90.6	270.9	43.7	264.5
149.0	108.22	1.37	-91.23	91.2	270.9	43.5	264.7
150.0	108.94	1.31	-91.92	91.9	270.8	44.0	264.6
151.0	109.66	1.28	-92.62	92.6	270.8	43.8	265.8
152.0	110.38	1.24	-93.31	93.3	270.8	44.0	266.7
153.0	111.10	1.19	-94.01	94.0	270.7	44.0	266.1
154.0	111.82	1.14	-94.70	94.7	270.7	43.4	265.0
155.0	112.52	1.17	-95.40	95.4	270.7	44.0	274.8

* * * * * * * COMPU-LOG - VERTICAL DEVIATION * * * * * * *

CLIENT : TEXAS SSC SITE
FIELD OFFICE : CORSICANA
DATA FROM :
MAG. DECL. : 7.000

HOLE ID. : BIR 42
DATE OF LOG : 09/23/89
PROBE : 9055A , 135
DEPTH UNITS : FEET LOG 9

CABLE DEPTH	TRUE DEPTH	NORTH DEV.	EAST DEV.	DISTANCE	AZIMUTH	SANG	SANGB
156.0	113.24	1.17	-96.10	96.1	270.7	44.6	268.2
157.0	113.95	1.15	-96.80	96.8	270.7	44.1	267.5
158.0	114.67	1.12	-97.50	97.5	270.7	44.3	268.1
159.0	115.38	1.10	-98.20	98.2	270.6	44.5	267.8
160.0	116.10	1.07	-98.89	98.9	270.6	43.8	267.0
161.0	116.83	1.01	-99.58	99.6	270.6	43.8	265.2
162.0	117.54	0.97	-100.28	100.3	270.6	44.3	266.8
163.0	118.26	0.94	-100.97	101.0	270.5	44.3	267.8
164.0	118.98	0.88	-101.66	101.7	270.5	44.7	266.6
165.0	119.70	0.85	-102.35	102.4	270.5	42.4	262.4
166.0	120.41	0.80	-103.06	103.1	270.4	45.0	268.6
167.0	121.13	0.77	-103.75	103.8	270.4	44.4	268.9
168.0	121.85	0.74	-104.45	104.4	270.4	43.8	267.1
169.0	122.57	0.69	-105.14	105.1	270.4	44.3	265.3
170.0	123.28	0.64	-105.84	105.8	270.3	44.0	266.6
171.0	124.00	0.59	-106.53	106.5	270.3	44.3	265.1
172.0	124.72	0.56	-107.23	107.2	270.3	44.5	268.7
173.0	125.43	0.53	-107.92	107.9	270.3	44.3	267.3
174.0	126.15	0.50	-108.62	108.6	270.3	44.3	267.1
175.0	126.87	0.45	-109.31	109.3	270.2	43.7	264.0
176.0	127.59	0.42	-110.01	110.0	270.2	43.9	264.2
177.0	128.30	0.39	-110.71	110.7	270.2	44.1	267.4
178.0	129.02	0.36	-111.41	111.4	270.2	44.6	268.3
179.0	129.73	0.33	-112.10	112.1	270.2	44.3	266.4
180.0	130.45	0.28	-112.80	112.8	270.1	43.9	266.3
181.0	131.16	0.24	-113.50	113.5	270.1	44.3	268.0
182.0	131.88	0.22	-114.19	114.2	270.1	44.5	268.2
183.0	132.59	0.20	-114.90	114.9	270.1	44.2	268.8
184.0	133.31	0.16	-115.59	115.6	270.1	44.2	266.8
185.0	134.02	0.12	-116.29	116.3	270.1	44.2	264.1
186.0	134.74	0.09	-116.99	117.0	270.0	43.9	264.9
187.0	135.45	0.04	-117.68	117.7	270.0	44.6	267.6
188.0	136.17	0.00	-118.38	118.4	270.0	43.4	266.0
189.0	136.89	-0.04	-119.07	119.1	270.0	43.9	265.9
190.0	137.61	-0.08	-119.77	119.8	270.0	43.9	267.4
191.0	138.33	-0.12	-120.46	120.5	269.9	44.2	266.2
192.0	139.04	-0.17	-121.16	121.2	269.9	44.4	266.5
193.0	139.76	-0.21	-121.86	121.9	269.9	44.1	266.6
194.0	140.48	-0.26	-122.55	122.5	269.9	44.1	265.7
195.0	141.19	-0.30	-123.25	123.2	269.9	44.3	267.3
196.0	141.91	-0.34	-123.94	123.9	269.8	44.1	266.8
197.0	142.63	-0.40	-124.63	124.6	269.8	44.2	267.0
198.0	143.34	-0.45	-125.33	125.3	269.8	44.7	266.1
199.0	144.06	-0.49	-126.03	126.0	269.8	44.5	265.8
200.0	144.77	-0.54	-126.73	126.7	269.8	42.7	263.1
201.0	145.49	-0.59	-127.43	127.4	269.7	44.5	267.5
202.0	146.20	-0.63	-128.13	128.1	269.7	44.9	266.8
203.0	146.91	-0.67	-128.83	128.8	269.7	44.8	266.0
204.0	147.62	-0.70	-129.54	129.5	269.7	44.7	267.9
205.0	148.33	-0.75	-130.24	130.2	269.7	45.2	264.9
206.0	149.04	-0.80	-130.93	130.9	269.6	44.8	265.9
207.0	149.76	-0.83	-131.63	131.6	269.6	44.5	267.5

* * * * * * * COMPU-LOG - VERTICAL DEVIATION * * * * * * *

CLIENT : TEXAS SSC SITE
FIELD OFFICE : CORSICANA
DATA FROM :
MAG. DECL. : 7.000

HOLE ID. : BIR 42
DATE OF LOG : 09/23/89
PROBE : 9055A , 135
DEPTH UNITS : FEET LOG 9

CABLE DEPTH	TRUE DEPTH	NORTH DEV.	EAST DEV.	DISTANCE	AZIMUTH	SANG	SANGB
208.0	150.47	-0.86	-132.34	132.3	269.6	44.9	270.0
209.0	151.18	-0.91	-133.03	133.0	269.6	44.2	262.9
210.0	151.89	-0.90	-133.74	133.7	269.6	45.4	268.2
211.0	152.60	-0.92	-134.44	134.4	269.6	45.0	267.9
212.0	153.31	-0.96	-135.14	135.1	269.6	44.4	265.4
213.0	154.02	-1.02	-135.84	135.8	269.6	44.5	266.0
214.0	154.74	-1.06	-136.54	136.5	269.6	44.6	267.6
215.0	155.45	-1.09	-137.24	137.2	269.5	44.3	266.8
216.0	156.17	-1.14	-137.94	137.9	269.5	44.0	266.2
217.0	156.88	-1.20	-138.63	138.6	269.5	44.4	264.6
218.0	157.60	-1.25	-139.33	139.3	269.5	44.5	267.7
219.0	158.31	-1.30	-140.02	140.0	269.5	45.2	269.1
220.0	159.03	-1.34	-140.72	140.7	269.5	44.4	263.3
221.0	159.74	-1.38	-141.42	141.4	269.4	44.2	264.0
222.0	160.45	-1.42	-142.12	142.1	269.4	44.1	264.4
223.0	161.16	-1.46	-142.82	142.8	269.4	45.9	269.4
224.0	161.88	-1.49	-143.52	143.5	269.4	44.0	272.0
225.0	162.59	-1.51	-144.22	144.2	269.4	44.5	268.7
226.0	163.31	-1.57	-144.91	144.9	269.4	45.2	258.4
227.0	164.02	-1.60	-145.61	145.6	269.4	43.3	269.3
228.0	164.74	-1.66	-146.30	146.3	269.4	44.2	266.1
229.0	165.46	-1.70	-147.00	147.0	269.3	44.4	266.3
230.0	166.17	-1.77	-147.69	147.7	269.3	44.3	266.6
231.0	166.89	-1.83	-148.39	148.4	269.3	45.0	269.4
232.0	167.60	-1.87	-149.09	149.1	269.3	44.6	265.6
233.0	168.31	-1.92	-149.79	149.8	269.3	44.3	266.0
234.0	169.02	-1.95	-150.49	150.5	269.3	52.1	281.6
235.0	169.76	-1.99	-151.13	151.1	269.2	43.3	271.6
236.0	170.49	-2.03	-151.81	151.8	269.2	43.1	259.4
237.0	171.22	-2.13	-152.49	152.5	269.2	43.1	261.6
238.0	171.95	-2.21	-153.16	153.2	269.2	43.2	263.3
239.0	172.68	-2.28	-153.85	153.9	269.1	43.4	263.4
240.0	173.41	-2.36	-154.53	154.5	269.1	43.1	263.8
241.0	174.14	-2.43	-155.21	155.2	269.1	43.2	264.9
242.0	174.86	-2.51	-155.89	155.9	269.1	43.3	262.7
243.0	175.59	-2.59	-156.57	156.6	269.1	43.4	264.5
244.0	176.32	-2.65	-157.25	157.3	269.0	43.3	269.1
245.0	177.05	-2.69	-157.94	158.0	269.0	41.0	265.8
246.0	177.77	-2.79	-158.62	158.6	269.0	45.4	257.7
247.0	178.47	-2.87	-159.32	159.3	269.0	45.9	264.3
248.0	179.18	-2.94	-160.02	160.0	268.9	45.3	259.8
249.0	179.89	-2.97	-160.72	160.8	268.9	44.4	270.9
250.0	180.61	-3.01	-161.41	161.4	268.9	42.2	267.9
251.0	181.32	-3.07	-162.11	162.1	268.9	44.2	263.1
252.0	182.03	-3.13	-162.80	162.8	268.9	44.2	265.5
253.0	182.75	-3.19	-163.50	163.5	268.9	44.4	268.4
254.0	183.47	-3.24	-164.19	164.2	268.9	43.8	265.6
255.0	184.19	-3.34	-164.87	164.9	268.8	42.8	262.2
256.0	184.90	-3.40	-165.58	165.6	268.8	45.2	268.4
257.0	185.62	-3.43	-166.27	166.3	268.8	43.6	264.0
258.0	186.34	-3.51	-166.96	167.0	268.8	44.6	267.3
259.0	187.04	-3.49	-167.66	167.7	268.8	43.3	283.1

* * * * * * * COMPU-LOG - VERTICAL DEVIATION * * * * * * *

CLIENT : TEXAS SSC SITE
FIELD OFFICE : CORSICANA
DATA FROM :
MAG. DECL. : 7.000

HOLE ID. : BIR 42
DATE OF LOG : 09/23/89
PROBE : 9055A , 135
DEPTH UNITS : FEET LOG 9

CABLE DEPTH	TRUE DEPTH	NORTH DEV.	EAST DEV.	DISTANCE	AZIMUTH	SANG	SANGB
260.0	187.76	-3.56	-168.34	168.4	268.8	43.6	263.0
261.0	188.49	-3.68	-169.01	169.1	268.8	43.5	260.9
262.0	189.21	-3.76	-169.70	169.7	268.7	43.6	263.1
263.0	189.94	-3.82	-170.38	170.4	268.7	43.4	264.3
264.0	190.67	-3.88	-171.06	171.1	268.7	43.2	262.0
265.0	191.40	-3.97	-171.74	171.8	268.7	42.0	268.0
266.0	192.11	-4.06	-172.42	172.5	268.7	39.2	264.0
267.0	192.81	-4.11	-173.13	173.2	268.6	44.4	266.1
268.0	193.52	-4.13	-173.83	173.9	268.6	43.7	273.0
269.0	194.24	-4.15	-174.52	174.6	268.6	43.4	269.1
270.0	194.97	-4.22	-175.21	175.3	268.6	43.9	263.9
271.0	195.69	-4.27	-175.90	175.9	268.6	43.3	266.3
272.0	196.42	-4.31	-176.58	176.6	268.6	43.3	266.8
273.0	197.15	-4.39	-177.26	177.3	268.6	43.9	264.9
274.0	197.87	-4.45	-177.95	178.0	268.6	44.4	269.1
275.0	198.59	-4.49	-178.64	178.7	268.6	43.6	266.5
276.0	199.31	-4.54	-179.33	179.4	268.6	43.4	267.6
277.0	200.04	-4.59	-180.01	180.1	268.5	43.4	264.6
278.0	200.77	-4.64	-180.69	180.8	268.5	43.1	269.1
279.0	201.50	-4.68	-181.37	181.4	268.5	43.4	267.3
280.0	202.24	-4.74	-182.04	182.1	268.5	43.2	269.5
281.0	202.97	-4.79	-182.71	182.8	268.5	42.4	264.6
281.3	203.07	-4.79	-182.71	182.8	268.5	0.0	0.0

WIRE-LINE LOGGING PARAMETERS

Hole No. BIR 43 **Log Measured From:** Ground Level

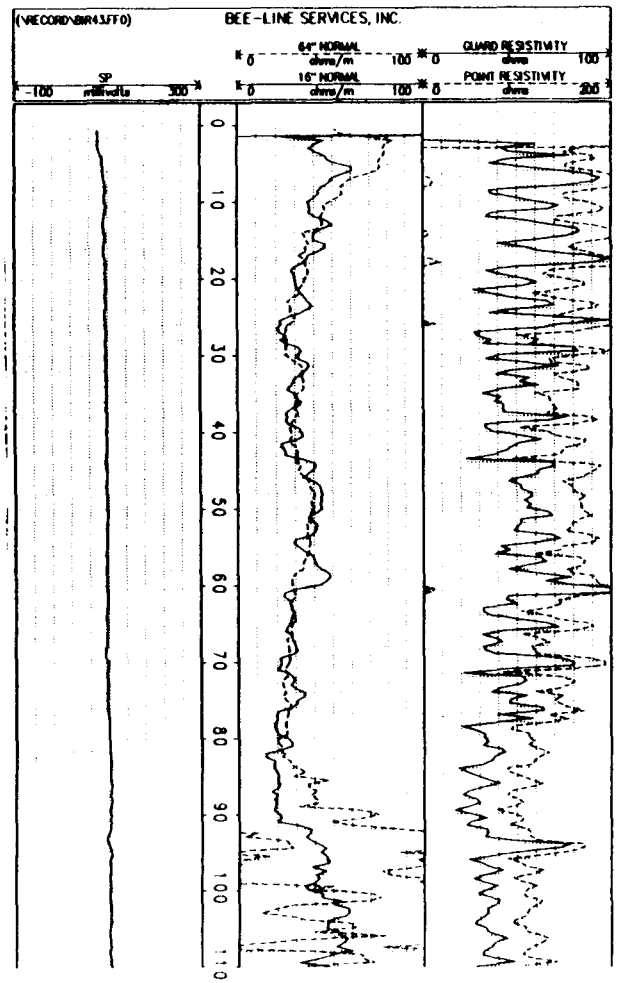
Drilling Parameters
Depth 320.0 feet
Bit Diameter 4.25 inches

Logging Parameters	Electrical Log	Gamma Log	Sonic Log
Date	March 16, 1990	March 16, 1990	Tool Malfunction
Bottom Log Interval	318.0 feet	318.5 feet	
Top Log Interval	surface	surface	
Type of Fluid in Hole	drilling mud	drilling mud	
Time Since Circulation Stop	45 minutes	45 minutes	
Probe Type/S.N.	ALP-4979	XAP-4383	
Module Type/S.N.	ALM-4979	XAM-4383	
Logging Speed	40 feet/min.	20 feet/min.	
Sample Interval	0.5 foot	0.5 foot	

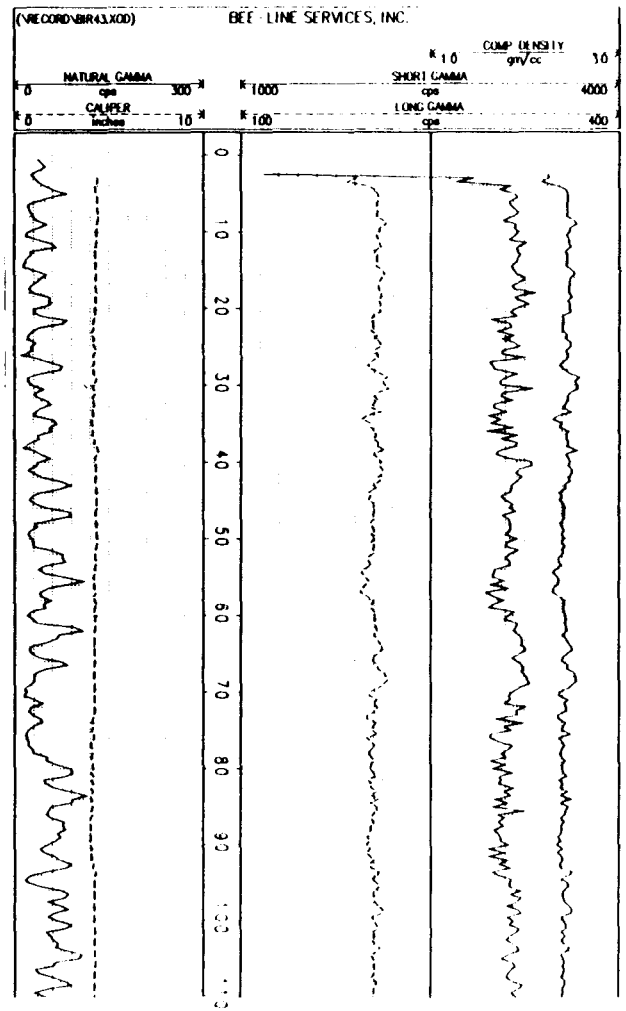
Logged by: BEE-LINE SERVICES, INC.
P. O. Box 2096
Corsicana, TX 75151

BIR 43 Wire-line logs run March 16, 1990. Surface elevation 623.3 feet.

ELECTRICAL LOG

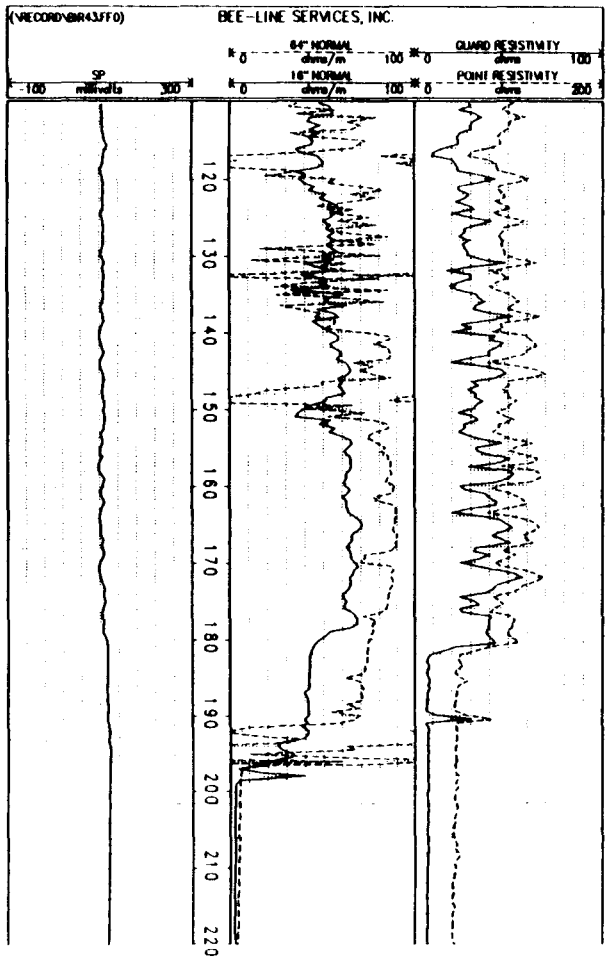


GAMMA LOG

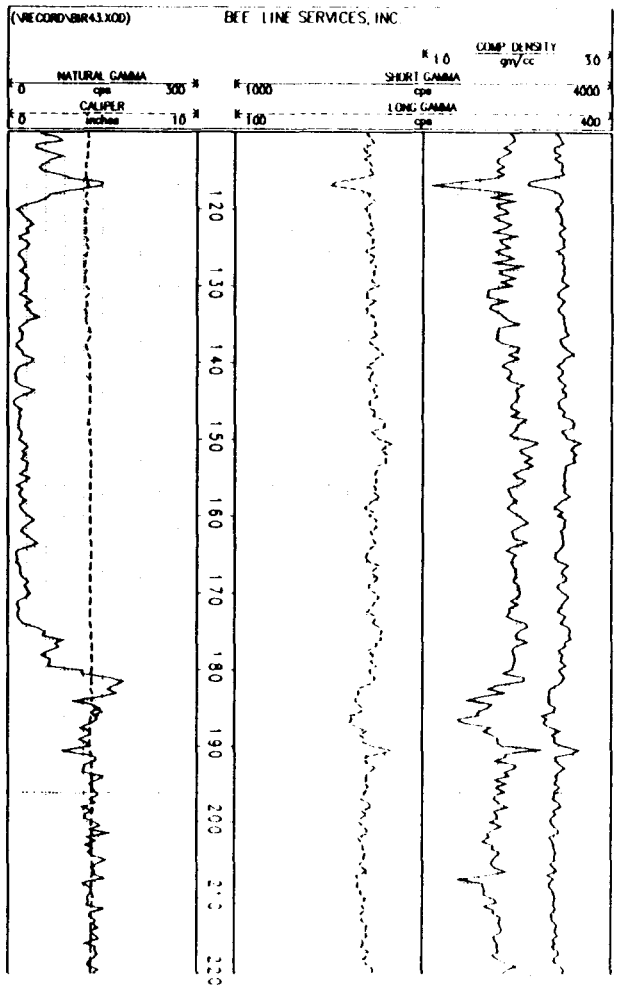


BIR 43 Wire-line logs run March 16, 1990 (Continued). Surface elevation 623.3 feet.

ELECTRICAL LOG CONTINUED

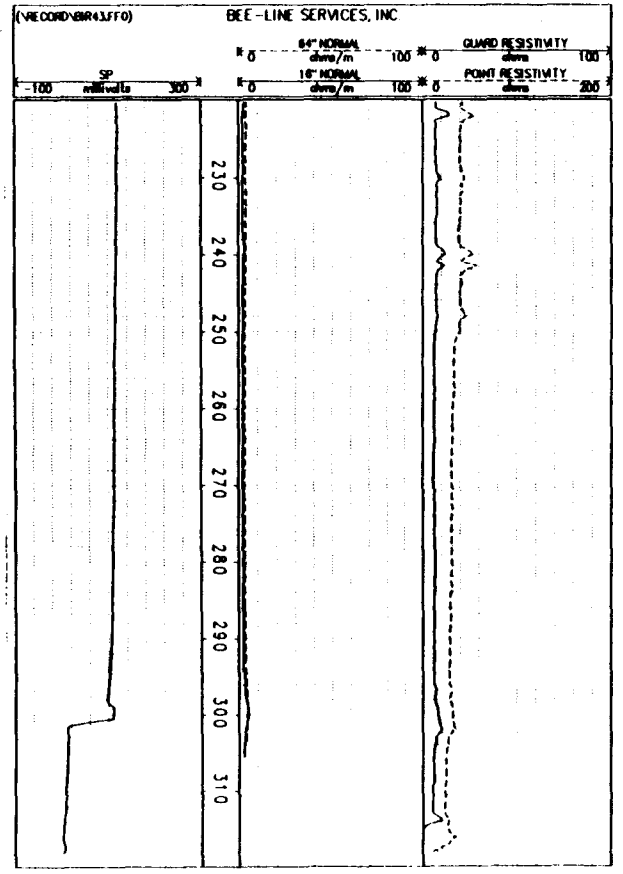


GAMMA LOG CONTINUED

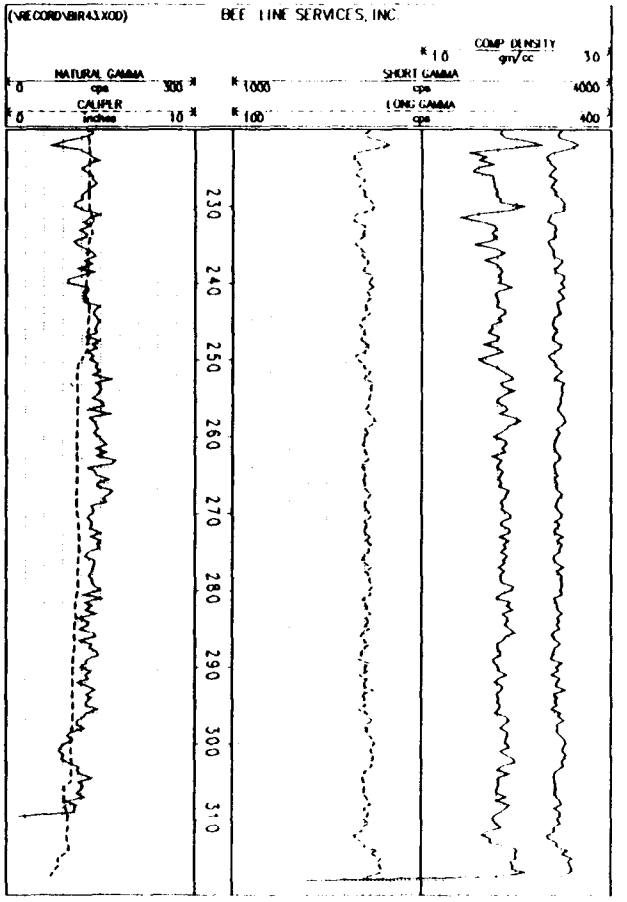


BIR 43 Wire-line logs run March 16, 1990 (Continued). Surface elevation 623.3 feet.

ELECTRICAL LOG CONTINUED



GAMMA LOG CONTINUED



WIRE-LINE LOGGING PARAMETERS

Hole No. BIR 44 **Log Measured From:** Ground Level

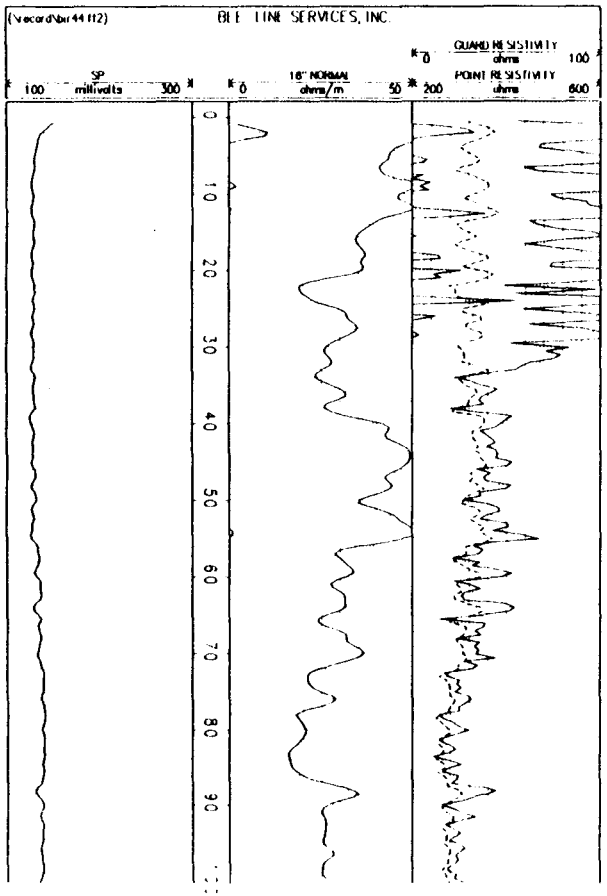
Drilling Parameters
Depth 315.0 feet
Bit Diameter 4.75 inches

Logging Parameters	Electrical Log	Gamma Log	Sonic Log
Date	March 15, 1990	March 15, 1990	Tool Malfunction
Bottom Log Interval	310.0 feet	309.5 feet	
Top Log Interval	surface	surface	
Type of Fluid in Hole	drilling fluid	drilling fluid	
Time Since Circulation Stop	36 hours	36 hours	
Probe Type/S.N.	ALP-4979	XAP-4383	
Module Type/S.N.	ALM-4979	XAM-4383	
Logging Speed	40 feet/min.	20 feet/min.	
Sample Interval	0.5 foot	0.5 foot	

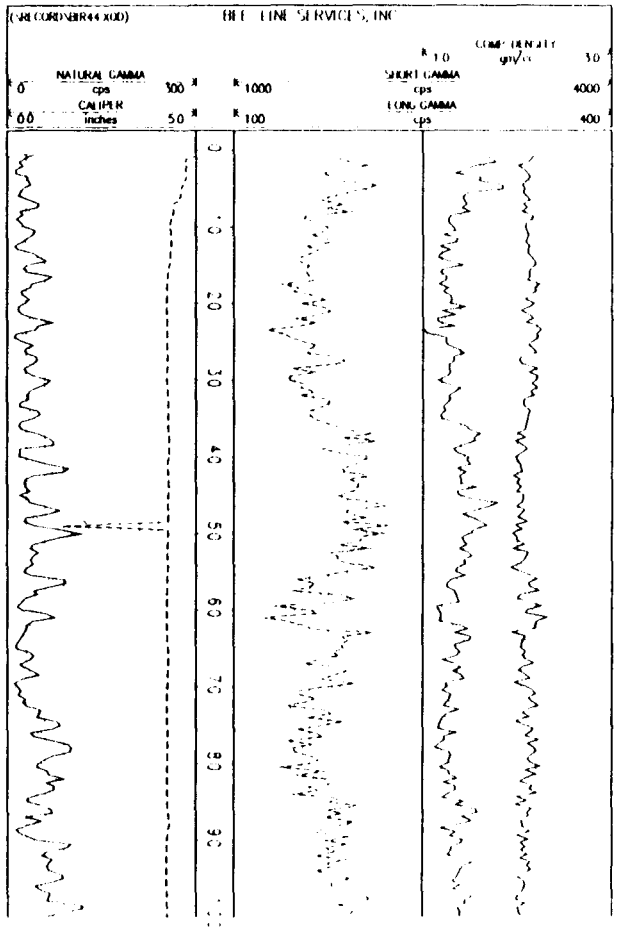
Logged by: BEE-LINE SERVICES, INC.
P. O. Box 2096
Corsicana, TX 75151

BIR 44 Wire-line logs run March 15, 1990. Surface elevation 617.9 feet.

ELECTRICAL LOG

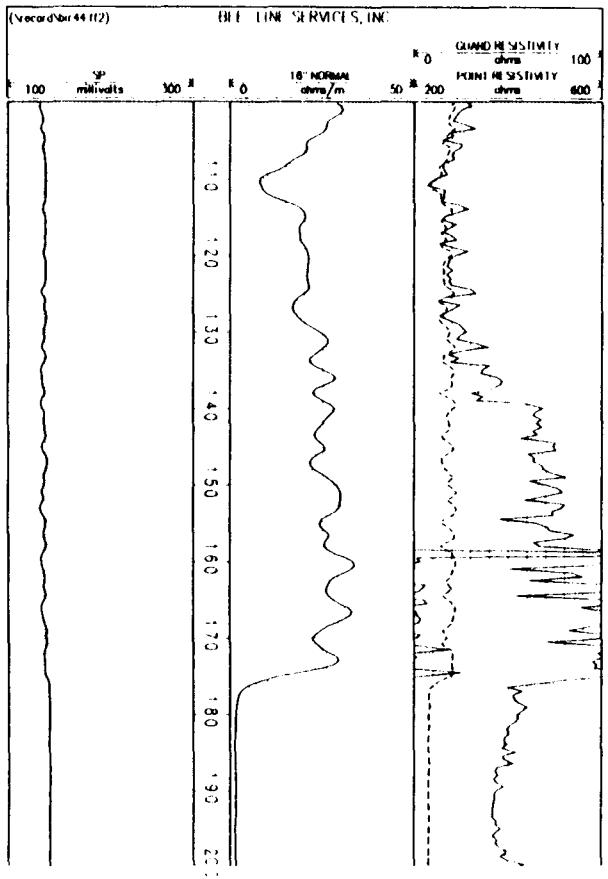


GAMMA LOG

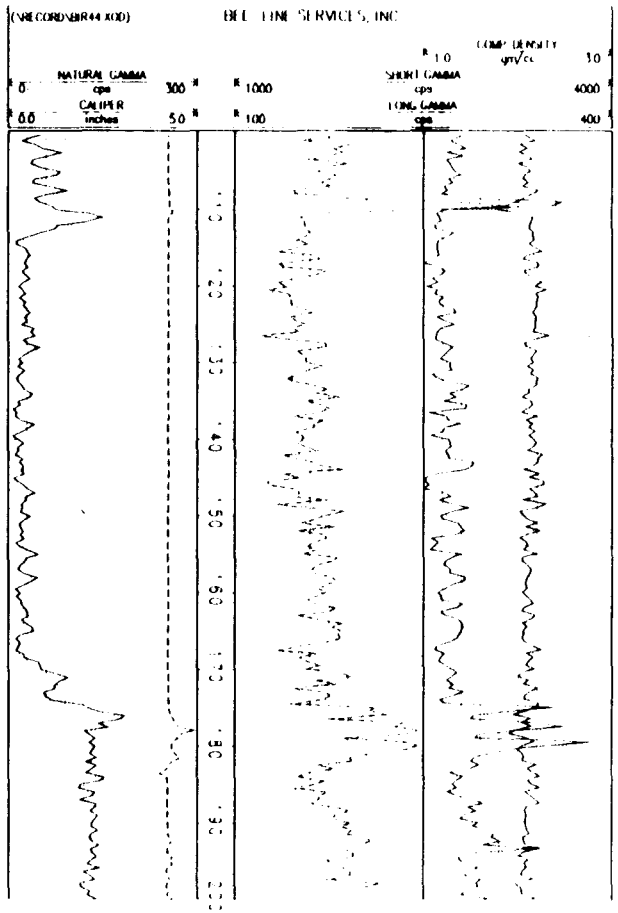


BIR 44 Wire-line logs run March 15, 1990 (Continued). Surface elevation 617.9 feet.

ELECTRICAL LOG CONTINUED

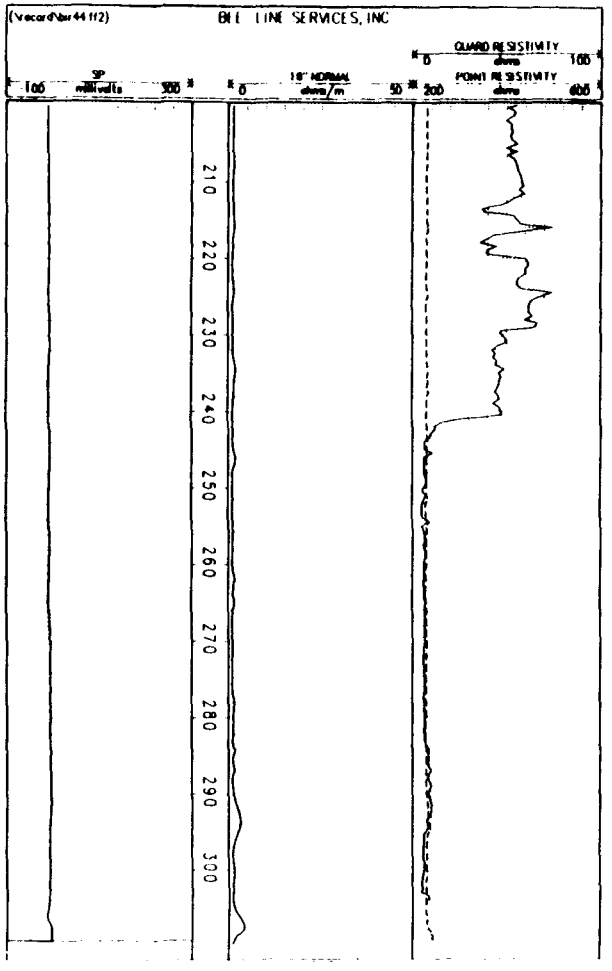


GAMMA LOG CONTINUED

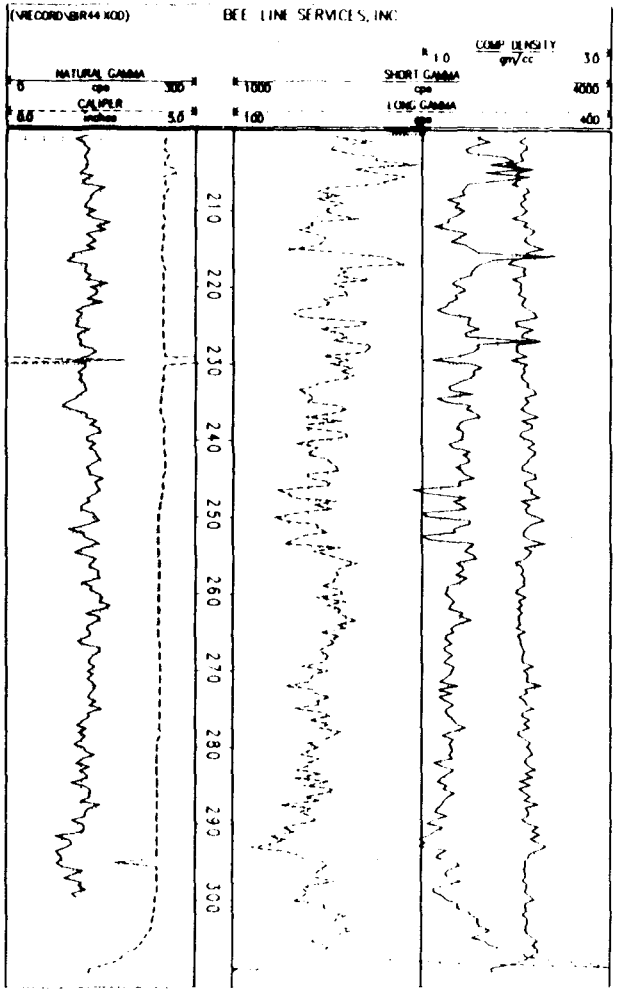


BIR 44 Wire-line logs run March 15, 1990 (Continued). Surface elevation 617.9 feet.

ELECTRICAL LOG CONTINUED



GAMMA LOG CONTINUED



WIRE-LINE LOGGING PARAMETERS

Hole No. BIR 45 **Log Measured From:** Ground Level

Drilling Parameters

Depth 312.0 feet

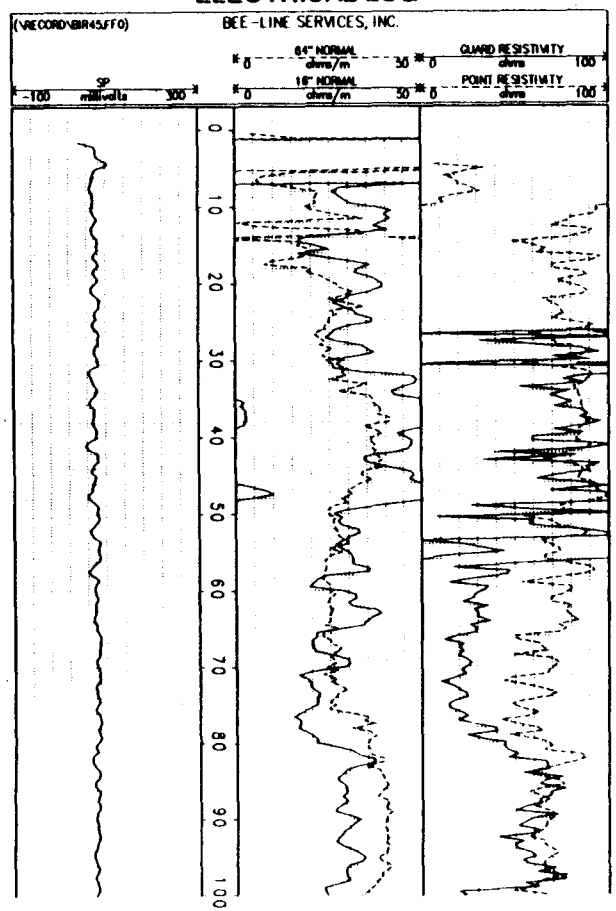
Bit Diameter 4.0 inches

Logging Parameters	Electrical Log	Gamma Log	Sonic Log
Date	April 10, 1990	April 10, 1990	April 10, 1990
Bottom Log Interval	309.0 feet	307.5 feet	303.4 feet
Top Log Interval	surface	surface	surface
Type of Fluid in Hole	drilling mud	drilling mud	drilling mud
Time Since Circulation Stop	1 hour	1 hour	1 hour
Probe Type/S.N.	ALP-4979	XAP-4383	CLP-4877A
Module Type/S.N.	ALM-4979	XAM-4383	CLM-4877A
Logging Speed	40 feet/min.	20 feet/min.	20 feet/min.
Sample Interval	0.5 foot	0.5 foot	0.5 foot

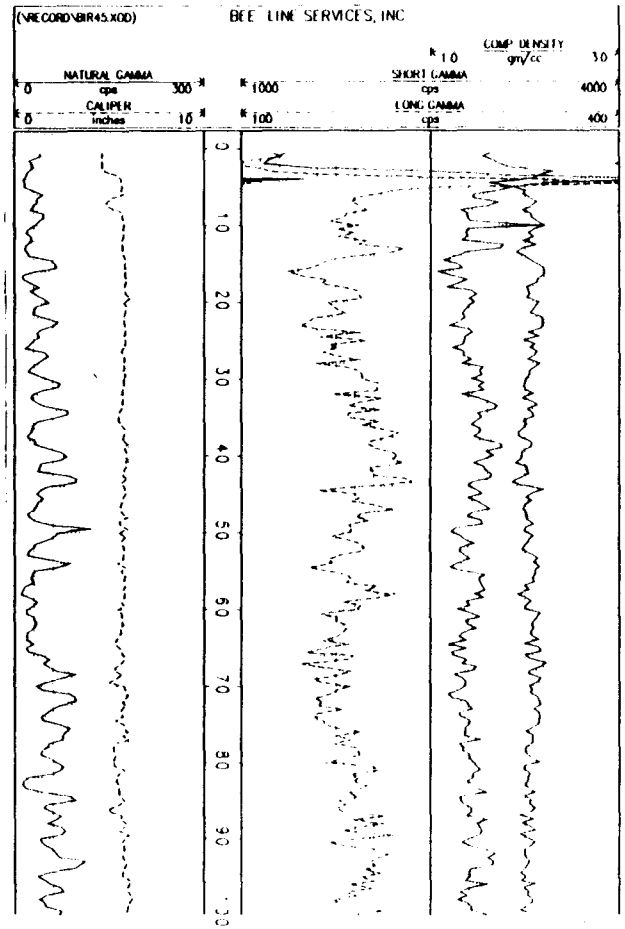
Logged by: BEE-LINE SERVICES, INC.
P. O. Box 2096
Corsicana, TX 75151

BIR 45 Wire-line logs run March 10, 1990. Surface elevation 616.3 feet.

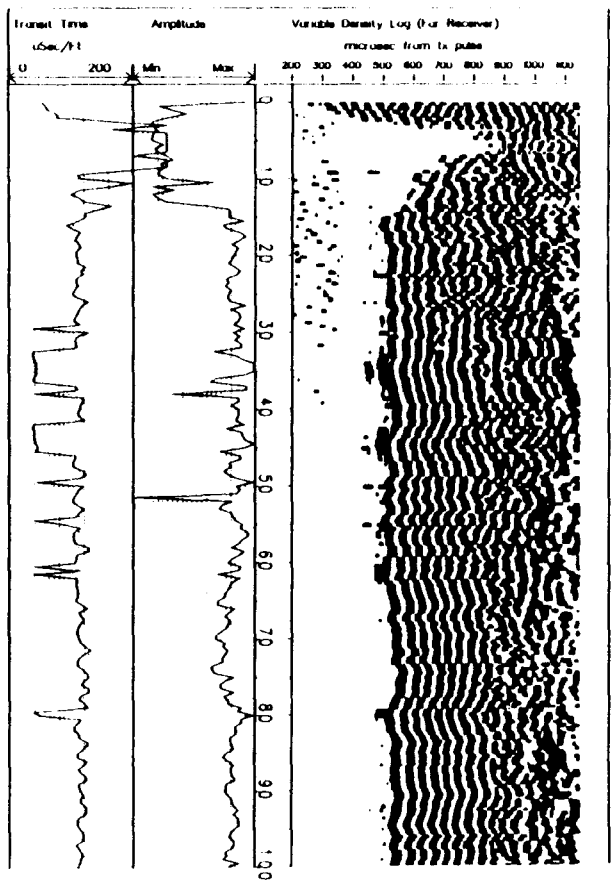
ELECTRICAL LOG



GAMMA LOG

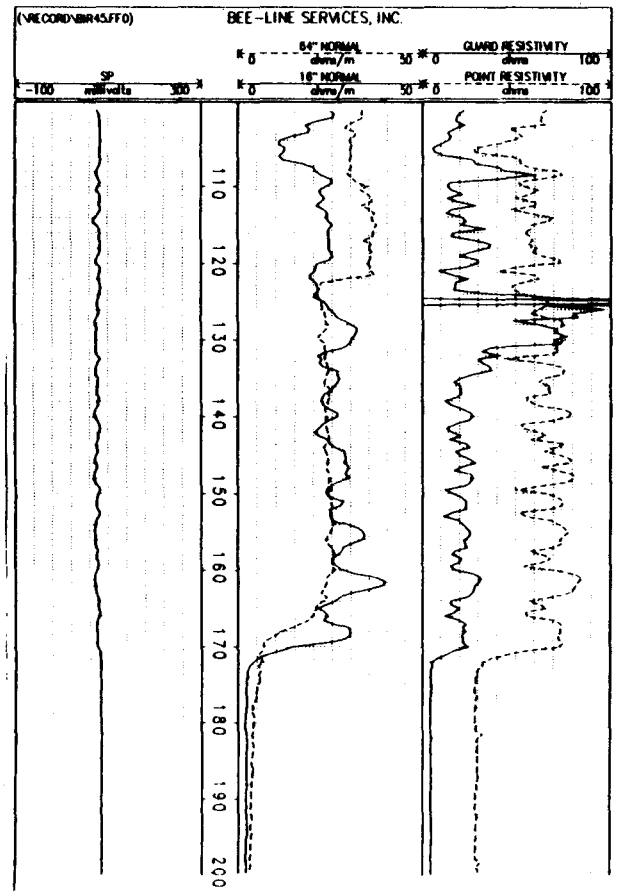


SONIC LOG

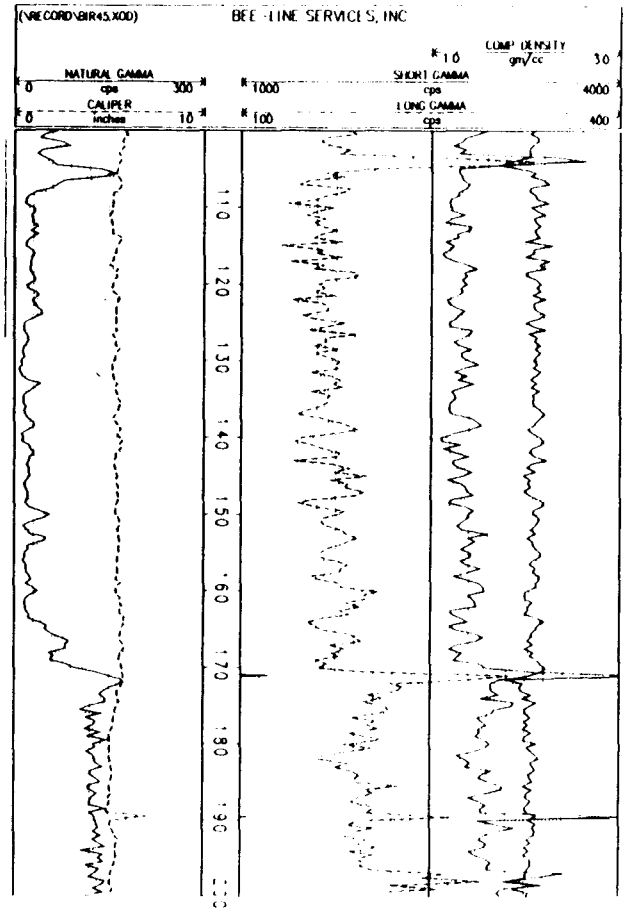


BIR 45 Wire-line logs run March 10, 1990 (Continued). Surface elevation 616.3 feet.

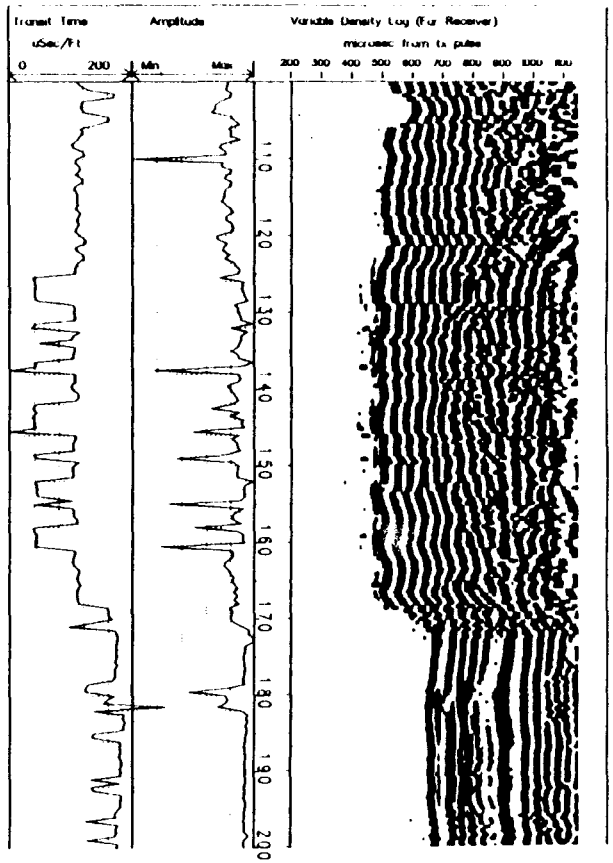
ELECTRICAL LOG CONTINUED



GAMMA LOG CONTINUED

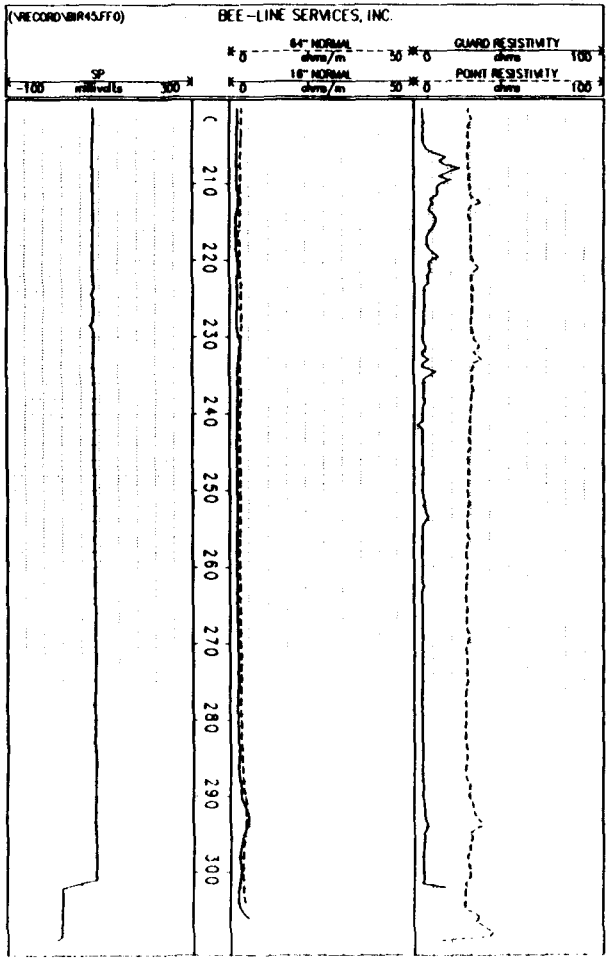


SONIC LOG CONTINUED

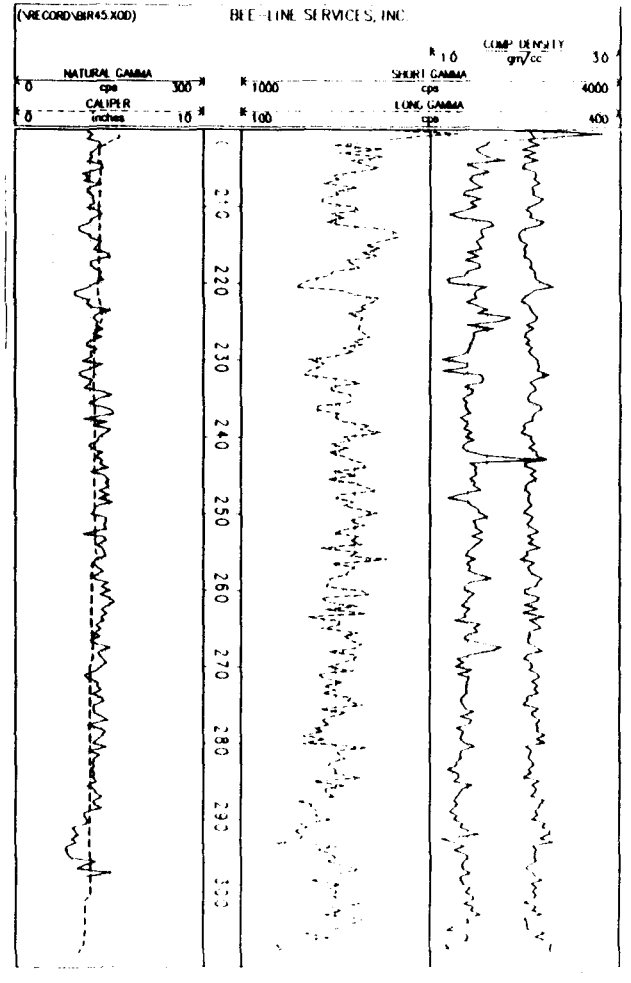


BIR 45 Wire-line logs run March 10, 1990 (Continued). Surface elevation 616.3 feet.

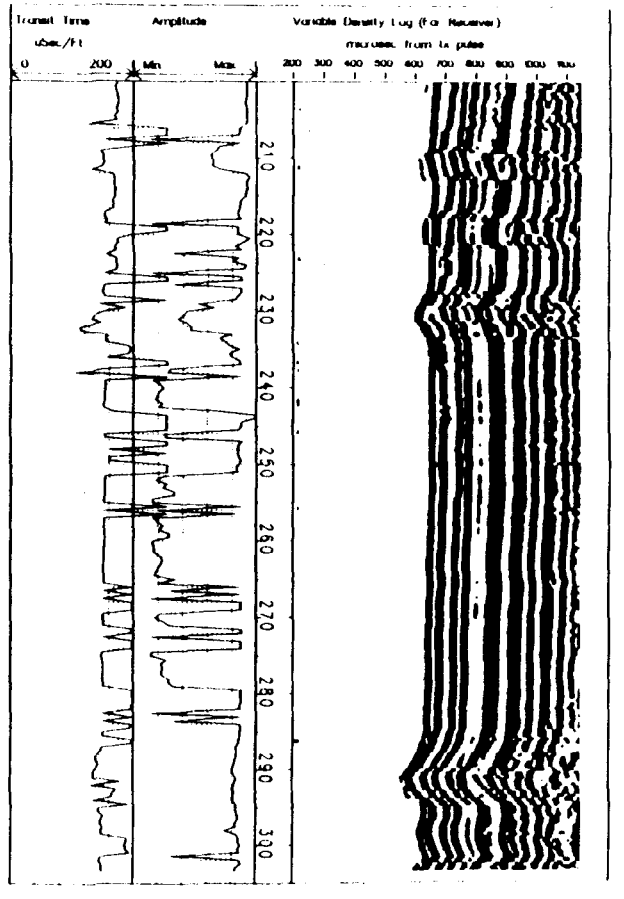
ELECTRICAL LOG CONTINUED



GAMMA LOG CONTINUED



SONIC LOG CONTINUED



APPENDIX C

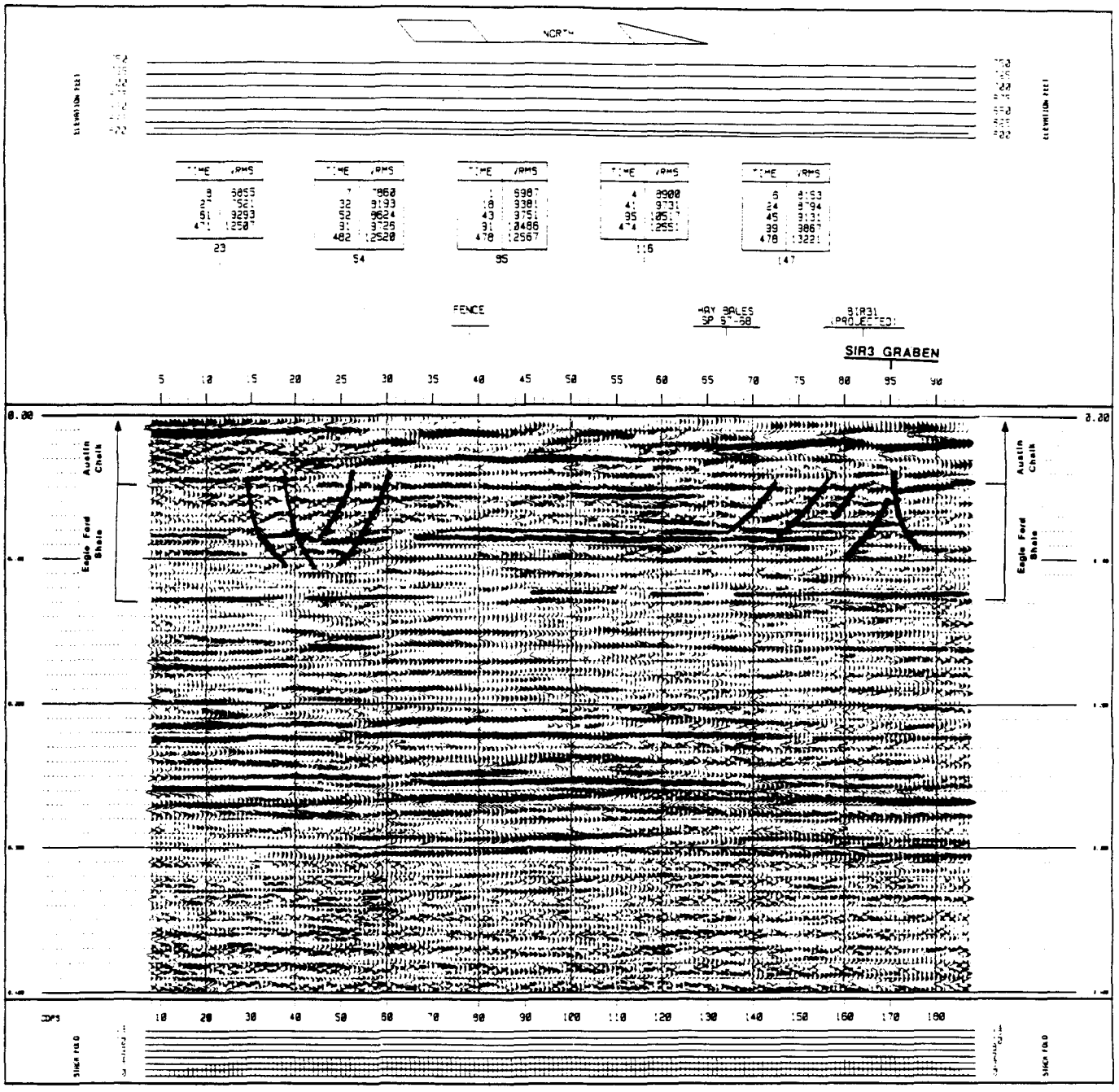
SITE GEOLOGY

APPENDIX C

SITE GEOLOGY – INTERACTION REGION 4

Field mapping at IR 4 consisted primarily of locating and measuring the bearing of joints and locating and identifying the presence of faults within the area. Over 100 joints were measured along a nearby drainage and in an L-shaped trench (Trench IR 4) excavated at the site. The depth of the trench was 4.3 feet. Three joint sets were recognized and each was characterized according to the roughness of the joint surfaces and the degree of alteration. Faults were identified by photo interpretation and the presence of crystalline or slickensided calcite along joints and in float. The nearest exposed mappable faults are over 700 feet to the west of the site. Seismic reflection (see Appendix C-1) and boring data indicate the presence of a small fault crossing the Interaction Region. (See Figure C-1, seismic reflection profile along the beam line through IR 4).

- **Setting**: See Drawing GP-2C (in pocket).
- **Location and Topographic Setting:** IR 4 is approximately 0.7 mile southeast of Boz, Texas, on gently sloping, slightly undulating topography.
- **Surface Slope:** Approximately 1° to the southwest.
- **Current and Prior Use:** Current use is pastureland; prior use was cultivated cropland and pastureland.
- **Cultural Features and Structures within 50 feet of the IR:** See Drawing GP-2C (in pocket). IR 4 is entirely within existing pastureland. Barbed wire fencing encloses the pasture 150 feet northwest and 230 feet west of the IR. A row of medium-size trees trending generally north-south parallels the western barbed wire fence. One overhead power line is approximately 400 feet west of the site.
- **Soil Type:** The soil ranges from 1.5 to 4.0 feet thick and consists of black to dark brown silty clay with medium to high plasticity. Weathered, tan to light gray chalk is predominant from 1.5 to 4.5 feet. Slightly fossiliferous, white to light gray, fine-grained chalk occurs at about 4.5 feet.
- **Erosional and Drainage Features:** One incised drainage is approximately 600 feet west of the IR. This drainage is incised approximately 15 feet. The area in the immediate vicinity of the IR is generally flat to gently undulating.
- **Vegetation:** Vegetation is dominated by short to medium height grasses and shrubs (thistle).
- **Surface Geology:** IR 4 is in the Austin Chalk. The formation is exposed in a drainage 600 feet west of the Hall and consists of alternating beds of slightly fossiliferous, white to light



The Earth Technology Corporation

Project No.: 87-888-0012

Seismic Reflection Profile
Interaction Region 4

5/90

Figure C-1

gray, fine-grained chalk and thin-bedded, nonfossiliferous, light-bluish-gray, argillaceous chalk. The clean chalk ranges from 1 to 3 feet thick while the argillaceous chalk ranges from 0.3 to 0.9 feet thick. The trench on the south side of the IR had approximately 1.5 to 2.0 feet of soil overlying 1.0 to 2.0 feet of weathered chalk. Chalk exposed on the floor of the trench is moderately fractured.

- **Subsurface Geology:** Drawing GS-6 (Geologic Profiles, in pocket) illustrates the subsurface geologic conditions that are expected to be encountered at the IR. These profiles were compiled using the data collected from the borings around the IR.

- **Joint Characterization:** (based on surface exposures)

The table below summarizes the joint characteristics observed in drainages near IR 4 where bedrock was exposed (see Drawing GP-2C). Samples were collected from site IR 4A and direct shear tests were performed on the fracture surfaces. See Appendix E for direct shear test results.

Joint Set	I	II	III
Orientation[1]	N30°W to N30°E subhorizontal, dips 1°SE to 32°NW	N55° to 84°E subvertical, dips 63°NW to 68°SE	N50° to 72°W subvertical, dips 54°SW to 62°NE
Joint Spacing[2]	0.9 ft (± 0.8) n = 20	13.8 ft (± 11.1) n = 20	3.3 ft (± 4.7) n = 15
Joint Roughness[3]	irregular, planar to smooth, undulating; JRC[4] = 4-14	smooth, undulating, to smooth, planar; JRC[4] = 4-16	smooth, undulating to smooth, planar; JRC[4] = 4-12
Joint Alteration	wall rock to wall rock contact; unaltered joint walls, surface staining only	wall rock to wall rock contact; unaltered joint walls, surface staining only	wall rock to wall rock contact; unaltered joint walls, surface staining only
Comments	bedding planes, illuvial clay common	occasional illuvial clay	occasional illuvial clay

1. See stereographic plots of poles to joints on Drawing GP-2C.
2. n = the number of fracture spacing measurements made in the field for that fracture set.
3. Descriptions refer to small-scale features and intermediate scale features, in that order.
4. JRC =Joint Roughness Coefficient.

APPENDIX C-1

SEISMIC REFLECTION PROFILE

Seismic reflection data was collected along the approximate interior beam bypass between IR 3 and IR 4 to help define the geologic structure across the Interaction Region. For a detailed discussion of how the seismic reflection data was collected and interpreted, see LCT Geophysical Services, Technical Memorandum, Seismic Reflection Investigation, Superconducting Super Collider Ring near Waxahachie, Texas, March, 1990.

Interpretation of the seismic profile (Figure C-1) suggests the presence of faults between shot points 15 and 30 and between shot points 70 and 85. The faults interpreted between shot points 15 and 30 correspond to the approximate area of IR4. Estimated throw on these faults is calculated by time displacements across the faults. Interpreted results from the seismic reflection data suggests approximately 36 feet of down to the north offset along the faults at IR 4. Additional drilling around the IR confirms the presence of faults in the area, but with offsets less than 10 feet.

APPENDIX D

HYDROLOGIC TEST RESULTS

APPENDIX D
HYDROLOGIC TEST RESULTS

The objectives of the hydrogeologic (packer) tests were to provide estimates of the hydraulic conductivity at the Austin Chalk/Eagle Ford Shale contact and within fractured or other suspected water-bearing zones. Intervals within boreholes were selected for packer testing based on visual inspections of rock cores and the results of borehole geophysical testing. Sections of a borehole that exhibited increased frequency of fractures or bedding plane parting were commonly packer tested.

Standard procedures used to conduct these tests included lowering a pair of pneumatically operated rubber packers (in straddle-packer configuration) separated by a known length of perforated pipe into the drill hole to a predetermined depth. The packer interval was approximately 20 feet. The packers were then inflated to a precalculated pressure to seal against the rock side walls and water was pumped into the test interval at a selected pressure while the flow rate was measured with a cumulative flow meter. To improve the accuracy of measurements at the low flow rates encountered in most of these tests, the water was often pumped from a large container (e.g., a drum or section of casing) and the volume removed was recorded. In addition to monitoring the water pressure and flow rate at appropriate intervals, the height of the water pressure gauge above ground surface, as well as the diameter and length of water pipe used, were recorded. The tests were continued until five consecutive readings indicated a stabilization of the flow rate but for a minimum of at least 10 minutes. Standard forms were used for data records and the hydraulic conductivity was calculated using standard Bureau of Reclamation procedures.

STRADDLE PACKER TEST RESULTS

Boring	Test Depth (feet)	Packer Pressure (psi)	Gauge Pressure (psi)	Formation/ Lithology	Hydraulic Conductivity* (cm/sec)
BIR 41	125.0-145.0	150	20	Austin Chalk	1.6×10^{-6}
	165.0-185.0	160	20	Austin Chalk/ Eagle Ford Shale Contact	1.1×10^{-6}
BIR 42	253.15-274.25 (vertical depth 182.9-198.1)	150	30	Fractured Eagle Ford Shale	1.0×10^{-5}

*Based on approximate static water level of 24 feet below ground surface.

At boring BIR 41, two test intervals were selected based on an inspection of the rock core and a review of the boring and wire-line logs. The first interval was selected from 125 to 145 feet and encompassed a shaly interval within the Austin Chalk. The second interval was from 165 to 185 feet and straddled the contact between the Austin Chalk and Eagle Ford Shale.

In angled boring BIR 42, one interval was selected based on an inspection of the rock core and a review of the boring and wire-line logs. This interval was from 253.15 to 274.25 feet (vertical depth 182.9 to 198.1 feet) and encompassed two 1- to 2-foot wide fracture zones in the Eagle Ford Shale just below the contact with the Austin Chalk.

Hydrogeologic (packer) testing followed the standard procedures outline above. Packer and gauge pressures are listed in the table. The volume of water used was measured with a calibrated container for tests in BIR 41 and with a flow meter for BIR 42.

APPENDIX E

LABORATORY RESULTS

BULK AND CLAY MINERALOGY

TEST RESULTS

TABLE E-1. BULK AND CLAY MINERALOGY TEST RESULTS

Boring BIR 41

Formation: Austin Chalk **Boring Depth:** 66.0 feet

Whole Rock Composition:

Mineral	Percent
quartz	1
calcite	98
pyrite	1
total clay	0
Total	100

Relative Clay Abundance:

Mineral	Percent
Not Analyzed	

Formation: Eagle Ford Shale **Boring Depth:** 205.0 feet

Whole Rock Composition:

Mineral	Percent
non-clay*	44
clay	56
Total	100

Relative Clay Abundance:

Mineral	Percent
illite	30
kaolinite	14
Fe-chlorite	1
mixed layer (illite/smectite)	55
Total	100

Boring BIR 42

Formation: Eagle Ford Shale **Boring Depth:** 249.8 feet

Whole Rock Composition:

Mineral	Percent
quartz	9
pyrite	2
clay	89
Total	100

Relative Clay Abundance:

Mineral	Percent
montmorillonite	36
illite	49
kaolinite	15
Total	100

Formation: Eagle Ford Shale **Boring Depth:** 250.1 feet

Whole Rock Composition:

Mineral	Percent
clay	100

Relative Clay Abundance:

Mineral	Percent
montmorillonite	40
illite	40
kaolinite	20
Total	100

TABLE E-1. BULK AND CLAY MINERALOGY TEST RESULTS

(Continued)

Boring BIR 42 (Cont'd)

Formation: Eagle Ford Shale **Boring Depth:** 271.5 feet

Whole Rock Composition:

Mineral	Percent
quartz	5
clay	95
Total	100

Relative Clay Abundance:

Mineral	Percent
montmorillonite	40
illite	33
kaolinite	27
Total	100

Formation: Eagle Ford Shale **Boring Depth:** 272.1 feet

Whole Rock Composition:

Mineral	Percent
quartz	18
pyrite	<1
clay	82
Total	100

Relative Clay Abundance:

Mineral	Percent
montmorillonite	33
illite	45
kaolinite	22
Total	100

Boring BIR 43

Formation: Eagle Ford Shale **Boring Depth:** 197.7 feet

Whole Rock Composition:

Mineral	Percent
total clay	61
non-clay*	39
Total	100

Relative Clay Abundance:

Mineral	Percent
illite	18
kaolinite	12
Fe-chlorite	1
mixed layer (illite/smectite)	69
Total	100

Formation: Eagle Ford Shale **Boring Depth:** 218.6 feet

Whole Rock Composition:

Mineral	Percent
total clay	74
non-clay*	26
Total	100

Relative Clay Abundance:

Mineral	Percent
illite	35
kaolinite	20
mixed layer (illite/smectite)	45
Total	100

TABLE E-1. BULK AND CLAY MINERALOGY TEST RESULTS

(Continued)

Boring BIR 44

Formation: Austin Chalk **Boring Depth:** 3.0-3.3 feet

Whole Rock Composition:

Mineral	Percent
quartz	3
calcite	96
total clay	1
Total	100

Relative Clay Abundance:

Mineral	Percent
Not Analyzed	

Boring BIR 45

Formation: Eagle Ford Shale **Boring Depth:** 179.6 feet

Whole Rock Composition:

Mineral	Percent
total clay	52
non-clay*	48
Total	100

Relative Clay Abundance:

Mineral	Percent
illite	17
kaolinite	16
Fe-chlorite	4
mixed layer (illite/smectite)	63
Total	100

*Specific composition not analyzed.

GEOMECHANICAL TEST RESULTS

DIRECT SHEAR TEST RESULTS

FOR JOINTS IN OUTCROP

TABLE E-2. DIRECT SHEAR TEST RESULTS FOR JOINTS IN OUTCROP*

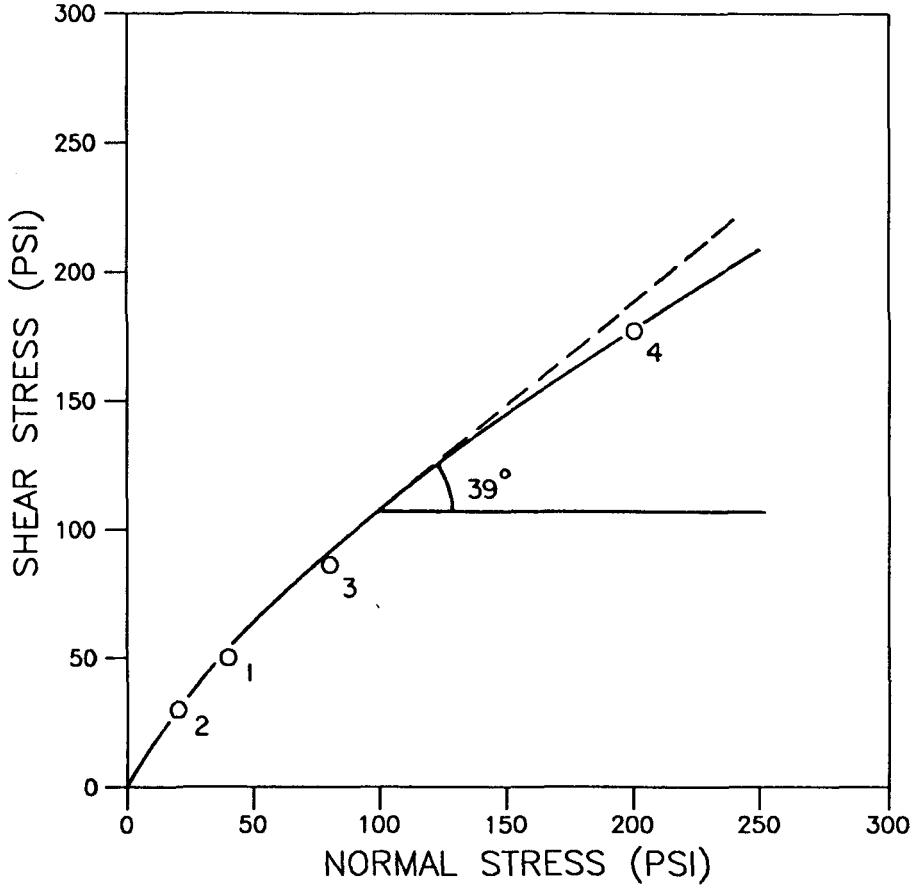
TEST NUMBER	JOINT SET (SEE APPENDIX C)	STRIKE/DIP	NORMAL LOAD (lbs.)	AREA (in.^{2})	SHEAR FORCE (lbs.)		DISPLACEMENT (in.)		NORMAL STRESS (psi)		SHEAR STRESS (psi)		FRICTION ANGLE** (deg)
					PEAK	MIN.	PEAK SHEAR STRESS	MINIMUM SHEAR STRESS	PEAK	MIN.	PEAK	MIN.	
IR4A1CN1	III	N32°W, 75°SW	347	8.68	494	---	0.102	---	40	---	56.9	---	39
IR4A1AX2	III	N32°W, 75°SW	174	8.68	262	---	0.404	---	20	---	30.2	---	
IR4A1AX3	III	N32°W, 75°SW	695	8.68	757	---	0.31	---	80	---	87.2	---	
IR4A1AX4	III	N32°W, 75°SW	1735	8.68	1614	---	0.205	---	200	---	186.1	---	
IR4A2CN1	II	N65°E, 87°SE	305	7.63	343	---	0.414	---	40	---	44.9	---	40
IR4A2AX2	II	N65°E, 87°SE	153	7.63	213	---	0.359	---	20	---	27.9	---	
IR4A2AX3	II	N65°E, 87°SE	610	7.63	610	---	0.329	---	80	---	80	---	
IR4A2AX4	II	N65°E, 87°SE	1525	7.63	1340	---	0.332	---	200	---	175.6	---	

NOTES:

1. Samples were cut and aligned so that a constant shear area was maintained during the tests.
2. Shear and normal loads have been corrected for piston packing friction.

* Samples of joints (both sides) were collected from surface outcrops for these shear tests (see Appendix C). In the test, the direction of shearing is parallel to the dip of the joint.

** Friction angle calculated using tangent line at 100 psi normal stress.



SAMPLE NO.: IR4A1
DEPTH: SURFACE
SHEAR AREA (SQ. IN.): 8.68
LITHOLOGY: AUSTIN CHALK LIMESTONE
DESCRIPTION: SURFACE IS UNALTERED AND IS ROUGH

STAGE:	1	2	3	4
NORMAL STRESS (PSI)	40	20	80	200

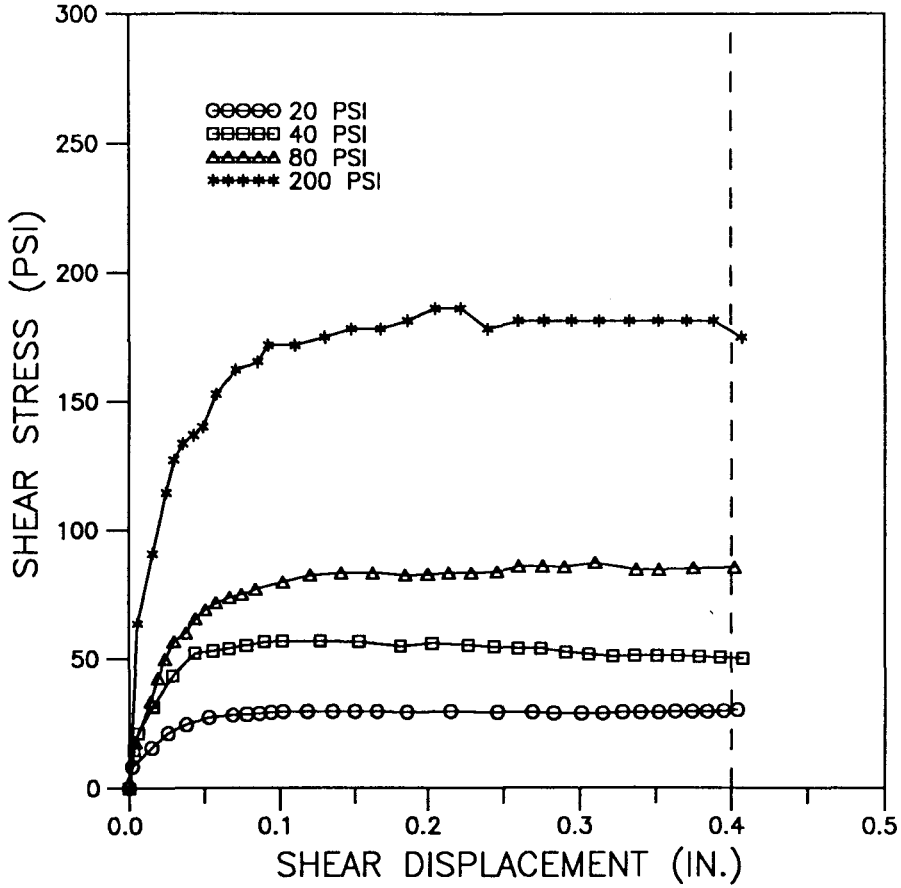
TEST PROCEDURE: ISRM

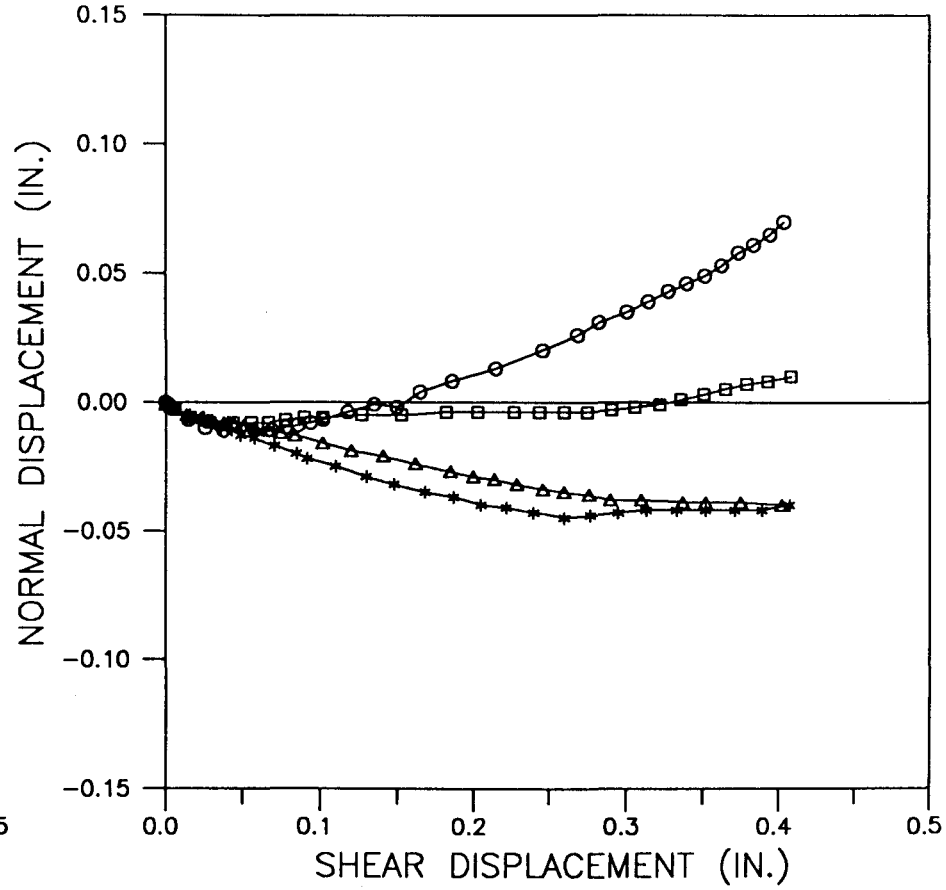
TEXAS SSC SITE

DISCONTINUITY SHEAR

MASON–JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS–ENGINEERS

JOB NO.: 5530.15 | FIGURE





SAMPLE NO.: IR4A1
DEPTH: SURFACE
SHEAR AREA (SQ. IN.): 8.68
LITHOLOGY: AUSTIN CHALK LIMESTONE
DESCRIPTION: SURFACE IS UNALTERED AND IS ROUGH

STAGE:	1	2	3	4
NORMAL STRESS (PSI)	40	20	80	200

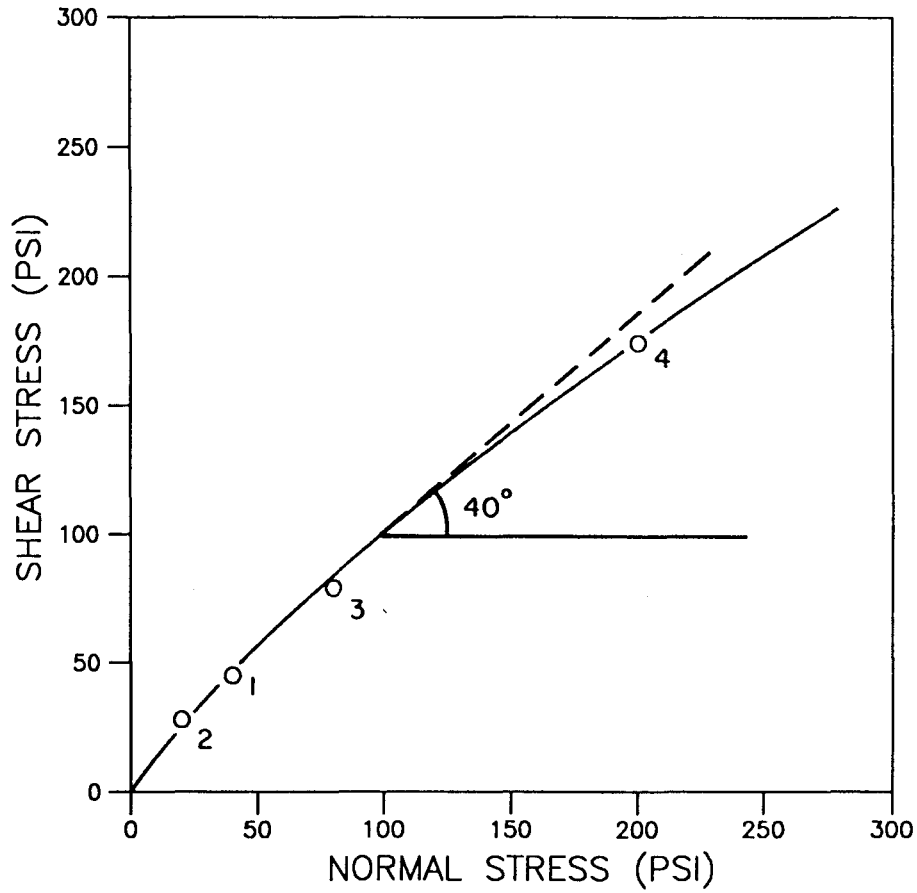
TEST PROCEDURE: ISRM

TEXAS SSC SITE

DISCONTINUITY SHEAR

MASON–JOHNSTON & ASSOCIATES,INC.
GEOLOGISTS–ENGINEERS

JOB NO.: 5530.15 | FIGURE



SAMPLE NO.: IR4A2
DEPTH: SURFACE
SHEAR AREA (SQ. IN.): 7.63
LITHOLOGY: AUSTIN CHALK LIMESTONE
DESCRIPTION: SURFACE IS VERY WEATHERED AND IS VERY ROUGH

STAGE:	1	2	3	4
NORMAL STRESS (PSI)	40	20	80	200

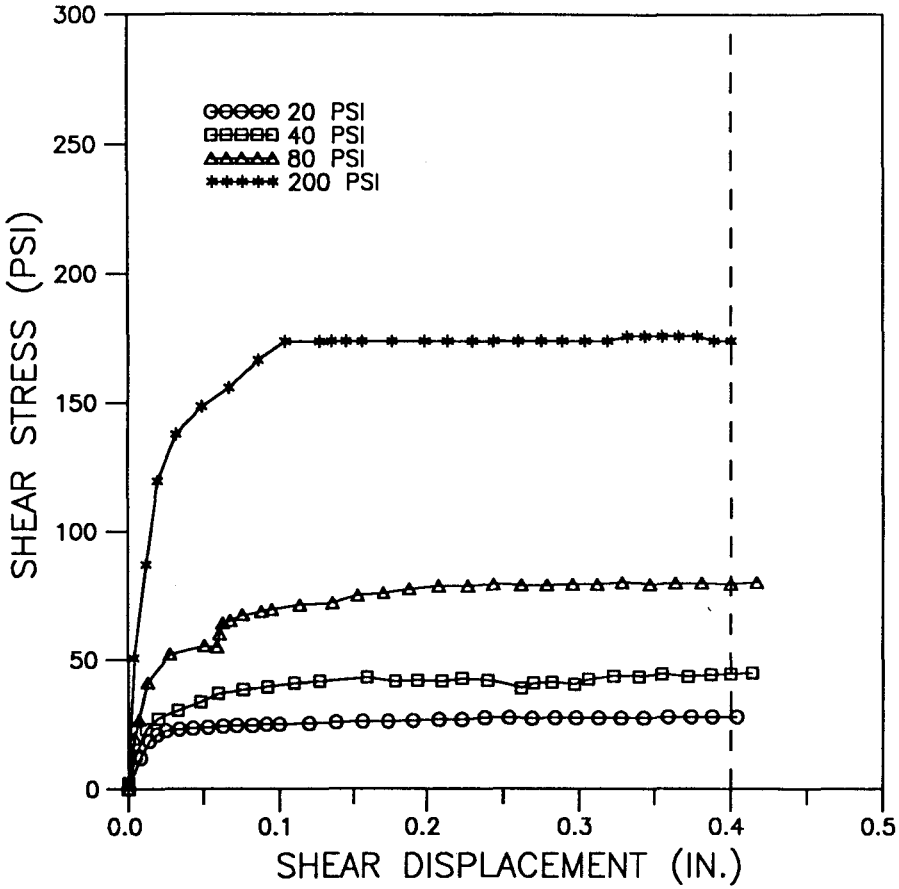
TEST PROCEDURE: ISRM

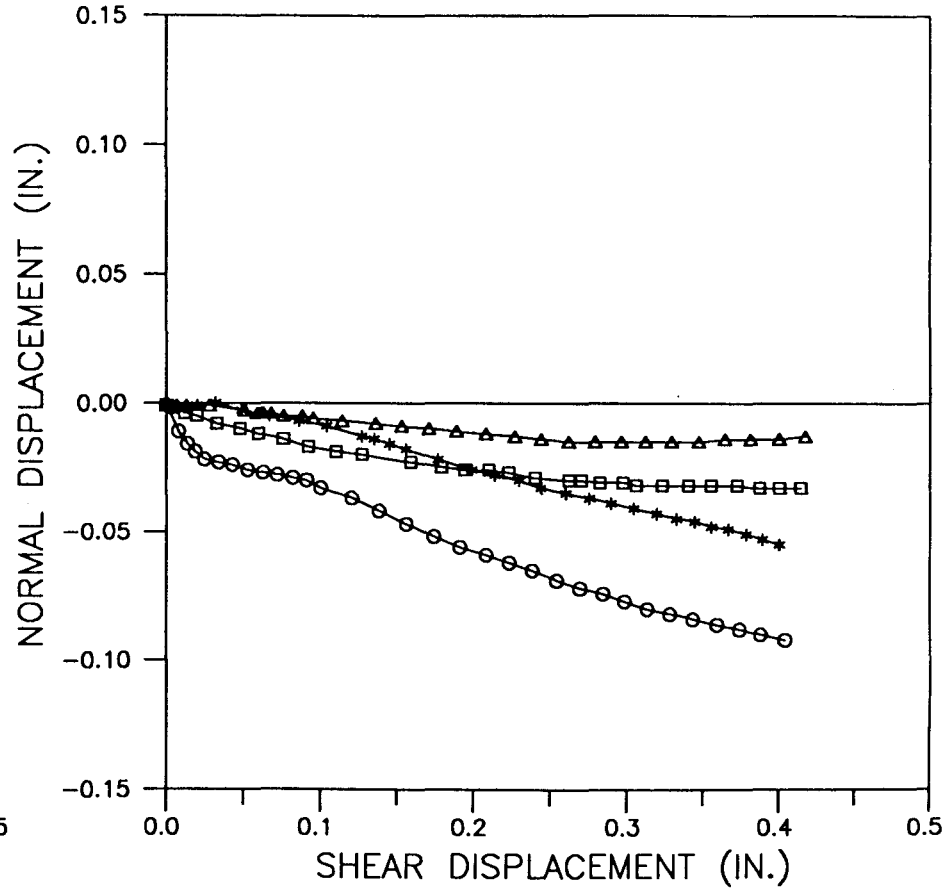
TEXAS SSC SITE

DISCONTINUITY SHEAR

MASON–JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS–ENGINEERS

JOB NO.: 5530.15 | FIGURE





SAMPLE NO.: IR4A2
DEPTH: SURFACE
SHEAR AREA (SQ. IN.): 7.63
LITHOLOGY: AUSTIN CHALK LIMESTONE
DESCRIPTION: SURFACE IS VERY WEATHERED AND IS VERY ROUGH

STAGE:	1	2	3	4
NORMAL STRESS (PSI)	40	20	80	200

TEST PROCEDURE: ISRM

TEXAS SSC SITE

DISCONTINUITY SHEAR

MASON-JOHNSTON & ASSOCIATES,INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15 | FIGURE

GEOMECHANICAL TEST RESULTS

BORING BIR 41

TABLE E-2. GEOMECHANICAL TEST RESULTS–BORING BIR 41

GENERAL LITHOLOGY	VERTICAL DEPTH	MOISTURE CONTENT	DRY DENSITY	SPECIFIC GRAVITY	ATTERBERG LIMITS		FRACTION FINER THAN	CARBONATE CONTENT	SAMPLE DIMENSION RATIO	SAMPLE FAILURE MODE/ DEGREES*	UNCONFINED COMPRESSIVE STRENGTH	TRIAXIAL COMPRESSION		FAILURE STRAIN	TANGENT YOUNG'S MODULUS			POISSON'S RATIO	BRAZIL TENSILE STRENGTH	2ND CYCLE SLAKE DURABILITY INDEX	MODIFIED TABOR ABRASION/ HARDNESS INDEX	SWELL PRESSURE INDEX	COMMENTS
					LL	PI	# 200 SIEVE					CONFINING PRESSURE	DEVIATOR STRESS		E50	UNLOAD/ RELOAD							
	feet	percent	pcf				percent	percent	L/D		psi	σ_3 psi	$\sigma_1-\sigma_3$ psi	percent	(psi)x10E5	(psi)x10E5	σ_3 psi		psi	percent		percent	
AUSTIN CHALK	24.9	12.0	125.0						2.5	E	2733			1.70			0						
AUSTIN CHALK	25.6																				0.372		
AUSTIN CHALK	65.8	11.9	126.8																				
AUSTIN CHALK	65.9	15.9							0.5										175				
AUSTIN CHALK	68.0	14.5	119.7						2.1	D		50	2025	0.18	3.40		50						NOTE 1
AUSTIN CHALK	68.0														14.40			0.48					NOTE 2
AUSTIN CHALK	68.0	15.7																					
AUSTIN CHALK	68.5	14.0	120.9						2.1	D		500	2817	0.81			500						
AUSTIN CHALK	68.9	16.5	116.0						2.1	B-4		200	2587	0.55			200						
AUSTIN CHALK	123.0	9.7																					
AUSTIN CHALK	123.1																				0.475		
AUSTIN CHALK	124.5	10.1							0.5										268				
AUSTIN CHALK	124.6	10.3	130.0						2.4	D	2904			1.30			0						
AUSTIN CHALK	128.4	10.4	131.2						2.1	D		100	2411	0.66	5.20		100						
AUSTIN CHALK	128.4	12.0																					
AUSTIN CHALK	128.8	11.0	127.9						2.1	B-1/15		500	2773	1.19			500						
AUSTIN CHALK	160.0	12.8																		96.9			
AUSTIN CHALK	162.9	15.0	119.0																				
AUSTIN CHALK	163.1	16.0							0.5										242				
EAGLE FORD SHALE	180.2	17.0																					
EAGLE FORD SHALE	182.2	16.4	116.2																			57.8	
EAGLE FORD SHALE	182.3	16.8	116.0																			43.4	
EAGLE FORD SHALE	182.4	16.5	118.5																			36.1	
EAGLE FORD SHALE	183.0	16.2																		21.8			
EAGLE FORD SHALE	183.7	15.8	117.4	2.72					2.3	B-1/45	360			1.20			0					7.7	
EAGLE FORD SHALE	183.9	16.3			97	63																	
EAGLE FORD SHALE	191.0	15.5	119.1						2.0	B-1/20	277			0.48	0.54		0						NOTE 1
EAGLE FORD SHALE	191.0														0.59			0.12					NOTE 2
EAGLE FORD SHALE	191.7	15.5	117.5		86	53			2.0	B-1/53		100	210	0.22	1.20		100						NOTE 1
EAGLE FORD SHALE	191.7														1.10			0.29					NOTE 2
EAGLE FORD SHALE	191.7	16.6																					
EAGLE FORD SHALE	192.1	15.6	116.7						2.1	B-1/50		300	365	0.52	0.81		300						NOTE 1
EAGLE FORD SHALE	192.1														1.07			0.19					NOTE 2
EAGLE FORD SHALE	204.0	16.0																					
EAGLE FORD SHALE	204.1	15.1																		22.6			
EAGLE FORD SHALE	204.2	16.8			101	63																	
EAGLE FORD SHALE	204.6	15.7	118.7						2.1	D	288			0.60			0						
EAGLE FORD SHALE	206.7	16.0																				21.6	
EAGLE FORD SHALE	206.9	16.5	117.9																			21.6	
EAGLE FORD SHALE	207.0																					36.2	
EAGLE FORD SHALE	207.1	16.2	118.3																			36.0	
EAGLE FORD SHALE	211.5	15.4																					
EAGLE FORD SHALE	211.6			2.77																			
EAGLE FORD SHALE	211.7	15.9			98	63																	
EAGLE FORD SHALE	212.1	15.4	119.6																			43.2	
EAGLE FORD SHALE	212.4	15.6	121.8																			43.4	
EAGLE FORD SHALE	212.7	15.6	118.7																			57.6	
EAGLE FORD SHALE	213.2	12.7	125.7					10.4	2.2	D	432			1.50			0						
EAGLE FORD SHALE	214.0	14.8																		24.1			
EAGLE FORD SHALE	215.0	15.4																					
EAGLE FORD SHALE	215.2	15.3																					
EAGLE FORD SHALE	215.2	14.2	120.5						2.1	B-1/45		200	514	0.64	1.11		200						NOTE 1
EAGLE FORD SHALE	215.2														1.08			0.27					NOTE 2
EAGLE FORD SHALE	215.6	15.1	116.6						2.1	B-1/40		500	519	1.08			500						
EAGLE FORD SHALE	254.6																			32.7			
EAGLE FORD SHALE	278.6																			20.2			
PROCEDURE		ASTM-D2216		ASTM-D854	ASTM-D4318		ASTM-D422				ASTM-D2938	ASTM-D2664			ASTM-D3148			ASTM-D3148	ISRM	ISRM	ISRM	ISRM	

BIR41PRT.WK1
REVISION 1.5
DATE 5/2/99

PRELIMINARY
(Subject to Revision)

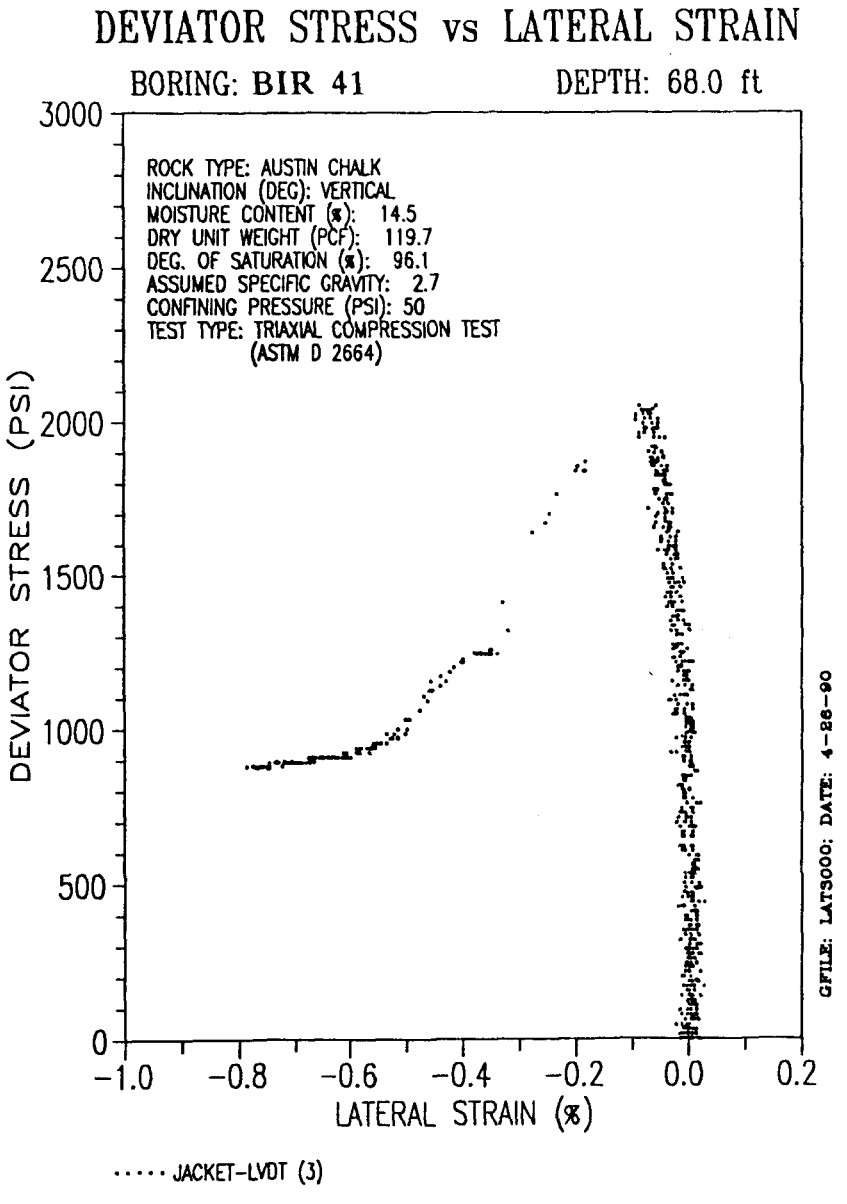
* EXPLANATION OF SAMPLE FAILURE MODE AS FOLLOWS.

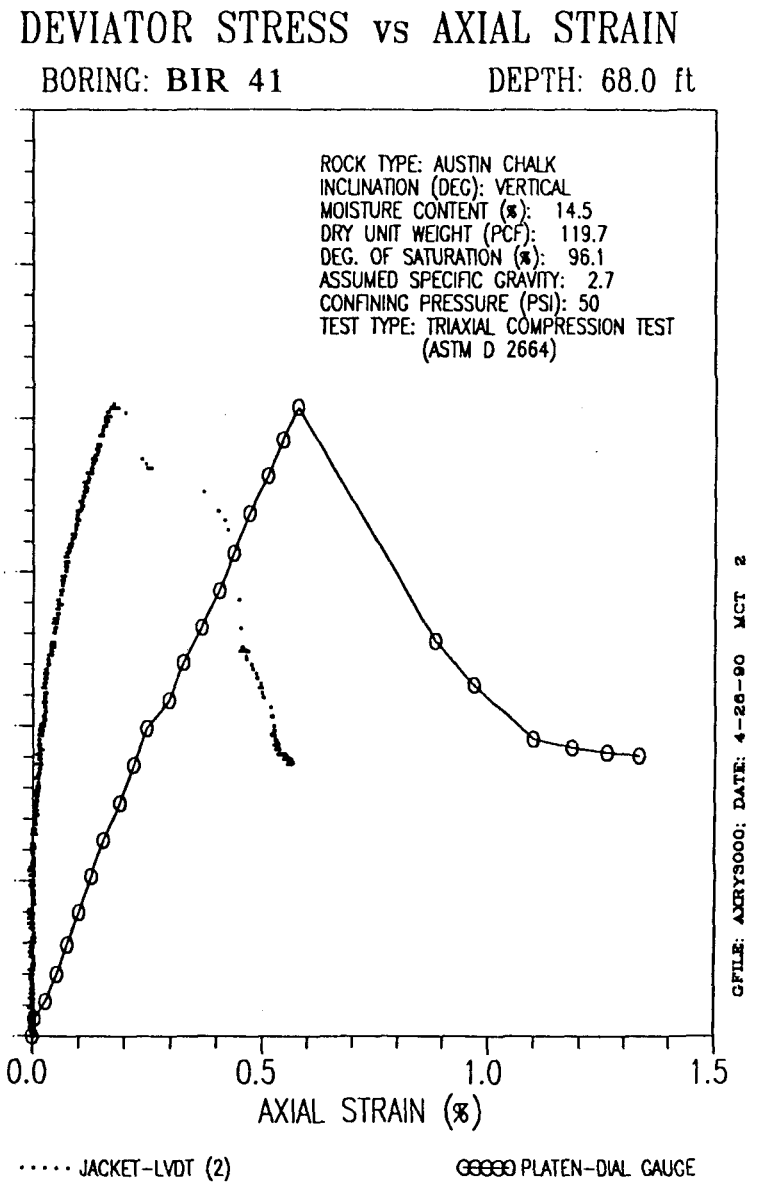
Symbol	Failure Type	Symbol	Failure Type
A	No discernible failure plane	B-4	Combination
(B)	Well defined shear plane @ "X" angle (deg) to vertical or to long axis of core	C	Barreling/Bulging
B-1	Shear plane	D	Longitudinal (axial) splitting
B-2	Bedding plane shear	E	Conical
B-3	Shear plane along pre-existing fracture, shear zone, etc.	F	No information

NOTES 1) MODULUS WAS CALCULATED FROM AXIAL STRAINS MEASURED USING DIAL MICROMETER. AXIAL LENGTH IS THE SAMPLE LENGTH.

2) MODULII AND POISSON'S RATIO WERE CALCULATED FROM AXIAL AND LATERAL STRAINS MEASURED USING AXIAL AND LATERAL LVDTS. AXIAL LENGTH IS 2.8 INCHES

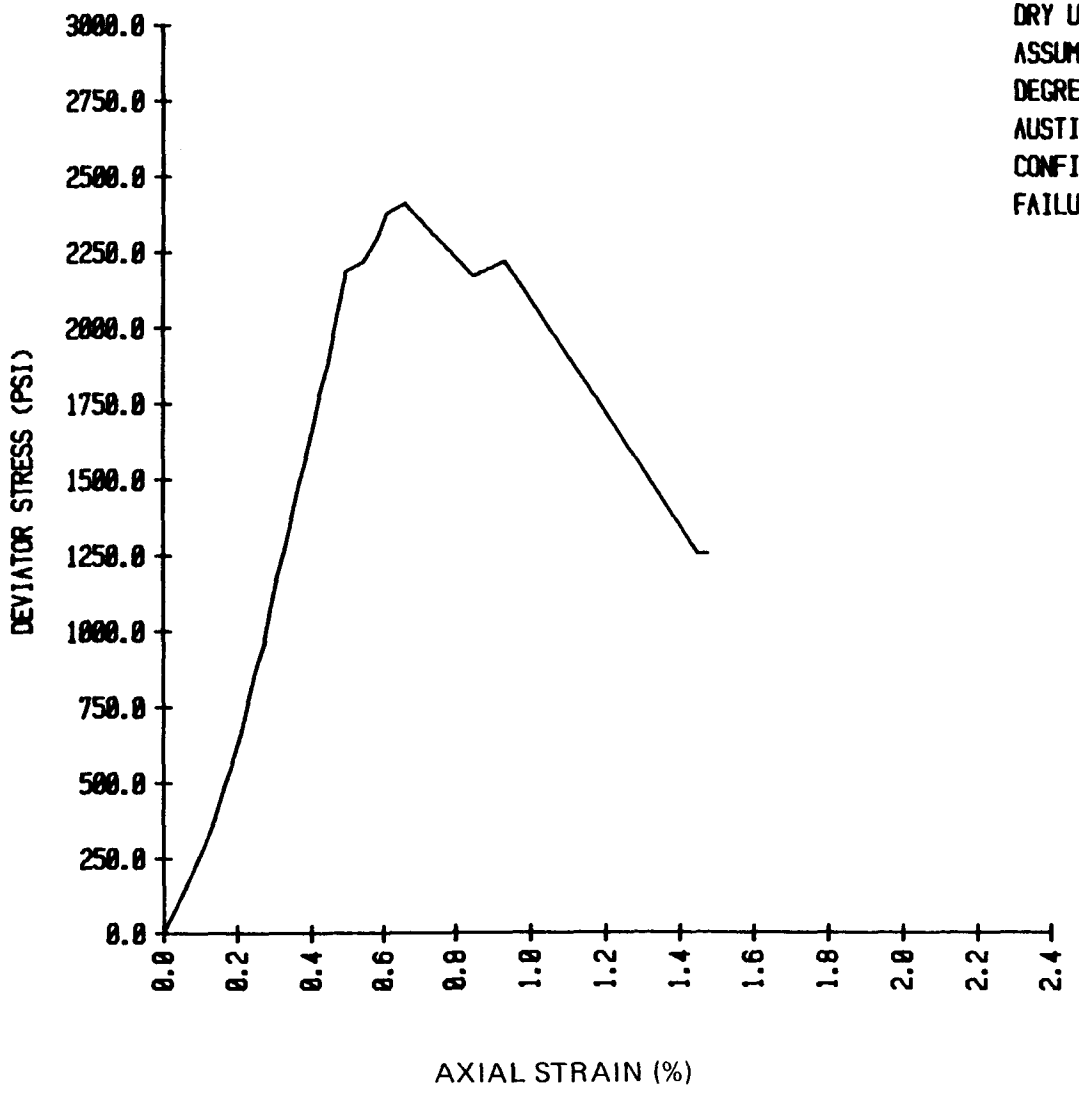
Note: Some values in this table may be revised based on reviews of test procedures and individual test results. The reader should refer to the latest revision of the gINT geotechnical data base (geotechnical report GR-70).





PRELIMINARY

BORING #: BIR 41
DEPTH: 128.4 FEET
INCLINATION : VERTICAL
MC TRIMMINGS,(%) = 12.0
MC AS TESTED (%) = 10.4
DRY UNIT WEIGHT (PCF) = 131.2
ASSUMED SPECIFIC GRAVITY, G_s = 2.7
DEGREE OF SATURATION, (%) = 98.5
AUSTIN CHALK LIMESTONE
CONFINING PRESSURE PSI = 100
FAILURE MODE : AXIAL SPLITTING



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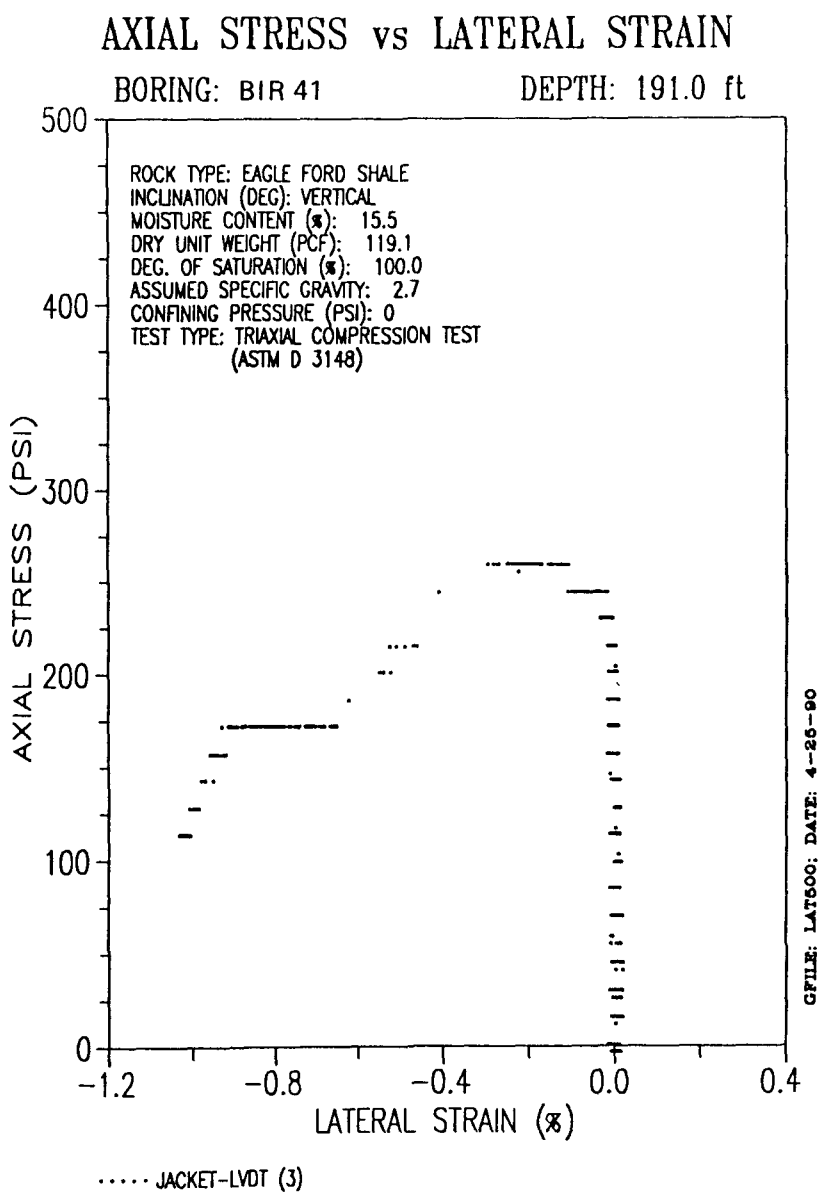
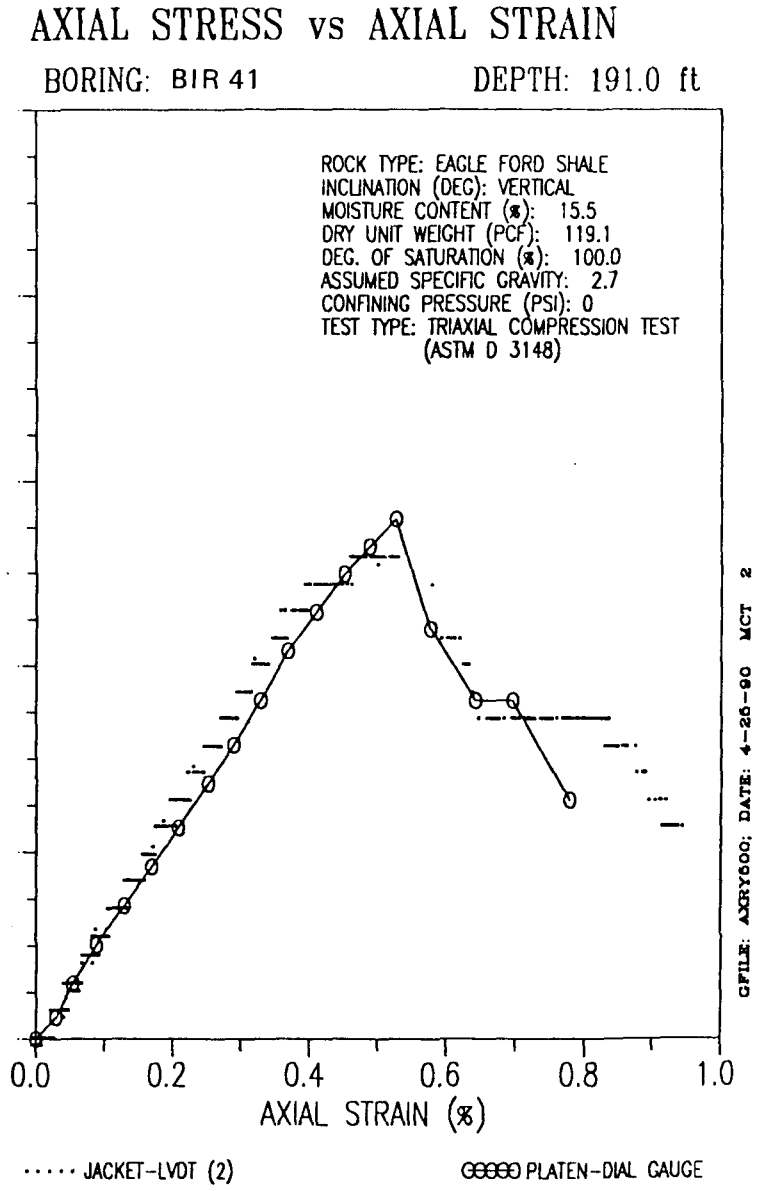
DATE: 10-1-89 | JOB # 5530.15

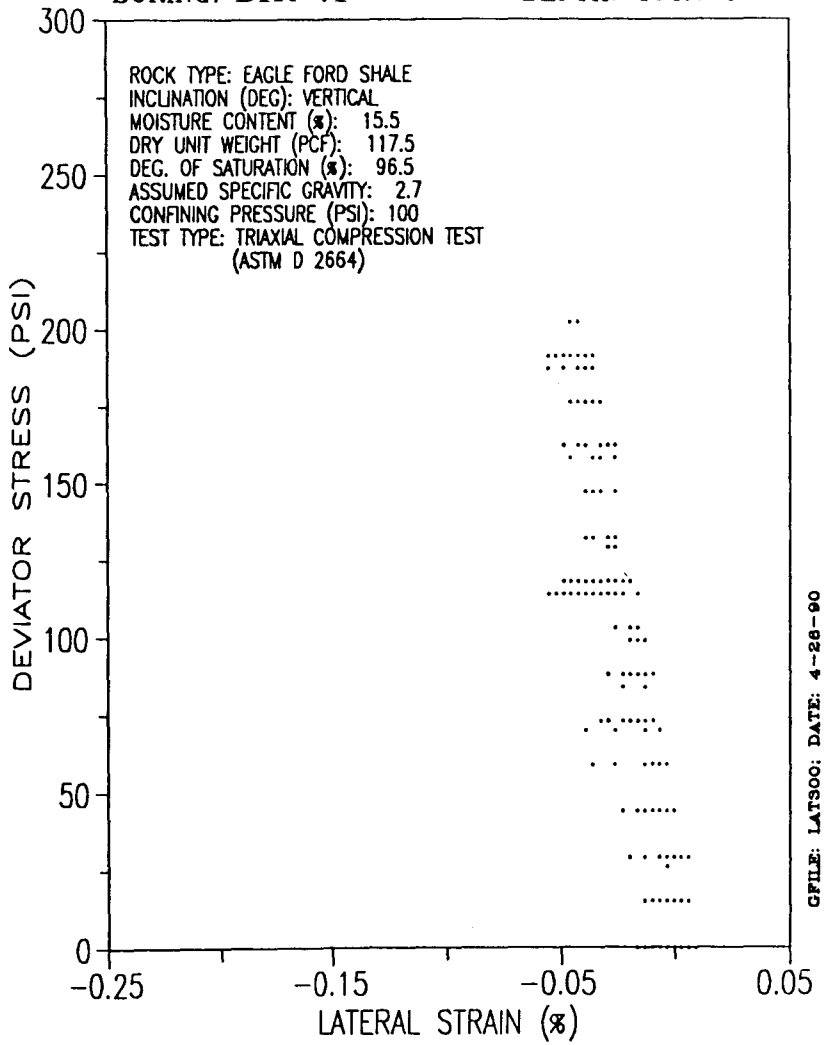




PRELIMINARY

DEVIATOR STRESS vs LATERAL STRAIN

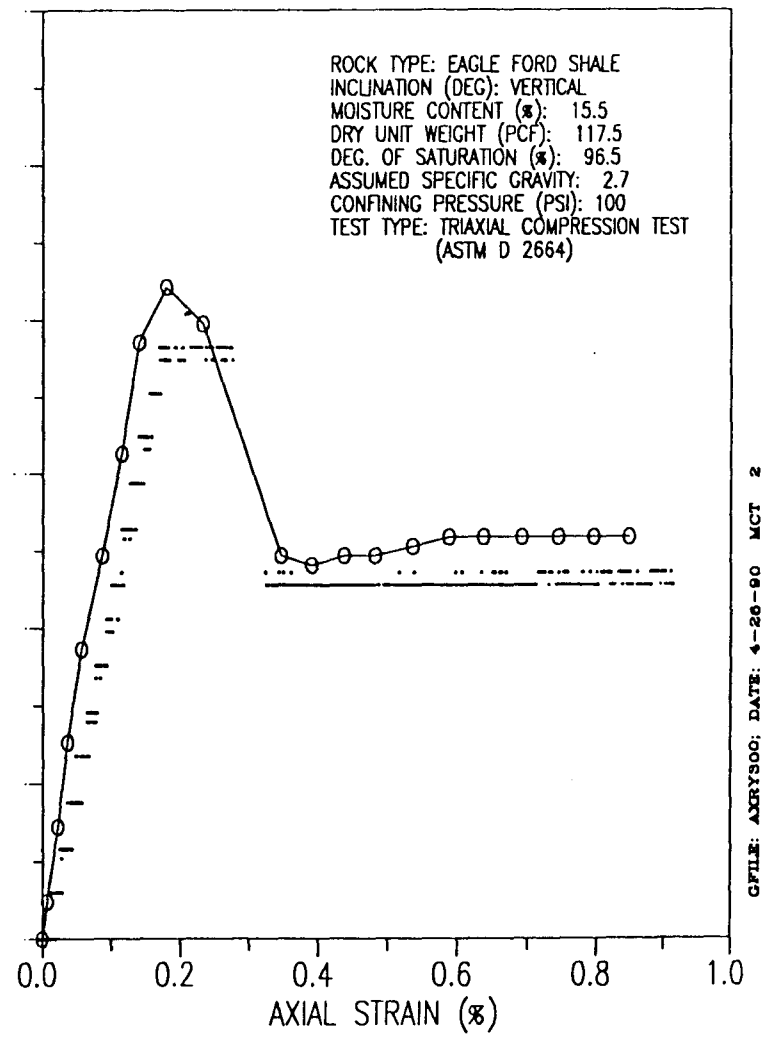
BORING: **BIR 41** DEPTH: 191.7 ft



····· JACKET-LVDT (3)

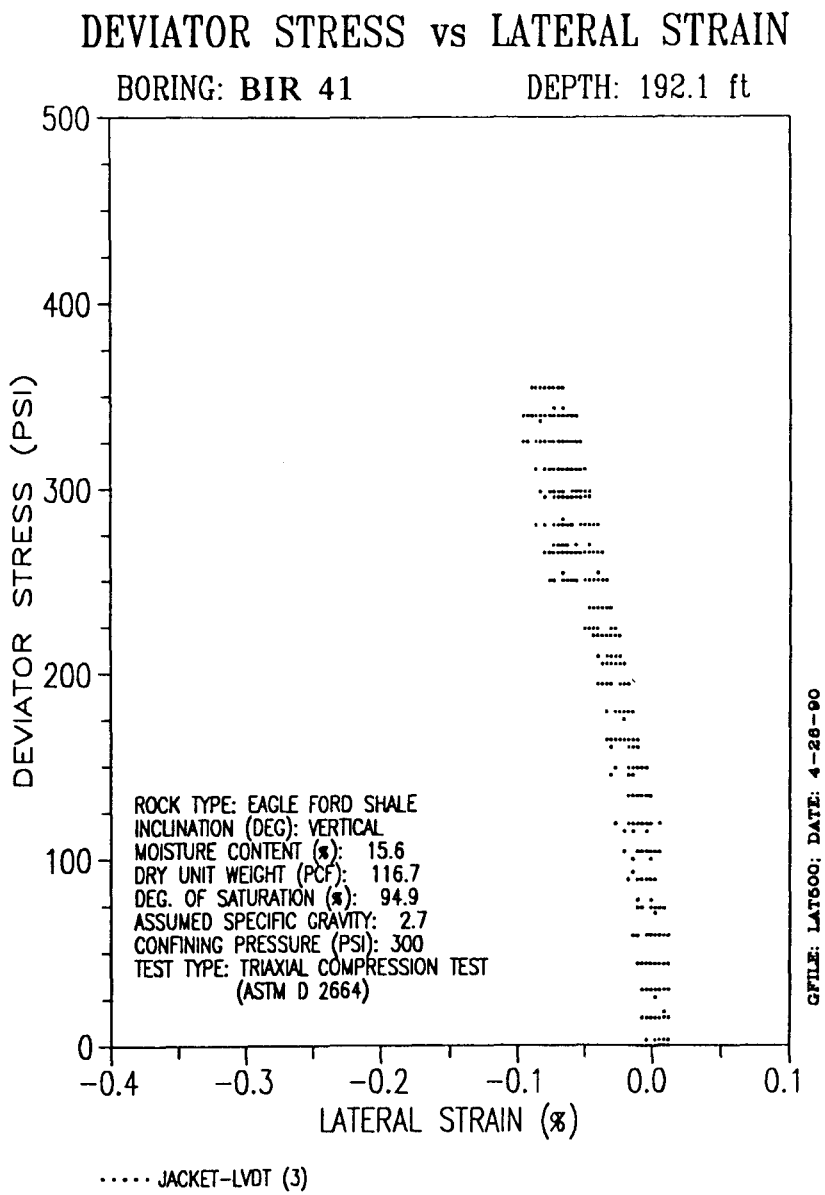
DEVIATOR STRESS vs AXIAL STRAIN

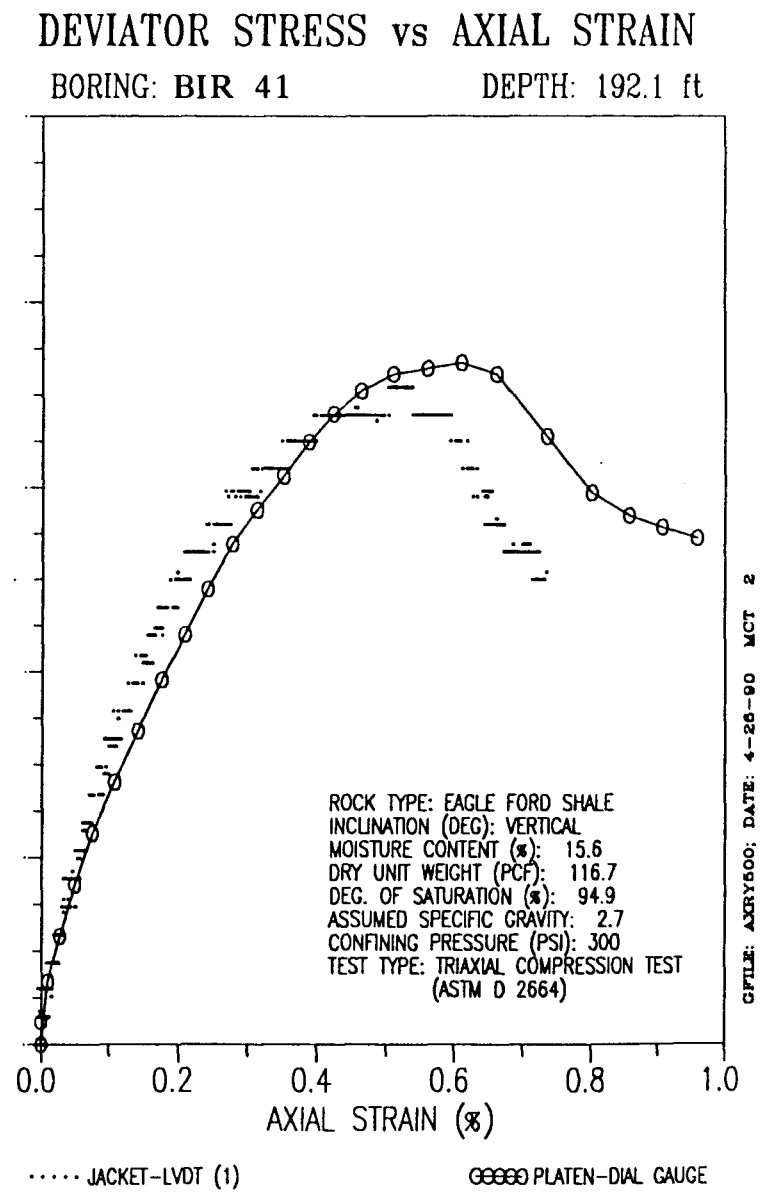
BORING: **BIR 41** DEPTH: 191.7 ft



····· JACKET-LVDT (2) ⊖⊖⊖⊖ PLATEN-DIAL GAUGE

PRELIMINARY

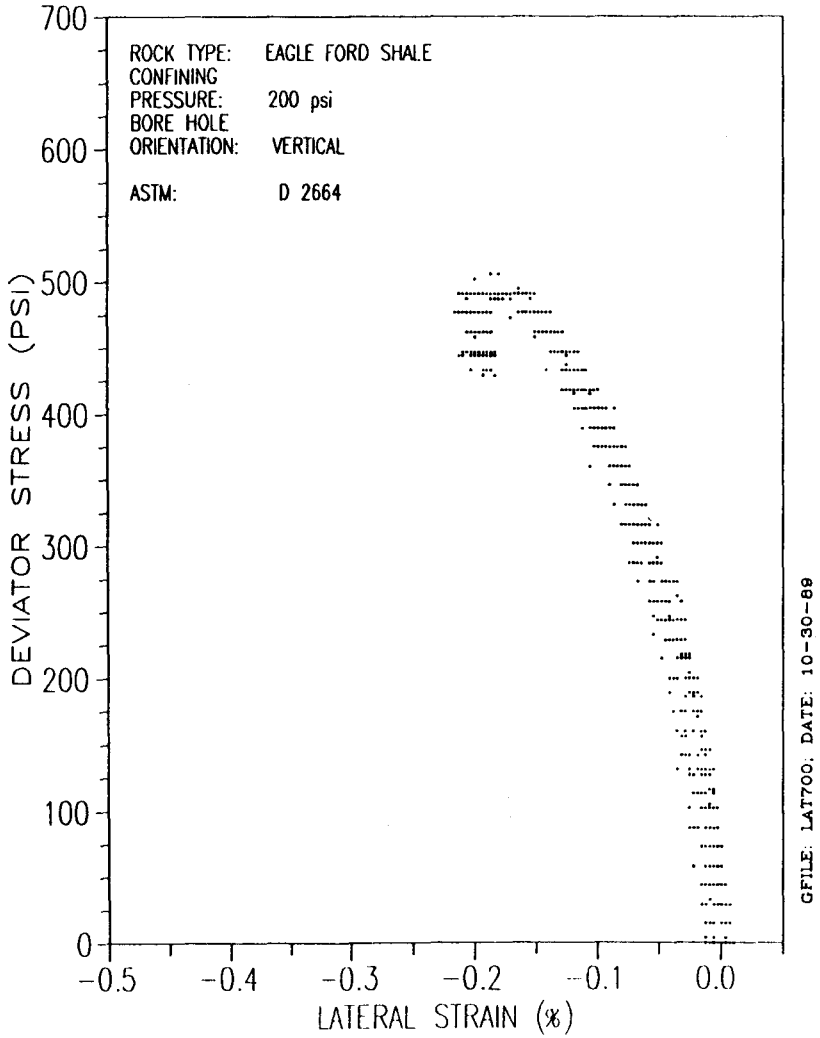




PRELIMINARY

DEVIATOR STRESS vs LATERAL STRAIN

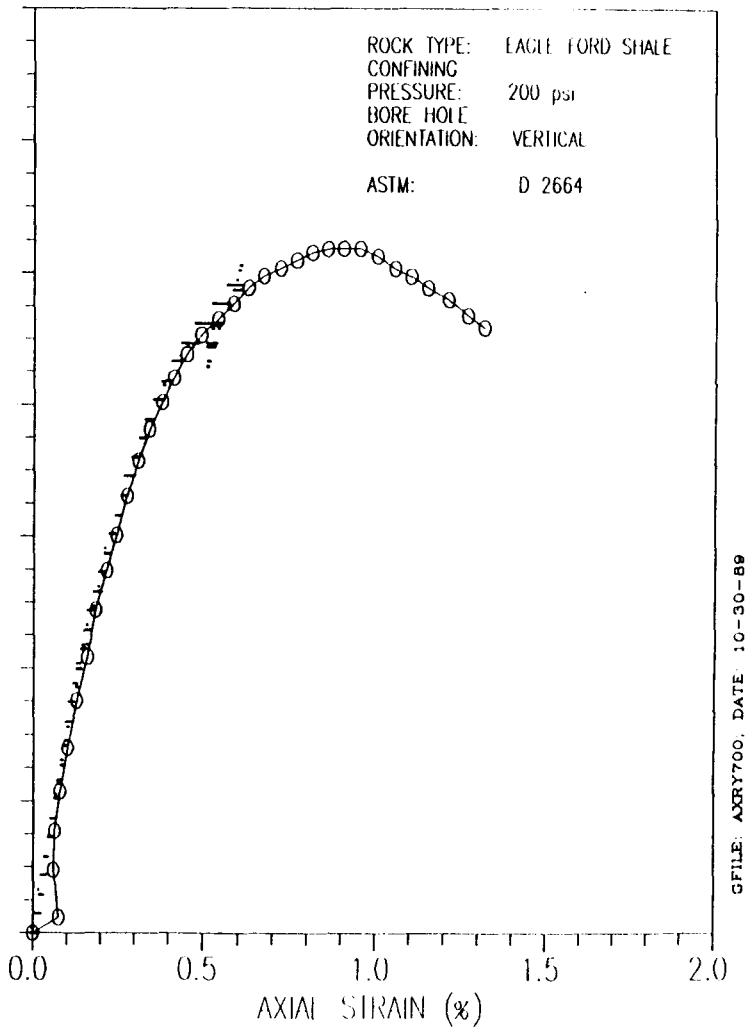
BORING: BIR 41 DEPTH: 215.2 ft



····· JACKET-LVDT (3)

DEVIATOR STRESS vs AXIAL STRAIN

BORING: BIR 41 DEPTH: 215.2 ft



····· JACKET-LVDT (2) ○○○○○ PLATEN GAIL GAUGE

GEOMECHANICAL TEST RESULTS

BORING BIR 42

TABLE E-3. GEOMECHANICAL TEST RESULTS–BORING BIR 42

GENERAL LITHOLOGY	VERTICAL DEPTH	MOISTURE CONTENT	DRY DENSITY	SPECIFIC GRAVITY	ATTERBERG LIMITS		FRACTION FINER THAN # 200 SIEVE	CARBONATE CONTENT	SAMPLE DIMENSION RATIO	SAMPLE FAILURE MODE/ DEGREES *	UNCONFINED COMPRESSIVE STRENGTH	TRIAXIAL COMPRESSION		FAILURE STRAIN	TANGENT YOUNG'S MODULUS			POISSON'S RATIO	BRAZIL TENSILE STRENGTH	2ND CYCLE SLAKE DURABILITY INDEX	MODIFIED TABOR ABRASION/ HARDNESS INDEX	SWELL PRESSURE INDEX	COMMENTS
					LL	PI						CONFINING PRESSURE	DEVIATOR STRESS		E50	UNLOAD/ RELOAD							
	feet	percent	pcf				percent	percent	L/D	DEGREES *	psi	σ_3 psi	$\sigma_1-\sigma_3$ psi	percent	(psi)x10E5	(psi)x10E5	σ_3 psi		psi	percent		percent	
AUSTIN CHALK	11.4	15.2	118.5						2.2	D	1484			0.62	2.30		0						
AUSTIN CHALK	37.1								0.5										179				
AUSTIN CHALK	37.2	13.0	122.1						2.1	D		50	2354	0.54			50						
AUSTIN CHALK	37.5	12.4	123.6						2.1	B-1/20		300	2674	0.70			300						
AUSTIN CHALK	37.8	12.0																					
AUSTIN CHALK	76.0	13.3																					
AUSTIN CHALK	76.0	13.8	119.7						2.1	D	2025			0.40	6.30		0						
AUSTIN CHALK	110.8	12.5																					
AUSTIN CHALK	110.9																		166				
AUSTIN CHALK	145.3	10.8	128.5						2.1	D	1941			0.55	4.50		0						
AUSTIN CHALK	145.8	9.8																					
EAGLE FORD SHALE	179.7	17.3	115.2																			34.0	
EAGLE FORD SHALE	179.9	17.4	115.2																			22.0	
EAGLE FORD SHALE	180.0	17.4	116.3																			18.0	
EAGLE FORD SHALE	180.2				87	55		4.7															
EAGLE FORD SHALE	181.3	17.6						6.5															
EAGLE FORD SHALE	181.5	17.3	114.7						2.2	B-2/45	99			0.16	0.61		0						
EAGLE FORD SHALE	181.8			2.70																			
EAGLE FORD SHALE	183.9	17.1																		32.7			
EAGLE FORD SHALE	189.4	14.9	122.0																			25.0	
EAGLE FORD SHALE	189.6	14.7	125.9																			32.0	
EAGLE FORD SHALE	189.7	15.8	119.4																			23.0	
EAGLE FORD SHALE	189.9							5.5															
EAGLE FORD SHALE	190.1	14.4																					
EAGLE FORD SHALE	190.3	14.7	117.7						2.2	B-2/45	143			0.23	0.62		0						
EAGLE FORD SHALE	190.6				85	53																	
EAGLE FORD SHALE	190.6	16.0	112.7						2.1	B-2/45		200	207	0.33	0.87		200						
EAGLE FORD SHALE	190.9	15.9	115.3						2.1	B-2/45		500	284	0.44			500						
EAGLE FORD SHALE	198.1	16.0																					
EAGLE FORD SHALE	198.2	14.1	122.0						2.0	B-2/45	157			0.31	0.66		0						
EAGLE FORD SHALE	198.5	15.4	119.8																			38.0	
EAGLE FORD SHALE	198.6	16.5	117.0																			35.0	
EAGLE FORD SHALE	198.8	17.6	104.8																			15.0	
EAGLE FORD SHALE	198.9				77	52																	
EAGLE FORD SHALE	201.2	16.8																		20.2			
PROCEDURE		ASTM-D2216		ASTM-D854	ASTM-D4318		ASTM-D422				ASTM-D2936	ASTM-D2664			ASTM-D3148			ASTM-D3148	ISRM	ISRM	ISRM	ISRM	

BIR42PRT WK1
REVISION: 1.5
DATE 5/2/90

PRELIMINARY
(Subject to Revision)

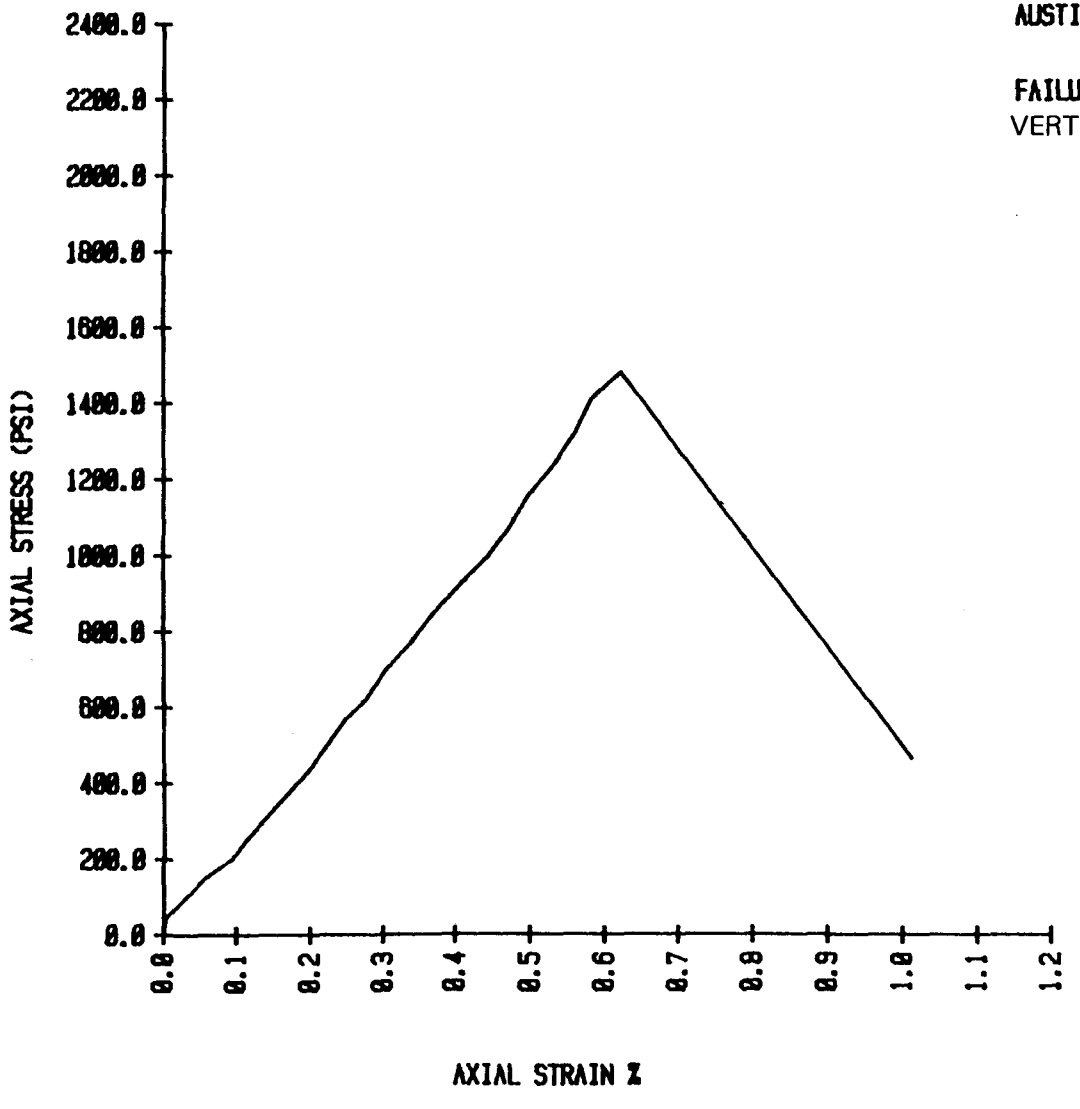
* EXPLANATION OF SAMPLE FAILURE MODE AS FOLLOWS.

Symbol	Failure Type	Symbol	Failure Type
A	No discernible failure plane	B-4	Combination
(B)	Well defined shear plane @ "X" angle (deg) to vertical or to long axis of core	C	Barreling/Bulging
B-1	Shear plane	D	Longitudinal (axial) splitting
B-2	Bedding plane shear	E	Conical
B-3	Shear plane along pre-existing fracture, shear zone, etc.	F	No information

Note: Some values in this table may be revised based on reviews of test procedures and individual test results. The reader should refer to the latest revision of the gINT geotechnical data base (geotechnical report GR-70).

BORING #: BIR 42
BORING DEPTH: 14.9 FEET
INCLINATION: APPROX. 45 DEGREES
DRY UNIT WEIGHT (PCF) = 118.5
MOISTURE CONTENT % = 15.2
AUSTIN CHALK LIMESTONE

FAILURE MODE : AXIAL SPLITTING
VERTICAL DEPTH: 11.4 FEET



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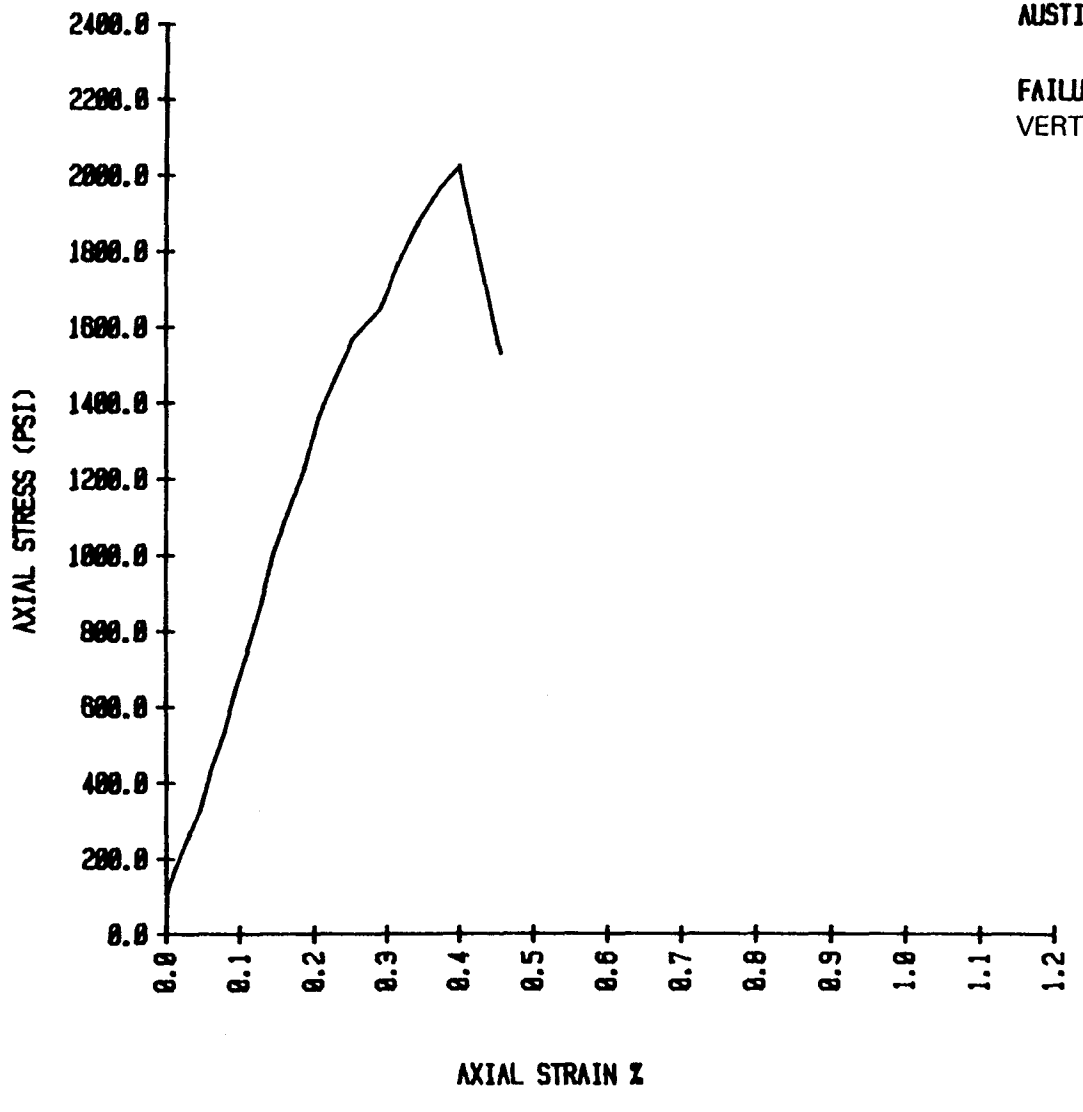
UNCONFINED COMPRESSIVE STRENGTH ASTM D-2938

DATE: 10-3-89 | JOB # 5530.15

BORING #: BIR 42
BORING DEPTH: 104.3 FEET
INCLINATION: APPROX. 45 DEGREES
DRY UNIT WEIGHT (PCF) = 119.7
MOISTURE CONTENT % = 13.8
AUSTIN CHALK LIMESTONE

FAILURE MODE : AXIAL SPLITTING
VERTICAL DEPTH: 76.0 FEET



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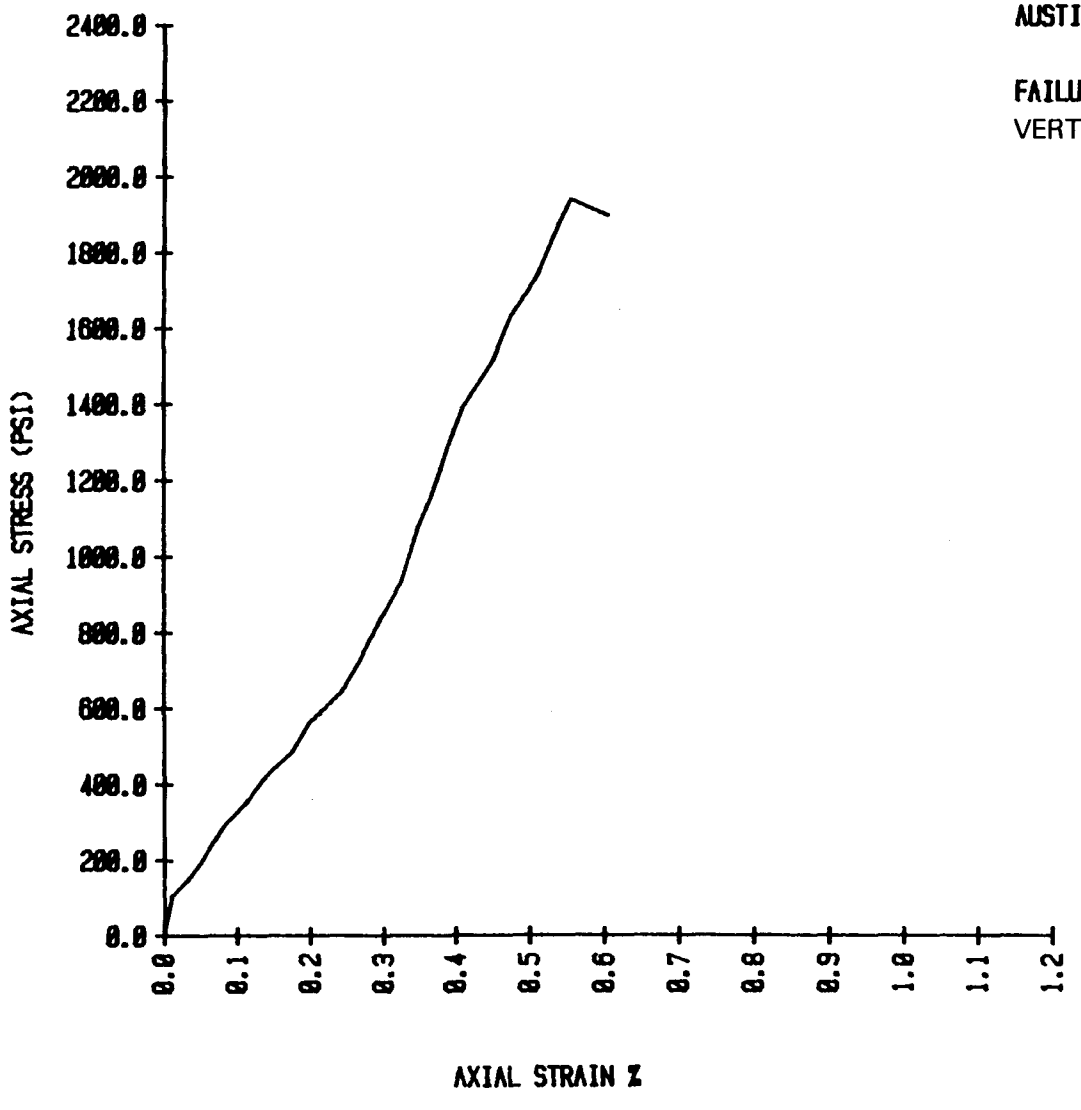
UNCONFINED COMPRESSIVE STRENGTH ASTM D-2938

DATE: 10-3-89 | JOB # 5530.15

BORING #: BIR 42
BORING DEPTH: 200.8 FEET
INCLINATION: APPROX. 45 DEGREES
DRY UNIT WEIGHT (PCF) = 128.5
MOISTURE CONTENT % = 10.8
AUSTIN CHALK LIMESTONE

FAILURE MODE : AXIAL SPLITTING
VERTICAL DEPTH: 145.3 FEET



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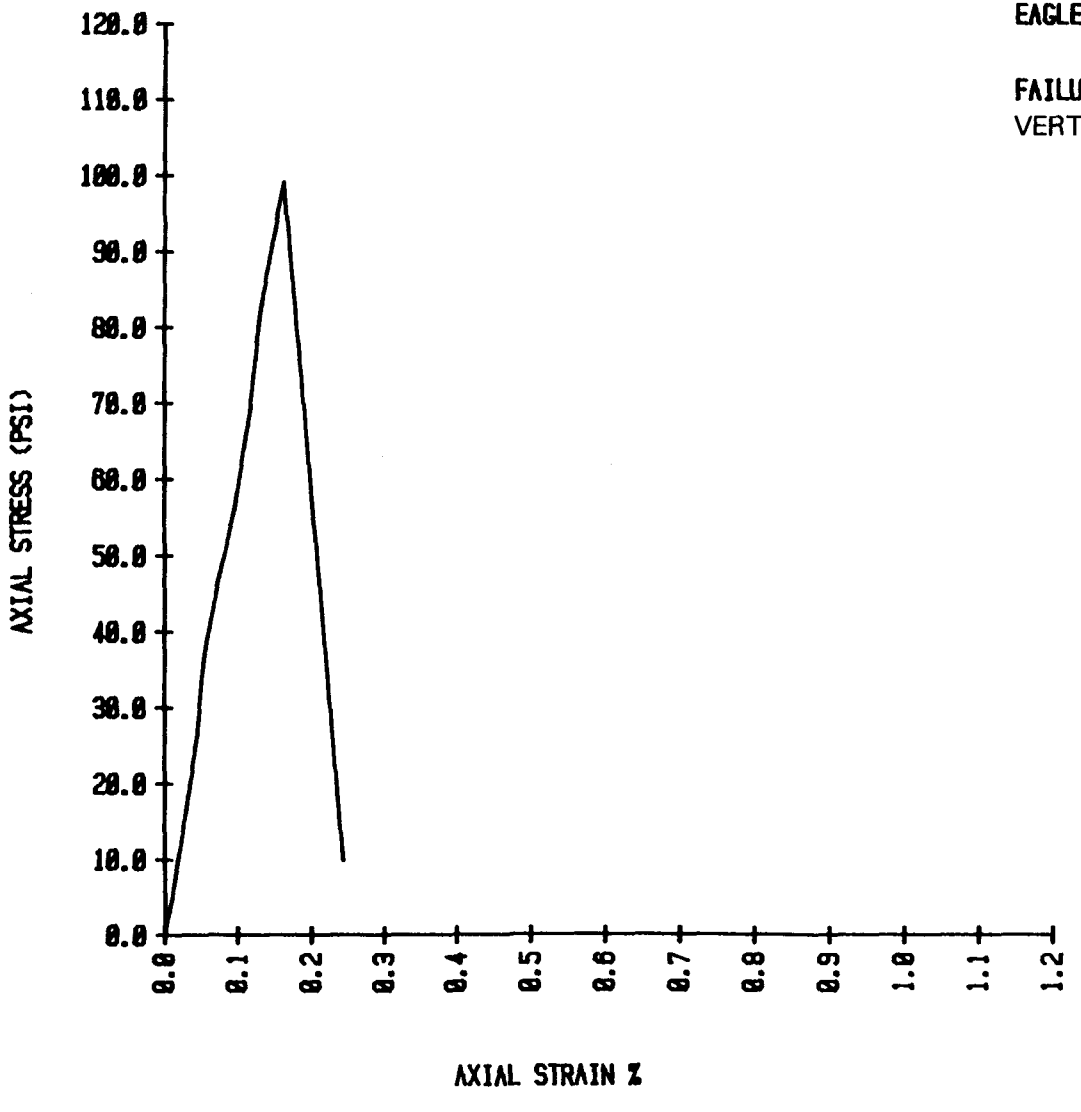
UNCONFINED COMPRESSIVE STRENGTH ASTM D-2938

DATE: 10-2-89 | JOB # 5530.15

BORING #: BIR 42
BORING DEPTH: 251.2 FEET
INCLINATION: APPROX. 45 DEGREES
DRY UNIT WEIGHT (PCF) = 114.7
MOISTURE CONTENT % = 17.3
EAGLE FORD SHALE

FAILURE MODE : BEDDING PLANE SHEAR AT 45 DEG.
VERTICAL DEPTH: 181.5 FEET



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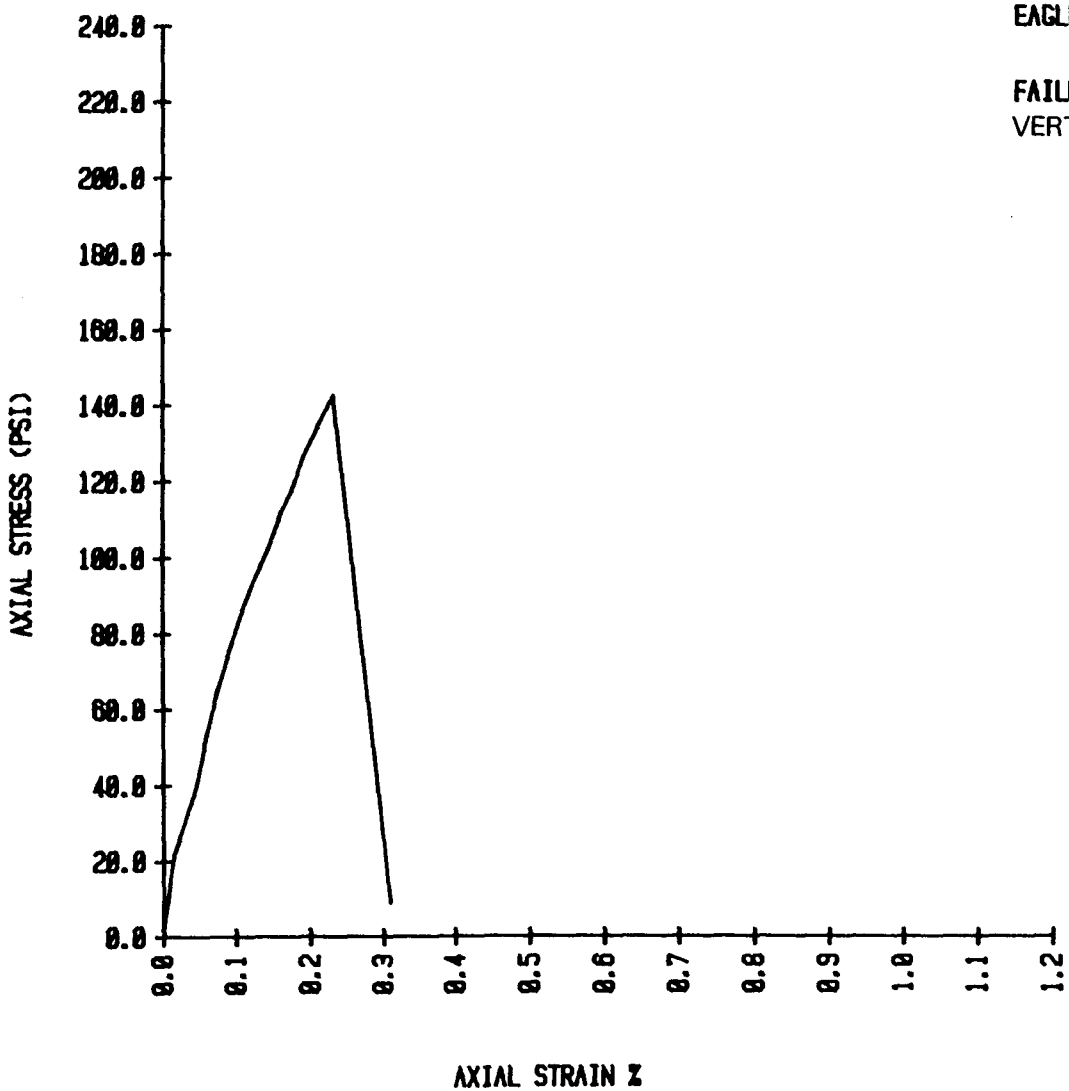
TEXAS SSC SITE

UNCONFINED COMPRESSIVE STRENGTH ASTM D-2938

DATE: 10-2-89 | JOB # 5530.15

BORING #: BIR 42
BORING DEPTH: 263.5 FEET
INCLINATION: APPROX. 45 DEGREES
DRY UNIT WEIGHT (PCF) = 117.8
MOISTURE CONTENT % = 14.7
EAGLE FORD SHALE

FAILURE MODE : BEDDING PLANE SHEAR AT 45 DEG.
VERTICAL DEPTH: 190.3 FEET



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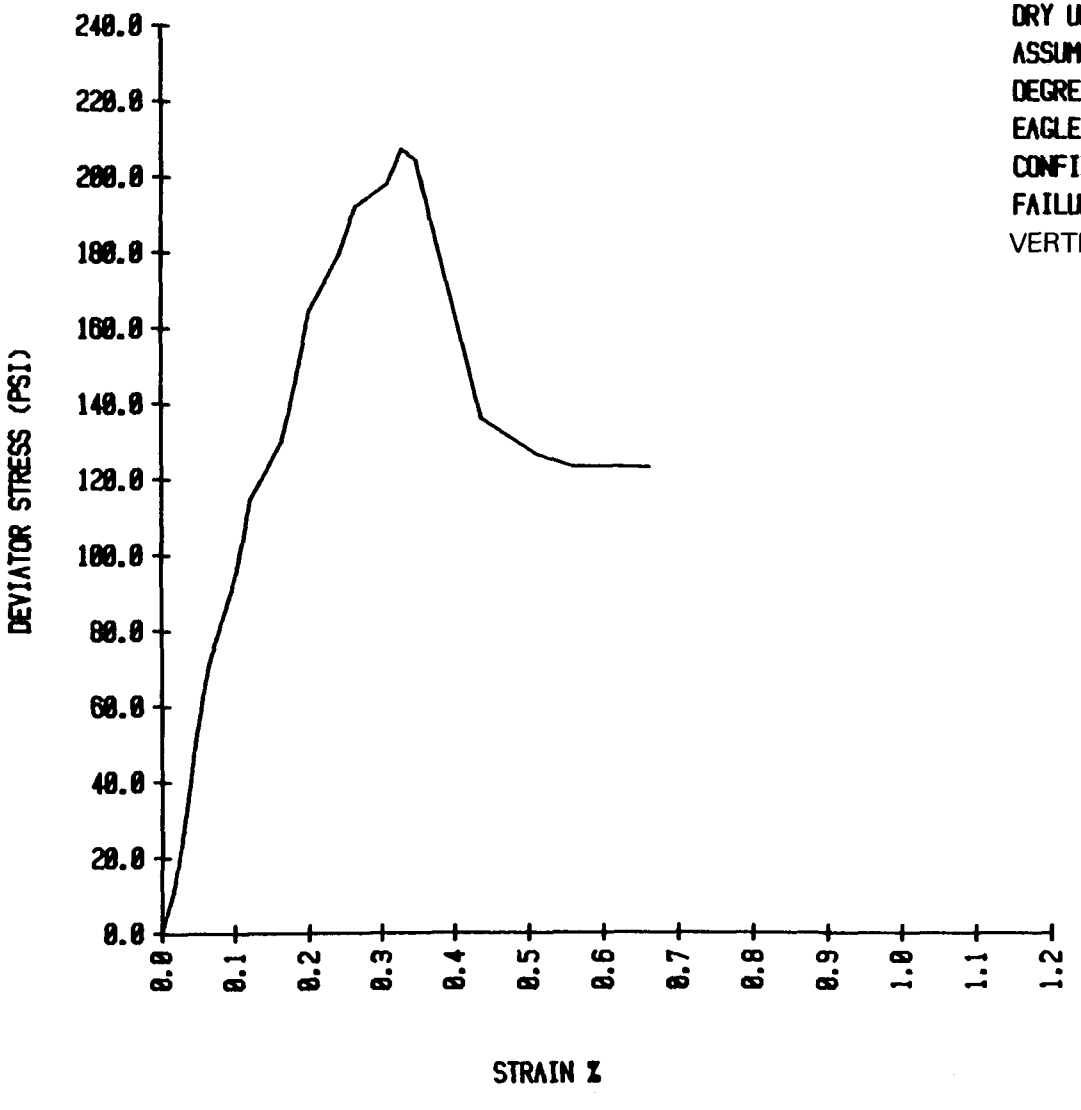
TEXAS SSC SITE

UNCONFINED COMPRESSIVE STRENGTH ASTM D-2938

DATE: 10-2-89 | JOB # 5530.15



BORING #: BIR 42
BORING DEPTH: 264.0 FEET
INCLINATION: APPROX. 45 DEGREES
MC TRIMMINGS, (%) = 14.4
MC AS TESTED (%) = 16.0
DRY UNIT WEIGHT (PCF) = 112.7
ASSUMED SPECIFIC GRAVITY, G_s = 2.7
DEGREE OF SATURATION, (%) = 87.2
EAGLE FORD SHALE
CONFINING PRESSURE PSI = 200
FAILURE MODE : BEDDING PLANE SHEAR AT 45 DEG.
VERTICAL DEPTH: 190.6 FEET

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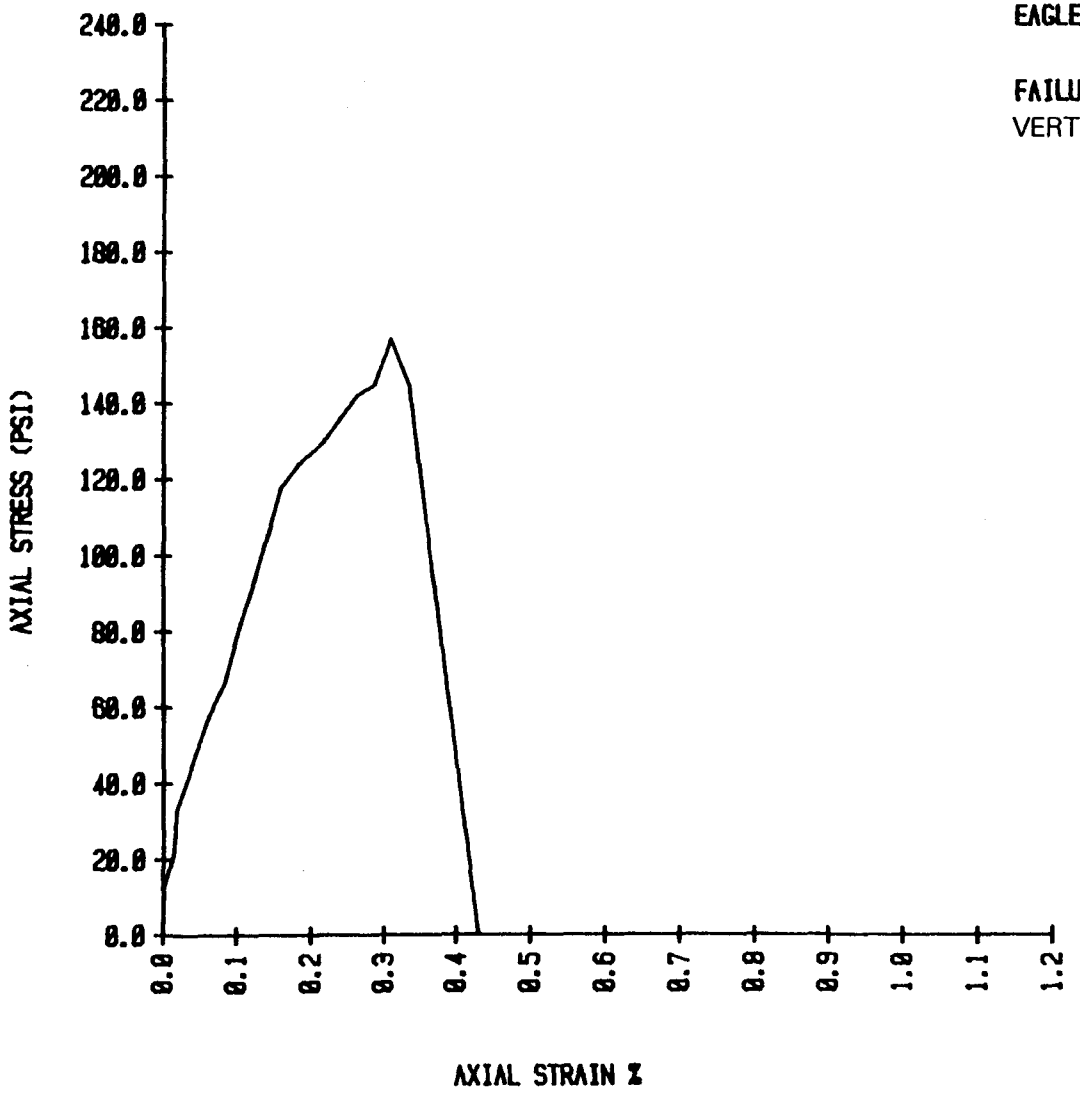
TEXAS SSC SITE
TRIAXIAL COMPRESSION ASTM D-2664

DATE: 9-28-89 | JOB # 5530.15

BORING #: BIR 42
BORING DEPTH: 274.4 FEET
INCLINATION: APPROX. 45 DEGREES
DRY UNIT WEIGHT (PCF) = 122.0
MOISTURE CONTENT % = 14.1
EAGLE FORD SHALE

FAILURE MODE : BEDDING PLANE SHEAR AT 45 DEG.
VERTICAL DEPTH: 198.2 FEET



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TEXAS SSC SITE

UNCONFINED COMPRESSIVE STRENGTH ASTM D-2938

DATE: 10-4-89 | JOB # 5530.15

GEOMECHANICAL TEST RESULTS

BORING BIR 43

TABLE E-4. GEOMECHANICAL TEST RESULTS-BORING BIR 43

GENERAL LITHOLOGY	BORING DEPTH feet	MOISTURE CONTENT percent	DRY DENSITY pcf	SPECIFIC GRAVITY	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	FRACTION FINER THAN # 200 SIEVE percent	CARBONATE CONTENT percent	SAMPLE DIMENSION RATIO L/D	SAMPLE FAILURE MODE/ DEGREES *	UNCONFINED COMPRESSIVE STRENGTH psi	TRIAXIAL COMPRESSION CONFINING PRESSURE σ_3 psi	TRIAXIAL COMPRESSION DEVIATOR STRESS $\sigma_1-\sigma_3$ psi	FAILURE STRAIN percent	TANGENT YOUNG'S MODULUS E50 (psi)x10E5	TANGENT YOUNG'S MODULUS UNLOAD/ RELOAD (psi)x10E5	TANGENT YOUNG'S MODULUS σ_3 psi	POISSON'S RATIO	BRAZIL TENSILE STRENGTH psi	2ND CYCLE SLAKE DURABILITY INDEX percent	MODIFIED TABOR ABRASION/ HARDNESS INDEX	SWELL PRESSURE INDEX percent	COMMENTS
CLAY	0.0	20.0			49	30	49.9																
AUSTIN CHALK	2.4	11.7	124.6						1.9	D	2268			0.54	4.17		0						NOTE 1
AUSTIN CHALK	2.4														7.71			0.19					NOTE 2
AUSTIN CHALK	3.1	13.2	121.6																				
AUSTIN CHALK	6.5	14.3	120.4																				
AUSTIN CHALK	6.6	13.9							0.5										232				
AUSTIN CHALK	19.0	12.5																					
AUSTIN CHALK	19.2	12.5	122.7						2.1	B-1/30	1703			1.56	1.22		0						
AUSTIN CHALK	38.6	13.2	119.7																				
AUSTIN CHALK	38.8	14.5							0.5										242				
AUSTIN CHALK	68.6	12.4																					
AUSTIN CHALK	69.0	12.2							0.5										222				
AUSTIN CHALK	69.1	11.1	125.8						2.1	B-1/45	2133			0.62	4.70		0						
AUSTIN CHALK	84.1	12.3	122.6						2.3	D		50	1702	0.90	2.08		50						
AUSTIN CHALK	84.7	13.8	121.4	2.65					2.1	D		100	503	1.71	0.77		100						NOTE 1
AUSTIN CHALK	84.7														0.17			0.73					NOTE 2
AUSTIN CHALK	85.1	11.4	143.5																				
AUSTIN CHALK	112.0	14.9	118.9																				
AUSTIN CHALK	112.4	15.7							0.5										205				
AUSTIN CHALK	112.5	14.0	120.3	2.66					2.2	D	1614			0.39	5.66		0						NOTE 1
AUSTIN CHALK	112.5														8.00			0.23					NOTE 2
AUSTIN CHALK	116.0	12.6	126.2						2.3	D	1286			0.62	2.31		0						
AUSTIN CHALK	116.4	14.2	124.4																				
AUSTIN CHALK	123.2	10.2	129.3						2.3	D	1698			1.08	2.06		0						NOTE 1
AUSTIN CHALK	123.2														2.61								NOTE 2
AUSTIN CHALK	123.6	12.0	122.8																				
AUSTIN CHALK	141.2	16.7	115.4																				
AUSTIN CHALK	165.9	15.1	116.2																				
AUSTIN CHALK	166.2	15.9	117.5	2.68					2.2	D		100	1575	0.73	3.21		100						
AUSTIN CHALK	166.6	14.4	123.0						2.4	B-1/20		200	2081	0.84	4.14	3.85	200						NOTES 1 & 3
AUSTIN CHALK	166.6														7.06	7.66		0.07					NOTES 2 & 3
AUSTIN CHALK	179.0	12.3																					
AUSTIN CHALK	179.2	12.2							0.5										265				
AUSTIN CHALK	179.3	13.3	122.4	2.66					2.2	D	2184			0.37	7.05		0						
EAGLE FORD SHALE	218.0	15.6																					
EAGLE FORD SHALE	218.1	15.2	120.4	2.79	91	56	99.5		2.4	D	357			1.45	0.80		0						
EAGLE FORD SHALE	218.9	15.0																		31.8			
EAGLE FORD SHALE	254.9	17.7																					
EAGLE FORD SHALE	255.0	17.3	118.0	2.80	87	53	99.7		2.3	B-4	146			0.73	0.31		0						
EAGLE FORD SHALE	274.7	15.9	117.1	2.70	60	36	99.8	7.8	2.1	D		200	338	1.97	0.57		200						
EAGLE FORD SHALE	275.1	16.1	118.3						2.1	B-1/40		300	242	1.17	0.55	0.57	300						NOTES 1 & 3
EAGLE FORD SHALE	275.1														1.00	1.62		0.02					NOTES 2 & 3
EAGLE FORD SHALE	275.5	16.1	116.5																				
EAGLE FORD SHALE	315.0	13.0																					
EAGLE FORD SHALE	315.1	10.3	125.4		49	26	64.7		2.2	D	335			1.53	0.28		0						
PROCEDURE		ASTM-D2216		ASTM-D854	ASTM-D4318		ASTM-D422				ASTM-D2938	ASTM-D2664				ASTM-D3148		ASTM-D3148	ISRM	ISRM	ISRM	ISRM	

BIR43PAT.WK1
REVISION: 1.0
DATE: 5/2/90

PRELIMINARY
(Subject to Revision)

* EXPLANATION OF SAMPLE FAILURE MODE AS FOLLOWS.

Symbol	Failure Type
A	No discernible failure plane
(B)	Well defined shear plane @ "X" angle (deg) to vertical or to long axis of core
B-1	Shear plane
B-2	Bedding plane shear
B-3	Shear plane along pre-existing fracture, shear zone, etc.

Symbol	Failure Type
B-4	Combination
C	Barreling/Bulging
D	Longitudinal (axial) splitting
E	Conical
F	No information

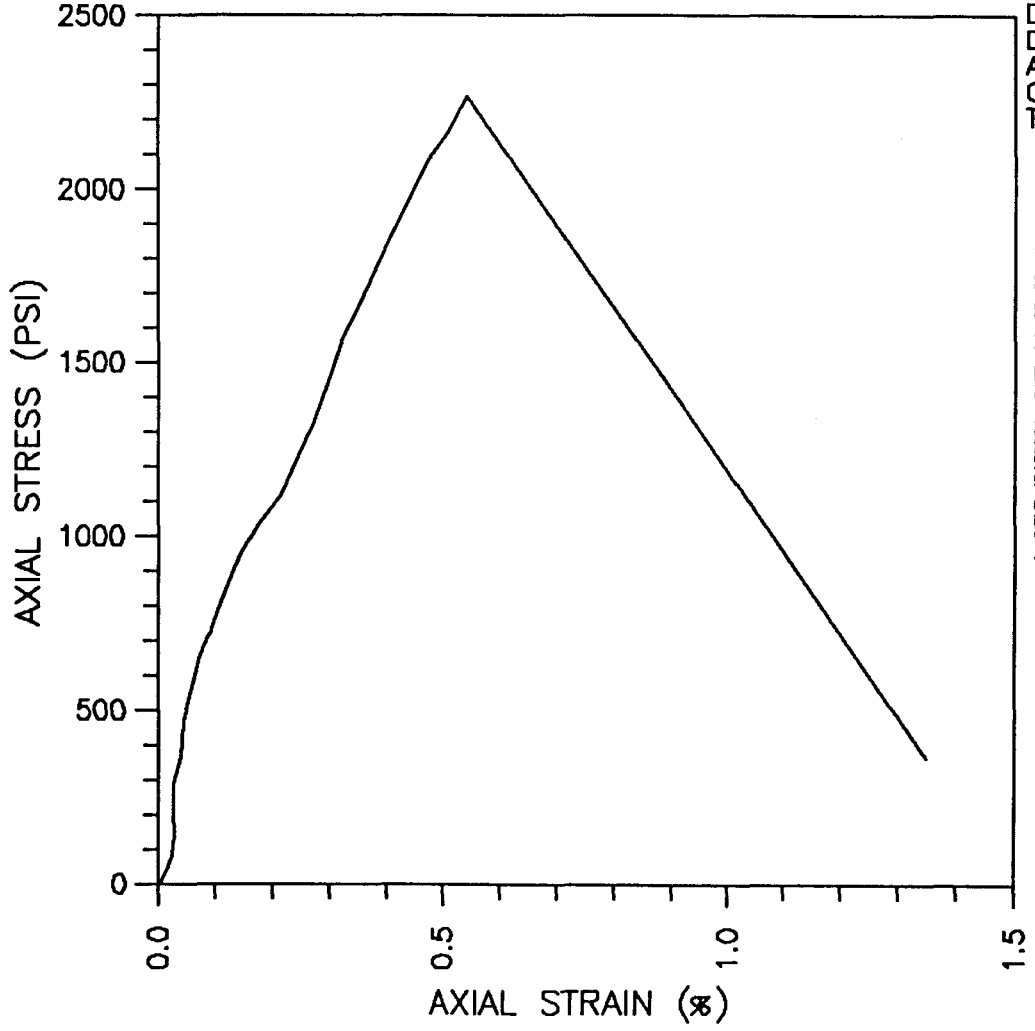
Note: Some values in this table may be revised based on reviews of test procedures and individual test results. The reader should refer to the latest revision of the gINT geotechnical data base (geotechnical report GR-70).

NOTES: 1) MODULUS WAS CALCULATED FROM AXIAL STRAINS MEASURED USING DIAL MICROMETER. AXIAL LENGTH IS THE SAMPLE LENGTH.

2) MODULII AND POISSON'S RATIO WERE CALCULATED FROM AXIAL AND LATERAL STRAINS MEASURED USING AXIAL AND LATERAL LVDTS. AXIAL LENGTH IS 2.8 INCHES.

3) TRIAXIAL TESTS (UU) @ 166.6 FT AND 275.1 FT ARE CYCLIC TESTS WITH ONE UNLOAD-RELOAD CYCLE

BORING NO.: BIR43
DEPTH (FT): 2.4
AUSTIN CHALK LIMESTONE



INCLINATION (DEG) VERTICAL
MOISTURE CONTENT (%): 11.7
DRY UNIT WEIGHT (PCF): 124.6
DEG. OF SATURATION (%): 90.0
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE: UNCONFINED COMPRESSION
(ASTM D 2938)

FILE: IR430024 DATE: 04-23-90 CAL: MCU3

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
4.167 x10E5 PSI

FAILURE MODE:
AXIAL SPLITTING

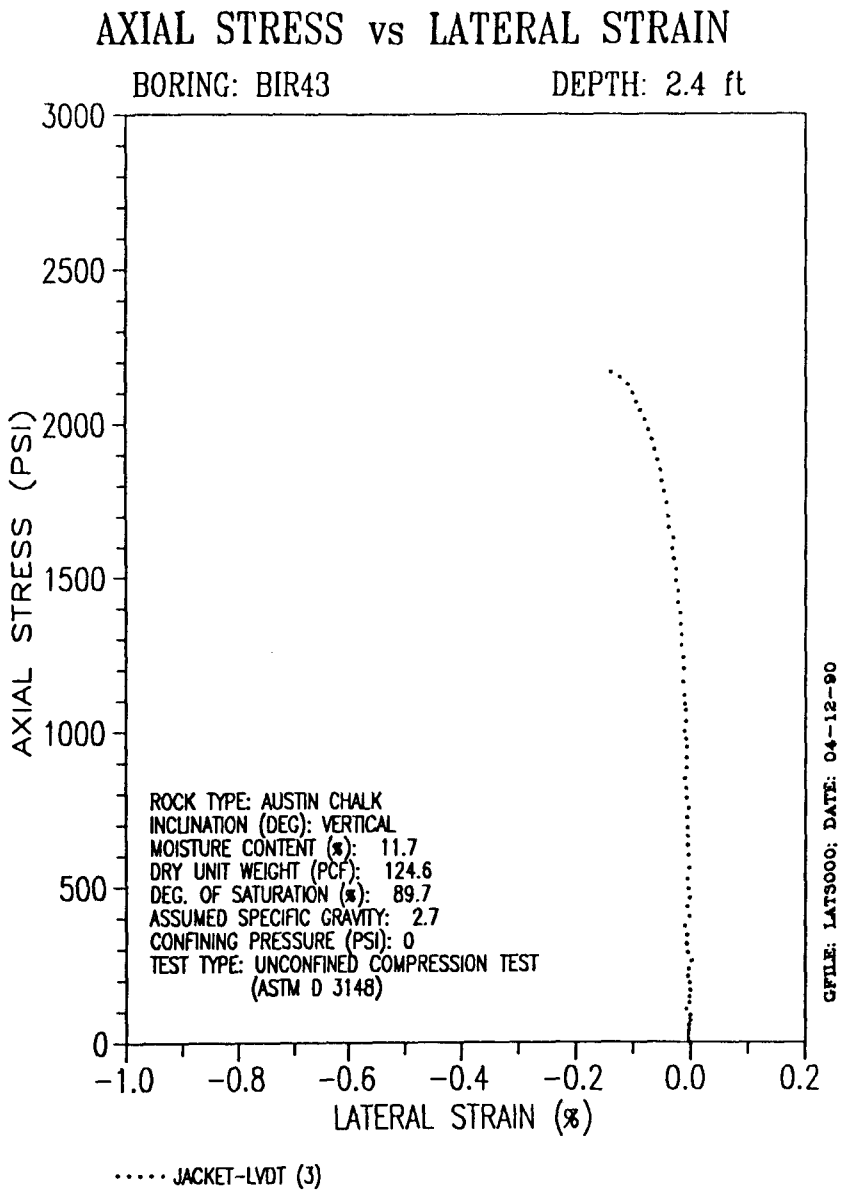
TEXAS SSC SITE

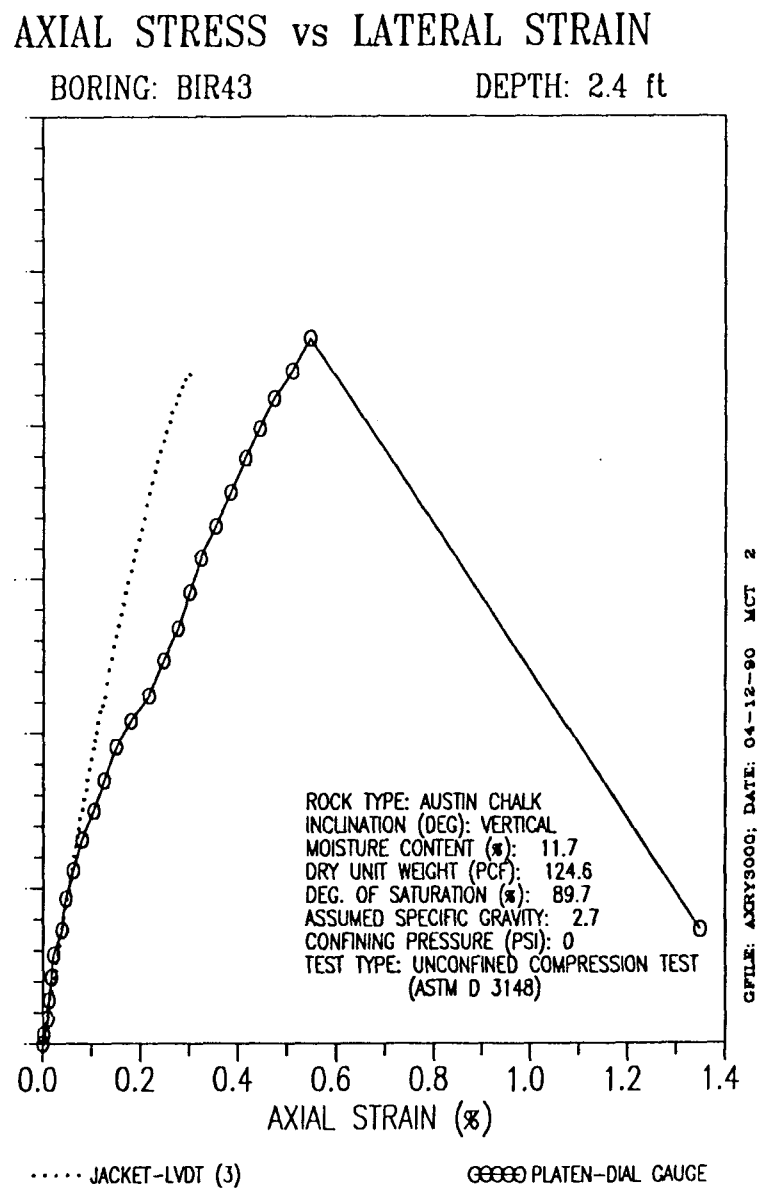
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

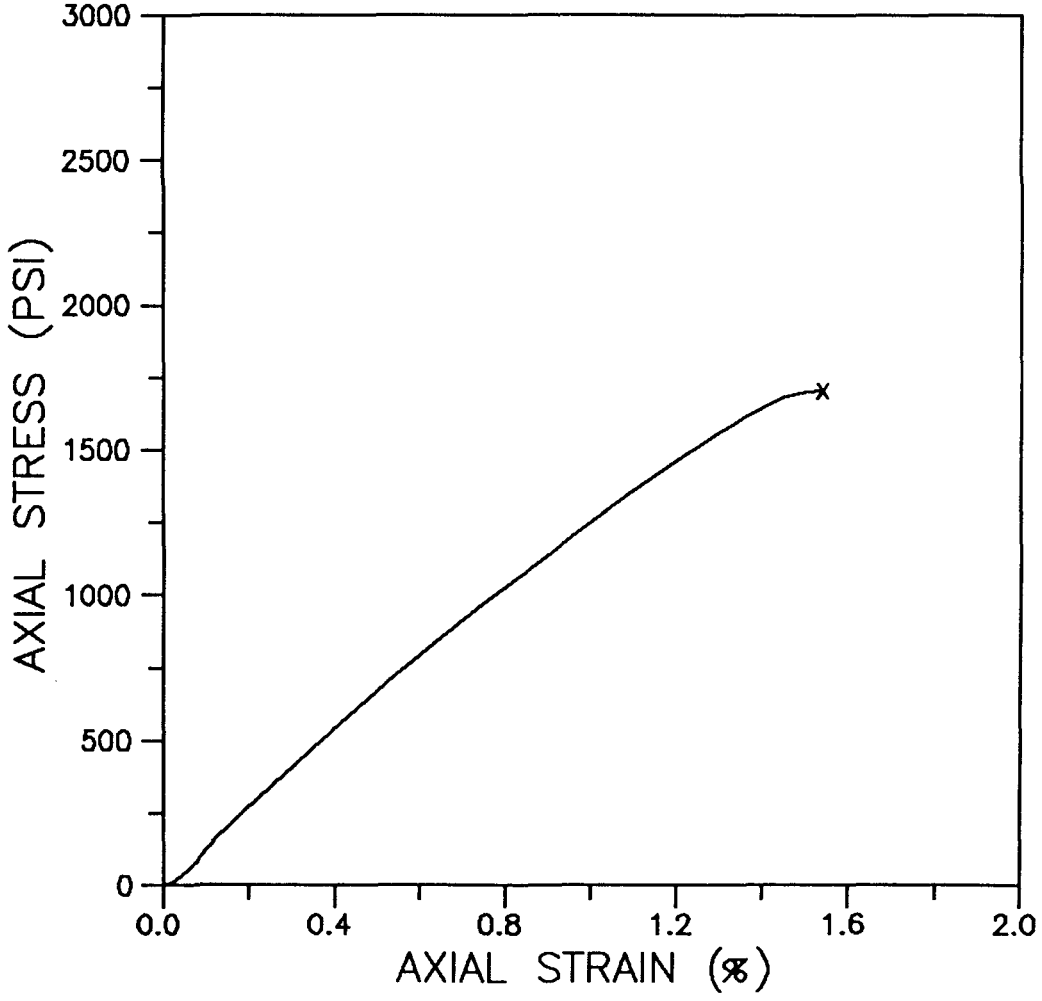
FIGURE





PRELIMINARY

BORING NO: BIR43
DEPTH (FT): 19.2
AUSTIN CHALK



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 12.5
DRY UNIT WEIGHT (PCF): 122.7
DEG. OF SATURATION (%): 90.5
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
1.220 x 10E5 PSI

FAILURE MODE:
SHEAR PLANE AT 30 DEG

TEXAS SSC SITE

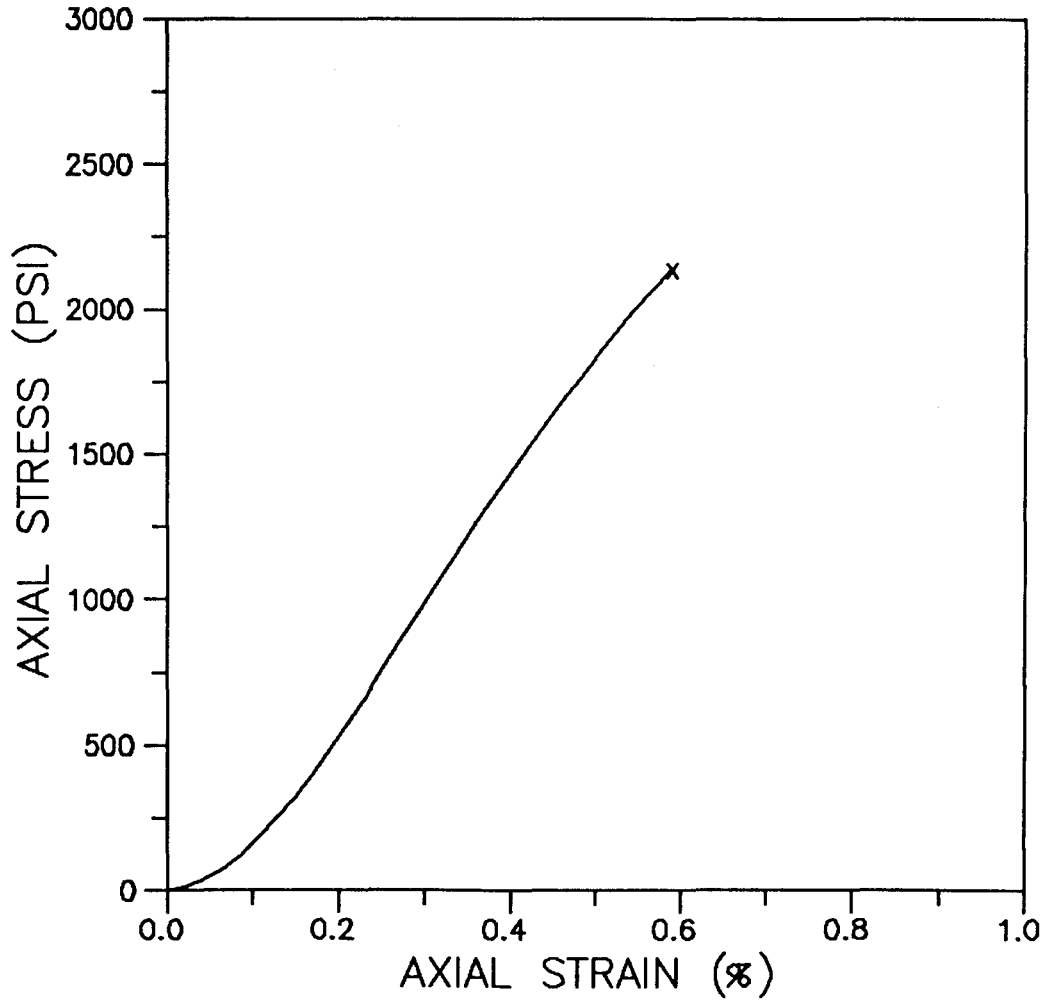
STRESS-STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89-192

FIGURE

BORING NO: BIR43
DEPTH (FT): 69.1
AUSTIN CHALK



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 11.1
DRY UNIT WEIGHT (PCF): 125.8
DEG. OF SATURATION (%): 88.3
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
4.695 x 10E5 PSI

FAILURE MODE:
SHEAR PLANE AT 45 DEG

TEXAS SSC SITE

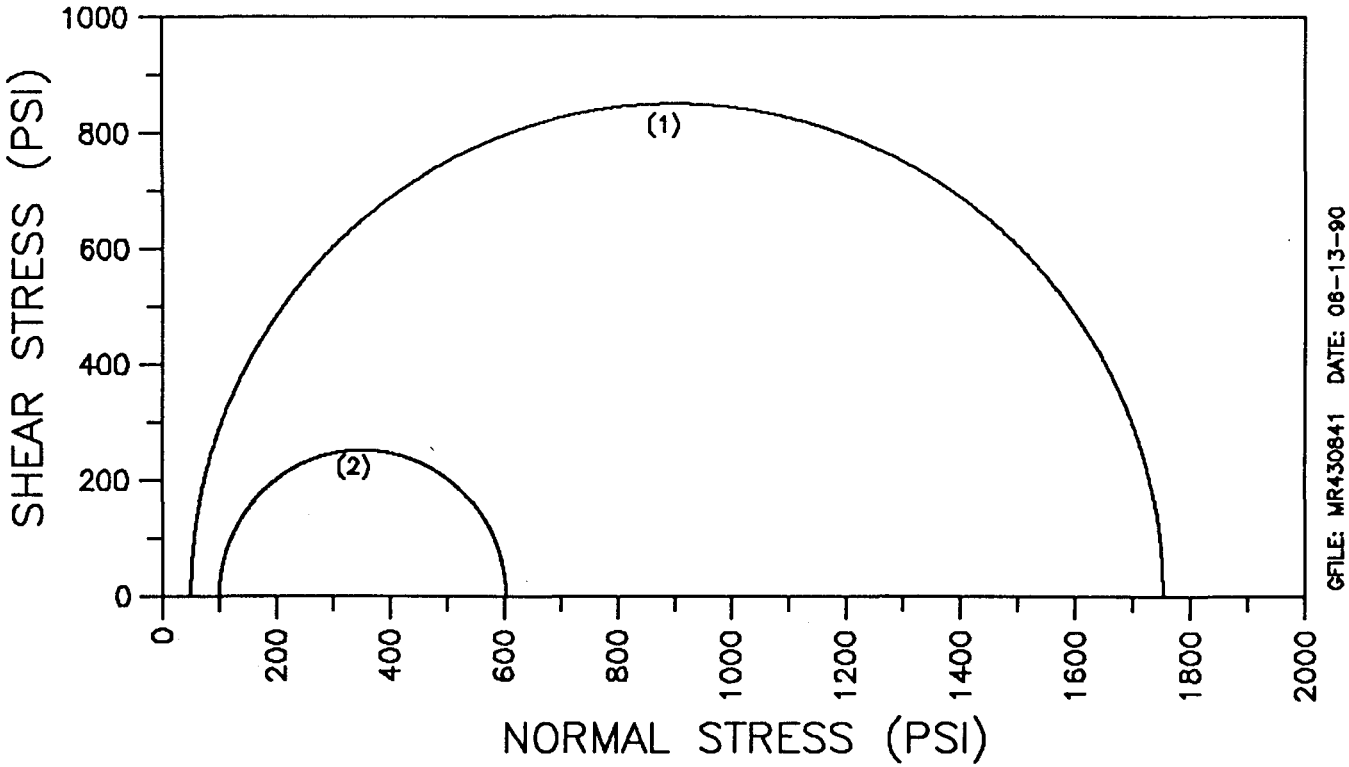
STRESS-STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89-192

FIGURE

BORING NO.: BIR43
DEPTH RANGE (FT): 84.1–85.1
AUSTIN CHALK LIMESTONE



GFILE: MR430841 DATE: 06-13-90

SEE STRESS–STRAIN PLOTS
FOR INDIVIDUAL SAMPLE DATA

(1) DEPTH (FT): 84.1
(2) DEPTH (FT): 84.7

INCLINATION (DEG): VERTICAL
TEST TYPE: TRIAXIAL COMPRESSION (ASTM D2664)

TEXAS SSC SITE

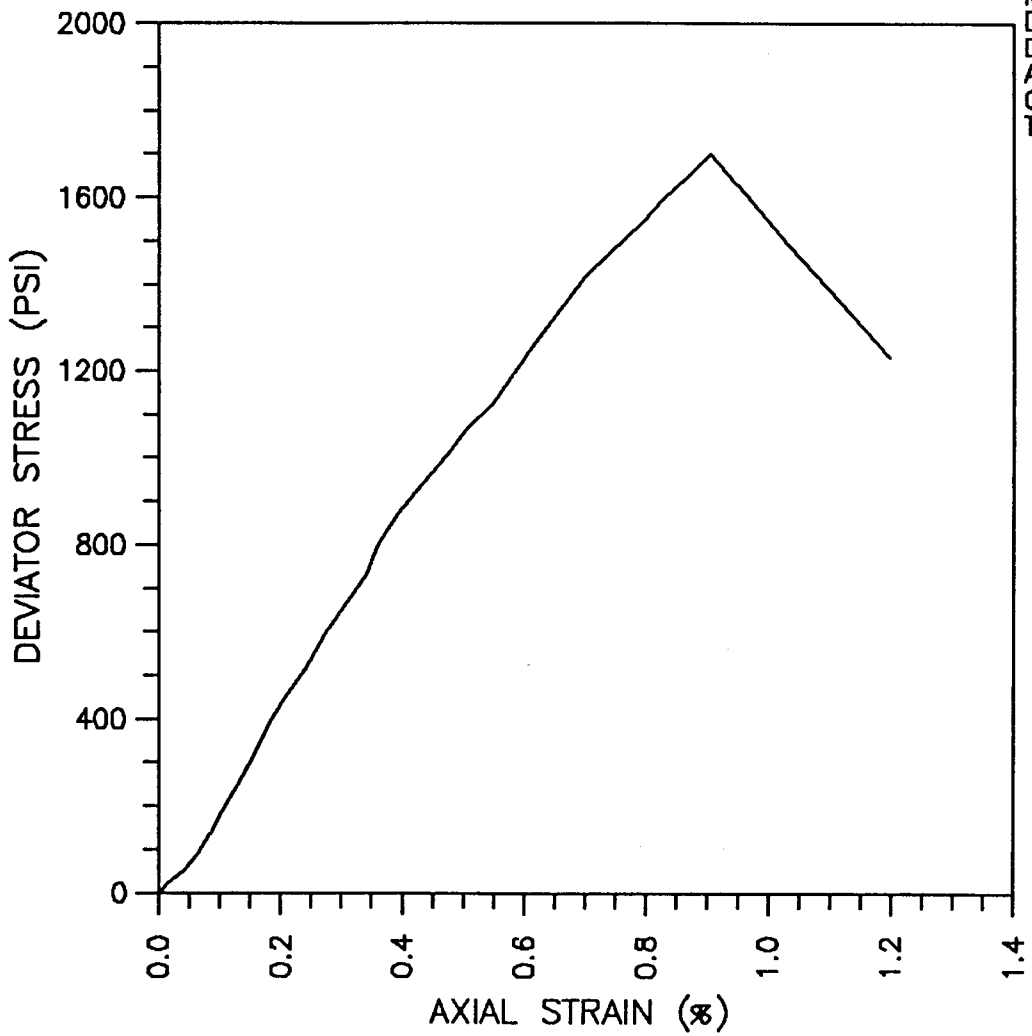
MOHR CIRCLE PLOT

MASON–JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS–ENGINEERS

JOB NO.: 5530.15

FIGURE

BORING NO.: BIR43
DEPTH (FT): 84.1
AUSTIN CHALK LIMESTONE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 12.3
DRY UNIT WEIGHT (PCF): 122.6
DEG. OF SATURATION (%): 88.8
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 50
TEST TYPE: TRIAXIAL COMPRESSION
(ASTM D 2664)

DFILE: BIR43D41 DATE: 04-20-90 CAL: MCT4

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
2.083 x10E5 PSI

FAILURE MODE:
AXIAL SPLITTING

TEXAS SSC SITE

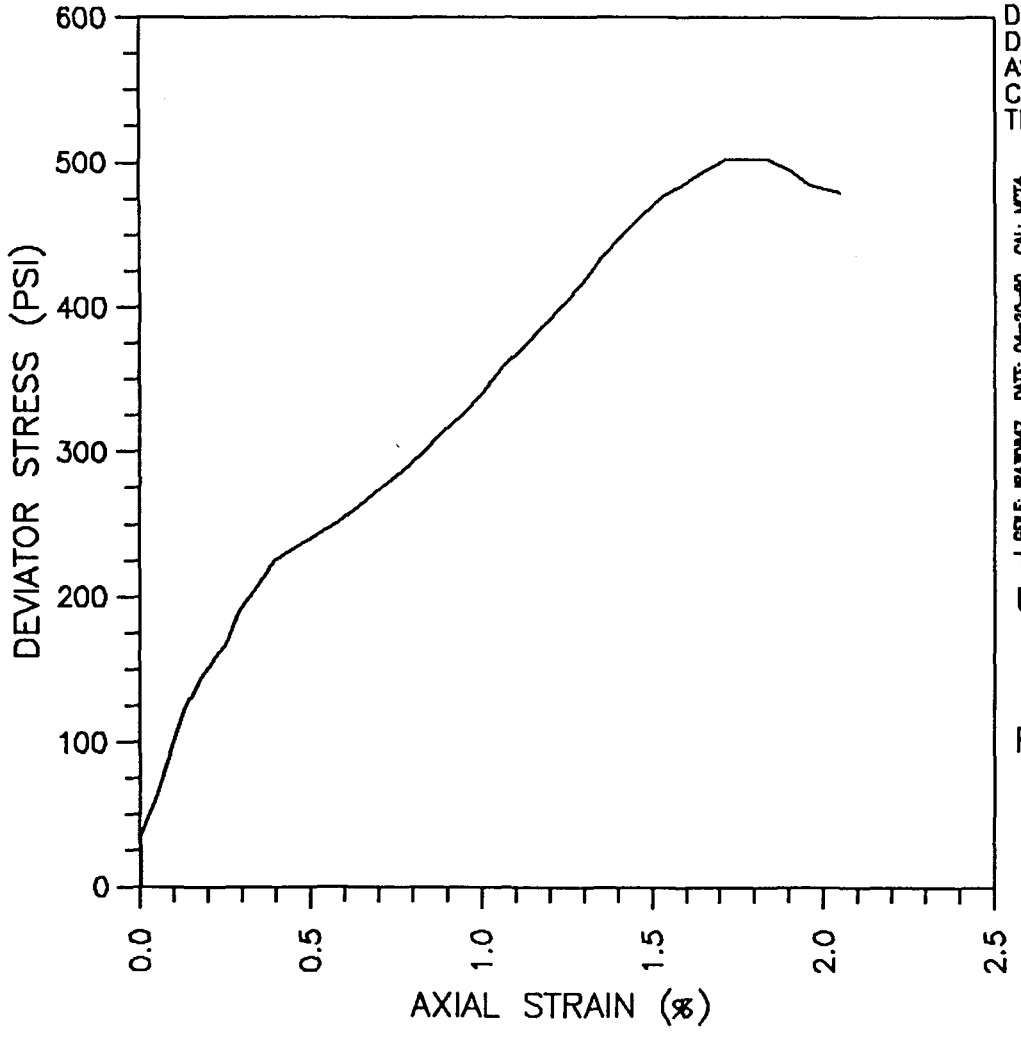
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES,INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

FIGURE

BORING NO.: BIR43
DEPTH (FT): 84.7
AUSTIN CHALK LIMESTONE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 13.8
DRY UNIT WEIGHT (PCF): 121.4
DEG. OF SATURATION (%): 96.3
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 100
TEST TYPE: TRIAXIAL COMPRESSION
(ASTM D 2664)

GFILE: IR43D847 DATE: 04-20-90 CAL: MCT4

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
0.769 x10E5 PSI

FAILURE MODE:
AXIAL SPLITTING

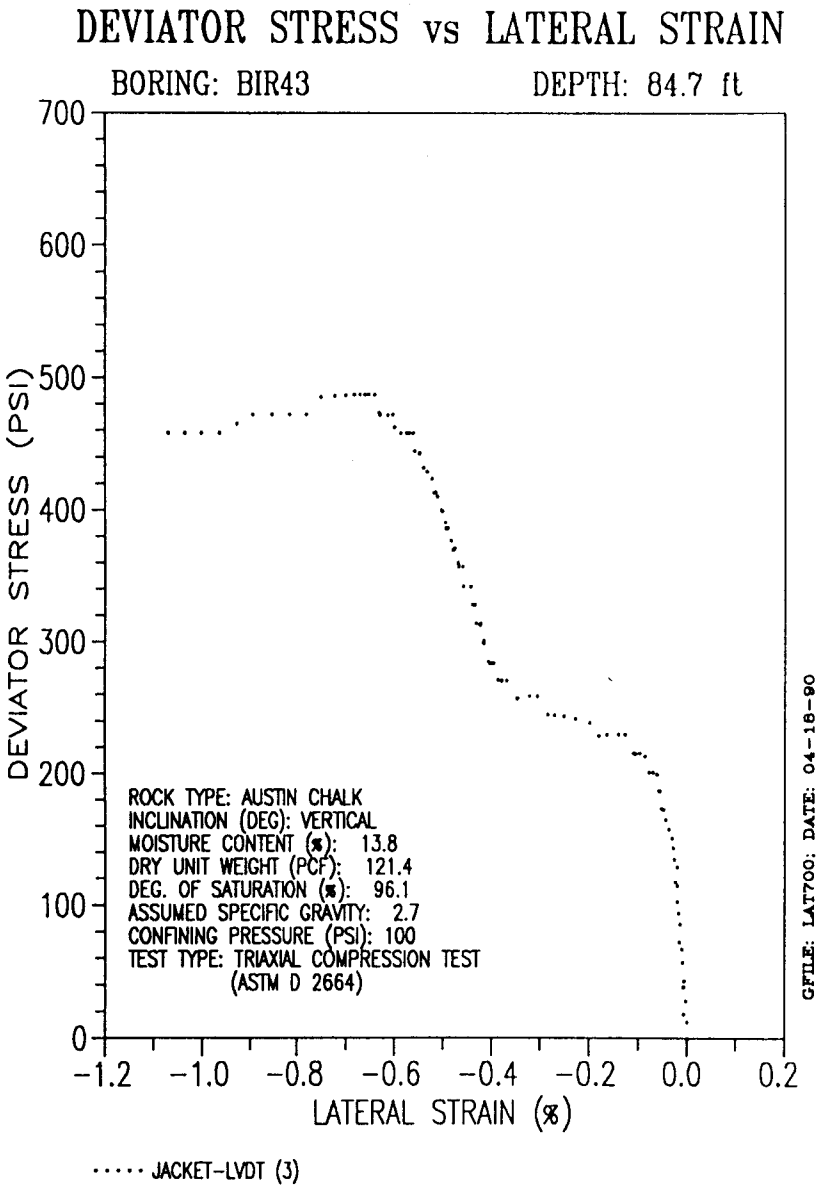
TEXAS SSC SITE

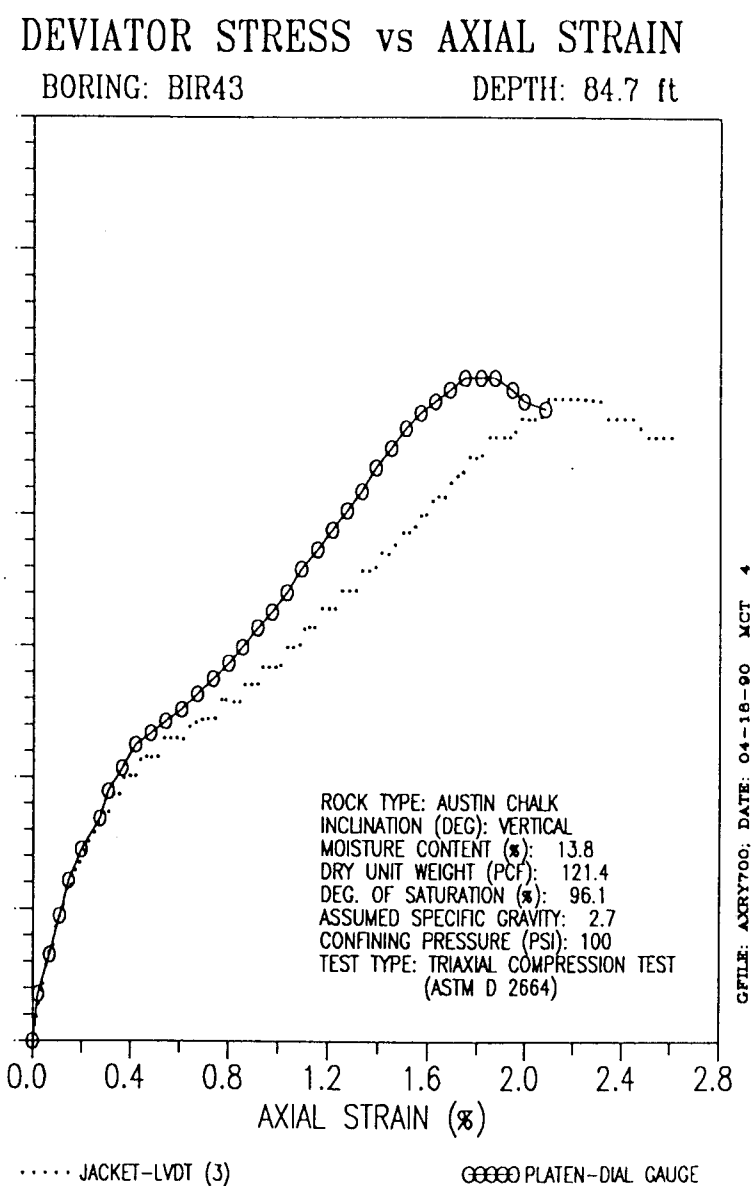
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

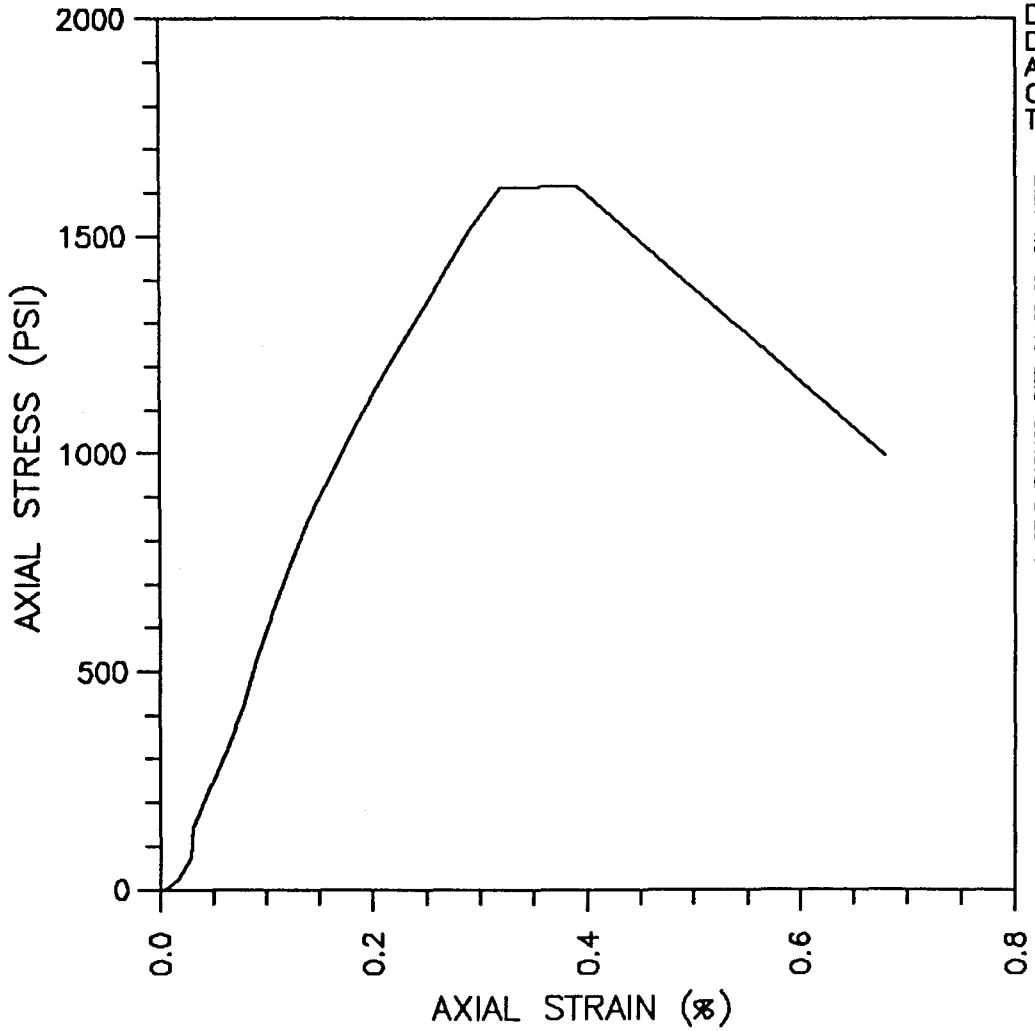
FIGURE





PRELIMINARY

BORING NO.: BIR43
DEPTH (FT): 112.5
AUSTIN CHALK LIMESTONE



INCLINATION (DEG) VERTICAL
MOISTURE CONTENT (%): 14.0
DRY UNIT WEIGHT (PCF): 120.3
DEG. OF SATURATION (%): 94.7
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE: UNCONFINED COMPRESSION
(ASTM D 2938)

GFILE: IR431125 DATE: 04-20-90 CAL: MCU3

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
5.660 x10E5 PSI

FAILURE MODE:
AXIAL SPLITTING

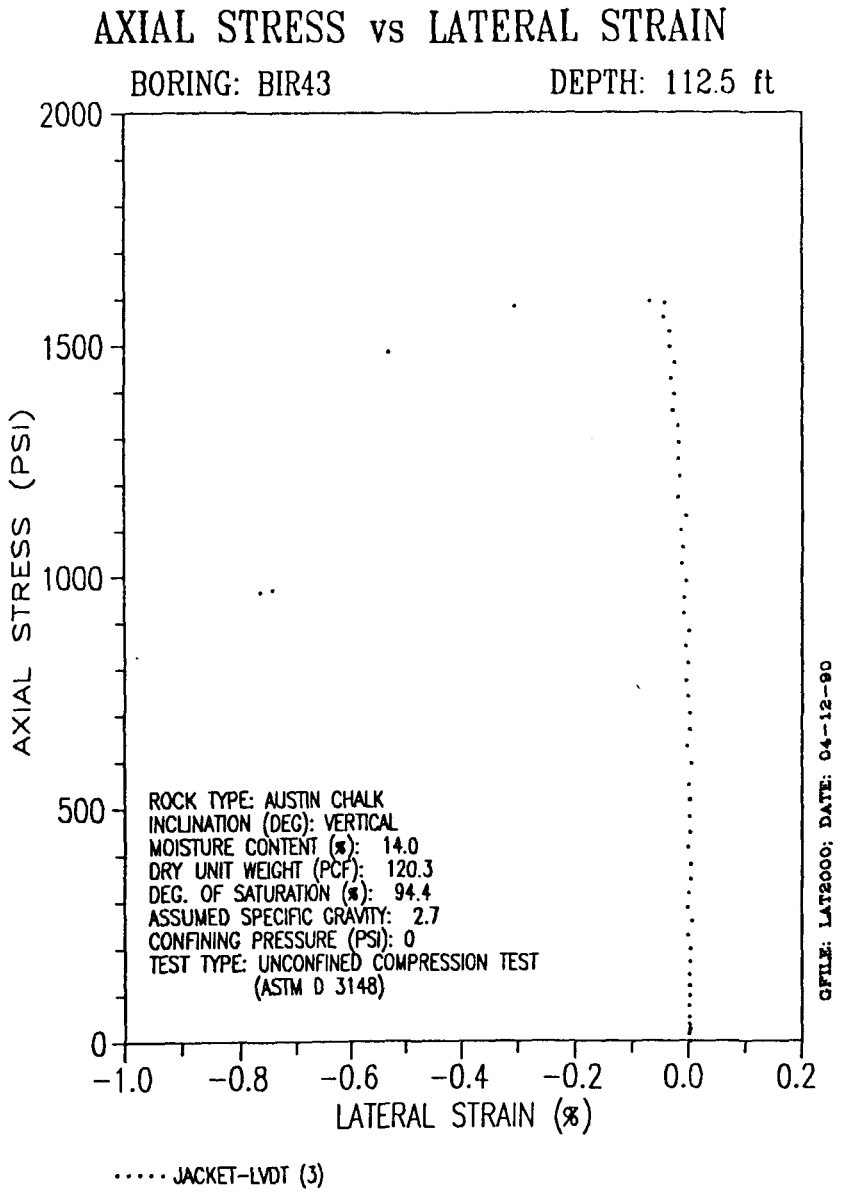
TEXAS SSC SITE

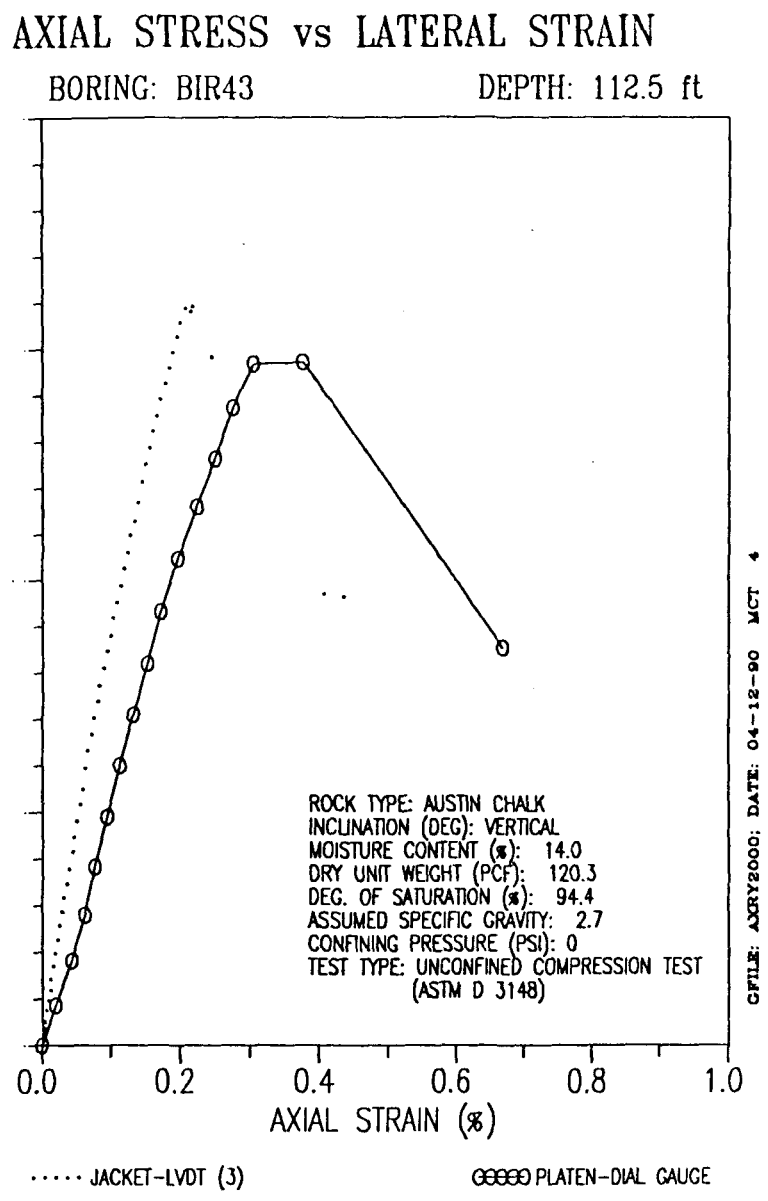
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

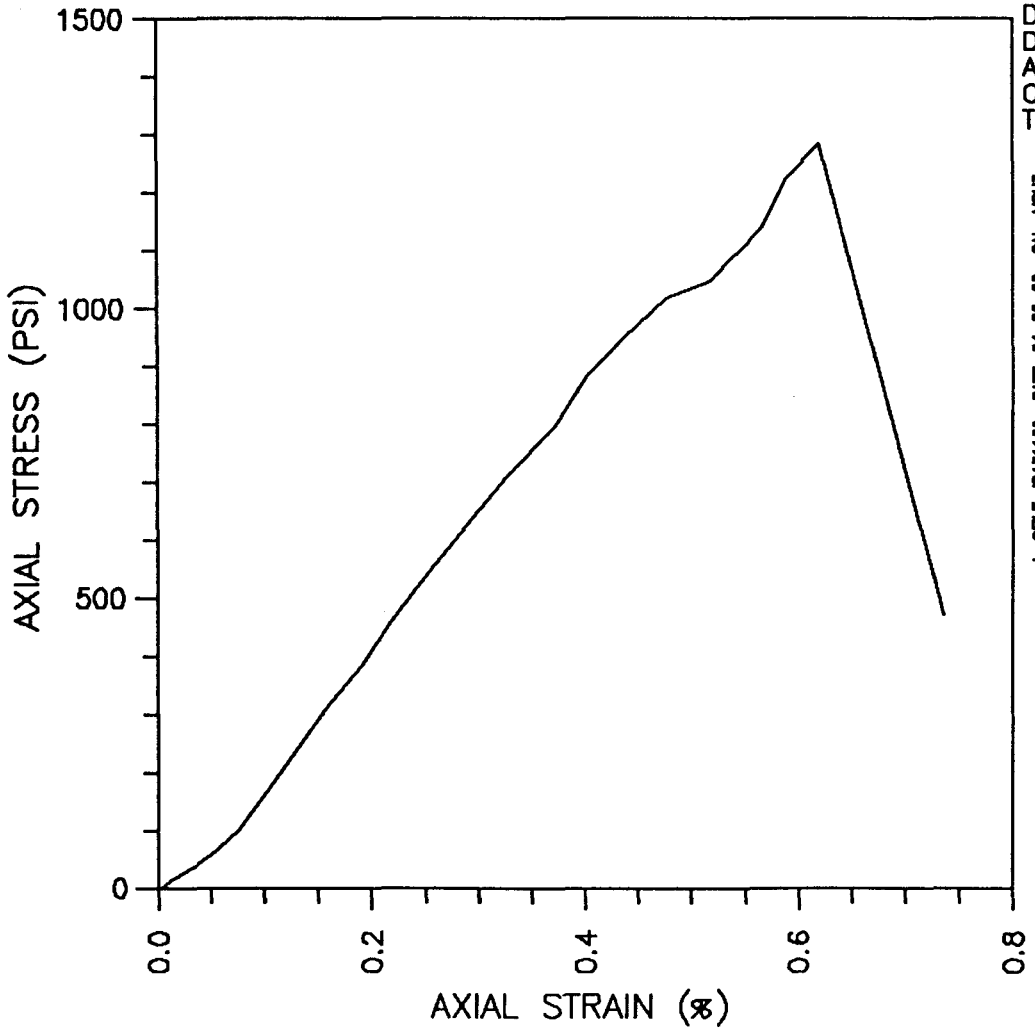
FIGURE





PRELIMINARY

BORING NO.: BIR43
DEPTH (FT): 116.0
AUSTIN CHALK LIMESTONE



INCLINATION (DEG) VERTICAL
MOISTURE CONTENT (%): 12.6
DRY UNIT WEIGHT (PCF): 126.2
DEG. OF SATURATION (%): 101.7
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE: UNCONFINED COMPRESSION
(ASTM D 2938)

FILE: BR43118D DATE: 04-20-90 CAL: MCU3

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
2.308 x10E5 PSI

FAILURE MODE:
AXIAL SPLITTING

TEXAS SSC SITE

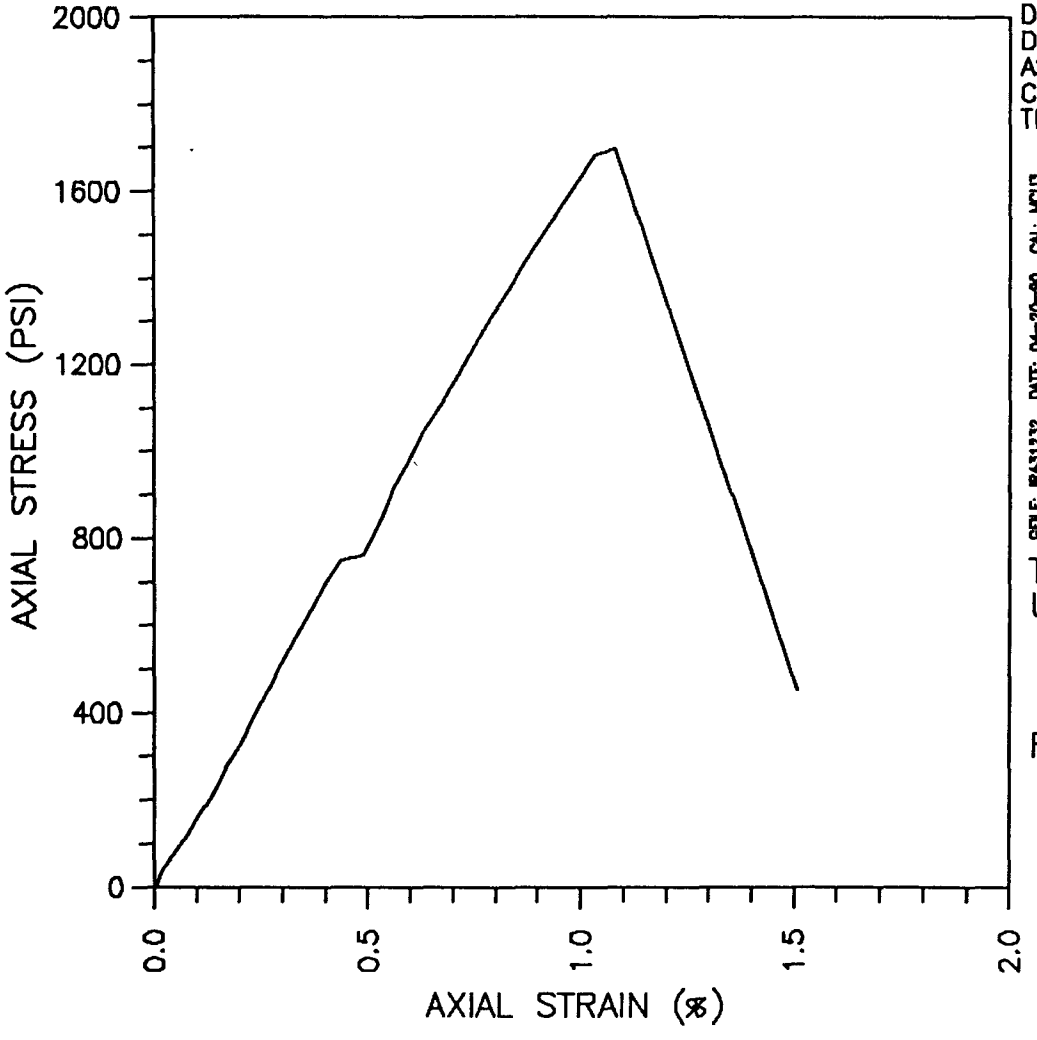
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES,INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

FIGURE

BORING NO.: BIR43
DEPTH (FT): 123.2
AUSTIN CHALK LIMESTONE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 10.2
DRY UNIT WEIGHT (PCF): 129.3
DEG. OF SATURATION (%): 90.6
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE: UNCONFINED COMPRESSION
(ASTM D 2938)

GFILE: IR431232 DATE: 04-20-90 CAL: MCL13

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
2.055 x10E5 PSI

FAILURE MODE:
AXIAL SPLITTING

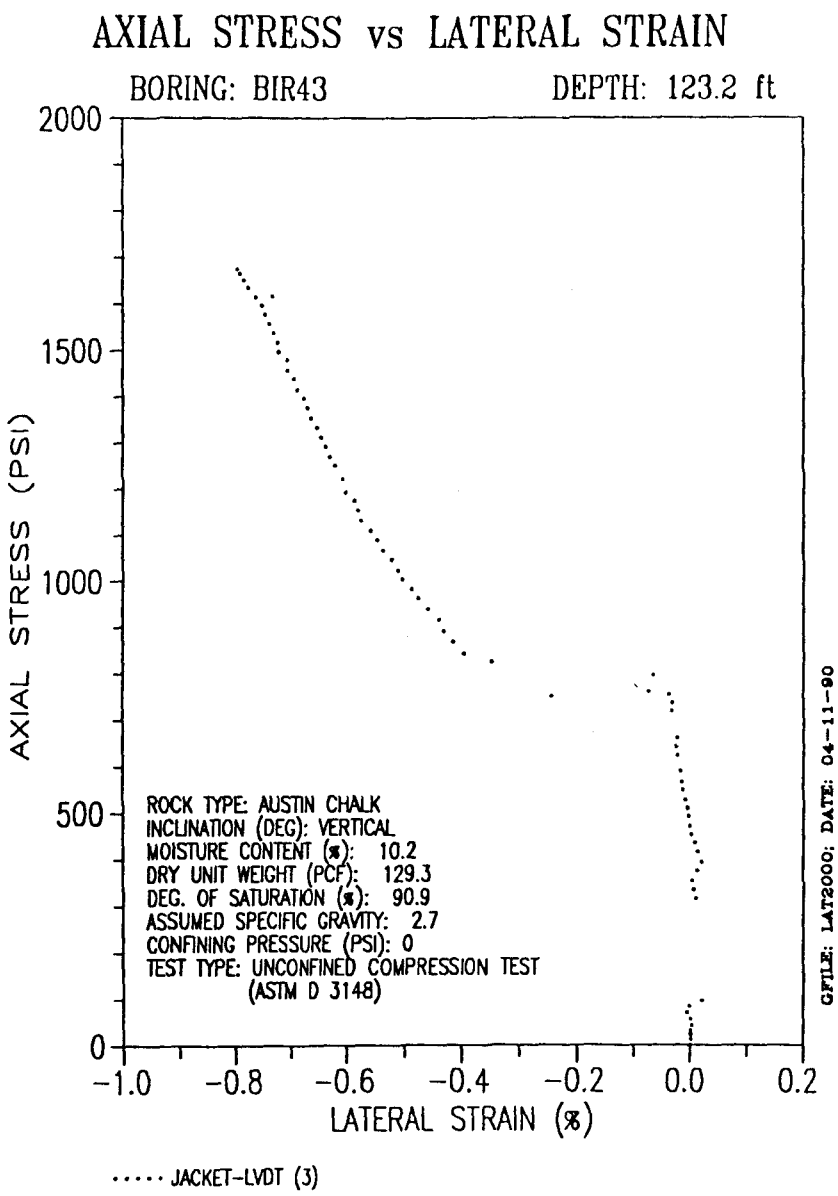
TEXAS SSC SITE

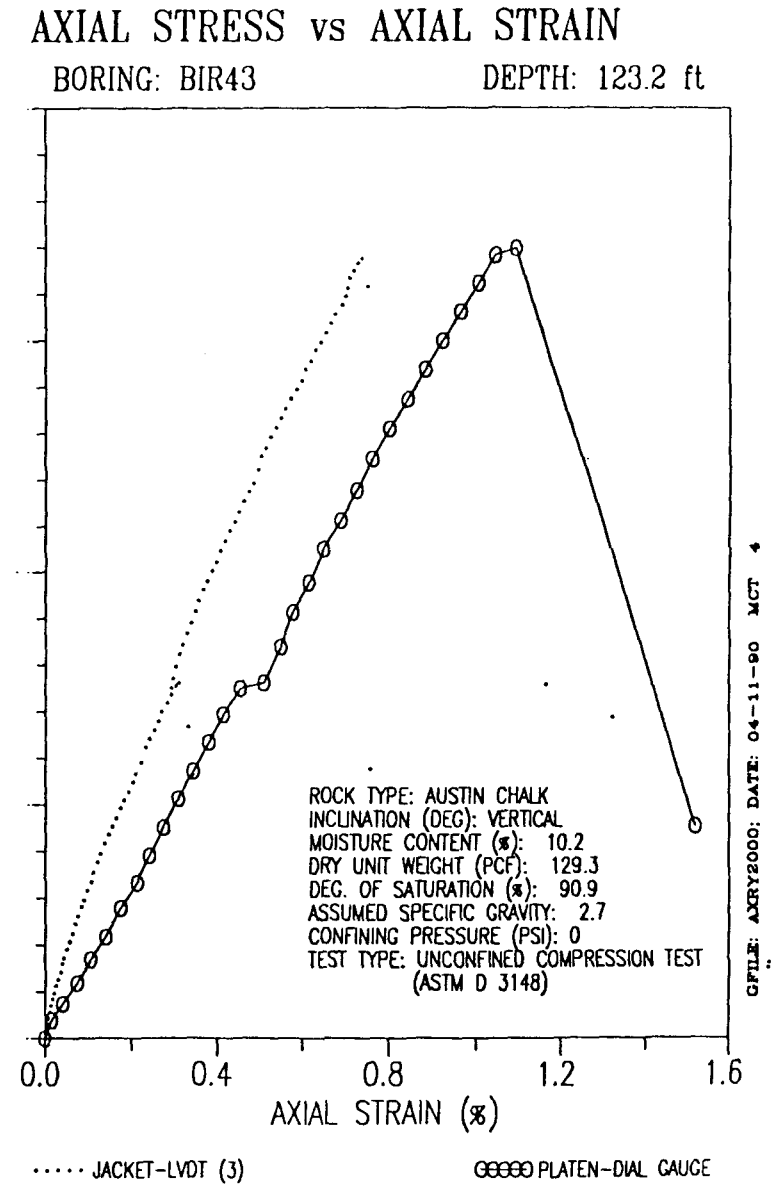
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

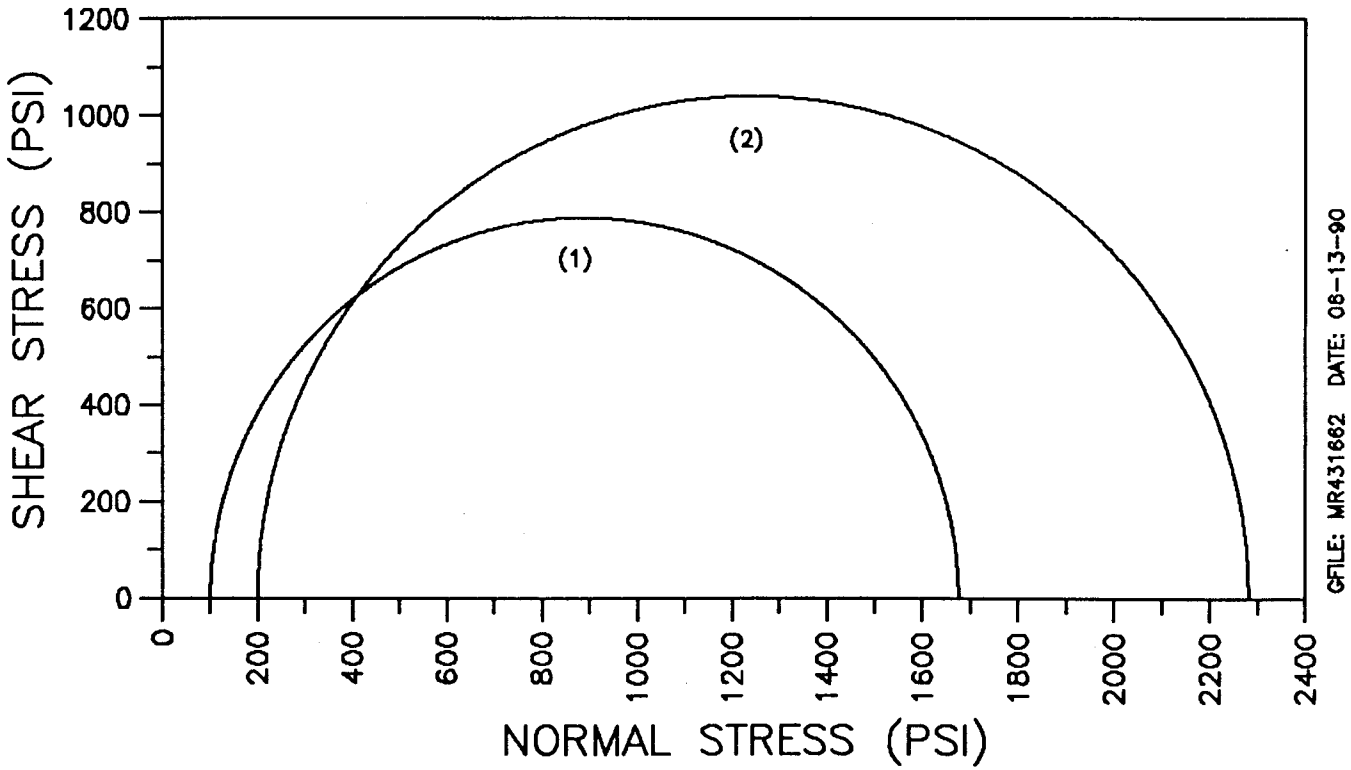
FIGURE





PRELIMINARY

BORING NO.: BIR43
DEPTH RANGE (FT): 166.2–167.0
AUSTIN CHALK LIMESTONE



GFILE: MR431662 DATE: 06-13-90

SEE STRESS–STRAIN PLOTS
FOR INDIVIDUAL SAMPLE DATA

(1) DEPTH (FT): 166.2
(2) DEPTH (FT): 166.6

INCLINATION (DEG): VERTICAL
TEST TYPE: TRIAXIAL COMPRESSION (ASTM D2664)

TEXAS SSC SITE

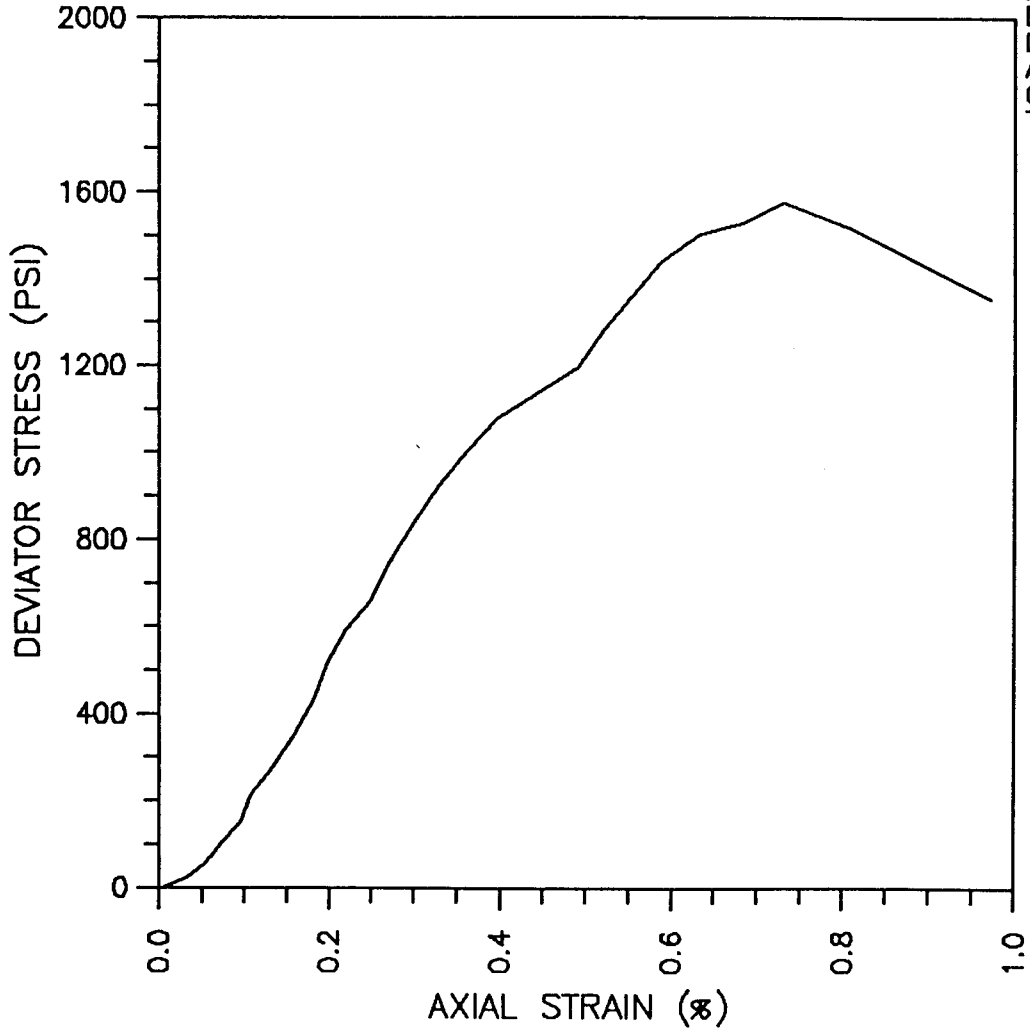
MOHR CIRCLE PLOT

MASON–JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS–ENGINEERS

JOB NO.: 5530.15

FIGURE

BORING NO.: BIR43
DEPTH (FT): 166.2
AUSTIN CHALK LIMESTONE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 15.9
DRY UNIT WEIGHT (PCF): 117.5
DEG. OF SATURATION (%): 99.2
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 100
TEST TYPE: TRIAXIAL COMPRESSION
(ASTM D 2664)

FILE: IR431B2 DATE: 04-20-90 CAL: MCT4

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
3.214 x10E5 PSI

FAILURE MODE:
AXIAL SPLITTING

TEXAS SSC SITE

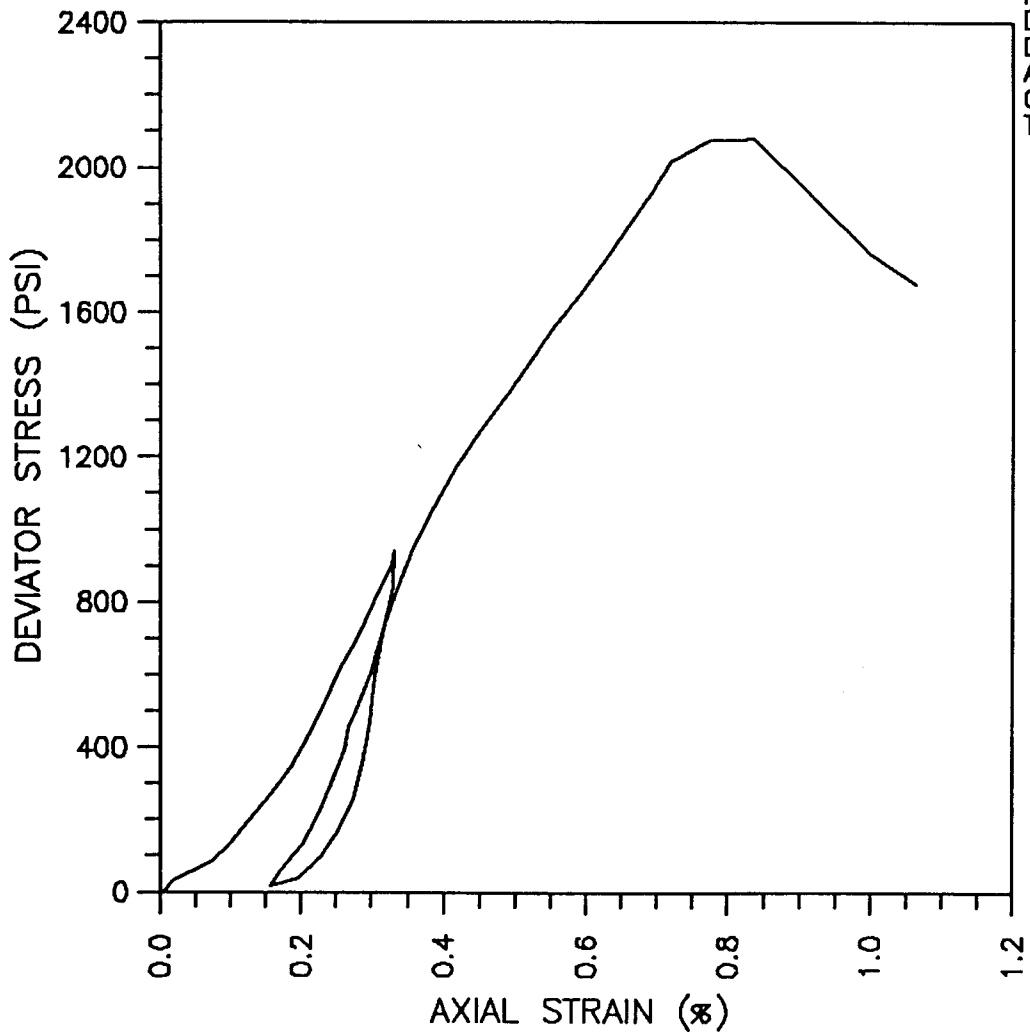
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

FIGURE

BORING NO.: BIR43
DEPTH (FT): 166.6
AUSTIN CHALK LIMESTONE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 14.4
DRY UNIT WEIGHT (PCF): 123.0
DEG. OF SATURATION (%): 105.0
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 200
TEST TYPE: TRIAXIAL COMPRESSION
(ASTM D 2664)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
3.846 x10E5 PSI

FAILURE MODE:
SHEAR PLANE
AT 20 DEG.

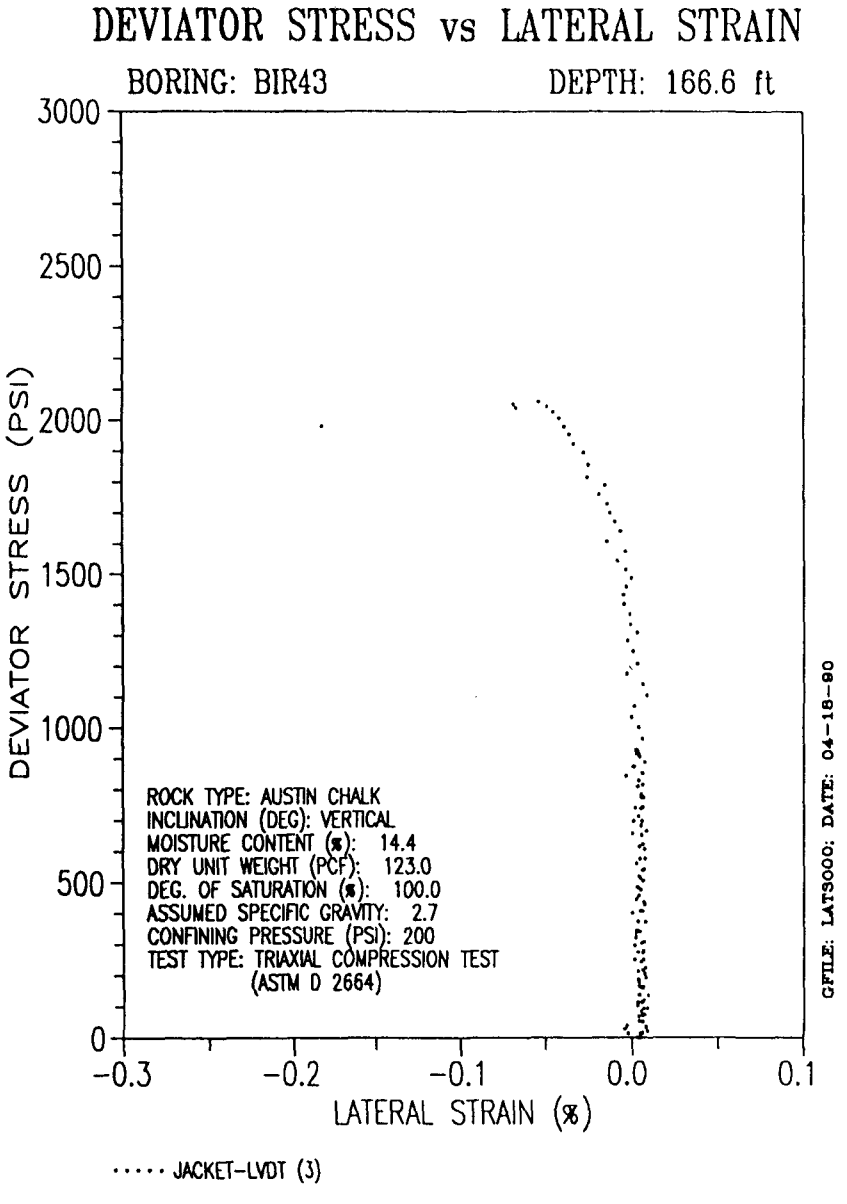
TEXAS SSC SITE

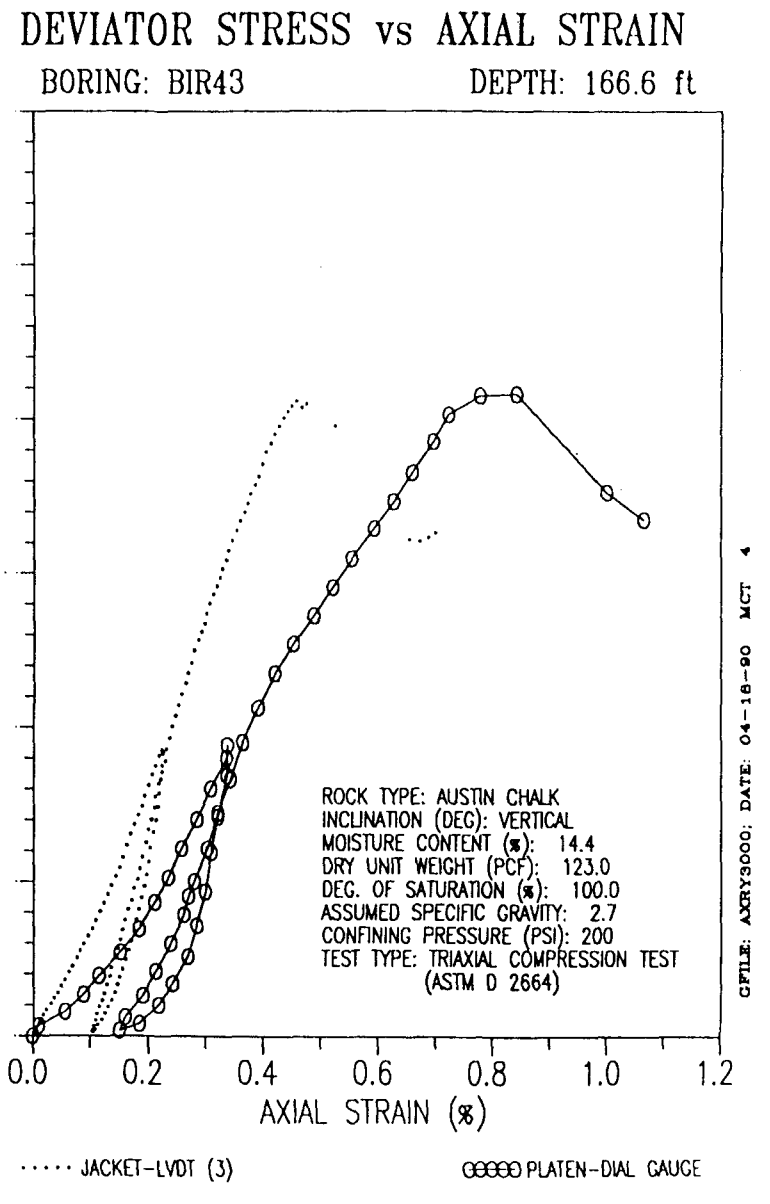
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES,INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

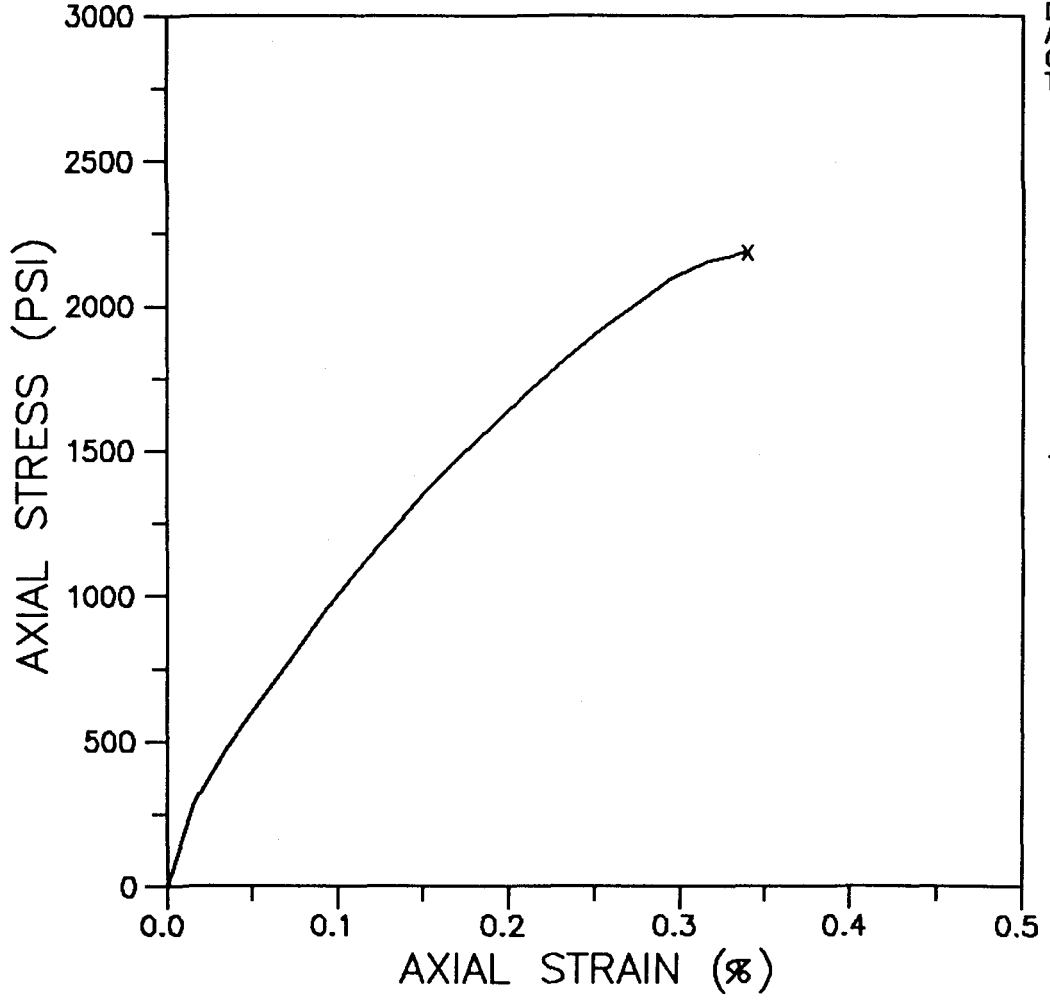
FIGURE





PRELIMINARY

BORING NO: BIR43
DEPTH (FT): 179.3
AUSTIN CHALK



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 13.3
DRY UNIT WEIGHT (PCF): 122.4
DEG. OF SATURATION (%): 95.4
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
7.052 x 10E5 PSI

FAILURE MODE:
LONGITUDINAL (AXIAL)
SPLITTING

TEXAS SSC SITE

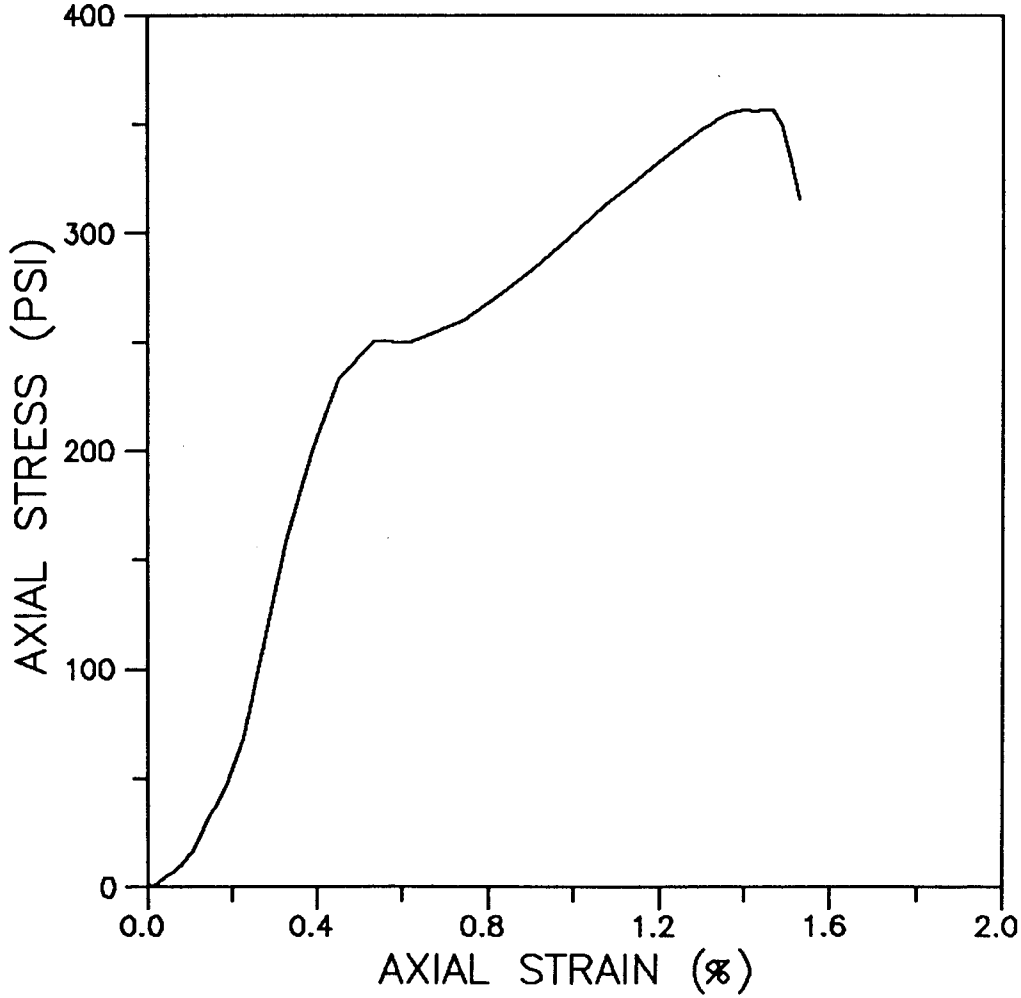
STRESS-STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89-192

FIGURE

BORING NO: BIR43
DEPTH (FT): 218.1
EAGLE FORD SHALE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 15.2
DRY UNIT WEIGHT (PCF): 120.4
DEG. OF SATURATION (%): 103.1
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
7.952 x 10E4 PSI

FAILURE MODE:
LONGITUDINAL (AXIAL)
SPLITTING

TEXAS SSC SITE

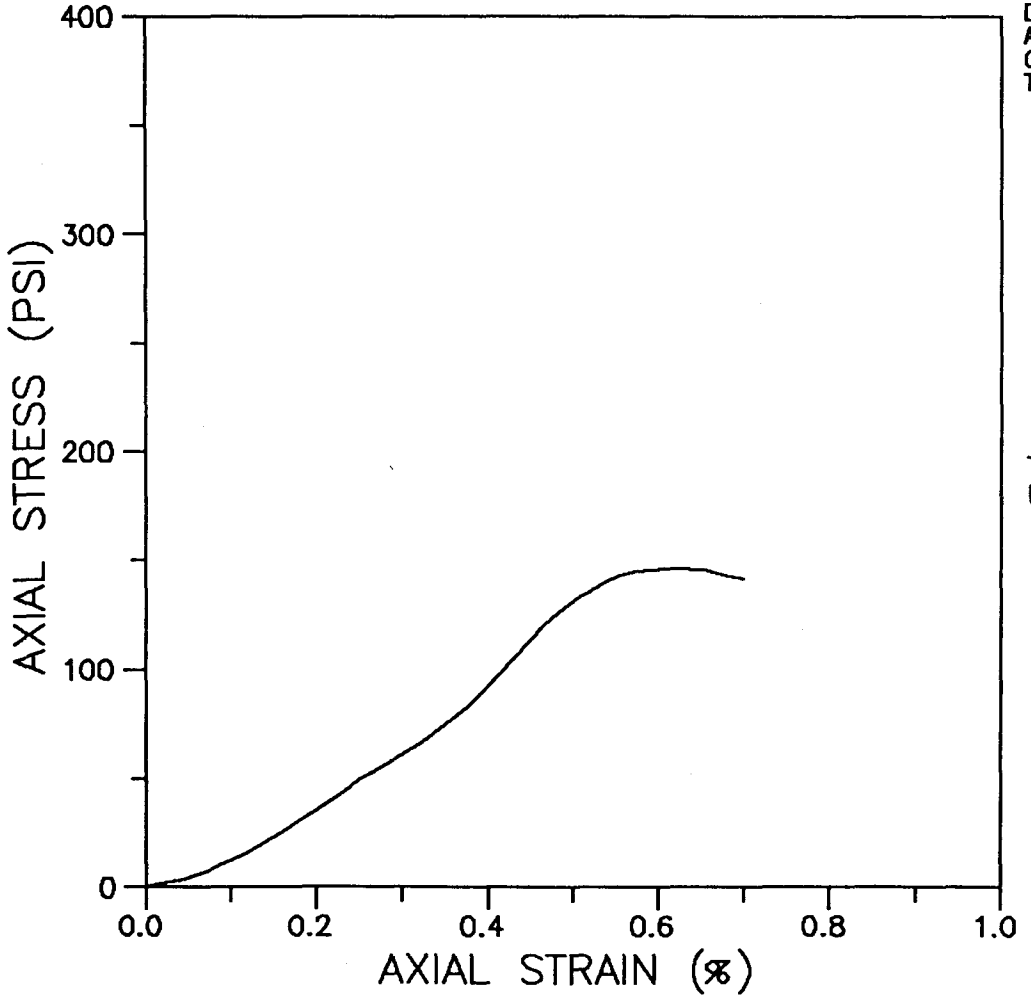
STRESS–STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89–192

FIGURE

BORING NO: BIR43
DEPTH (FT): 255.0
EAGLE FORD SHALE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 17.3
DRY UNIT WEIGHT (PCF): 118.0
DEG. OF SATURATION (%): 109.2
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
3.051 x 10E4 PSI

FAILURE MODE:
COMBINATION SHEAR PLANE
AT 70 DEG. & BEDDING
PLANE

TEXAS SSC SITE

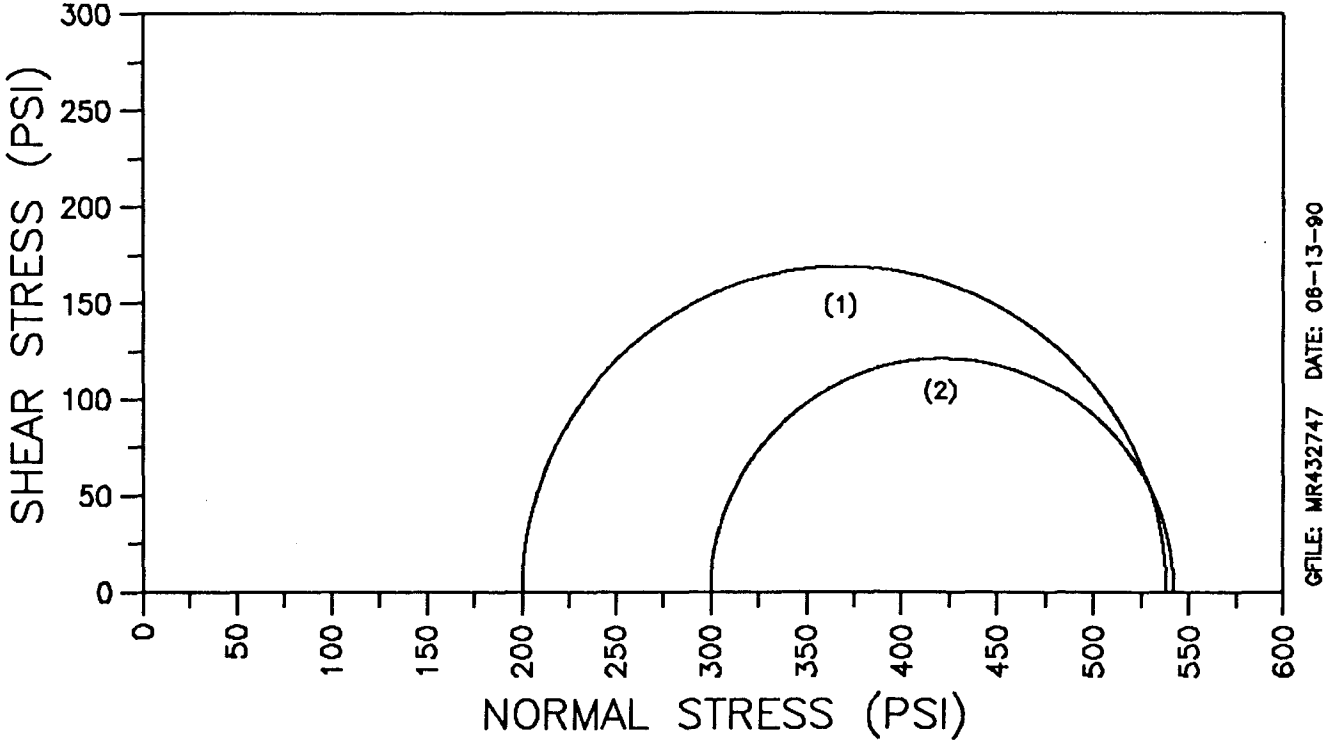
STRESS-STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89-192

FIGURE

BORING NO.: BIR43
DEPTH RANGE (FT): 274.7–275.5
EAGLE FORD SHALE



GFILE: MR432747 DATE: 06-13-90

SEE STRESS-STRAIN PLOTS
FOR INDIVIDUAL SAMPLE DATA

(1) DEPTH (FT): 274.7
(2) DEPTH (FT): 275.1

INCLINATION (DEG): VERTICAL
TEST TYPE: TRIAXIAL COMPRESSION (ASTM D2664)

TEXAS SSC SITE

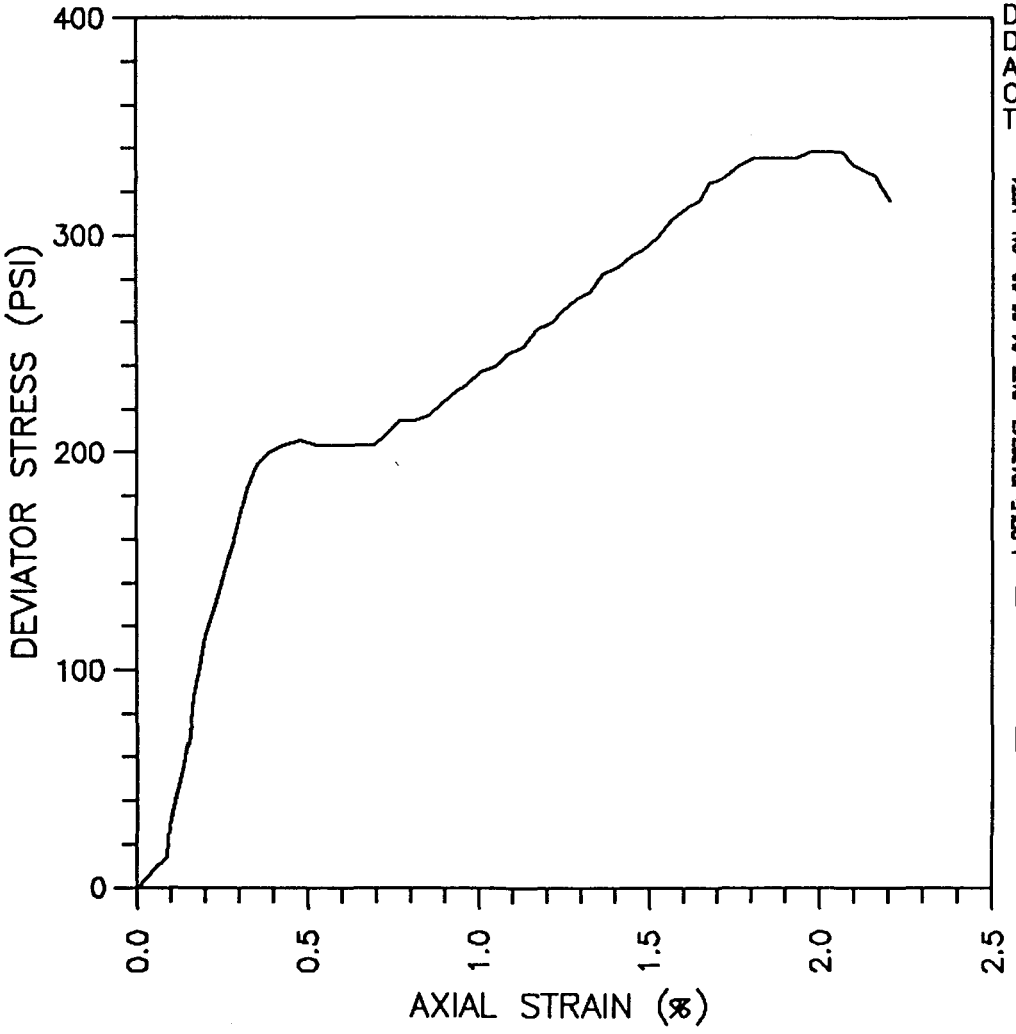
MOHR CIRCLE PLOT

MASON-JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

FIGURE

BORING NO.: BIR43
DEPTH (FT): 274.7
EAGLE FORD SHALE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 15.9
DRY UNIT WEIGHT (PCF): 117.1
DEG. OF SATURATION (%): 97.9
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 200
TEST TYPE: TRIAXIAL COMPRESSION
(ASTM D 2664)

GFILE: IR432747 DATE: 04-20-90 CAL: MGT4

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
0.566 x10E5 PSI

FAILURE MODE:
AXIAL SPLITTING

TEXAS SSC SITE

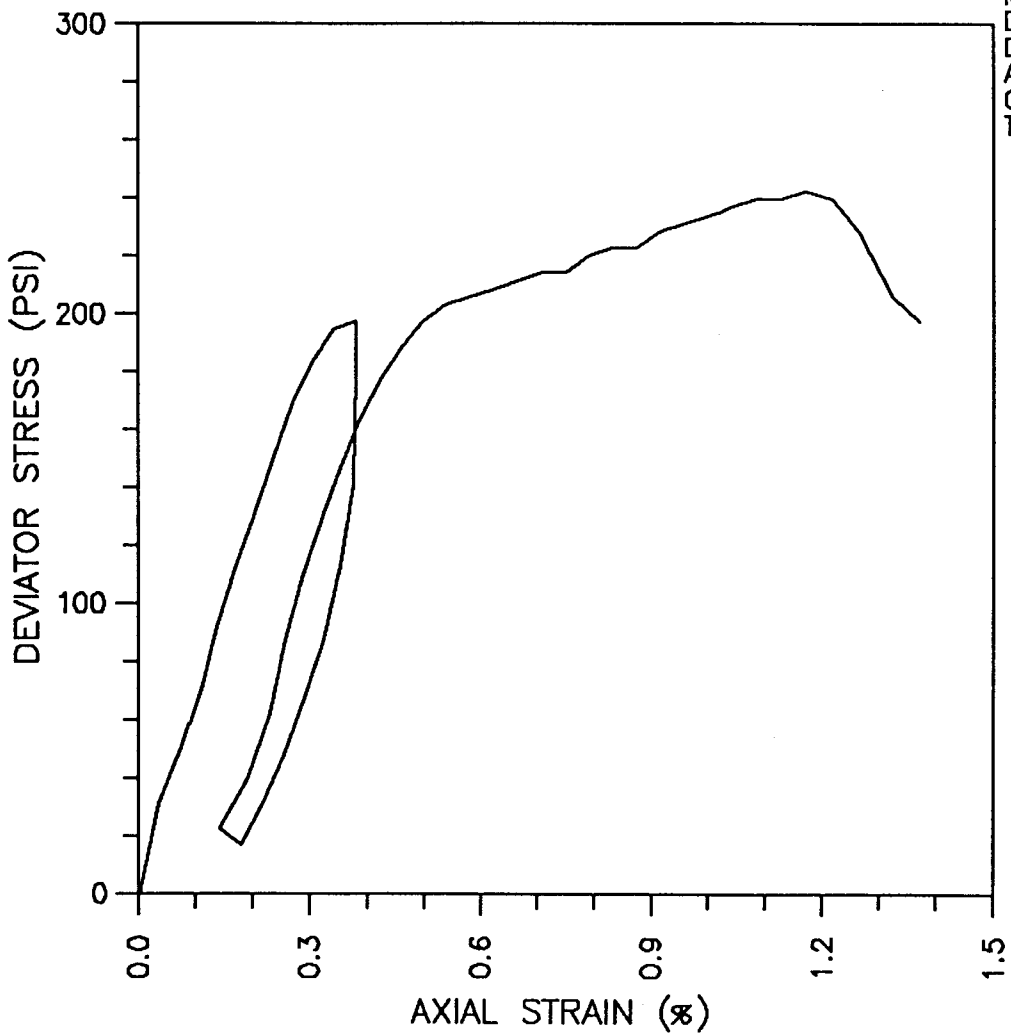
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

FIGURE

BORING NO.: BIR43
DEPTH (FT): 275.1
EAGLE FORD SHALE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 16.1
DRY UNIT WEIGHT (PCF): 118.3
DEG. OF SATURATION (%): 102.5
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 300
TEST TYPE: TRIAXIAL COMPRESSION
(ASTM D 2664)

GFILE: BIR32751 DATE: 04-20-90 CAL: MCT4

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
0.568 x10E5 PSI

FAILURE MODE:
SHEAR PLANE
AT 40 DEG.

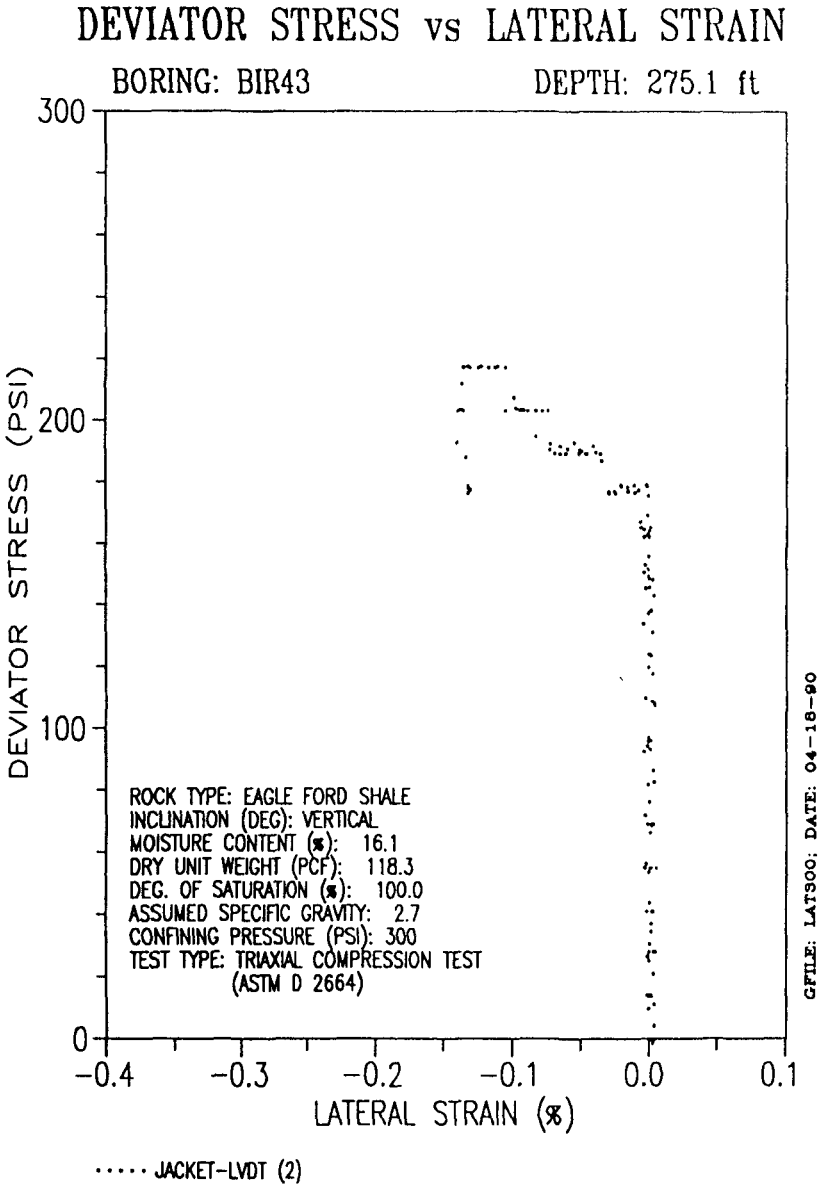
TEXAS SSC SITE

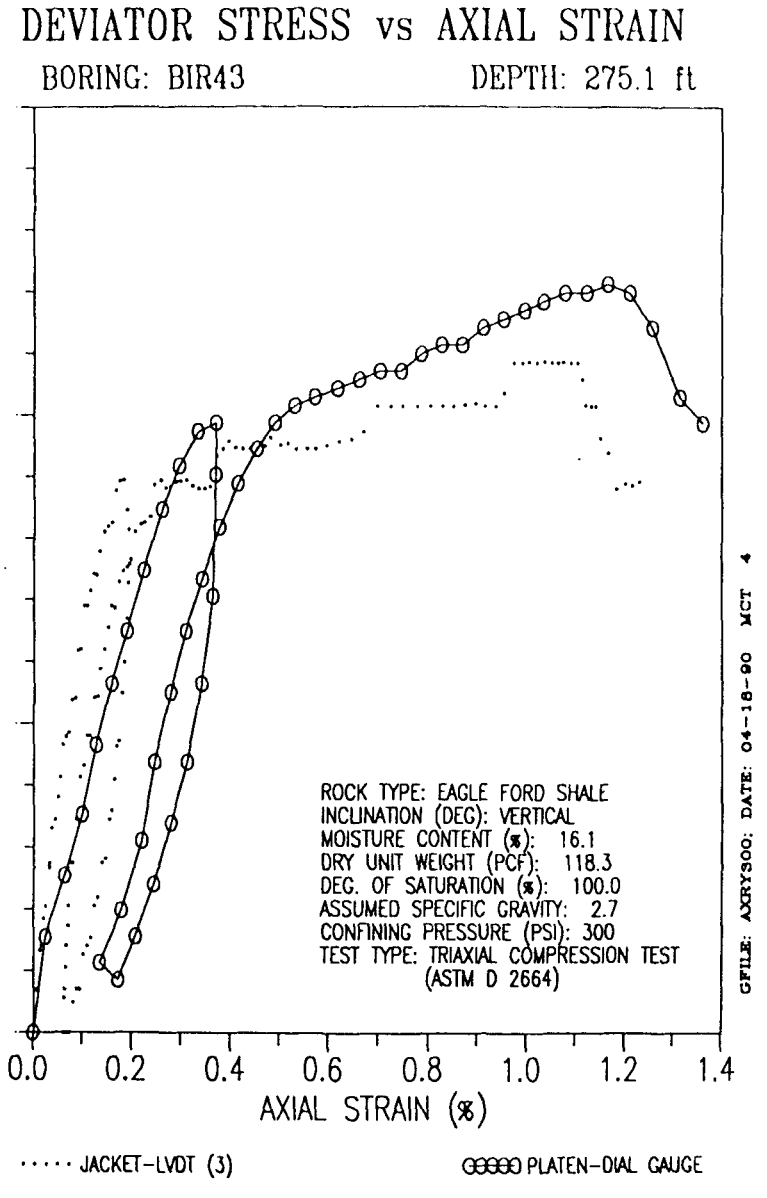
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

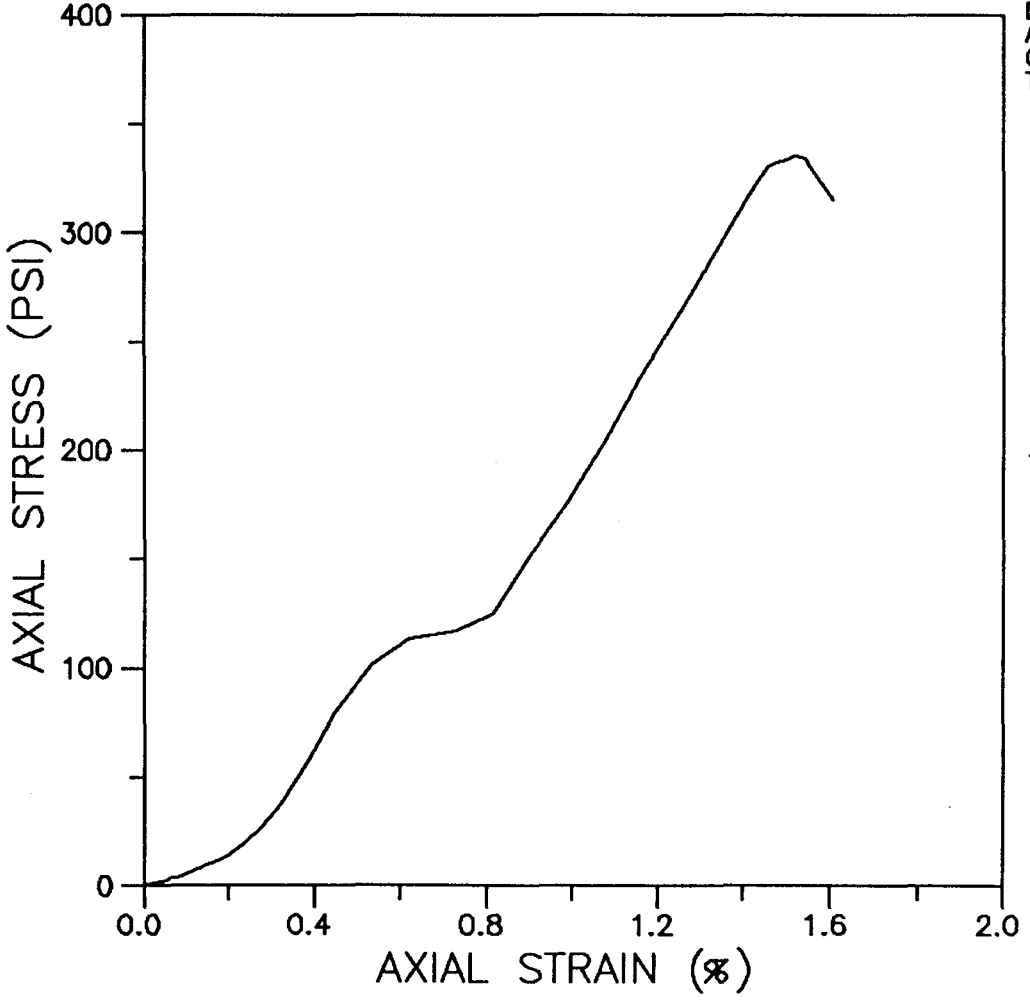
FIGURE





PRELIMINARY

BORING NO: BIR43
DEPTH (FT): 315.1
EAGLE FORD SHALE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 10.3
DRY UNIT WEIGHT (PCF): 125.4
DEG. OF SATURATION (%): 81.0
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
2.795 x 10E4 PSI

FAILURE MODE:
LONGITUDINAL (AXIAL)
SPLITTING

TEXAS SSC SITE

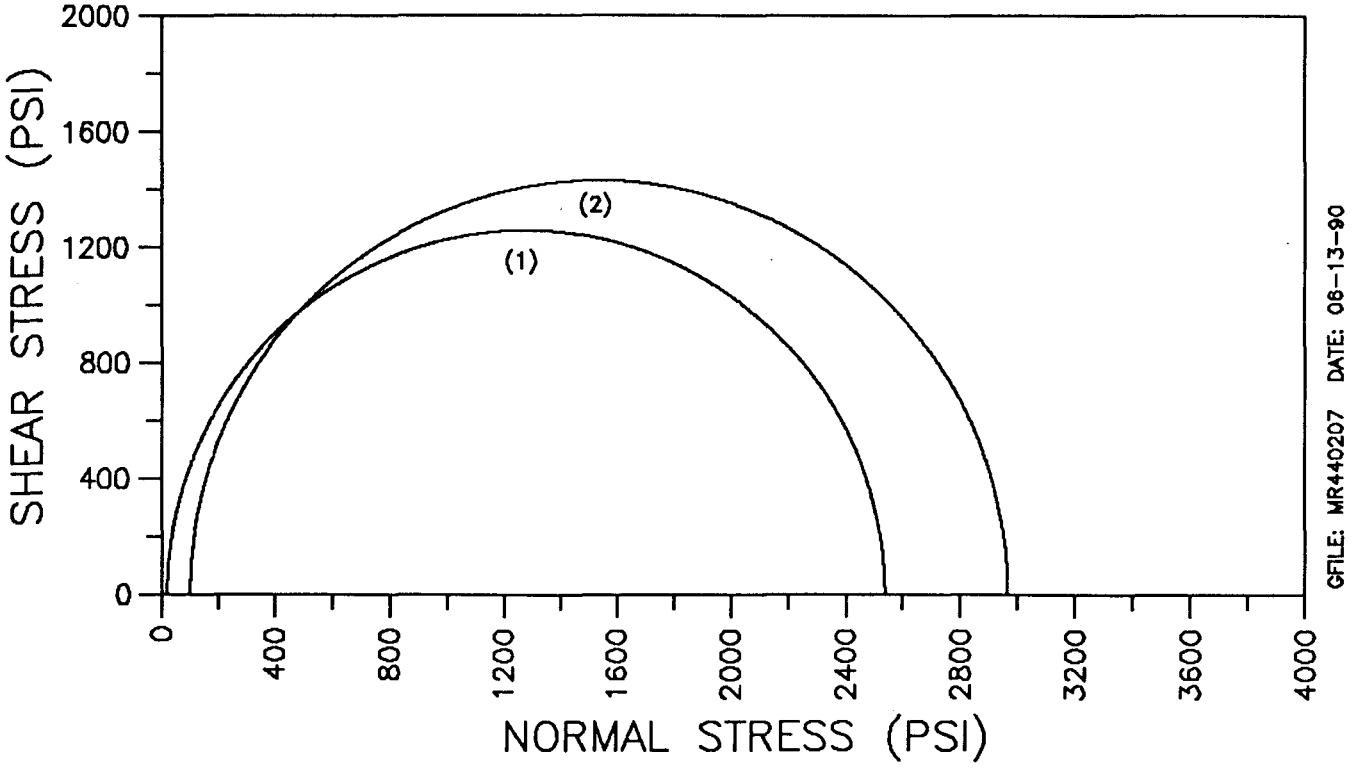
STRESS-STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89-192

FIGURE

BORING NO.: BIR44
DEPTH RANGE (FT): 20.7–21.5
AUSTIN CHALK LIMESTONE



GFILE: MR440207 DATE: 08-13-90

SEE STRESS–STRAIN PLOTS
FOR INDIVIDUAL SAMPLE DATA

(1) DEPTH (FT): 20.7
(2) DEPTH (FT): 21.1

INCLINATION (DEG): VERTICAL
TEST TYPE: TRIAXIAL COMPRESSION (ASTM D2664)

TEXAS SSC SITE

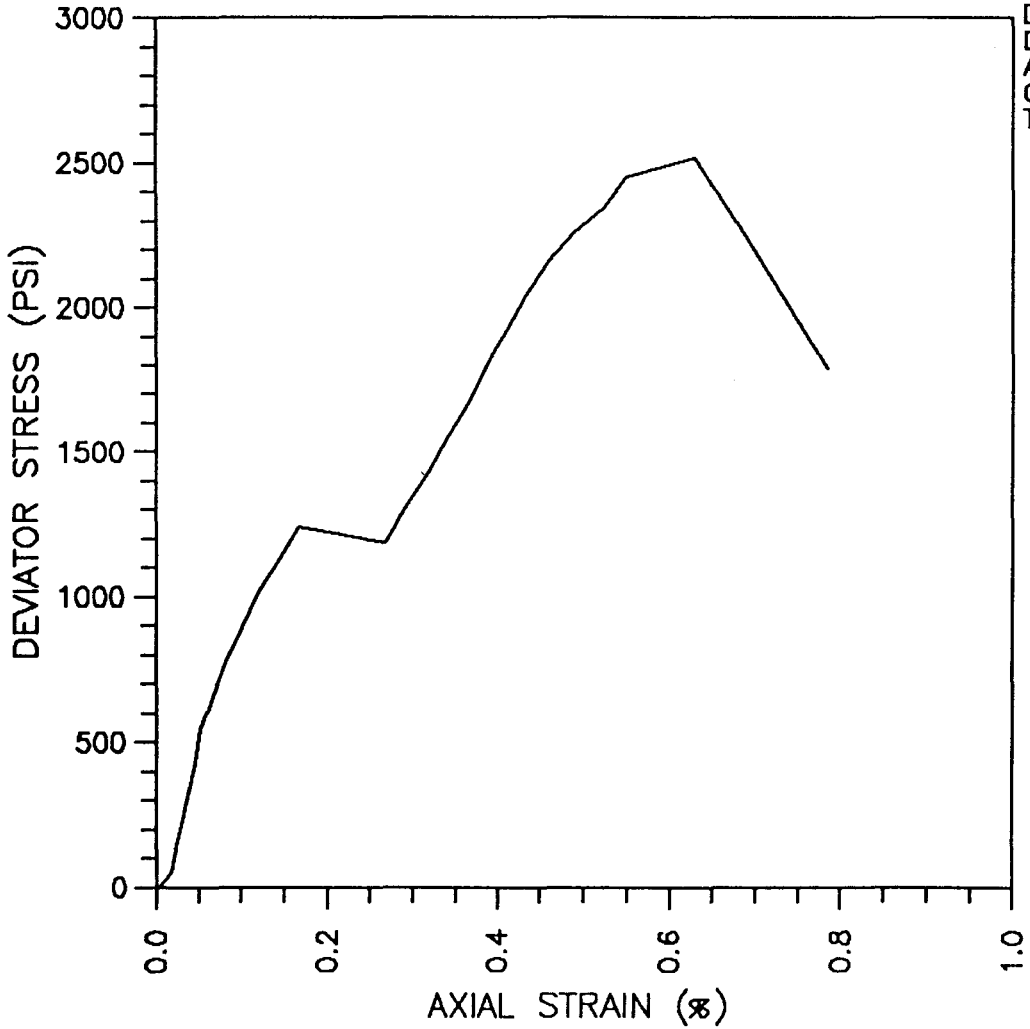
MOHR CIRCLE PLOT

MASON–JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS–ENGINEERS

JOB NO.: 5530.15

FIGURE

BORING NO.: BIR44
DEPTH (FT): 20.7
AUSTIN CHALK LIMESTONE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 11.9
DRY UNIT WEIGHT (PCF): 123.2
DEG. OF SATURATION (%): 87.7
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 20
TEST TYPE: TRIAXIAL COMPRESSION
(ASTM D 2664)

GFILE: IR440207 DATE: 05-01-90 CAL: MCT4

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
5.114 x10E5 PSI

FAILURE MODE:
AXIAL SPLITTING

TEXAS SSC SITE

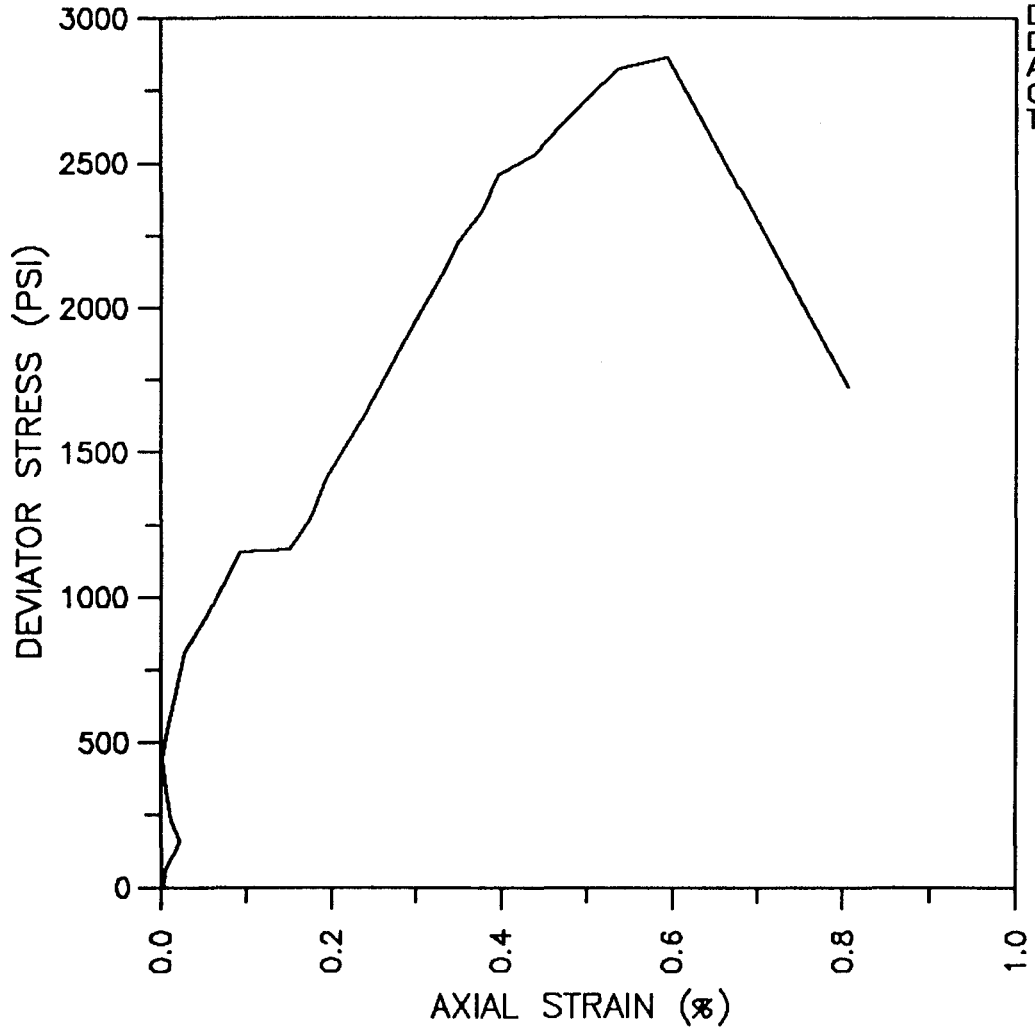
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

FIGURE

BORING NO.: BIR44
DEPTH (FT): 21.1
AUSTIN CHALK LIMESTONE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 12.3
DRY UNIT WEIGHT (PCF): 122.0
DEG. OF SATURATION (%): 86.9
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 100
TEST TYPE: TRIAXIAL COMPRESSION
(ASTM D 2664)

GFILE: IR440211 DATE: 05-01-90 CAL: MCT4

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
5.494 x10E5 PSI

FAILURE MODE:
AXIAL SPLITTING

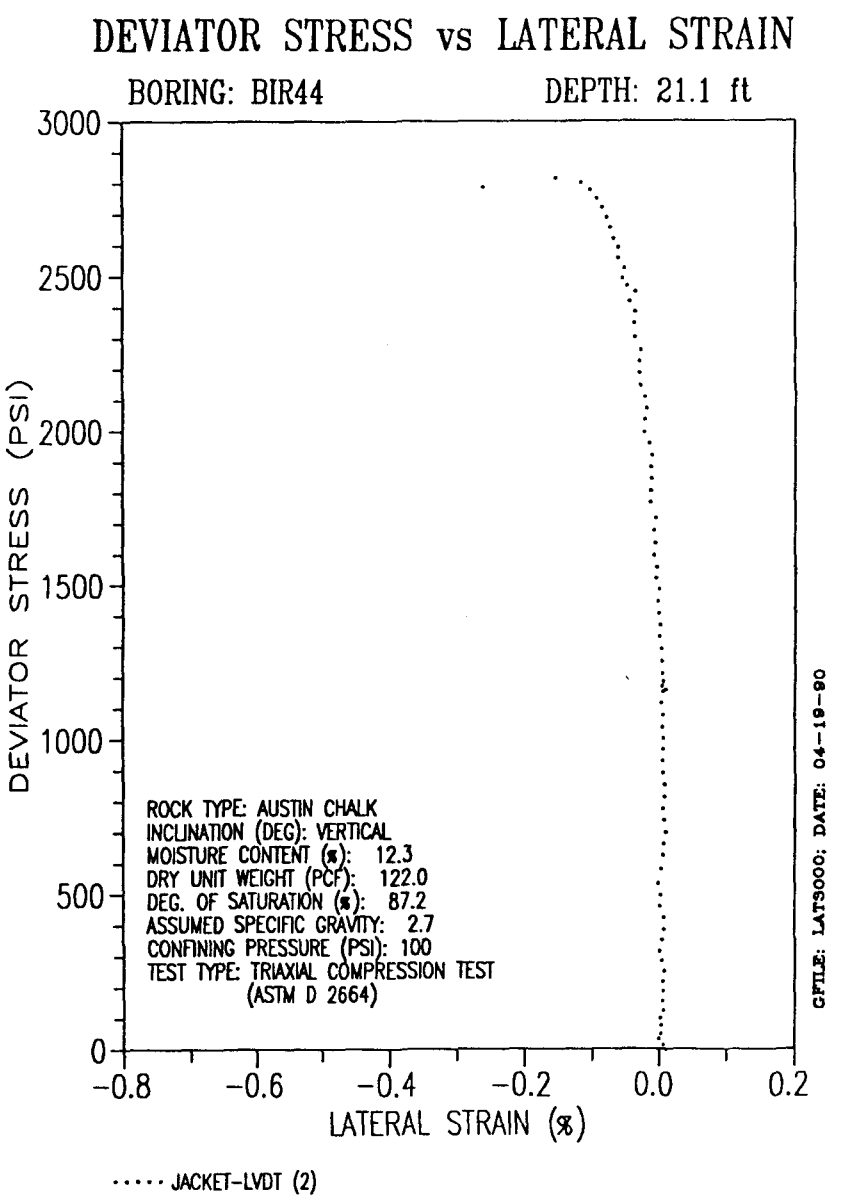
TEXAS SSC SITE

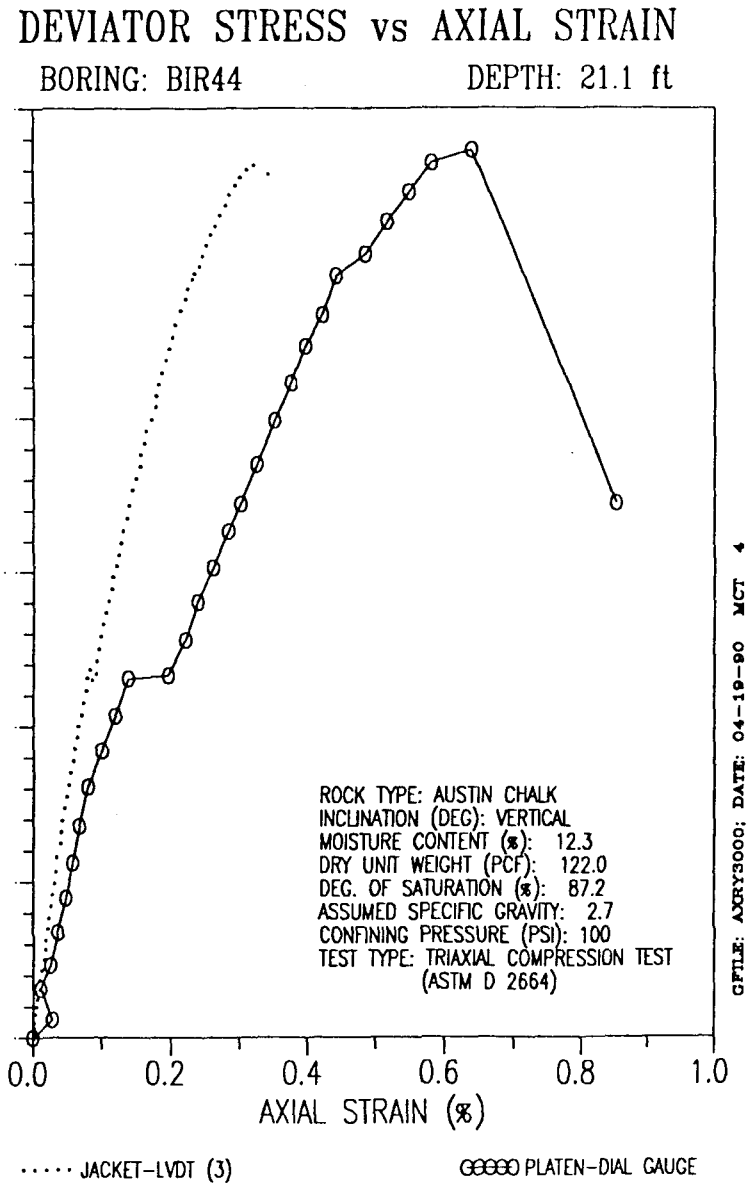
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES,INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

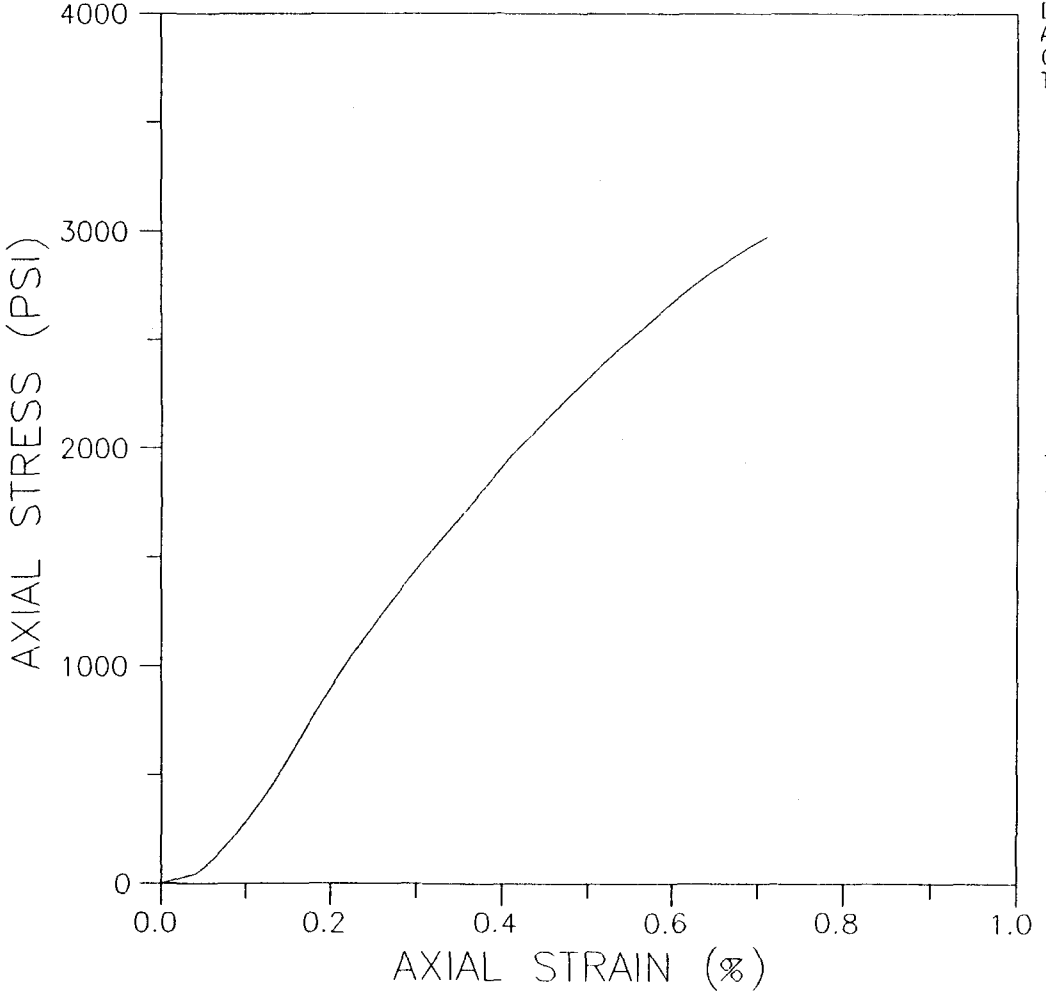
FIGURE





PRELIMINARY

BORING NO: BIR44
DEPTH (FT): 30.3
AUSTIN CHALK



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 11.4
DRY UNIT WEIGHT (PCF): 124.5
DEG. OF SATURATION (%): 87.1
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
5.0 x 10E5 PSI

FAILURE MODE:
CONICAL BREAK

TEXAS SSC SITE

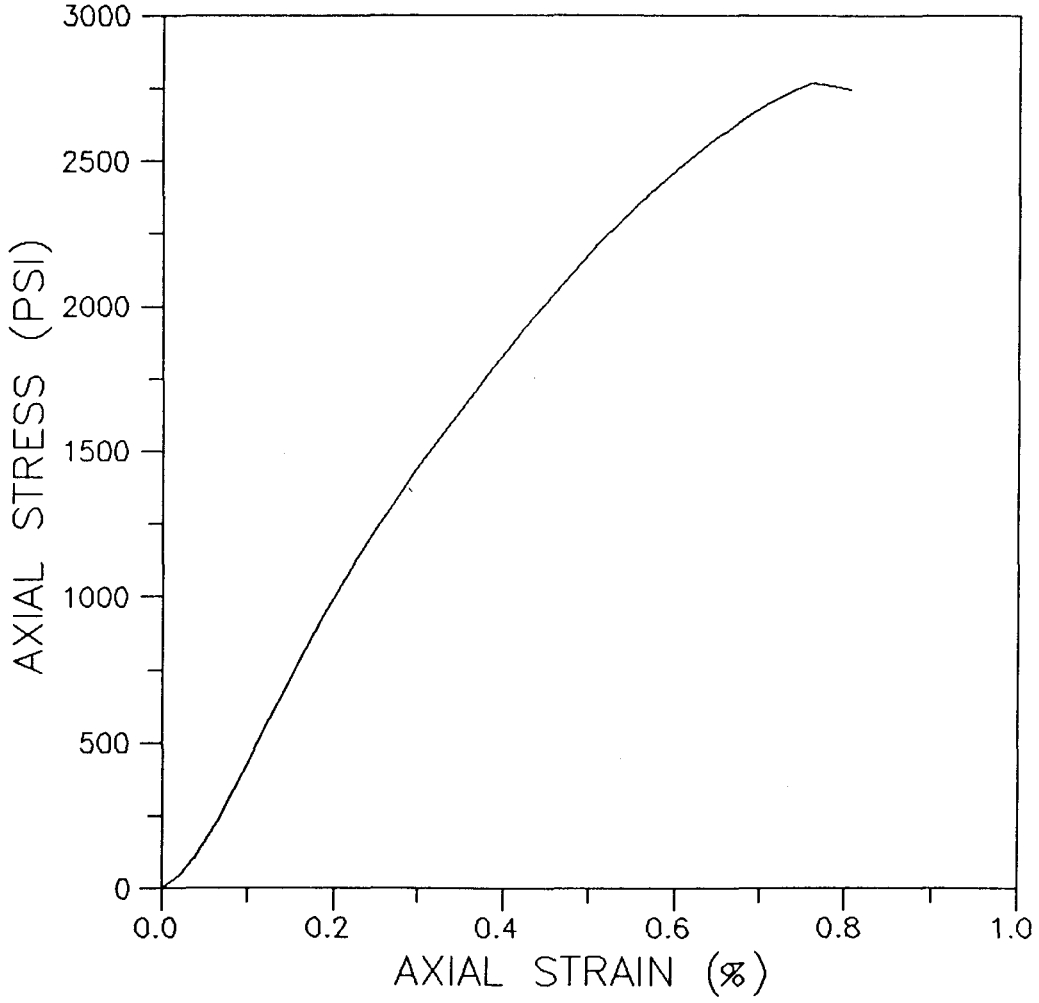
STRESS-STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89-192

FIGURE

BORING NO: BIR44
DEPTH (FT): 47.0
AUSTIN CHALK



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 14.3
DRY UNIT WEIGHT (PCF): 117.3
DEG. OF SATURATION (%): 88.5
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
4.4 x 10E5 PSI

FAILURE MODE:
SHEAR PLANE AT 30 DEG

TEXAS SSC SITE

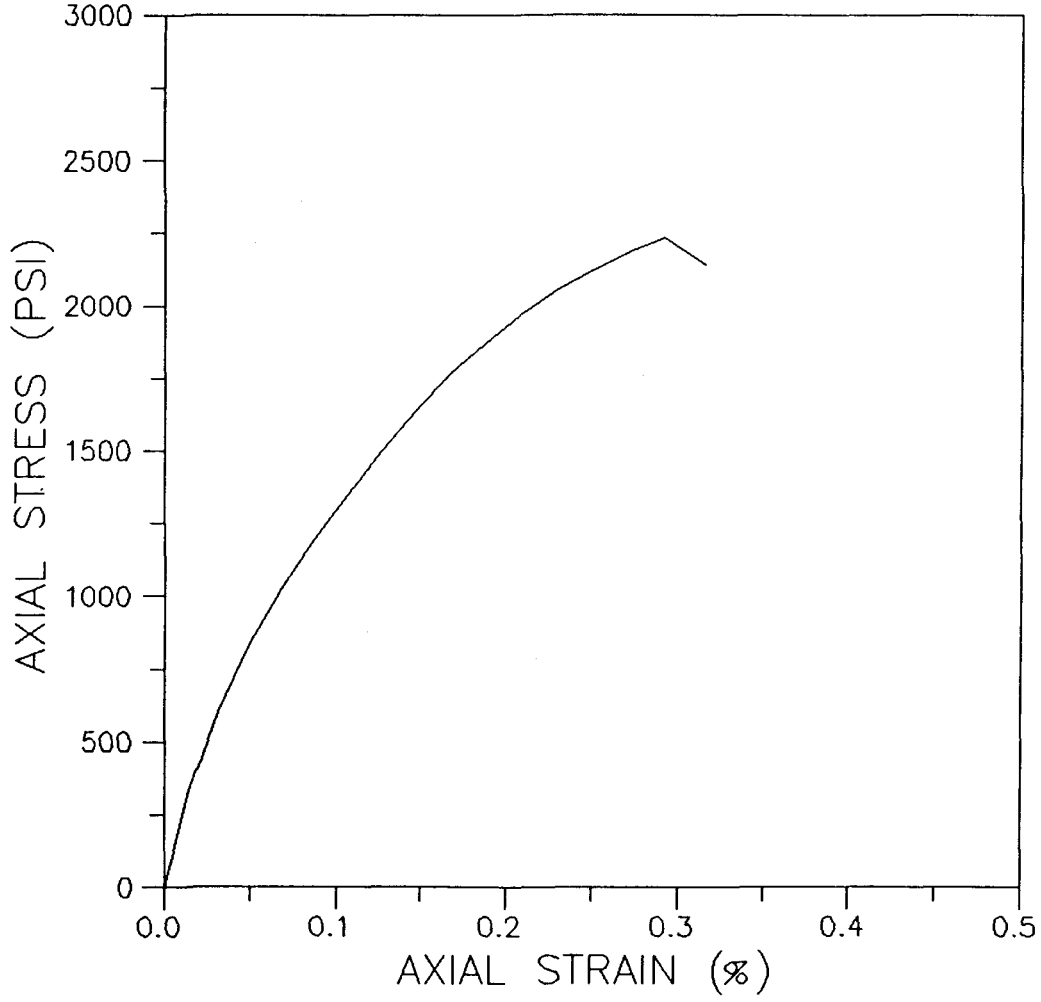
STRESS-STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89-192

FIGURE

BORING NO: BIR44
DEPTH (FT): 51.3
AUSTIN CHALK



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 18.7
DRY UNIT WEIGHT (PCF): 110.4
DEG. OF SATURATION (%): 96.0
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
8.4 x 10E5 PSI

FAILURE MODE:
SHEAR PLANE AT 30 DEG

TEXAS SSC SITE

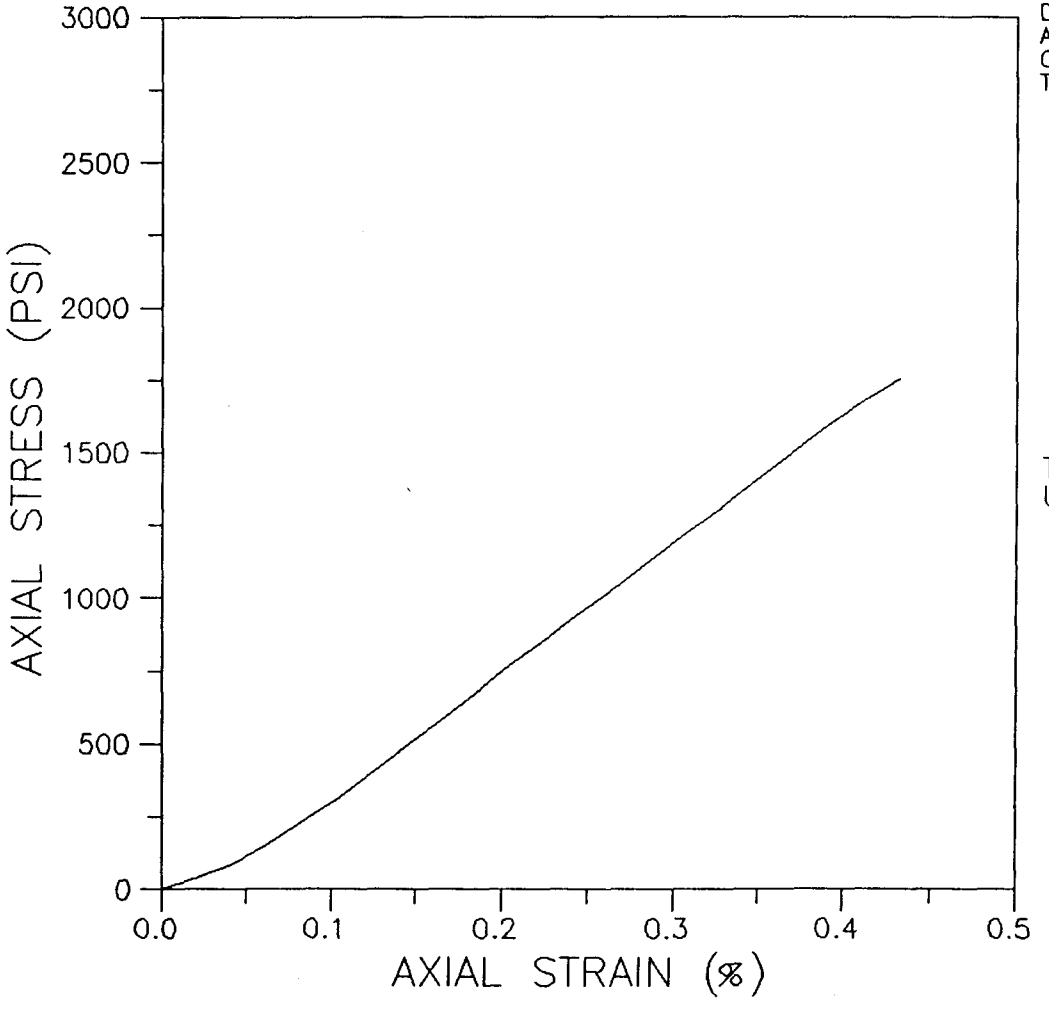
STRESS-STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89-192

FIGURE

BORING NO: BIR44
DEPTH (FT): 69.4
AUSTIN CHALK



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 11.3
DRY UNIT WEIGHT (PCF): 122.9
DEG. OF SATURATION (%): 82.3
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
4.4 x 10E5 PSI

FAILURE MODE:
LONGITUDINAL (AXIAL)
SPLITTING

TEXAS SSC SITE

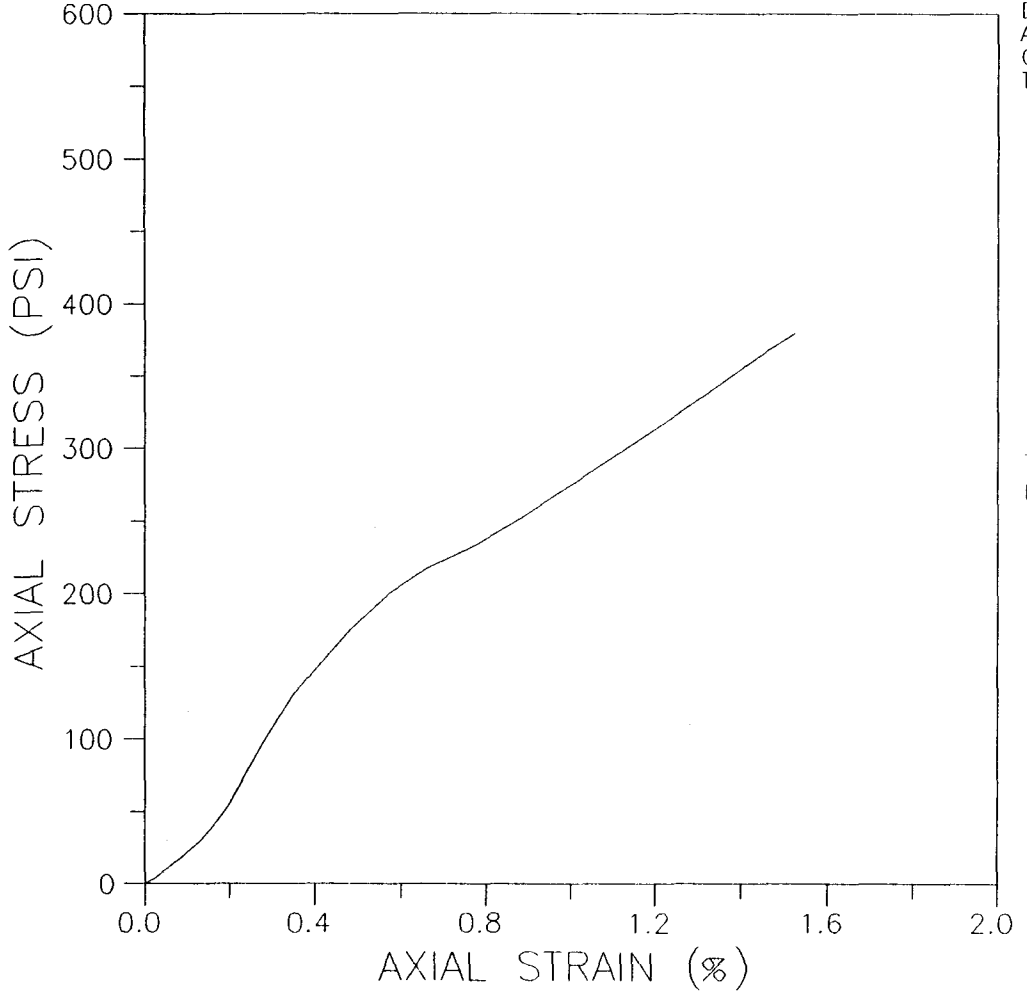
STRESS-STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89-192

FIGURE

BORING NO: BIR44
DEPTH (FT): 78.8
AUSTIN CHALK



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 12.9
DRY UNIT WEIGHT (PCF): 122.6
DEG. OF SATURATION (%): 93.1
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
2.9 x 10E4 PSI

FAILURE MODE:
BARRELING / BULGING

TEXAS SSC SITE

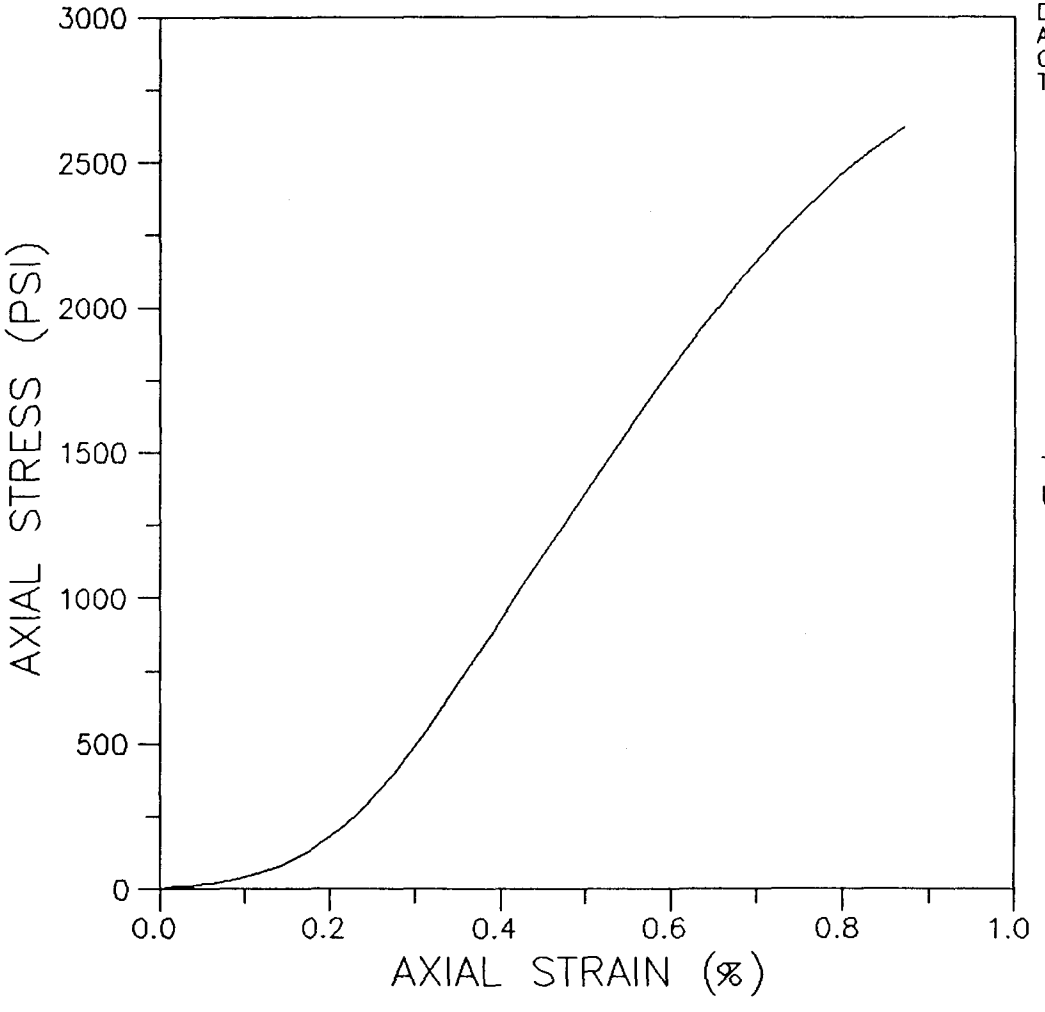
STRESS-STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89-192

FIGURE

BORING NO: BIR44
DEPTH (FT): 108.3
AUSTIN CHALK



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 12.5
DRY UNIT WEIGHT (PCF): 121.5
DEG. OF SATURATION (%): 87.3
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
4.4 x 10E5 PSI

FAILURE MODE:
LONGITUDINAL (AXIAL)
SPLITTING

TEXAS SSC SITE

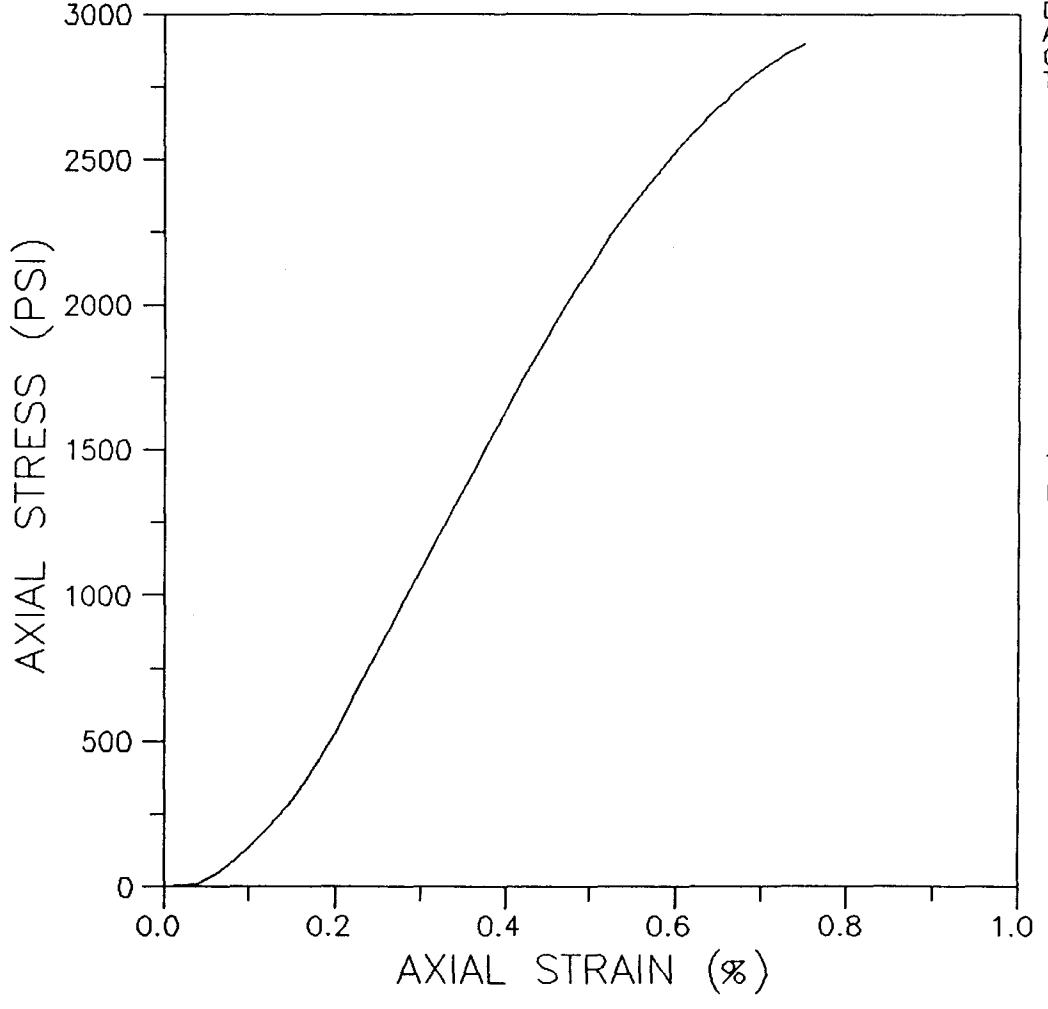
STRESS-STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89-192

FIGURE

BORING NO: BIR44
DEPTH (FT): 130.1
AUSTIN CHALK



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 13.3
DRY UNIT WEIGHT (PCF): 124.2
DEG. OF SATURATION (%): 100.7
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
5.7 x 10E5 PSI

FAILURE MODE:
SHEAR PLANE AT 30 DEG

TEXAS SSC SITE

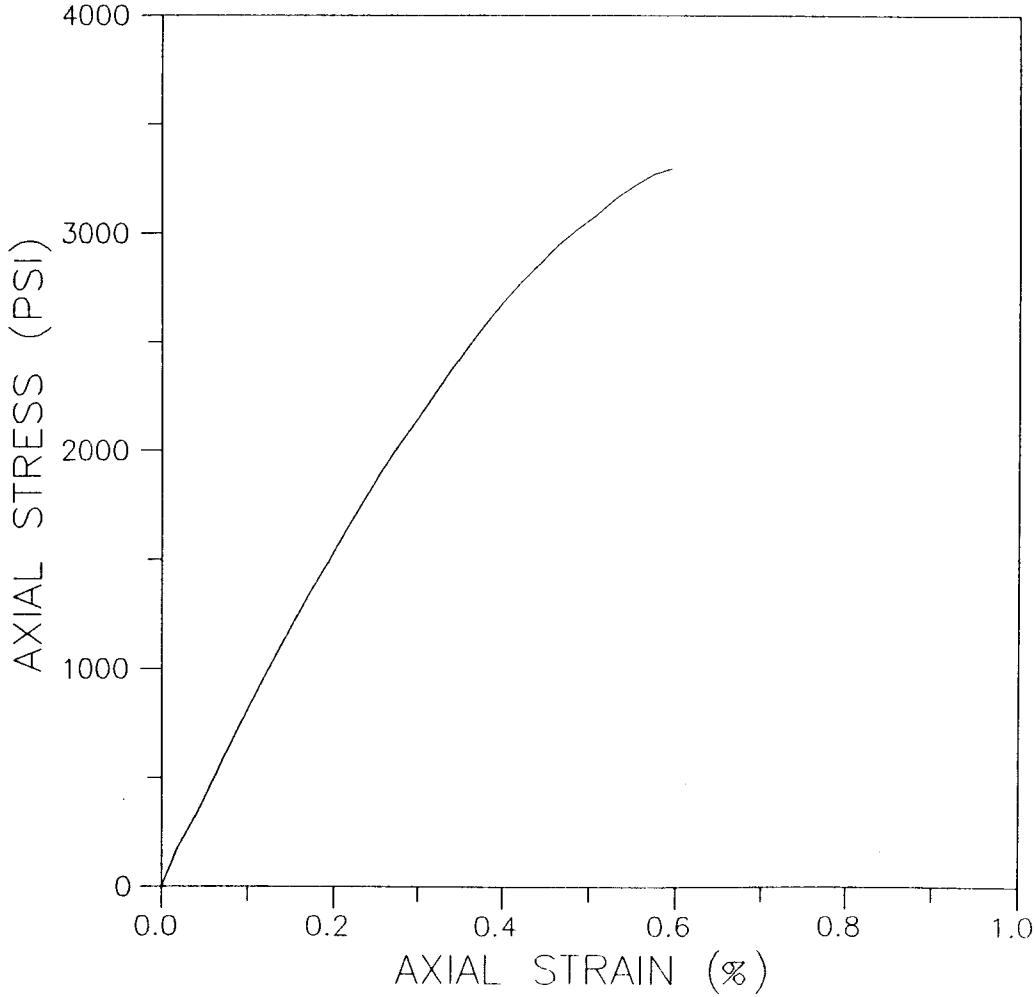
STRESS-STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89-192

FIGURE

BORING NO: BIR44
DEPTH (FT): 156.4
AUSTIN CHALK



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 11.5
DRY UNIT WEIGHT (PCF): 127.8
DEG. OF SATURATION (%): 97.5
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
6.6 x 10E5 PSI

FAILURE MODE:
SHEAR PLANE AT 30 DEG

TEXAS SSC SITE

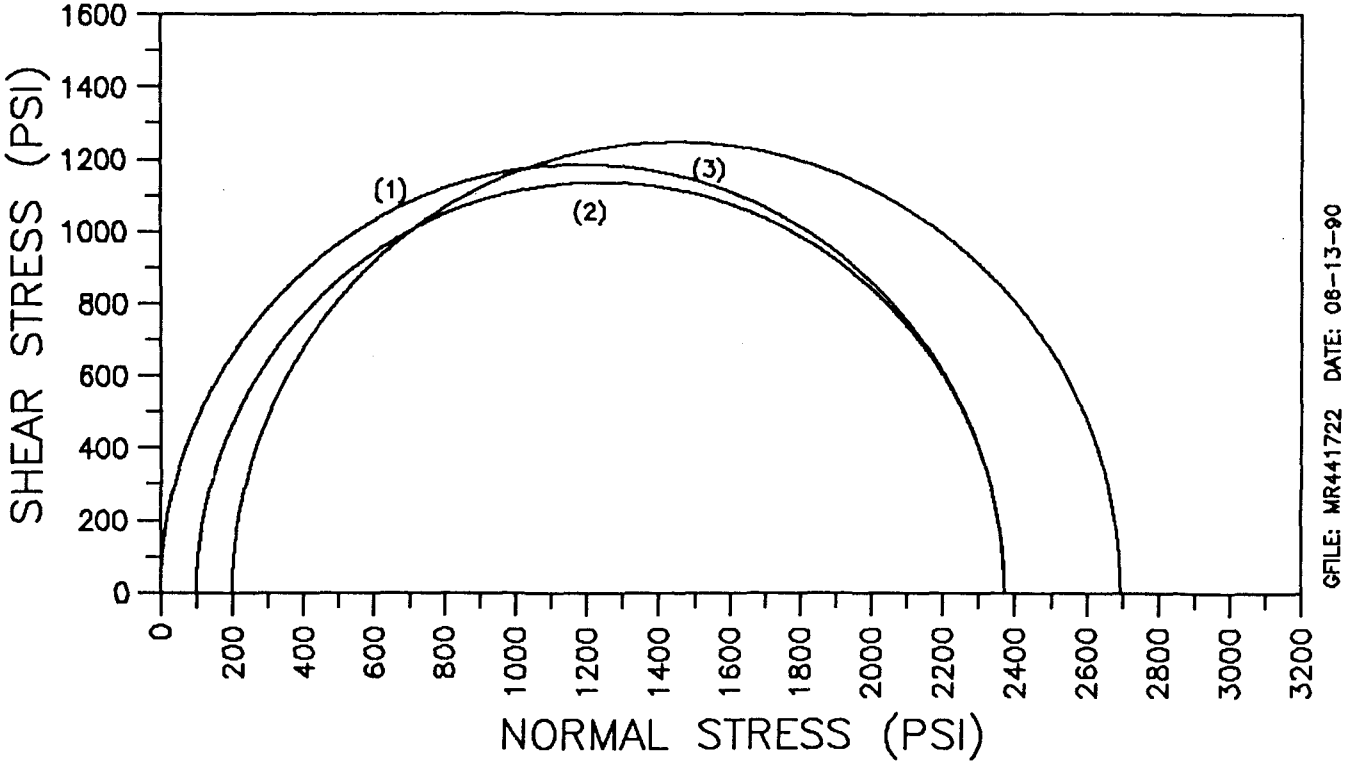
STRESS-STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89-192

FIGURE

BORING NO.: BIR44
DEPTH RANGE (FT): 172.2–173.8
AUSTIN CHALK LIMESTONE



GFILE: MR441722 DATE: 08-13-90

SEE STRESS–STRAIN PLOTS
FOR INDIVIDUAL SAMPLE DATA

(1) DEPTH (FT): 172.2
(2) DEPTH (FT): 172.9
(3) DEPTH (FT): 173.4

INCLINATION (DEG): VERTICAL
TEST TYPE: UNCONFINED COMPRESSION (ASTM D2938)
TRIAXIAL COMPRESSION (ASTM D2664)

TEXAS SSC SITE

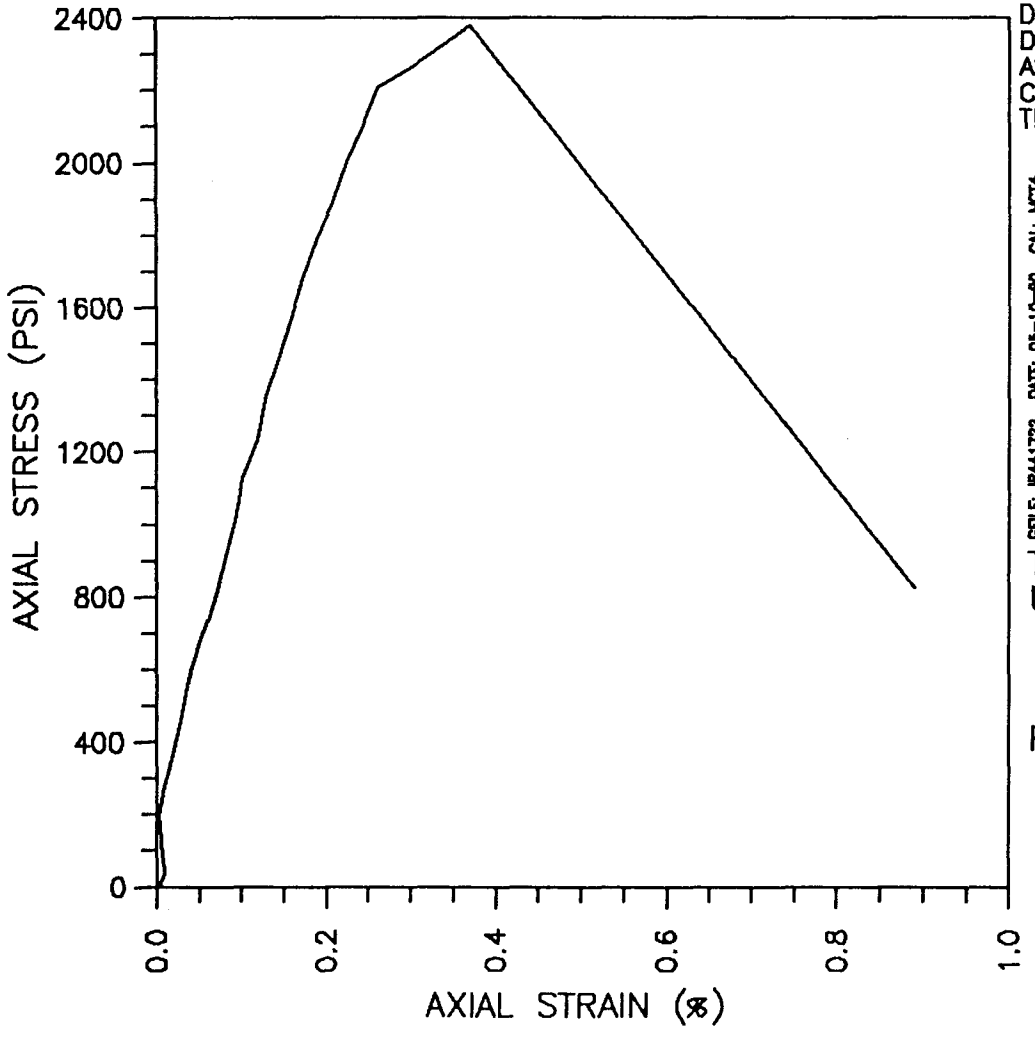
MOHR CIRCLE PLOT

MASON–JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS–ENGINEERS

JOB NO.: 5530.15

FIGURE

BORING NO.: BIR44
DEPTH (FT): 172.2
AUSTIN CHALK LIMESTONE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 12.0
DRY UNIT WEIGHT (PCF): 124.7
DEG. OF SATURATION (%): 92.3
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE: UNCONFINED COMPRESSION
(ASTM D 2938)

GFILE: IR441722 DATE: 05-10-90 CAL: MCT4

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
8.421 x10E5 PSI

FAILURE MODE:
AXIAL SPLITTING

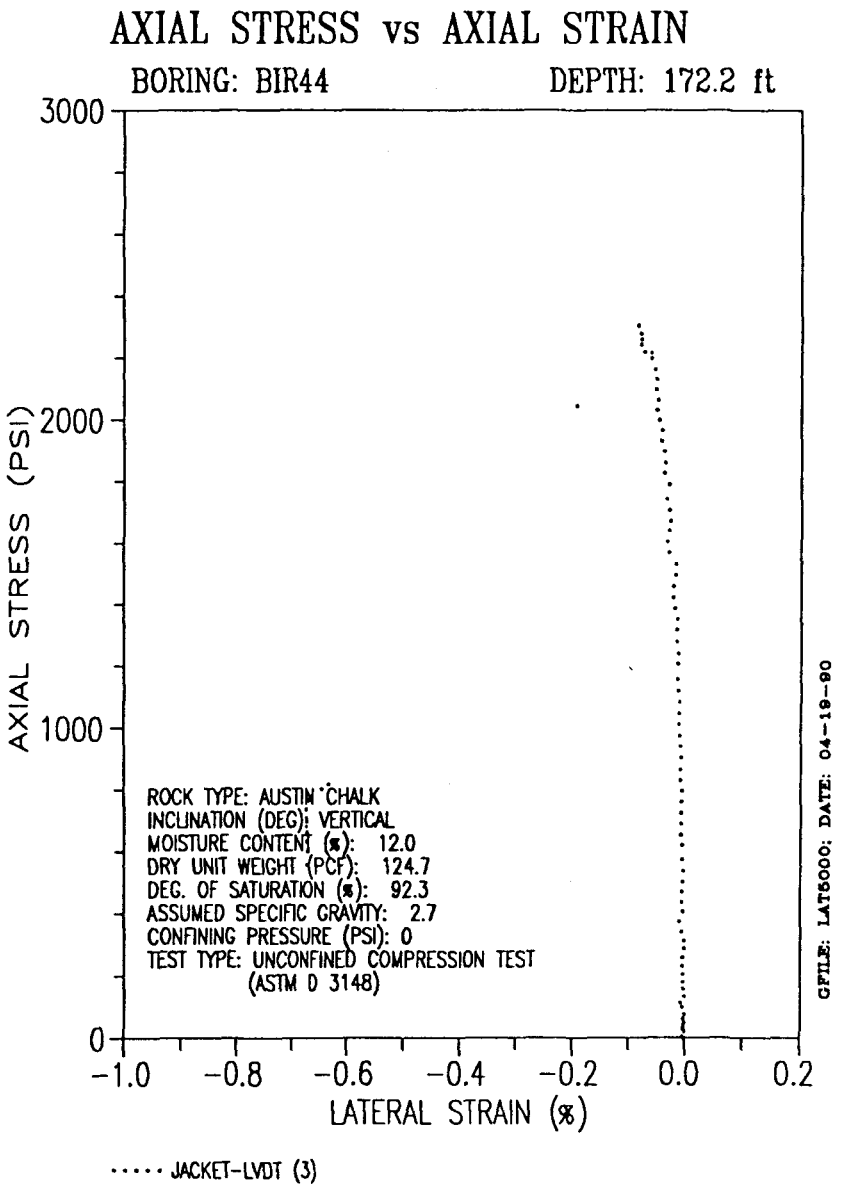
TEXAS SSC SITE

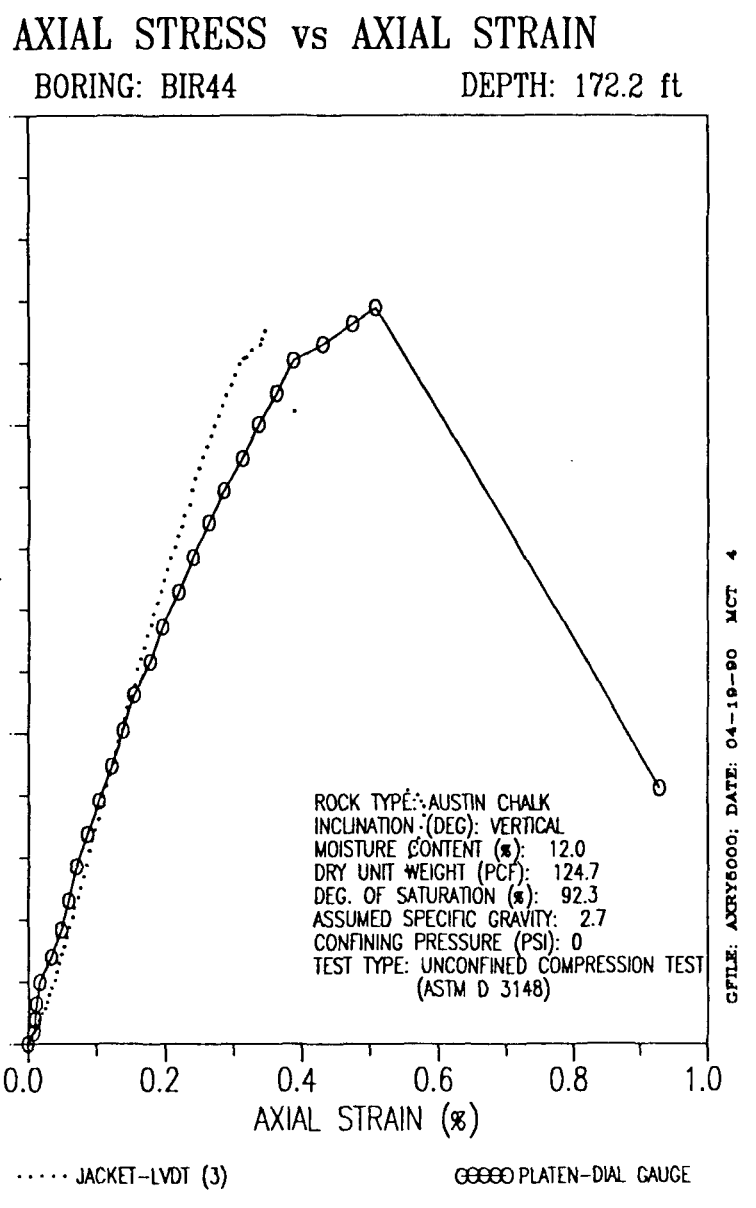
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES,INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

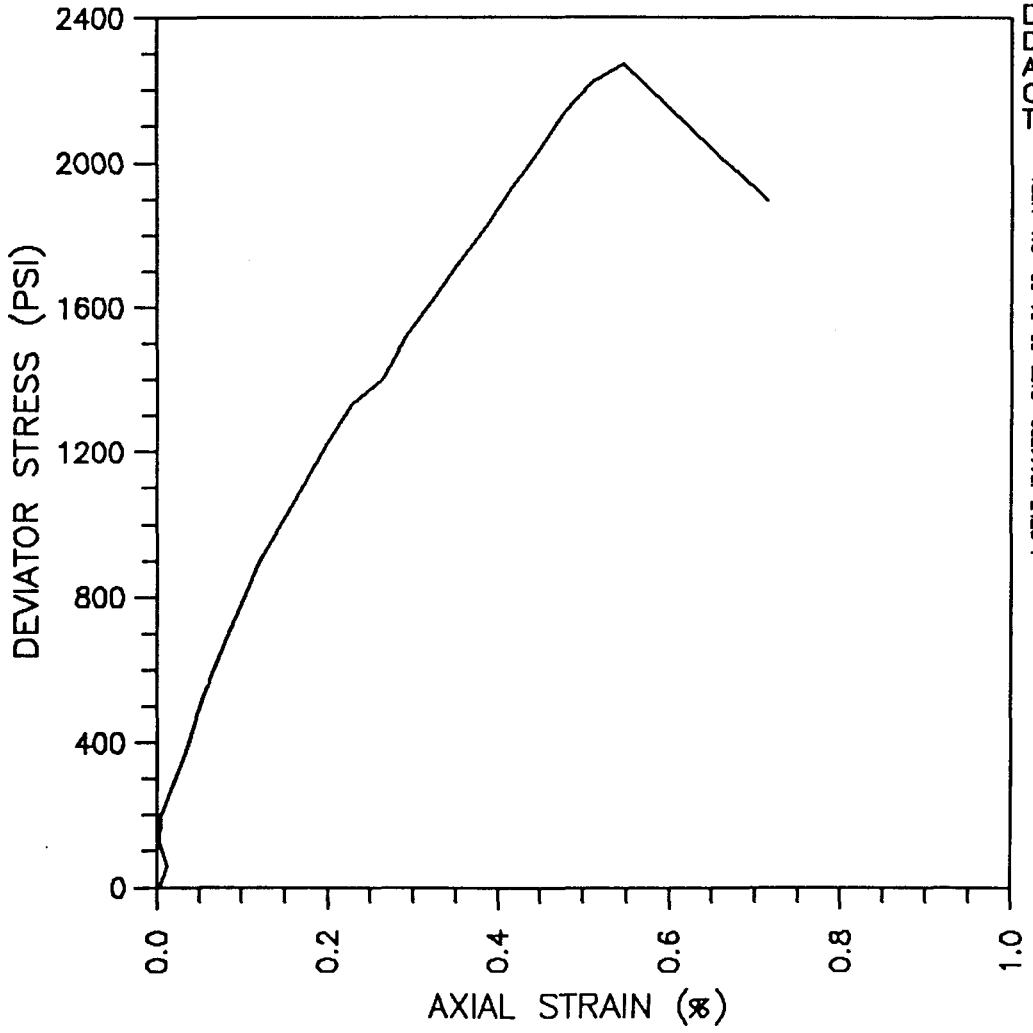
FIGURE





PRELIMINARY

BORING NO.: BIR44
DEPTH (FT): 172.9
AUSTIN CHALK LIMESTONE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 14.6
DRY UNIT WEIGHT (PCF): 119.4
DEG. OF SATURATION (%): 95.7
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 100
TEST TYPE: TRIAXIAL COMPRESSION
(ASTM D 2664)

GFILE: IR441729 DATE: 05-01-90 CAL: MCT4

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
4.062 x10E5 PSI

FAILURE MODE:
SHEAR PLANE
AT 20 DEG.

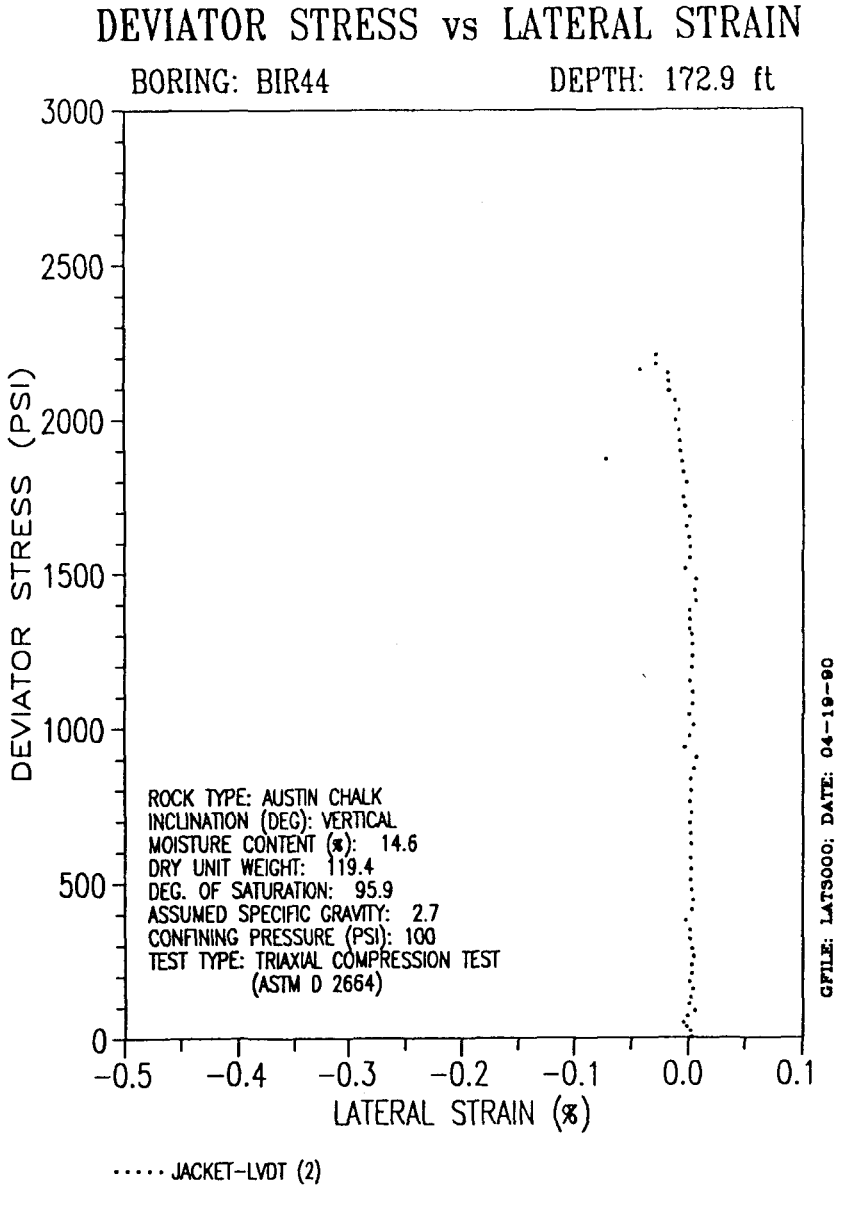
TEXAS SSC SITE

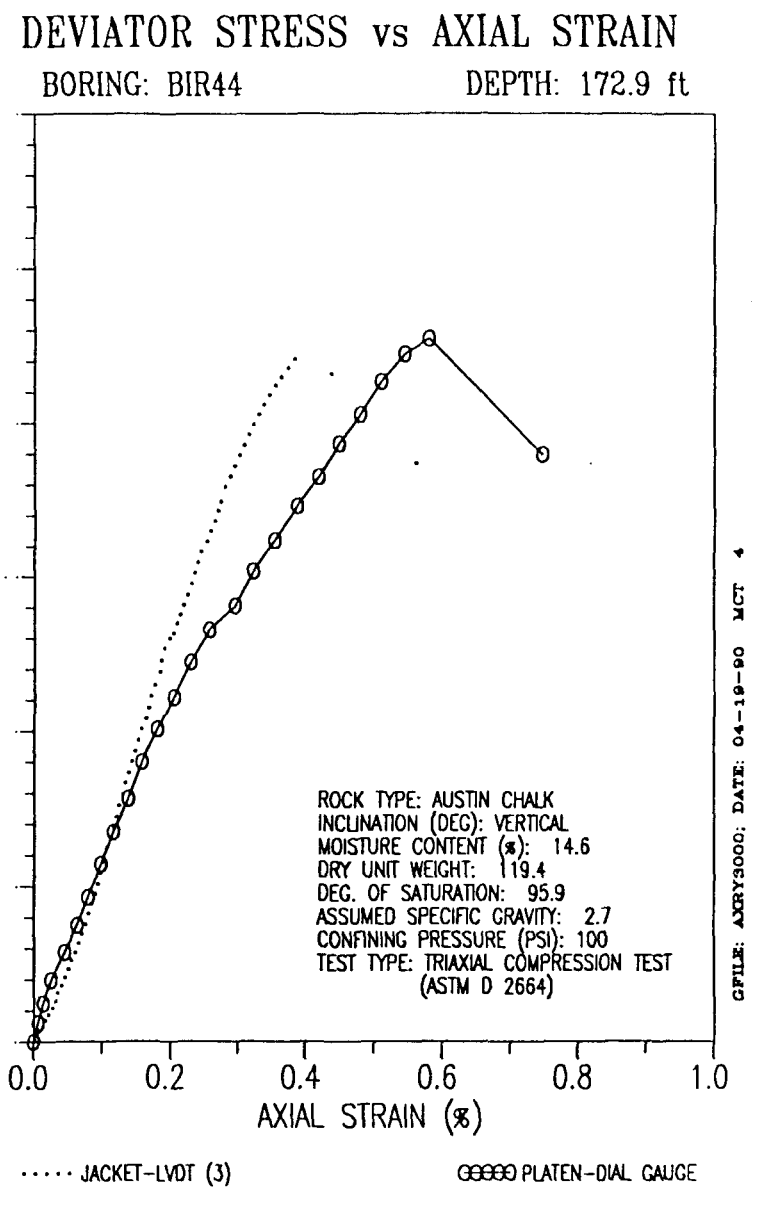
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

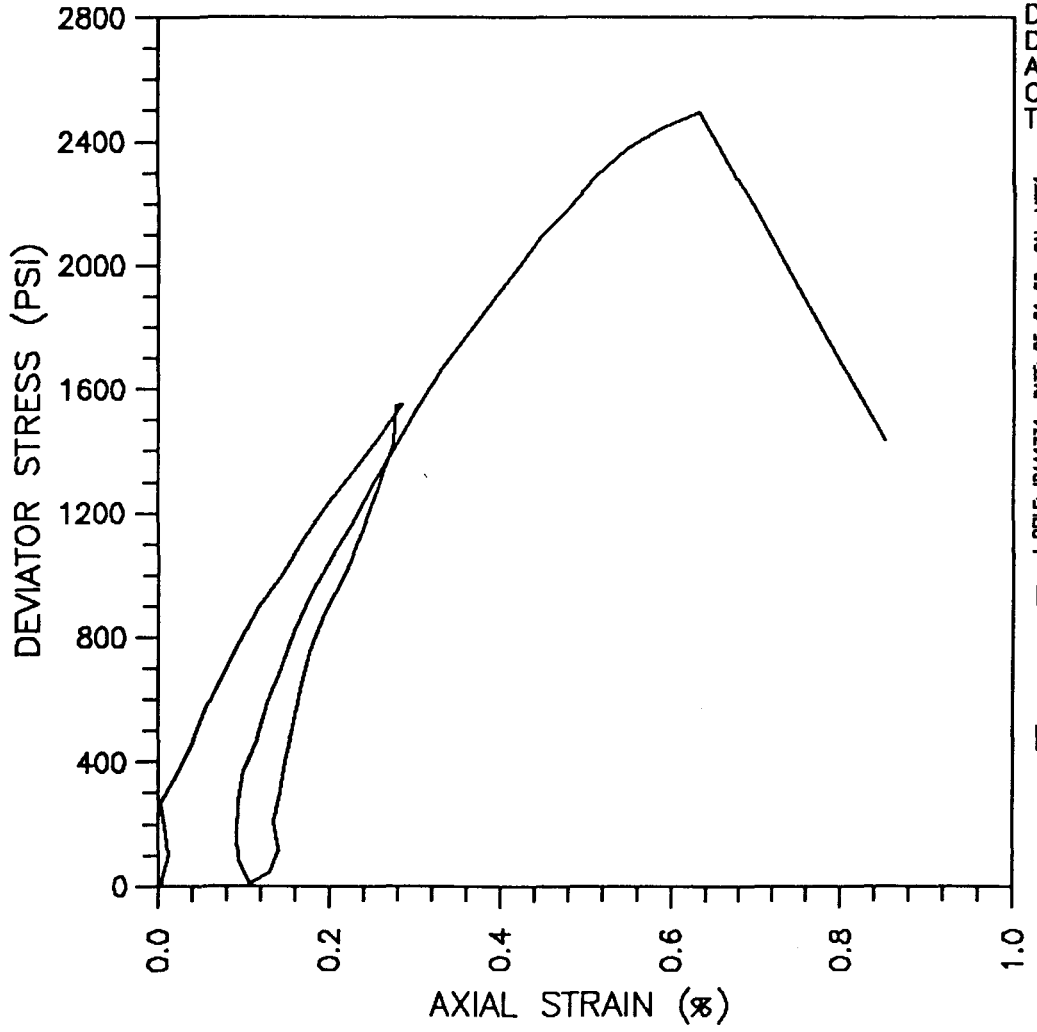
FIGURE





PRELIMINARY

BORING NO.: BIR44
DEPTH (FT): 173.4
AUSTIN CHALK LIMESTONE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 13.4
DRY UNIT WEIGHT (PCF): 121.3
DEG. OF SATURATION (%): 93.1
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 200
TEST TYPE: TRIAXIAL COMPRESSION
(ASTM D 2664)

RFILE: IR441734 DATE: 05-01-90 CAL: MCT4

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
4.040 x10E5 PSI

FAILURE MODE:
SHEAR PLANE
AT 30 DEG.

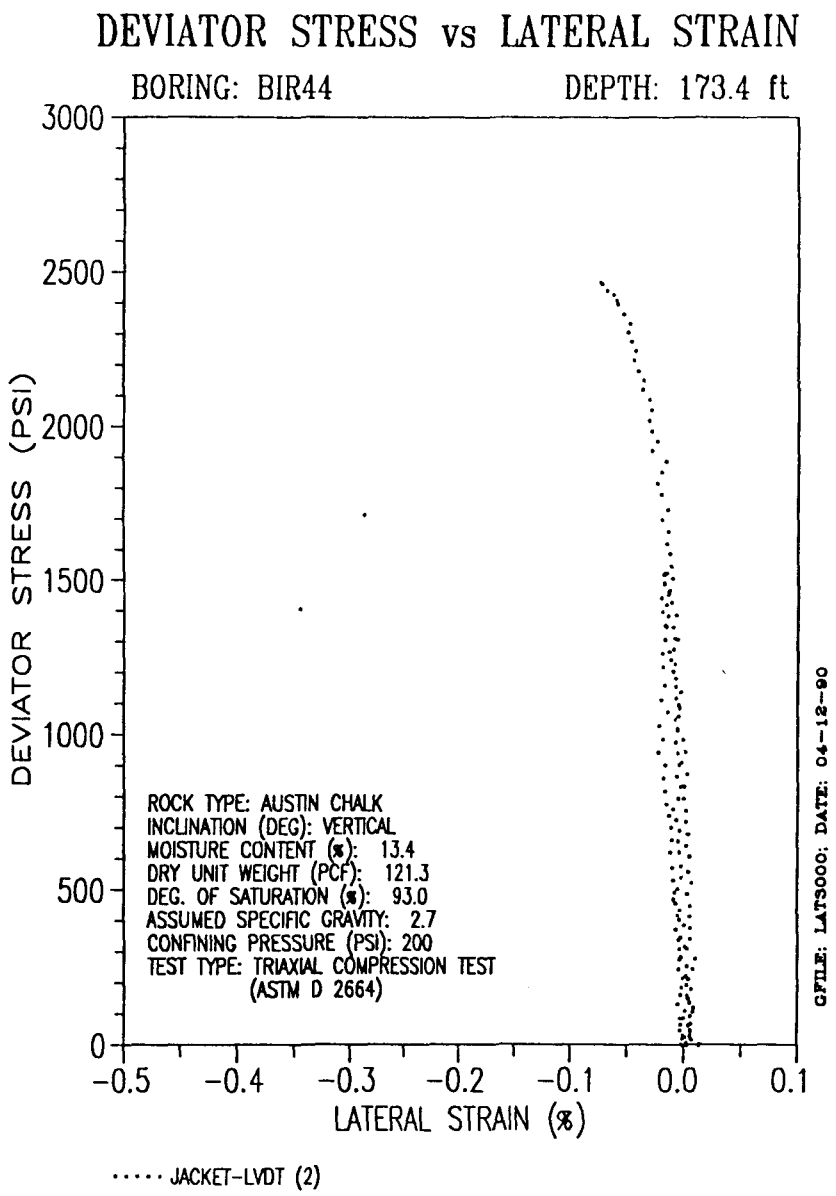
TEXAS SSC SITE

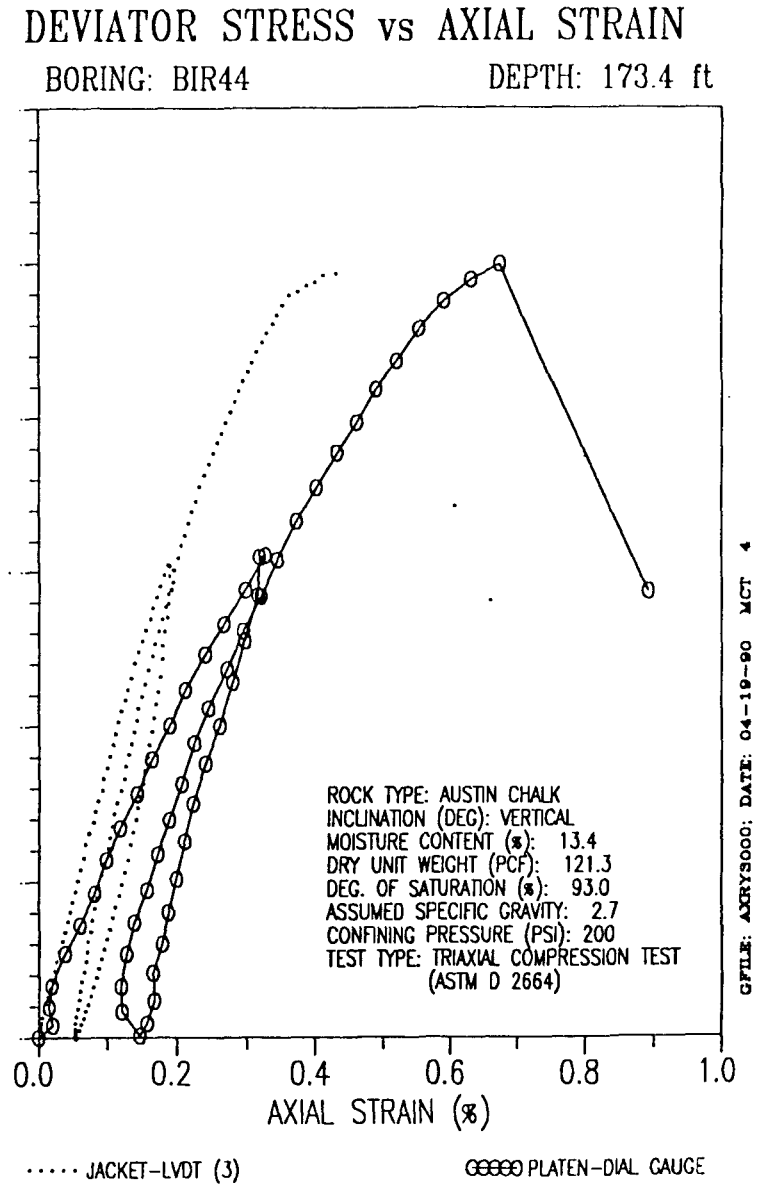
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES,INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

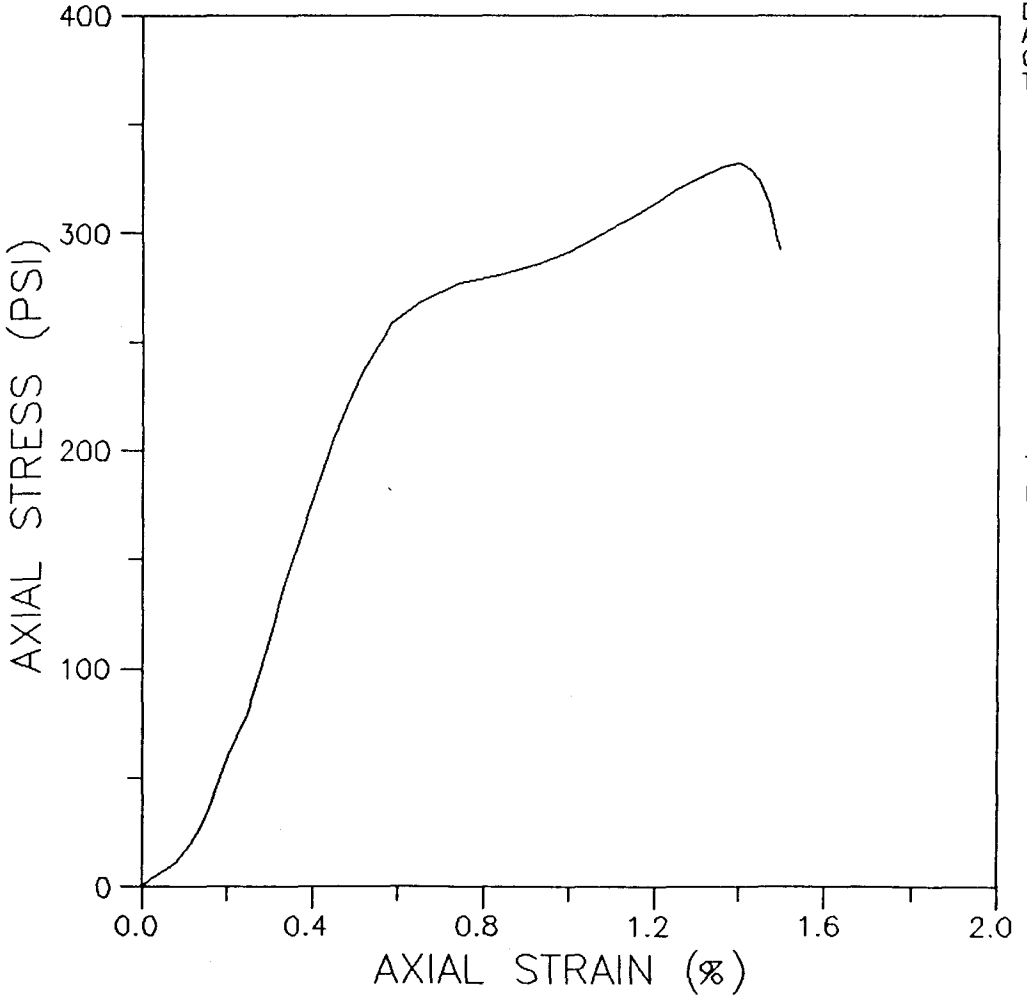
FIGURE





PRELIMINARY

BORING NO: BIR44
DEPTH (FT): 186.3
EAGLE FORD SHALE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 14.6
DRY UNIT WEIGHT (PCF): 120.2
DEG. OF SATURATION (%): 98.1
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
6.0 x 10E4 PSI

FAILURE MODE:
LONGITUDINAL (AXIAL)
SPLITTING

TEXAS SSC SITE

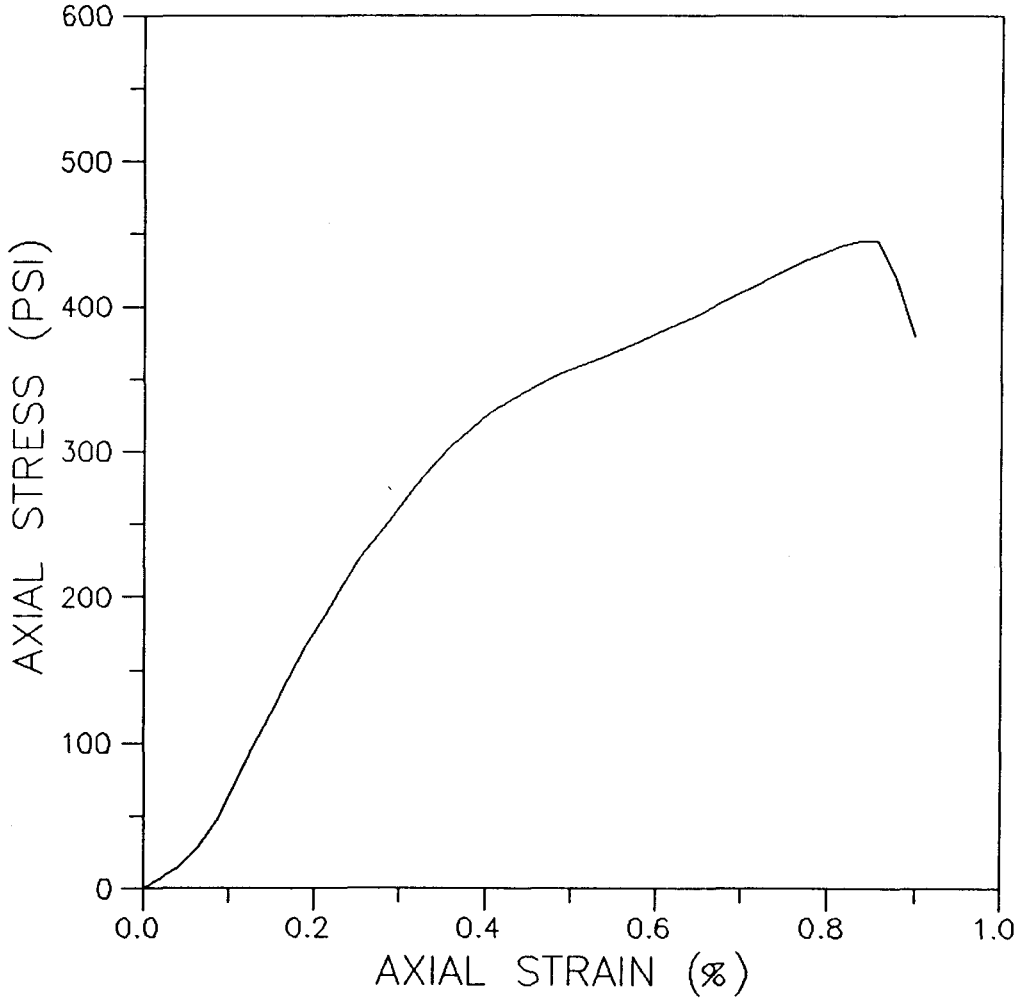
STRESS-STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89-192

FIGURE

BORING NO: BIR44
DEPTH (FT): 224.6
EAGLE FORD SHALE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 12.2
DRY UNIT WEIGHT (PCF): 124.7
DEG. OF SATURATION (%): 93.8
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
8.7 x 10E4 PSI

FAILURE MODE:
LONGITUDINAL (AXIAL)
SPLITTING

TEXAS SSC SITE

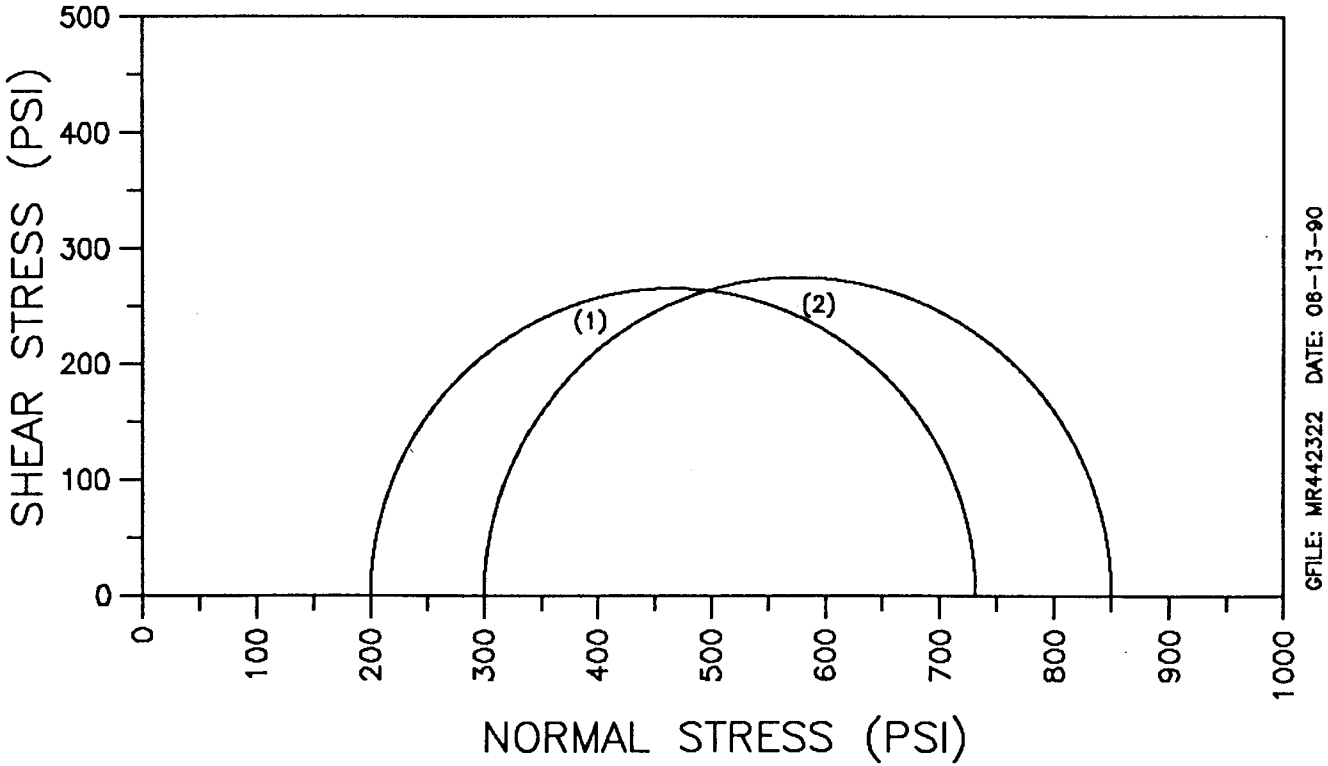
STRESS-STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89-192

FIGURE

BORING NO.: BIR44
DEPTH RANGE (FT): 232.2-233.4
EAGLE FORD SHALE



GFILE: MR442322 DATE: 08-13-90

SEE STRESS-STRAIN PLOTS
FOR INDIVIDUAL SAMPLE DATA

(1) DEPTH (FT): 232.2
(2) DEPTH (FT): 233.0

INCLINATION (DEG): VERTICAL
TEST TYPE: TRIAXIAL COMPRESSION (ASTM D2664)

TEXAS SSC SITE

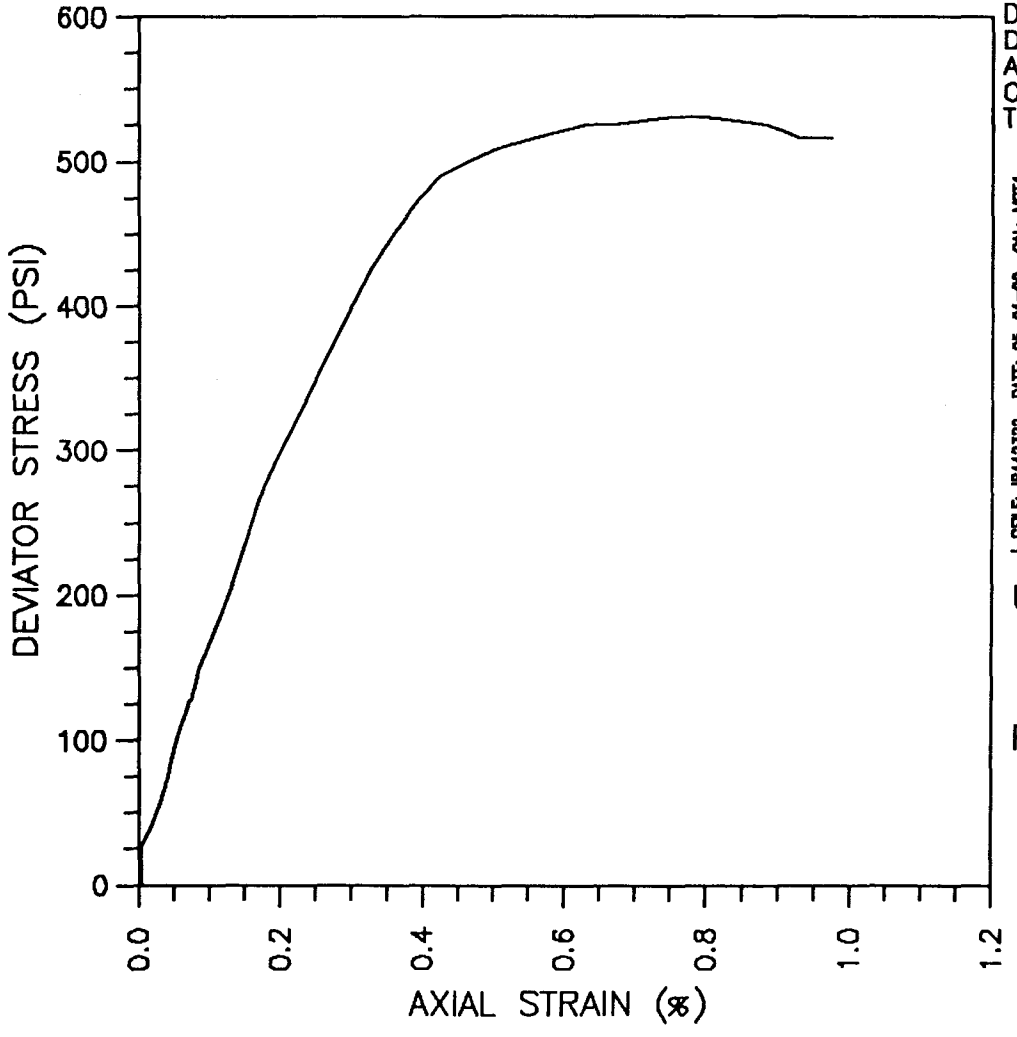
MOHR CIRCLE PLOT

MASON-JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

FIGURE

BORING NO.: BIR44
DEPTH (FT): 232.2
EAGLE FORD SHALE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 14.9
DRY UNIT WEIGHT (PCF): 121.9
DEG. OF SATURATION (%): 105.5
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 200
TEST TYPE: TRIAXIAL COMPRESSION
(ASTM D 2664)

GFILE: IR442322 DATE: 05-01-90 CAL: MCT4

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
1.250 x10E5 PSI

FAILURE MODE:
SHEAR PLANE
AT 30 DEG.

TEXAS SSC SITE

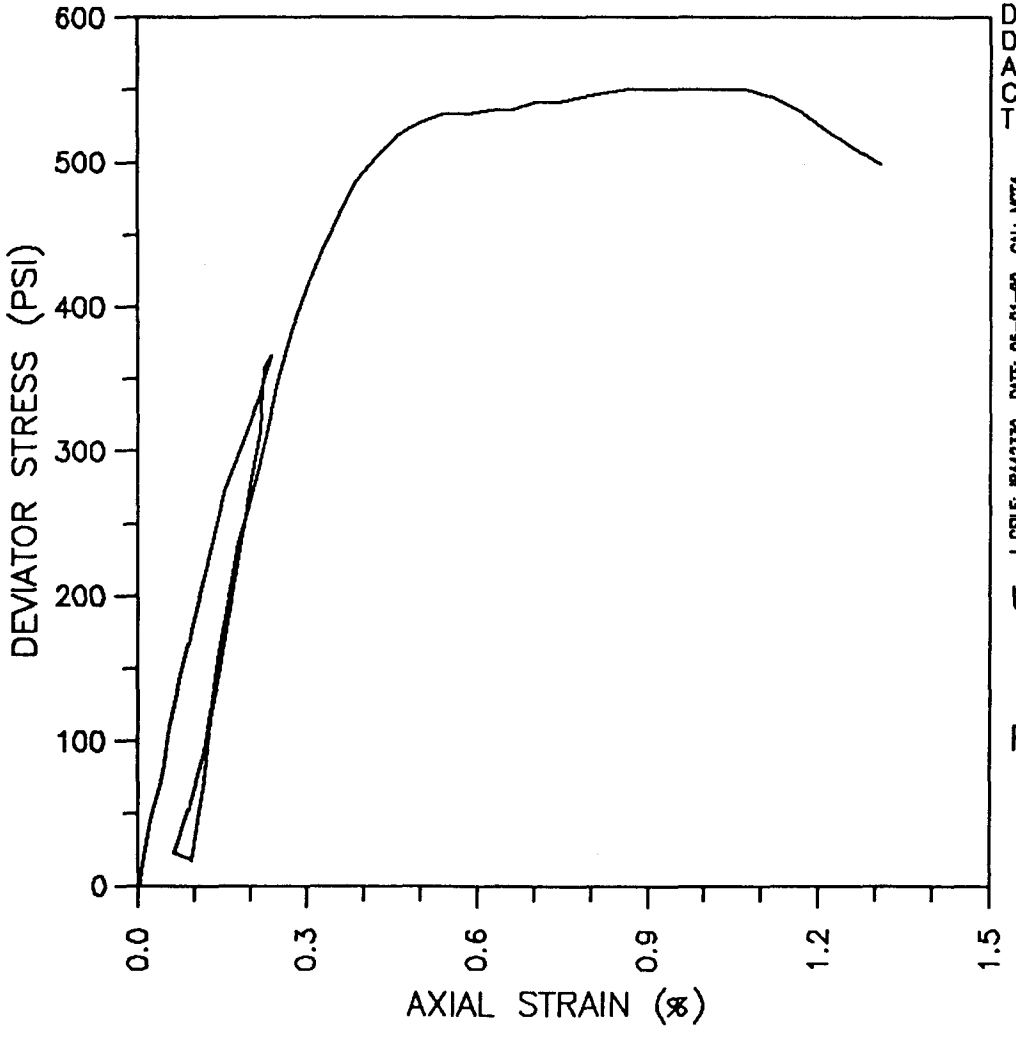
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES,INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

FIGURE

BORING NO.: BIR44
DEPTH (FT): 233.0
EAGLE FORD SHALE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 14.8
DRY UNIT WEIGHT (PCF): 121.9
DEG. OF SATURATION (%): 104.3
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 300
TEST TYPE: TRIAXIAL COMPRESSION
(ASTM D 2664)

GFILE: IR442330 DATE: 05-01-90 CAL: MGT4

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
1.538 x10E5 PSI

FAILURE MODE:
SHEAR PLANE
AT 40 DEG.

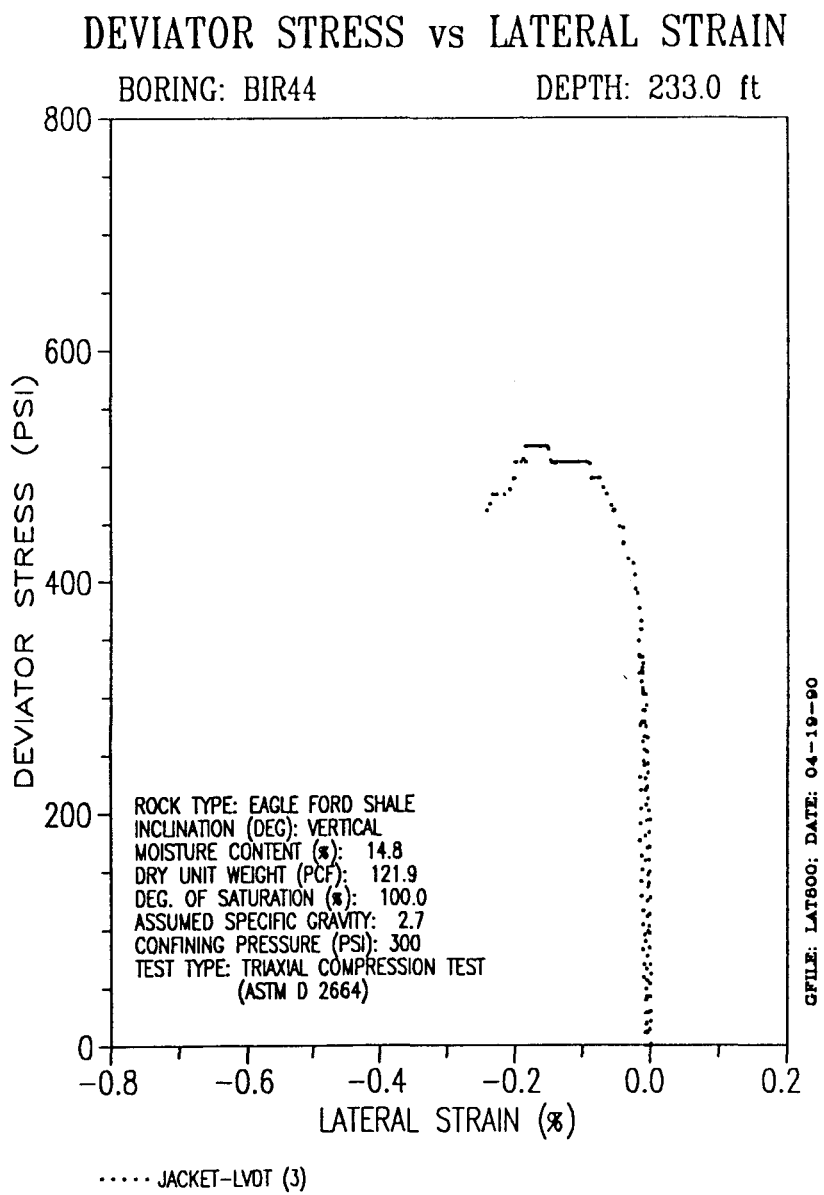
TEXAS SSC SITE

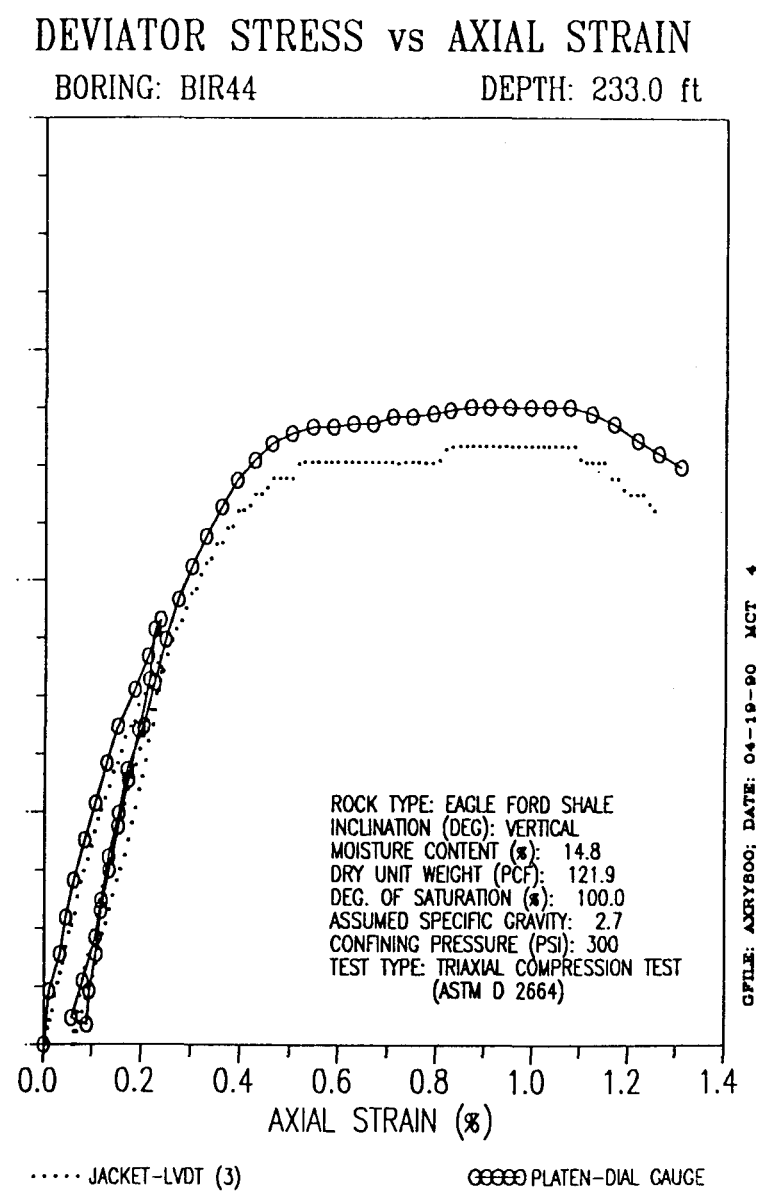
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES,INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

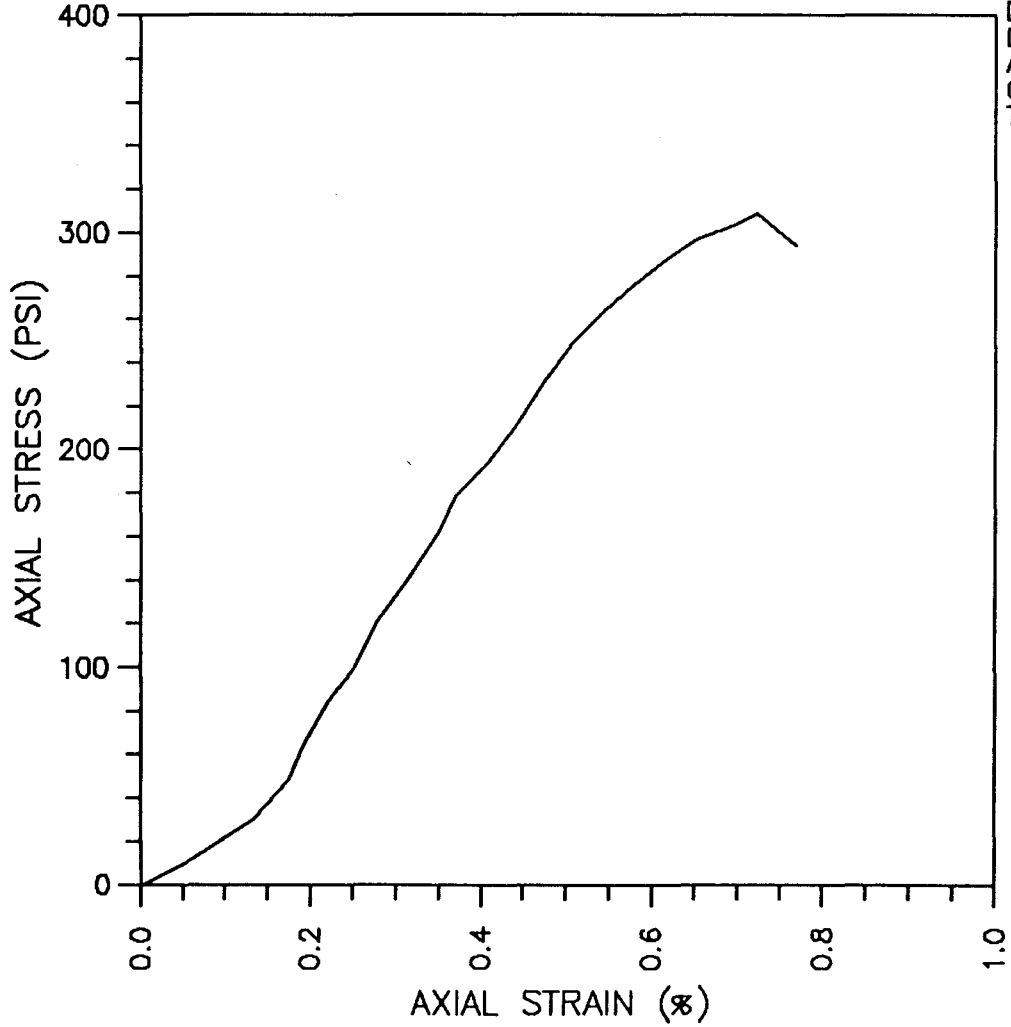
FIGURE





PRELIMINARY

BORING NO.: BIR44
DEPTH (FT): 287.1
EAGLE FORD SHALE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 13.9
DRY UNIT WEIGHT (PCF): 122.0
DEG. OF SATURATION (%): 98.3
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE: UNCONFINED COMPRESSION
(ASTM D 2938)

GFILE: IR442871 DATE: 05-01-90 CAL: MCL13

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
0.628 x10E5 PSI

FAILURE MODE:
AXIAL SPLITTING

TEXAS SSC SITE

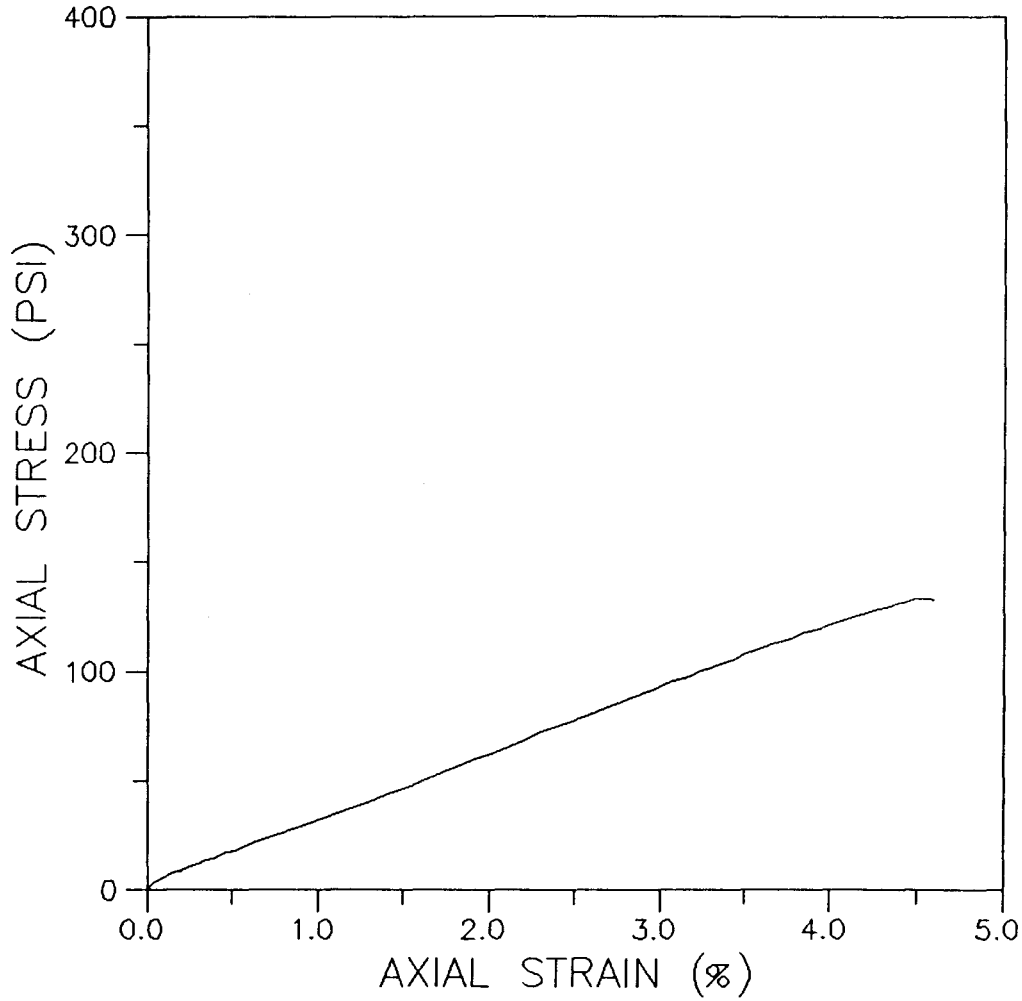
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

FIGURE

BORING NO: BIR44
DEPTH (FT): 295.7
EAGLE FORD SHALE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 10.0
DRY UNIT WEIGHT (PCF): 126.7
DEG. OF SATURATION (%): 81.9
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
3.3 x 10E3 PSI

FAILURE MODE:
LONGITUDINAL (AXIAL)
SPLITTING

TEXAS SSC SITE

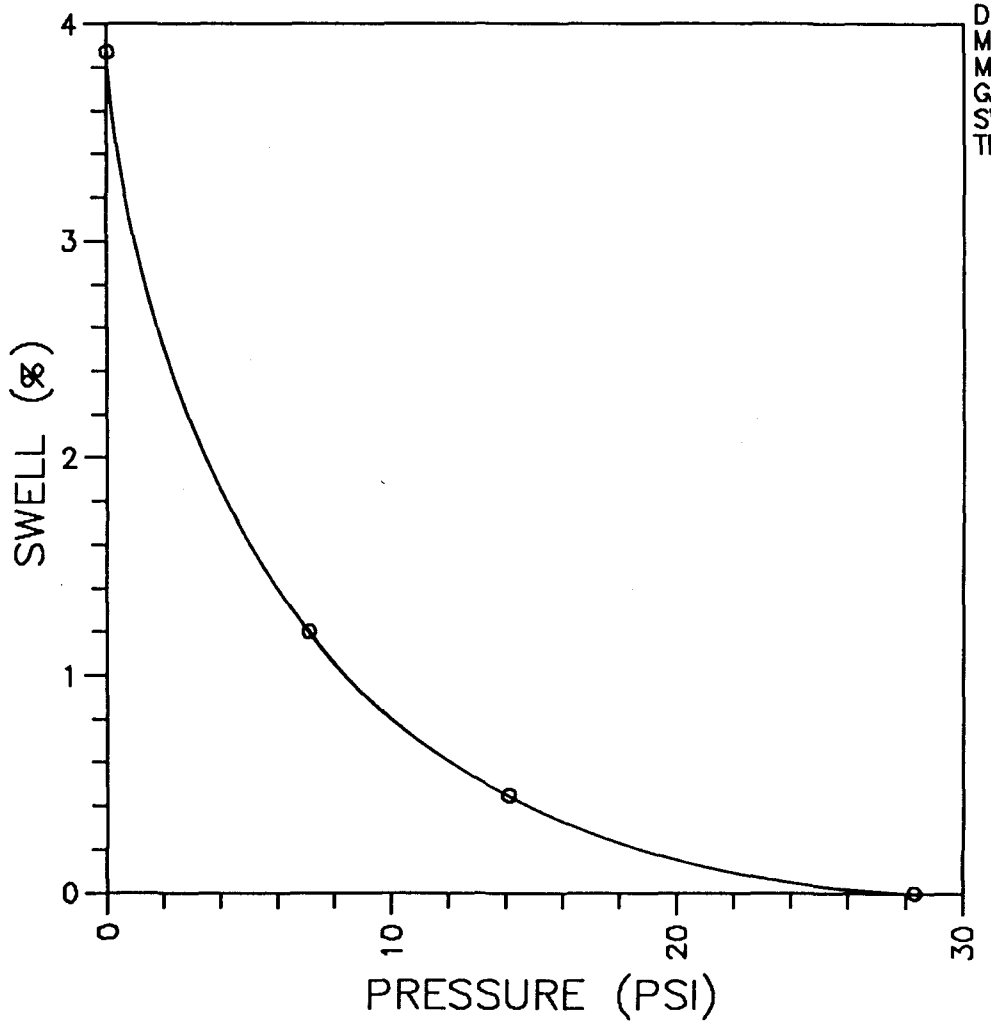
STRESS–STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89–192

FIGURE

BORING NO.: BIR44
DEPTH (FT): 194.6
EAGLE FORD SHALE



INCLINATION (DEG): VERTICAL
DRY UNIT WEIGHT (PCF): 128.6
M.C. BEFORE TEST (%): 13.9
M.C.AFTER TEST (%): 19.1
GAIN IN MOISTURE (%): 5.2
SWELLING PRESSURE INDEX (PSI): 28
TEST TYPE: SWELLING PRESSURE INDEX (ISRM)

TEXAS SSC SITE

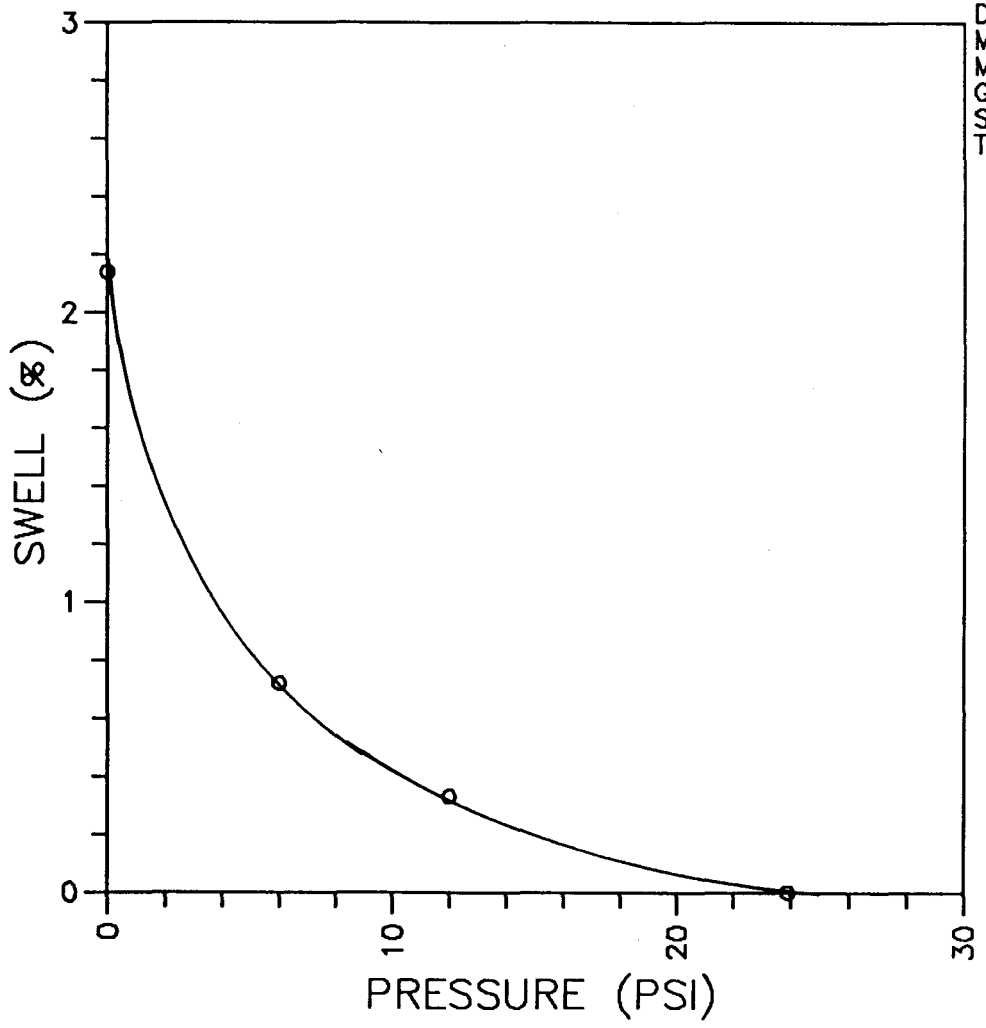
SWELLING PRESSURE INDEX

MASON-JOHNSTON & ASSOCIATES,INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

FIGURE

BORING NO.: BIR44
DEPTH (FT): 256.9
EAGLE FORD SHALE



INCLINATION (DEG): VERTICAL
DRY UNIT WEIGHT (PCF): 117.6
M.C. BEFORE TEST (%): 15.6
M.C.AFTER TEST (%): 19.2
GAIN IN MOISTURE (%): 3.6
SWELLING PRESSURE INDEX (PSI): 24
TEST TYPE: SWELLING PRESSURE INDEX (ISRM)

TEXAS SSC SITE

SWELLING PRESSURE INDEX

MASON-JOHNSTON & ASSOCIATES,INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

FIGURE

GEOMECHANICAL TEST RESULTS

BORING BIR 45

GEOMECHANICAL TEST RESULTS

BORING BIR 44

TABLE E-5. GEOMECHANICAL TEST RESULTS–BORING BIR 44

GENERAL LITHOLOGY	BORING DEPTH	MOISTURE CONTENT	DRY DENSITY	SPECIFIC GRAVITY	ATTERBERG LIMITS		FRACTION FINER THAN # 200 SIEVE	CARBONATE CONTENT	SAMPLE DIMENSION RATIO	SAMPLE FAILURE MODE/ DEGREES*	UNCONFINED COMPRESSIVE STRENGTH	TRIAXIAL COMPRESSION		FAILURE STRAIN	TANGENT YOUNG'S MODULUS			POISSON'S RATIO	BRAZIL TENSILE STRENGTH	2ND CYCLE SLAKE DURABILITY INDEX	MODIFIED TABOR ABRASION/ HARDNESS INDEX	SWELL PRESSURE INDEX	COMMENTS
												CONFINING PRESSURE	DEVIATOR STRESS		E50	UNLOAD/ RELOAD							
	feet	percent	pcf		LL	PI	percent	percent	L/D	DEGREES*	psi	σ_3 psi	$\sigma_1-\sigma_3$ psi	percent	(psi)x10E5	(psi)x10E5	σ_3 psi		psi	percent		percent	
CLAY	0.0	22.8																					
CLAY	0.2	22.8			54	35																	
AUSTIN CHALK	2.0	12.7	121.2						2.2	D	1135			0.34	4.49		0						NOTE 1
AUSTIN CHALK	2.0														12.00			0.18					NOTE 2
AUSTIN CHALK	2.6	12.2																					
AUSTIN CHALK	3.5	14.2																					
AUSTIN CHALK	3.6	13.3	122.1						1.9	D	1150			0.58	3.30		0						
AUSTIN CHALK	20.3	11.7	125.9																				
AUSTIN CHALK	20.7	11.9	123.2						2.2	D		20	2518	0.63	5.11		20						
AUSTIN CHALK	21.1	12.3	122.0						2.2	D		100	2865	0.59	5.49		100						NOTE 1
AUSTIN CHALK	21.1														10.50			0.26					NOTE 2
AUSTIN CHALK	30.1	13.1																					
AUSTIN CHALK	30.2	11.2							0.5										331				
AUSTIN CHALK	30.3	11.4	124.5						2.1	E	2975			0.75	5.00		0						
AUSTIN CHALK	46.7	13.5																					
AUSTIN CHALK	46.9	13.9							0.4										229				
AUSTIN CHALK	47.0	14.3	117.3						2.1	D	2766			0.80	4.40		0						
AUSTIN CHALK	50.8	15.9																					
AUSTIN CHALK	51.2	17.1							0.5										210				
AUSTIN CHALK	51.3	18.7	110.4						2.2	B-1/30	2233			0.33	8.40		0						
AUSTIN CHALK	69.2	16.0																					
AUSTIN CHALK	69.3	15.6																	209				
AUSTIN CHALK	69.4	11.3	122.9						2.2	D	1751			0.46	4.40		0						
AUSTIN CHALK	78.4	11.5																					
AUSTIN CHALK	78.8	12.9	122.6						2.1	C	390			1.62	0.29		0						
AUSTIN CHALK	95.1	14.2	116.4																				
AUSTIN CHALK	95.3	13.9																		95.3			
AUSTIN CHALK	108.1	12.9		2.69																			
AUSTIN CHALK	108.3	12.5	121.5						2.3	D	2619			0.91	4.40		0						
AUSTIN CHALK	108.7	12.1							0.4										236				
AUSTIN CHALK	129.9	12.3																					
AUSTIN CHALK	130.1	13.3	124.2						2.3	B-1/30	2898			0.79	5.70		0						
AUSTIN CHALK	156.1	12.7																					
AUSTIN CHALK	156.3	12.4							0.5										286				
AUSTIN CHALK	156.4	11.5	127.8						2.1	B-1/30	3300			0.64	6.60		0						
AUSTIN CHALK	171.2	12.6	125.3																				
AUSTIN CHALK	171.3	11.9							0.5										285				
AUSTIN CHALK	172.2	12.0	124.7						2.3	D	2379			0.37	8.42		0						NOTE 1
AUSTIN CHALK	172.2														8.31			0.16					NOTE 2
AUSTIN CHALK	172.6	13.9	119.5																				
AUSTIN CHALK	172.9	14.6	119.4						2.2	B-1/20		100	2272	0.55	4.06		100						NOTE 1
AUSTIN CHALK	172.9														7.08			0.01					NOTE 2
AUSTIN CHALK	173.4	13.4	121.3						2.2	B-1/30		200	2494	0.63	4.04		200						NOTES 1 & 3
AUSTIN CHALK	173.4														7.32	11.22		0.11					NOTES 2 & 3
AUSTIN CHALK	173.8	12.0							0.5										213				

TABLE E-5. GEOMECHANICAL TEST RESULTS-BORING BIR 44 (Continued)

GENERAL LITHOLOGY	BORING DEPTH	MOISTURE CONTENT	DRY DENSITY	SPECIFIC GRAVITY	ATTERBERG LIMITS		FRACTION FINER THAN # 200 SIEVE	CARBONATE CONTENT	SAMPLE DIMENSION RATIO L/D	SAMPLE FAILURE MODE/ DEGREES*	UNCONFINED COMPRESSIVE STRENGTH	TRIAXIAL COMPRESSION		FAILURE STRAIN	TANGENT YOUNG'S MODULUS			POISSON'S RATIO	BRAZIL TENSILE STRENGTH	2ND CYCLE SLAKE DURABILITY INDEX	MODIFIED TABOR ABRASION/ HARDNESS INDEX	SWELL PRESSURE INDEX	COMMENTS
					LL	PI						CONFINING PRESSURE σ_3	DEVIATOR STRESS $\sigma_1-\sigma_3$		E50	UNLOAD/ RELOAD	σ_3						
	feet	percent	pcf				percent	percent			psi	psi	psi	percent	(psi)x10E5	(psi)x10E5	psi		psi	percent		percent	
EAGLE FORD SHALE	186.2	15.5																					
EAGLE FORD SHALE	186.3	15.8			100	65	99.0																
EAGLE FORD SHALE	186.3	14.6	120.2						2.1	D	332			1.41	0.60		0						
EAGLE FORD SHALE	192.1	15.4	119.2																				
EAGLE FORD SHALE	192.3	15.1																		35.6			
EAGLE FORD SHALE	194.2	15.9	117.8																				
EAGLE FORD SHALE	194.6	13.9	128.6		95	62	98.2	5.6														28.0	
EAGLE FORD SHALE	194.9	15.9	115.8																			28.0	
EAGLE FORD SHALE	224.4	13.9																					
EAGLE FORD SHALE	224.6	11.8			69	39	86.4																
EAGLE FORD SHALE	224.6	12.2	124.7						2.2	D	445			0.84	0.87		0						
EAGLE FORD SHALE	232.2	14.9	121.9	2.73	73	49	98.8	5.9	2.2	B-1/30		200	531	0.75	1.25		200						
EAGLE FORD SHALE	232.6	15.3	118.1																				
EAGLE FORD SHALE	233.0	14.8	121.9						2.3	B-1/40		300	550	0.86	1.54		300						NOTES 1 & 3
EAGLE FORD SHALE	233.0														1.12	1.89		0.08					NOTES 2 & 3
EAGLE FORD SHALE	256.3	15.9	117.3																				
EAGLE FORD SHALE	256.7	15.3	112.0	2.72	69	35	95.8	4.4														19.0	
EAGLE FORD SHALE	256.9	15.6	117.6																			24.0	
EAGLE FORD SHALE	286.4	13.5	123.1																				
EAGLE FORD SHALE	287.1	13.9	122.0						2.4	D	309			0.72	0.63		0						
EAGLE FORD SHALE	295.5	10.7																					
EAGLE FORD SHALE	295.7	9.8			39	21	70.4																
EAGLE FORD SHALE	295.7	10.0	126.7						2.3	D	133			4.58	0.03		0						
PROCEDURE		ASTM D2216		ASTM-D854	ASTM-D4318		ASTM-D422				ASTM-D2938	ASTM-D2664			ASTM-D3148			ASTM-D3148	ISRM	ISRM	ISRM	ISRM	

BIR44PRT.WK1
REVISION: 1.1
DATE: 5/9/90

PRELIMINARY
(Subject to Revision)

* EXPLANATION OF SAMPLE FAILURE MODE AS FOLLOWS.

Symbol	Failure Type
A	No discernible failure plane
(B)	Well defined shear plane @ "X" angle (deg) to vertical or to long axis of core
B-1	Shear plane
B-2	Bedding plane shear
B-3	Shear plane along pre-existing fracture, shear zone, etc.
B-4	Combination
C	Barreling/Bulging
D	Longitudinal (axial) splitting
E	Conical
F	No information

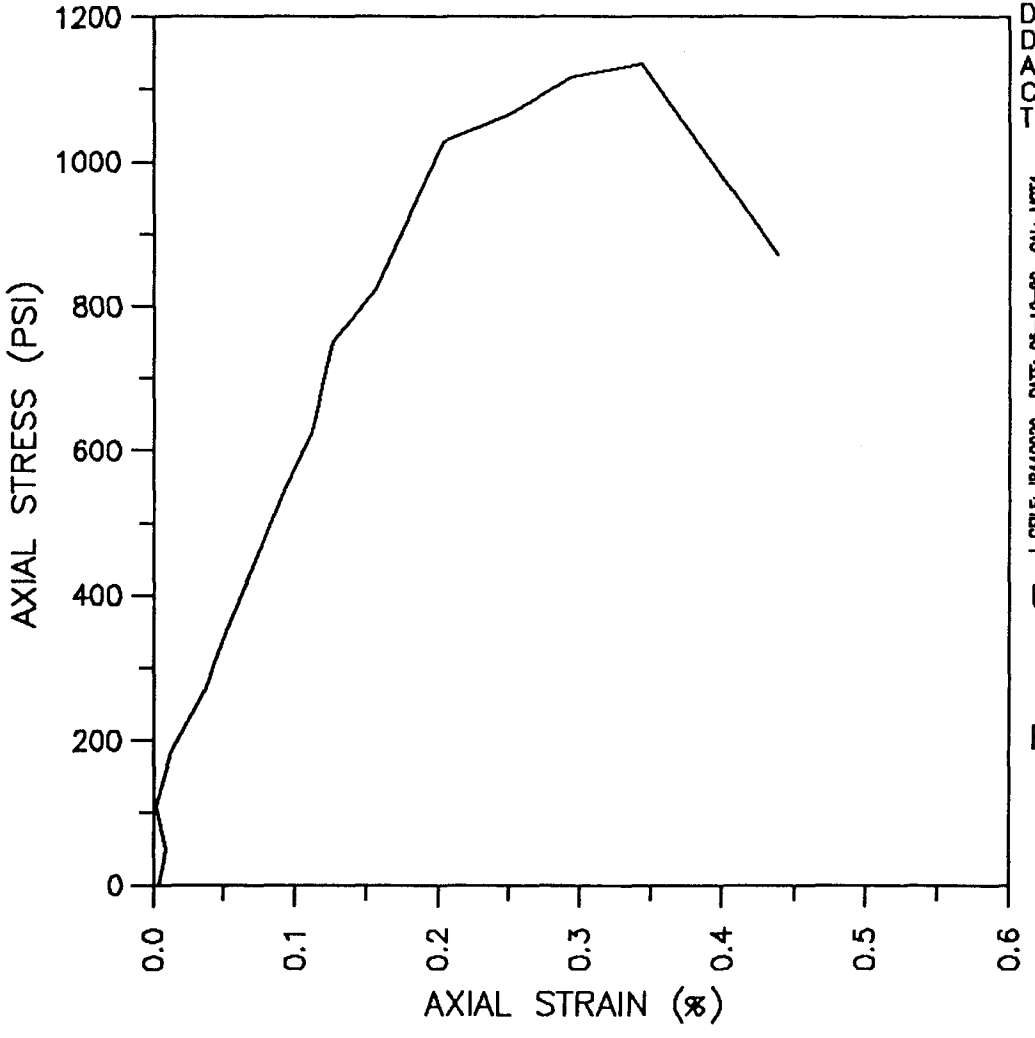
Note: Some values in this table may be revised based on reviews of test procedures and individual test results. The reader should refer to the latest revision of the gINT geotechnical data base (geotechnical report GR-70).

NOTES: 1) MODULUS WAS CALCULATED FROM AXIAL STRAINS MEASURED USING DIAL MICROMETER. AXIAL LENGTH IS THE SAMPLE LENGTH.

2) MODULII AND POISSON'S RATIO WERE CALCULATED FROM AXIAL AND LATERAL STRAINS MEASURED USING AXIAL AND LATERAL LVDTS. AXIAL LENGTH IS 2.8 INCHES.

3) CYCLIC TESTS WITH ONE UNLOAD-RELOAD CYCLE.

BORING NO.: BIR44
DEPTH (FT): 2.0
AUSTIN CHALK LIMESTONE, WEATHERED



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 12.7
DRY UNIT WEIGHT (PCF): 121.2
DEG. OF SATURATION (%): 87.7
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE: UNCONFINED COMPRESSION
(ASTM D 2938)

GFILE: IR440020 DATE: 05-10-90 CAL: MCT4

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
4.486 x10E5 PSI

FAILURE MODE:
AXIAL SPLITTING

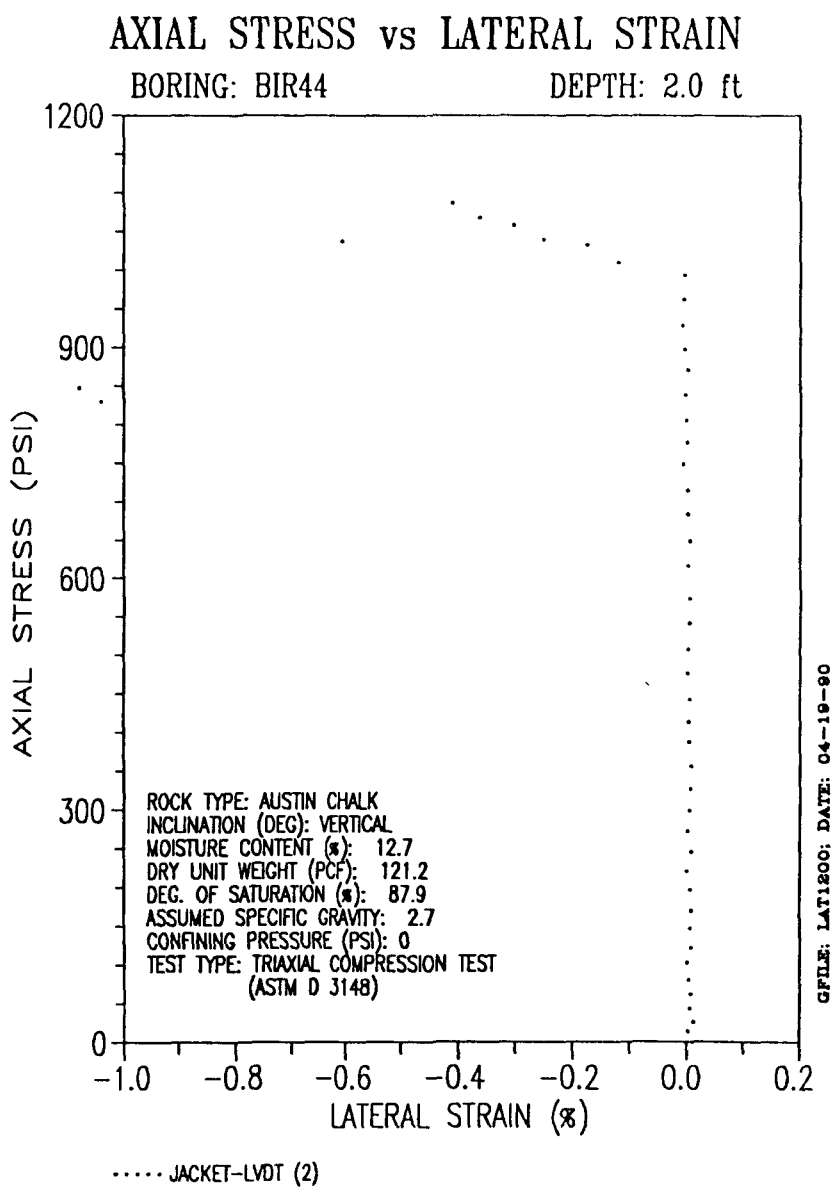
TEXAS SSC SITE

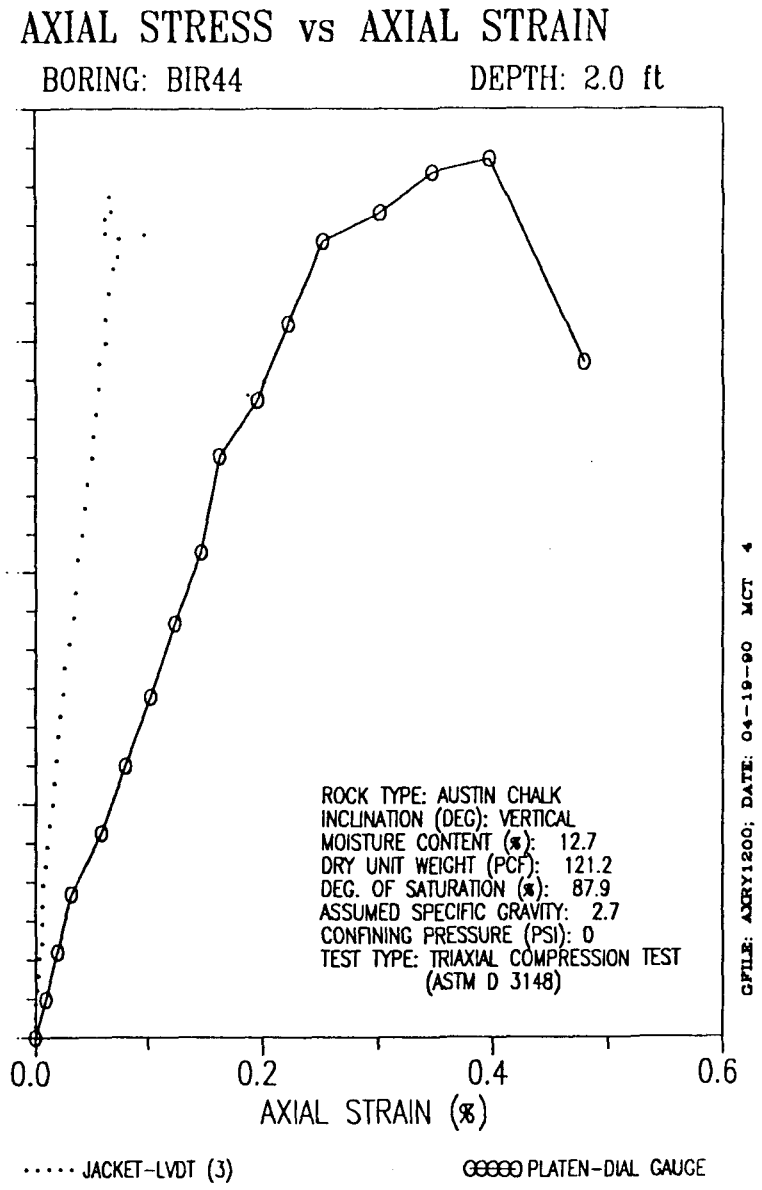
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

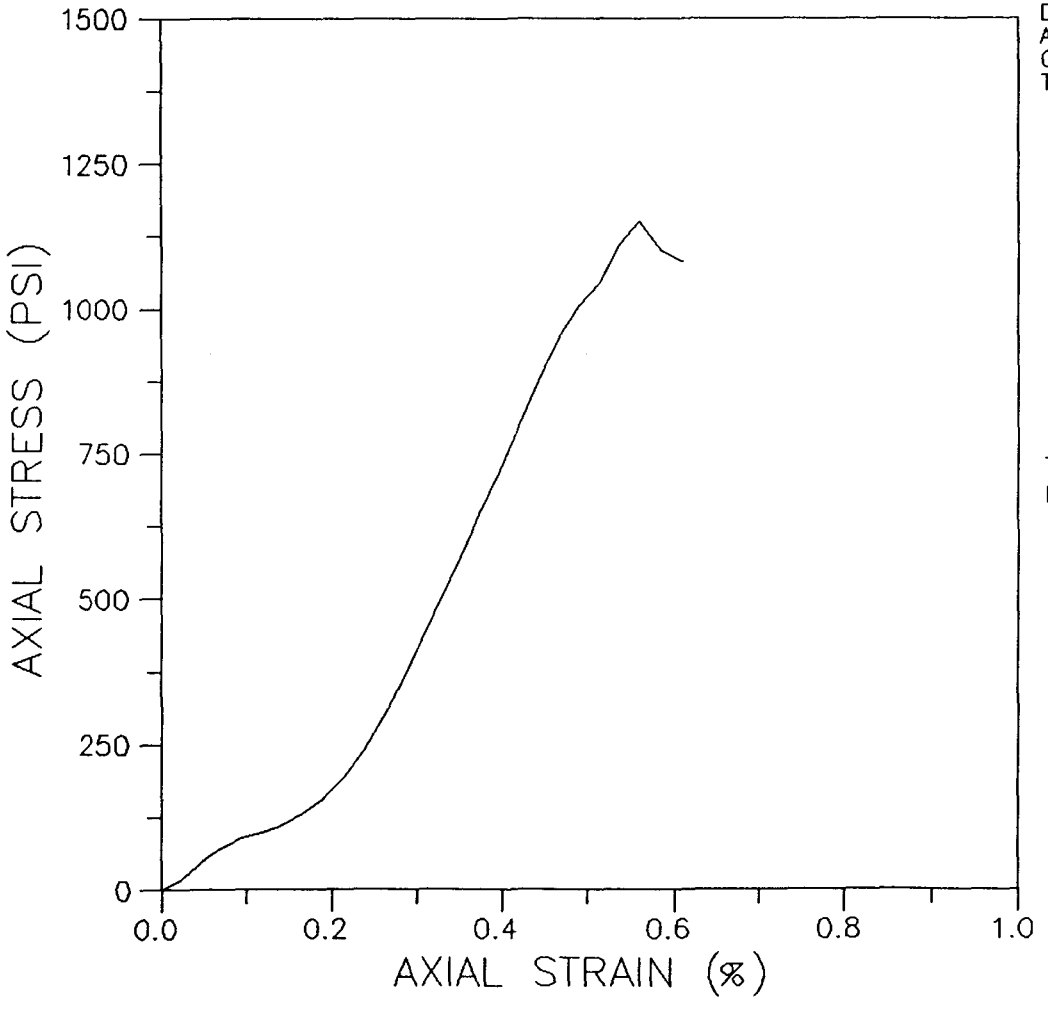
FIGURE





PRELIMINARY

BORING NO: BIR44
DEPTH (FT): 3.6
AUSTIN CHALK



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 13.3
DRY UNIT WEIGHT (PCF): 122.1
DEG. OF SATURATION (%): 94.5
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
3.3 x 10E5 PSI

FAILURE MODE:
LONGITUDINAL (AXIAL)
SPLITTING

TEXAS SSC SITE

STRESS-STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89-192

FIGURE

TABLE E-6. GEOMECHANICAL TEST RESULTS-BORING BIR 45

GENERAL LITHOLOGY	VERTICAL DEPTH feet	MOISTURE CONTENT percent	DRY DENSITY pcf	SPECIFIC GRAVITY	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	FRACTION FINER THAN # 200 SIEVE percent	CARBONATE CONTENT percent	SAMPLE DIMENSION RATIO L/D	SAMPLE FAILURE MODE/ DEGREES *	UNCONFINED COMPRESSIVE STRENGTH psi	TRIAXIAL COMPRESSION CONFINING PRESSURE σ_3 psi	TRIAXIAL COMPRESSION DEVIATOR STRESS $\sigma_1-\sigma_3$ psi	FAILURE STRAIN percent	TANGENT YOUNG'S MODULUS E50 (psi)x10E5	TANGENT YOUNG'S MODULUS UNLOAD/ RELOAD (psi)x10E5	TANGENT YOUNG'S MODULUS σ_3 psi	POISSON'S RATIO	BRAZIL TENSILE STRENGTH psi	2ND CYCLE SLAKE DURABILITY INDEX percent	MODIFIED TABOR ABRASION/ HARDNESS INDEX	SWELL PRESSURE INDEX percent	COMMENTS
CLAY	0.0	34.6			73	45	91.7																
AUSTIN CHALK	9.0	13.6																					
AUSTIN CHALK	9.1	12.9							0.5										204				
AUSTIN CHALK	9.2	14.1	119.5						2.1	E	1979			0.36	7.94		0						
AUSTIN CHALK	16.0	8.4	131.1						-														
AUSTIN CHALK	16.1	9.5							0.5										183				
AUSTIN CHALK	41.6	13.6																					
AUSTIN CHALK	41.8	15.3	114.5						2.1	B-1/30	2415			0.97	3.38		0						
AUSTIN CHALK	67.0	11.6																					
AUSTIN CHALK	67.2	12.3							0.5										294				
AUSTIN CHALK	67.3	12.4	122.7						2.1	B-1/30	2252			0.97	2.63		0						
AUSTIN CHALK	71.0	12.0																					
AUSTIN CHALK	71.2	13.8	122.2						2.2	D	487			1.33	0.29		0						
AUSTIN CHALK	81.0	15.7																					
AUSTIN CHALK	81.2	16.8							0.5										289				
AUSTIN CHALK	81.7	18.7	110.8						2.2	D	1924			0.29	9.78		0						
AUSTIN CHALK	102.0	13.5	122.1																				
AUSTIN CHALK	102.7	12.6							0.5										245				
AUSTIN CHALK	104.6	20.8	111.0		62	35	90.3																
BENTONITE	105.0	41.1	81.8		106	62	97.6															5.3	
BENTONITE	105.2	41.8	76.6																			5.3	
BENTONITE	105.6	40.2	80.5		95	48	97.1																
AUSTIN CHALK	109.2	13.1	125.6																				
AUSTIN CHALK	110.1	12.8	125.8	2.66					2.3	B-1/20		200	3246	0.72	6.00		200						
AUSTIN CHALK	110.5	11.6	123.8						2.2	B-1/20		100	2507	1.48	2.04		100						
AUSTIN CHALK	111.8	13.4																					
AUSTIN CHALK	111.9	12.0	126.8						2.2	B-1/30	3015			0.76	4.78		0						
AUSTIN CHALK	131.4	14.6																					
AUSTIN CHALK	131.5	16.0	116.0						2.2	D	1794			0.42	5.62		0						
AUSTIN CHALK	151.0	14.5																					
AUSTIN CHALK	151.1	14.4	120.2						2.2	B-1/30	2699			0.39	9.55		0						
AUSTIN CHALK	168.0	12.8	123.8						2.1	D		100	2460	0.65	4.08		100						
AUSTIN CHALK	168.4	13.0	123.7	2.69					2.2	B-4		200	2697	0.72	4.62		200						
AUSTIN CHALK	168.8	13.5	121.8																				
AUSTIN CHALK	169.0	12.7	124.8																				
AUSTIN CHALK	169.6	13.2	119.1						2.2	D	2194			0.69	4.32		0						
AUSTIN CHALK	171.0	11.7	126.6																				
AUSTIN CHALK	171.4	8.6	140.6						0.6										116				
EAGLE FORD SHALE	179.9	16.2	115.6																				
EAGLE FORD SHALE	180.1	16.4																		15.4			
EAGLE FORD SHALE	180.6			2.69	94	59	99.5																
EAGLE FORD SHALE	196.4	15.6	121.1																				
EAGLE FORD SHALE	196.5				101	66	99.7																
EAGLE FORD SHALE	197.6	16.8																					
EAGLE FORD SHALE	197.7	16.4	118.8		101	66	99.9		2.4	B-3/45	111			0.15	0.72		0						
EAGLE FORD SHALE	200.1	18.3	108.1																			44	
EAGLE FORD SHALE	200.8	16.7	114.0		90	63	99.8	5.9														32	
EAGLE FORD SHALE	230.5	15.0	121.6																				
EAGLE FORD SHALE	231.2	12.9	123.0						2.1	E		200	449	1.11	0.76		200						
EAGLE FORD SHALE	231.6	11.0	127.0	2.69	55	37	97.6	18.4	2.1	B-1/40		300	493	1.61	0.49		300						
EAGLE FORD SHALE	232.9	15.5																					
EAGLE FORD SHALE	233.0	15.5	118.4		69	40	92.8		2.2	D	346			0.92	0.90		0						
EAGLE FORD SHALE	260.1	16.5	118.5																				
EAGLE FORD SHALE	260.6	15.1	120.1		75	50	98.8	7.4	2.4	D	380			0.93	1.05		0						
EAGLE FORD SHALE	295.0	13.7	122.2																				
EAGLE FORD SHALE	295.4	12.9	123.6						2.3	B-1/40		200	579	0.86	1.21		200						
EAGLE FORD SHALE	295.8	13.7	121.3		51	29	93.8	29.3	2.2	B-1/50		300	567	1.05	1.05		300						
EAGLE FORD SHALE	307.2	9.1																					
EAGLE FORD SHALE	307.3	10.5	131.3						2.2	B-3/60	120			1.34	0.08		0						
EAGLE FORD SHALE	308.1								0.6										336				NOTE
PROCEDURE		ASTM-D2216		ASTM-D854	ASTM-D4318		ASTM-D422				ASTM-D2938	ASTM-D2664			ASTM-D3148			ASTM-D3148	ISRM	ISRM	ISRM	ISRM	

BIRSPRT WK1
REVISION 1.0
DATE 5/1/90

PRELIMINARY
(Subject to Revision)

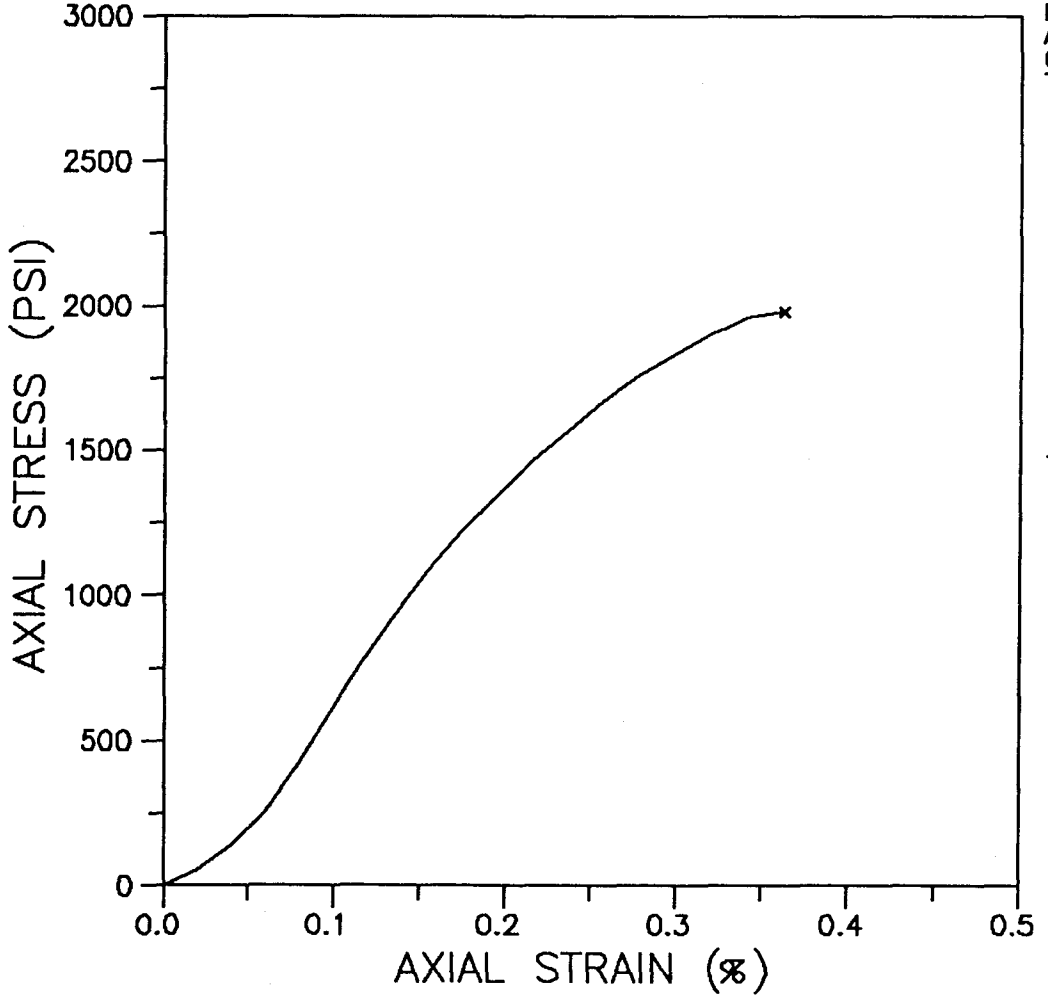
* EXPLANATION OF SAMPLE FAILURE MODE AS FOLLOWS.

Symbol	Failure Type	Symbol	Failure Type
A	No discernible failure plane	B-4	Combination
(B)	Well defined shear plane @ "X" angle (deg) to vertical or to long axis of core	C	Barreling/Bulging
B-1	Shear plane	D	Longitudinal (axial) splitting
B-2	Bedding plane shear	E	Conical
B-3	Shear plane along pre-existing fracture,	F	No information

NOTE: FAILURE OCCURRED ALONG BEDDING PLANE

Note: Some values in this table may be revised based on reviews of test procedures and individual test results. The reader should refer to the latest revision of the gINT geotechnical data base (geotechnical report GR-70).

BORING NO: BIR45
DEPTH (FT): 9.2
AUSTIN CHALK



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 14.1
DRY UNIT WEIGHT (PCF): 119.5
DEG. OF SATURATION (%): 92.9
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
7.94 x 10E5 PSI

FAILURE MODE:
CONICAL

TEXAS SSC SITE

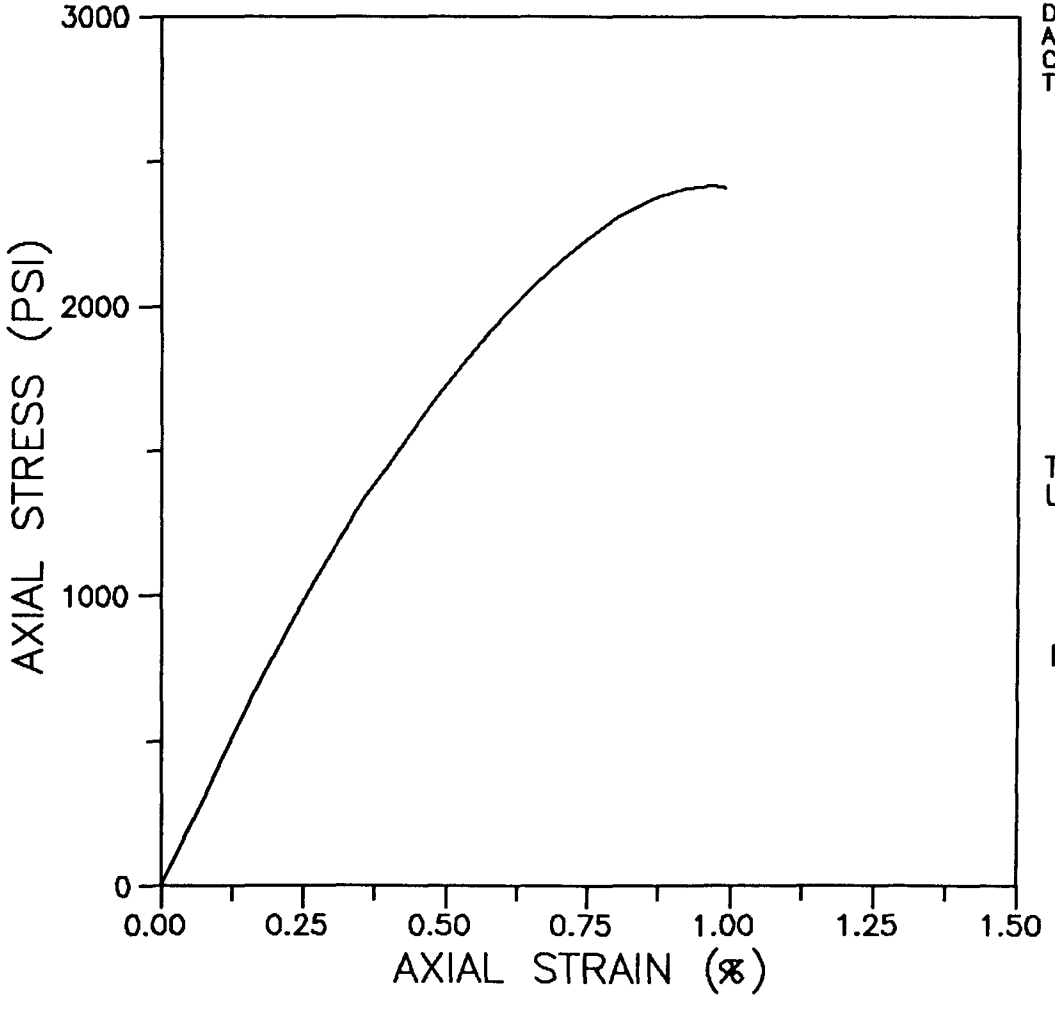
STRESS-STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89-192

FIGURE

BORING NO: BIR45
DEPTH (FT): 41.8
AUSTIN CHALK



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 15.3
DRY UNIT WEIGHT (PCF): 114.5
DEG. OF SATURATION (%): 87.6
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
3.38 x 10E5 PSI

FAILURE MODE:
SHEAR PLANE AT 30 DEG

TEXAS SSC SITE

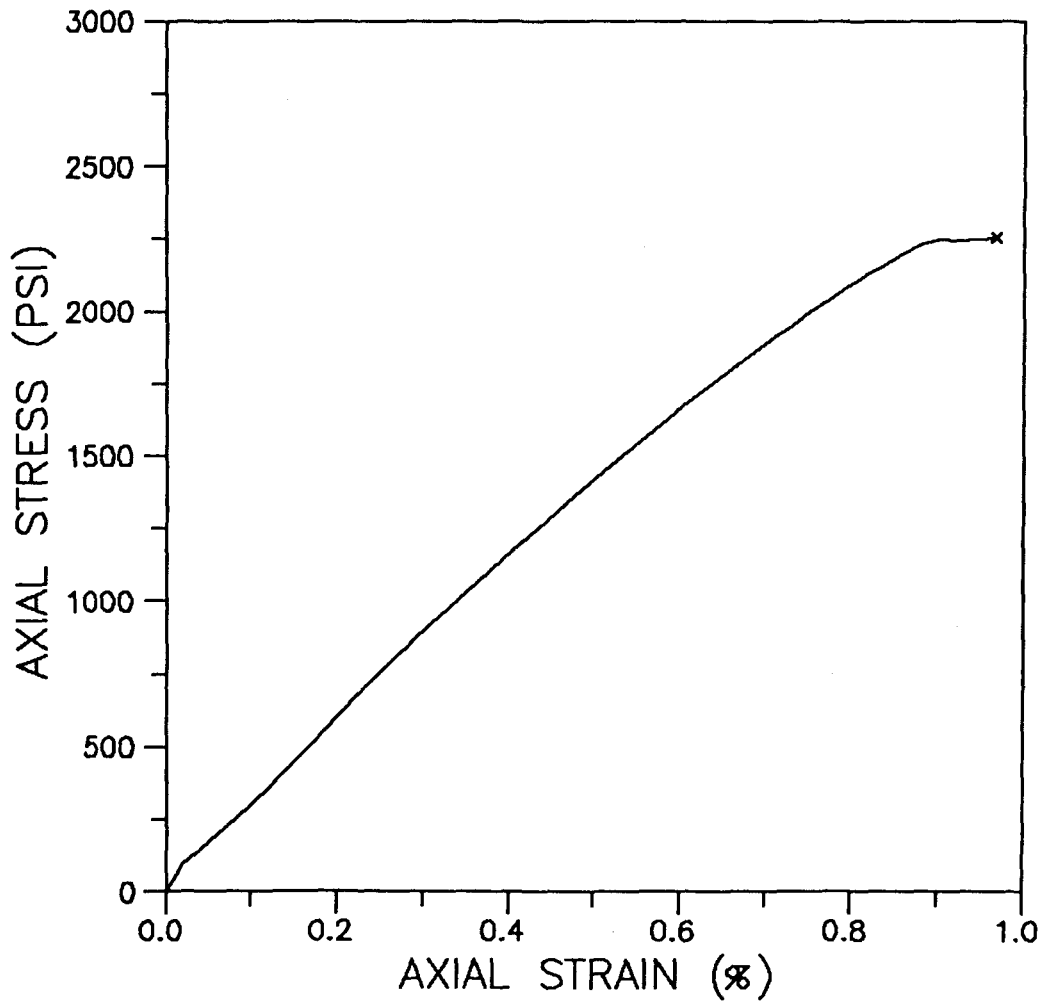
STRESS-STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89-192

FIGURE

BORING NO: BIR45
DEPTH (FT): 67.3
AUSTIN CHALK



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 12.4
DRY UNIT WEIGHT (PCF): 122.7
DEG. OF SATURATION (%): 89.7
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
2.63 x 10E5 PSI

FAILURE MODE:
SHEAR PLANE AT 30 DEG

TEXAS SSC SITE

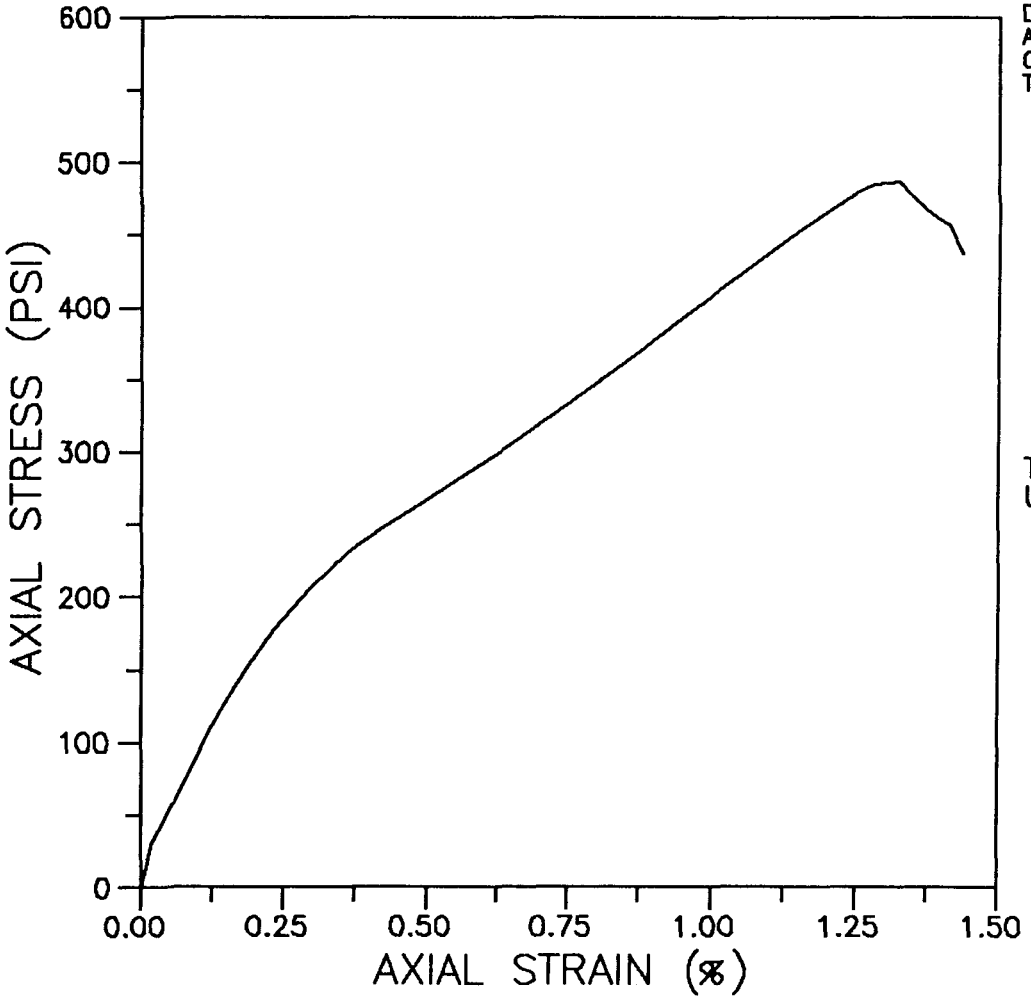
STRESS-STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89-192

FIGURE

BORING NO: BIR45
DEPTH (FT): 71.2
AUSTIN CHALK



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 13.8
DRY UNIT WEIGHT (PCF): 122.2
DEG. OF SATURATION (%): 98.4
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
2.93 x 10E4 PSI

FAILURE MODE:
LONGITUDINAL (AXIAL)
SPLITTING

TEXAS SSC SITE

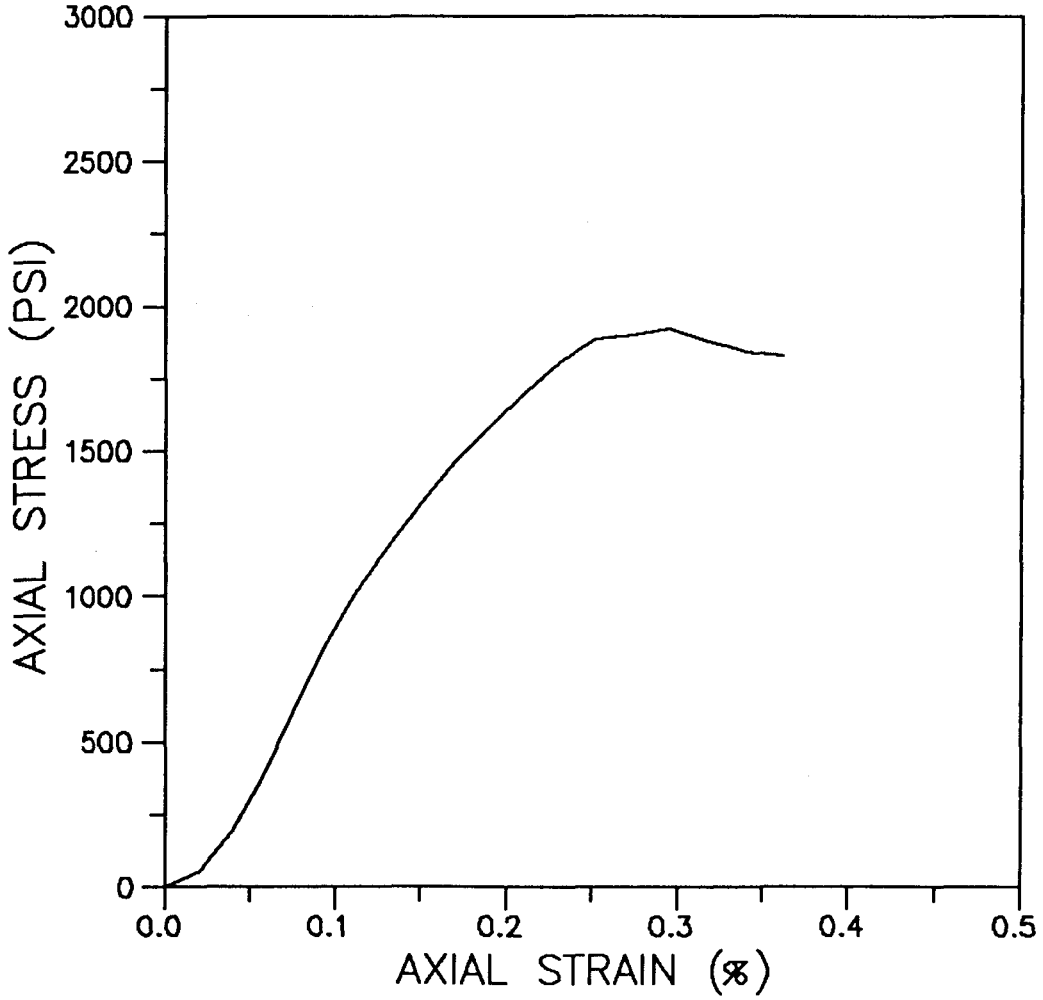
STRESS-STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89-192

FIGURE

BORING NO: BIR45
DEPTH (FT): 81.7
AUSTIN CHALK



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 18.7
DRY UNIT WEIGHT (PCF): 110.8
DEG. OF SATURATION (%): 97.0
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
9.78 x 10E5 PSI

FAILURE MODE:
LONGITUDINAL (AXIAL)
SPLITTING

TEXAS SSC SITE

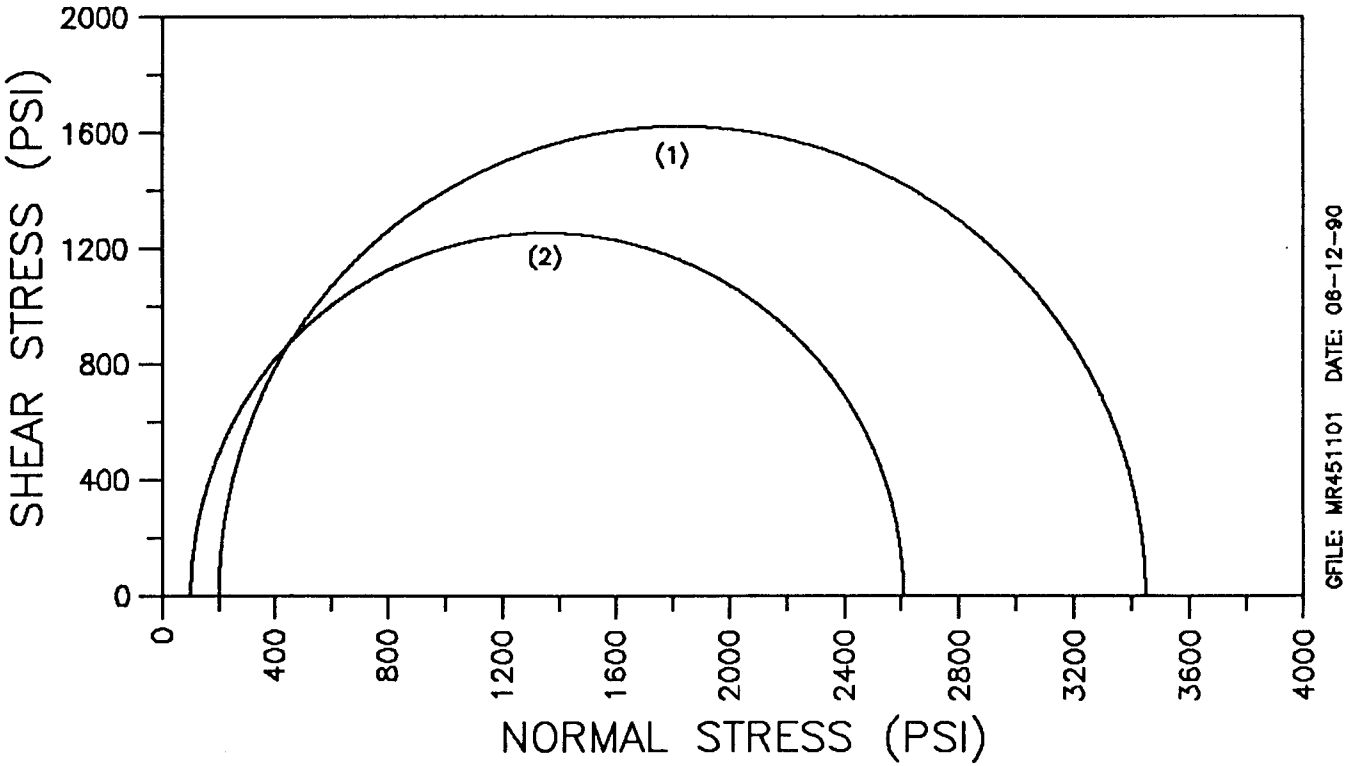
STRESS-STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89-192

FIGURE

BORING NO.: BIR45
DEPTH RANGE (FT): 110.1–110.9
AUSTIN CHALK LIMESTONE



GFILE: MR451101 DATE: 08-12-90

SEE STRESS–STRAIN PLOTS
FOR INDIVIDUAL SAMPLE DATA

(1) DEPTH (FT): 110.1
(2) DEPTH (FT): 110.5

INCLINATION (DEG): VERTICAL
TEST TYPE: TRIAXIAL COMPRESSION (ASTM D2664)

TEXAS SSC SITE

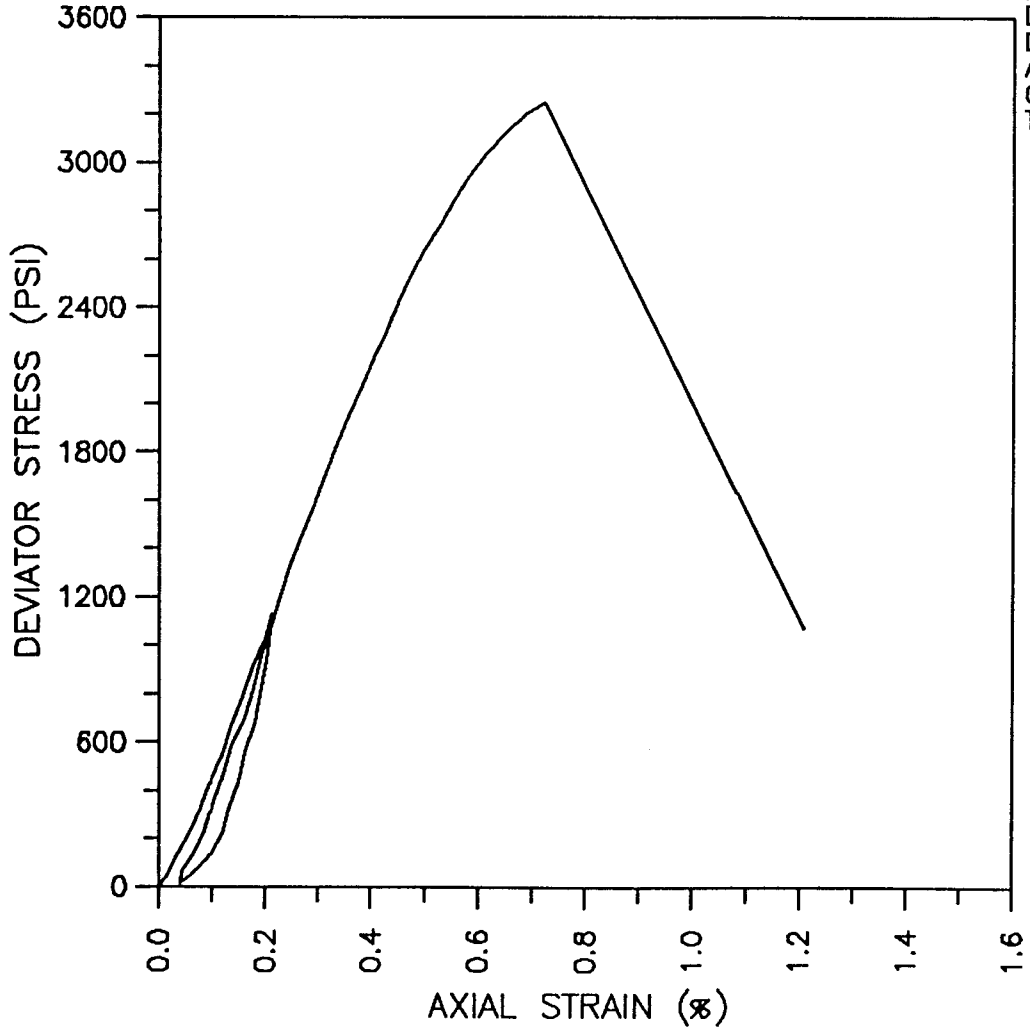
MOHR CIRCLE PLOT

MASON–JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS–ENGINEERS

JOB NO.: 5530.15

FIGURE

BORING NO.: BIR45
DEPTH (FT): 110.1
AUSTIN CHALK LIMESTONE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 12.8
DRY UNIT WEIGHT (PCF): 125.8
DEG. OF SATURATION (%): 101.5
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 200
TEST TYPE: TRIAXIAL COMPRESSION
(ASTM D 2664)

DFILE: BR451101 DATE: 04-28-90 CAL: MCTS

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
6.000 x10E5 PSI

FAILURE MODE:
SHEAR PLANE
AT 20 DEG.

TEXAS SSC SITE

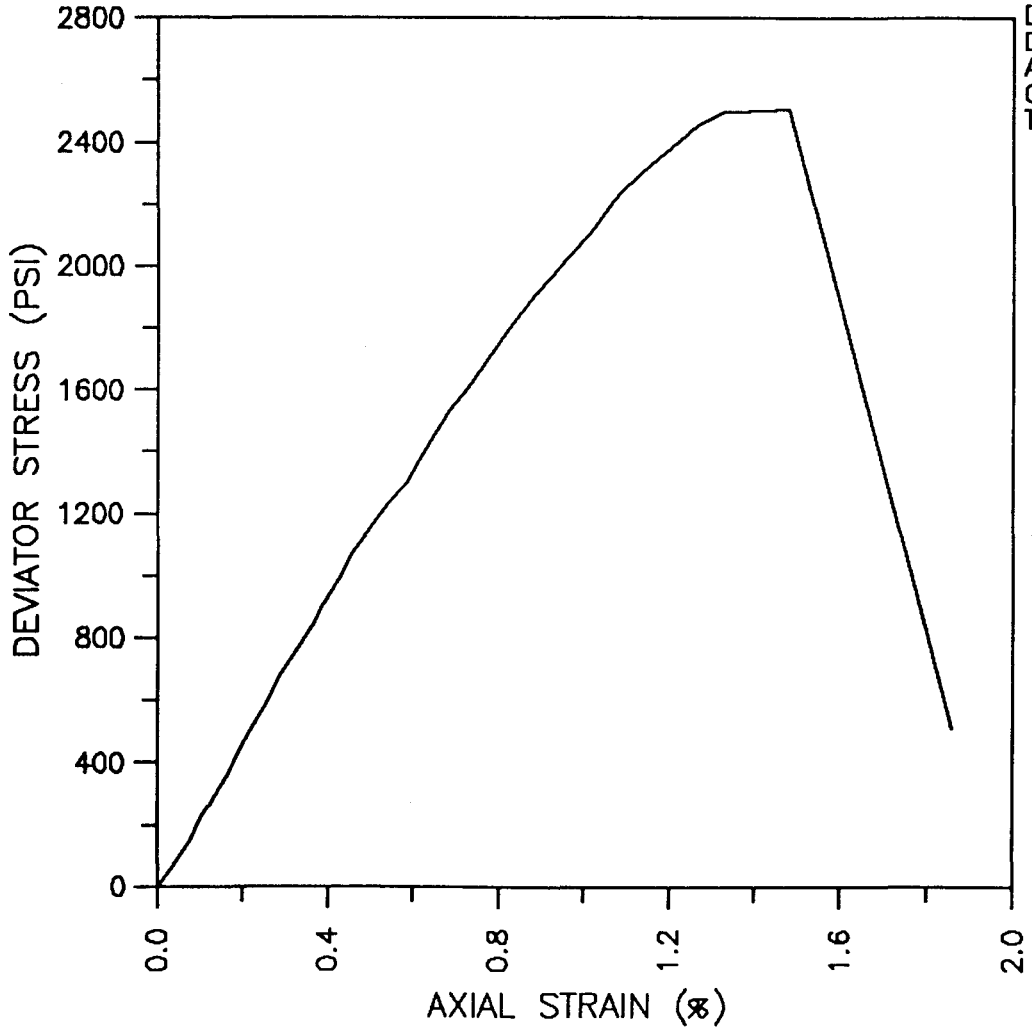
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

FIGURE

BORING NO.: BIR45
DEPTH (FT): 110.5
AUSTIN CHALK LIMESTONE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 11.6
DRY UNIT WEIGHT (PCF): 123.8
DEG. OF SATURATION (%): 86.6
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 100
TEST TYPE: TRIAXIAL COMPRESSION
(ASTM D 2664)

DFILE: IR451105 DATE: 04-30-90 CAL: MCTS

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
2.041 x10E5 PSI

FAILURE MODE:
SHEAR PLANE
AT 20 DEG.

TEXAS SSC SITE

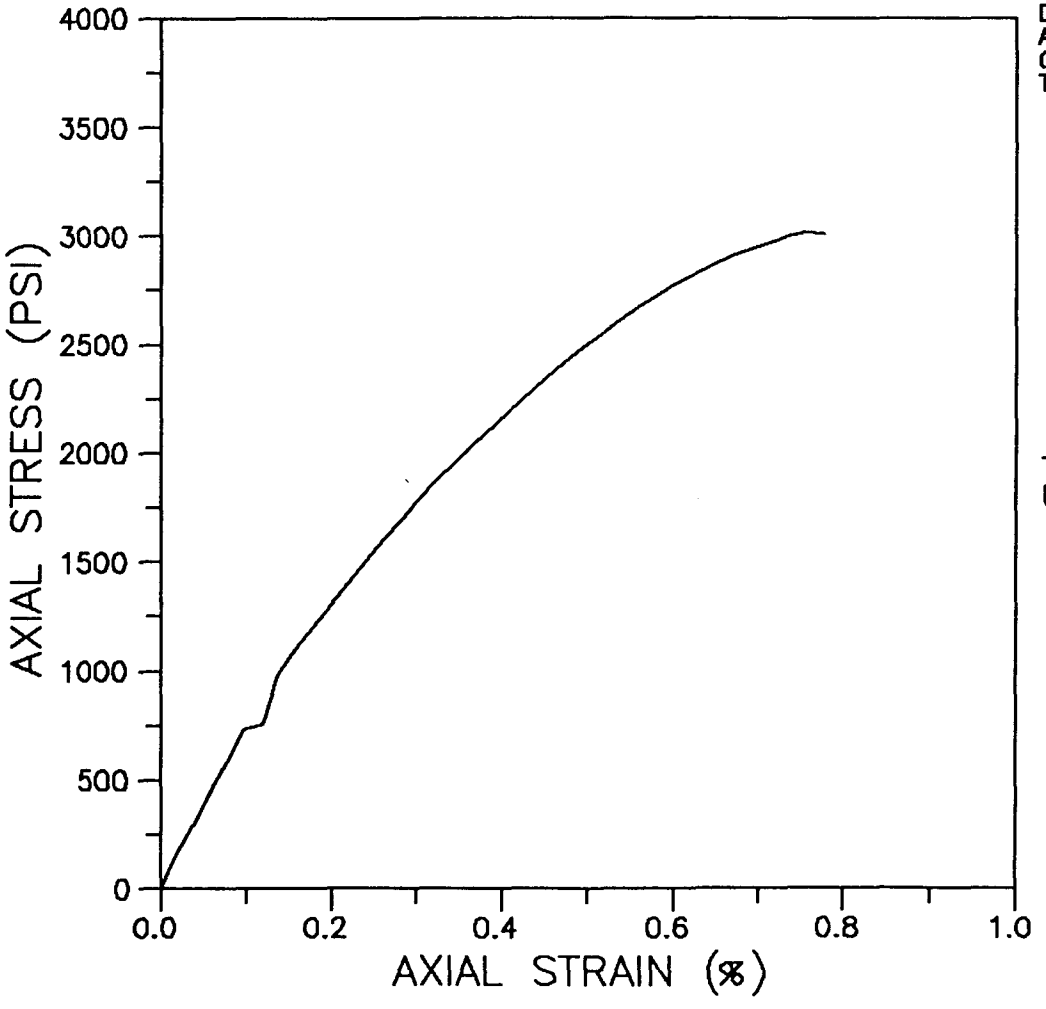
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

FIGURE

BORING NO: BIR45
DEPTH (FT): 111.9
AUSTIN CHALK



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 12.0
DRY UNIT WEIGHT (PCF): 126.8
DEG. OF SATURATION (%): 98.6
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
4.78 x 10E5 PSI

FAILURE MODE:
SHEAR PLANE AT 30 DEG

TEXAS SSC SITE

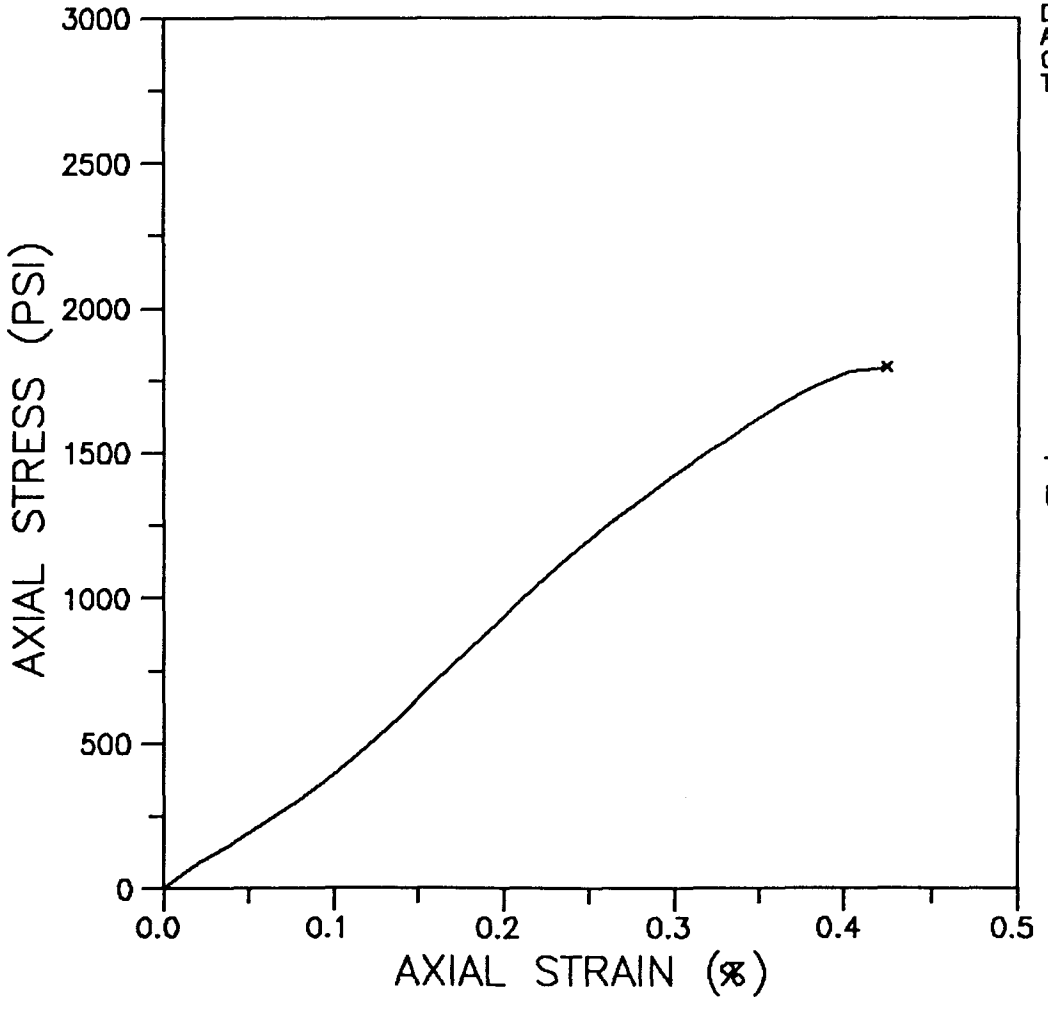
STRESS-STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89-192

FIGURE

BORING NO: BIR45
DEPTH (FT): 131.5
AUSTIN CHALK



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 16.0
DRY UNIT WEIGHT (PCF): 116.0
DEG. OF SATURATION (%): 95.5
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
5.62 x 10E5 PSI

FAILURE MODE:
LONGITUDINAL (AXIAL)
SPLITTING

TEXAS SSC SITE

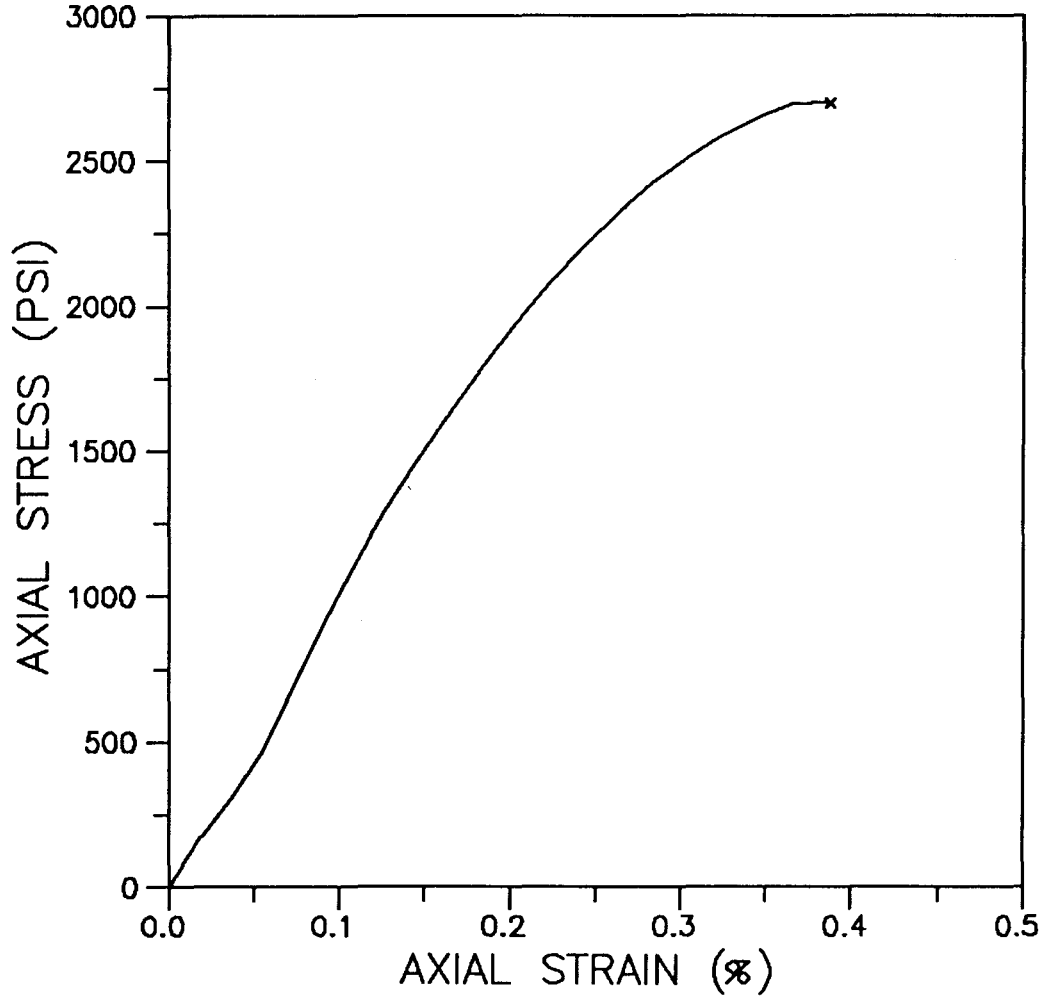
STRESS-STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89-192

FIGURE

BORING NO: BIR45
DEPTH (FT): 151.1
AUSTIN CHALK



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 14.4
DRY UNIT WEIGHT (PCF): 120.2
DEG. OF SATURATION (%): 96.8
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
9.55 x 10E5 PSI

FAILURE MODE:
SHEAR PLANE AT 30 DEG

TEXAS SSC SITE

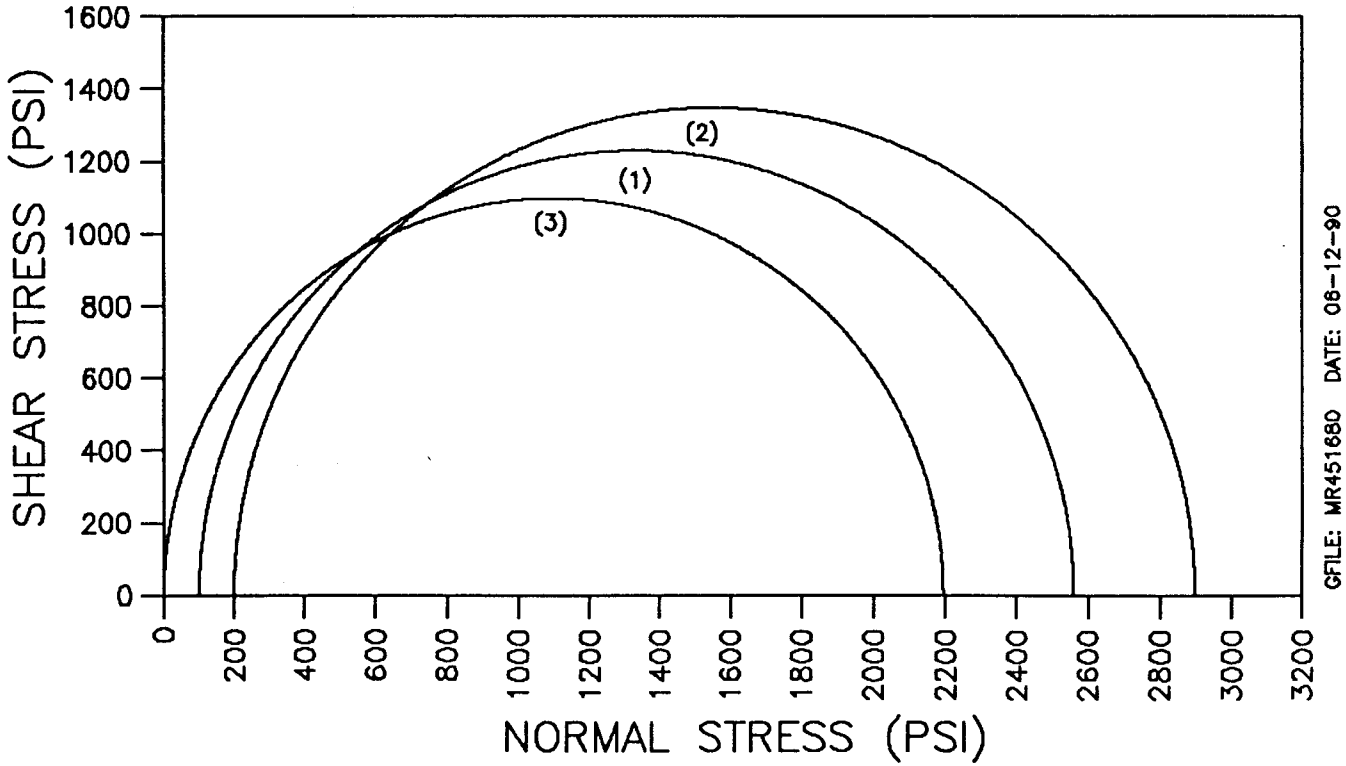
STRESS-STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89-192

FIGURE

BORING NO.: BIR45
DEPTH RANGE (FT): 168.0–170.0
AUSTIN CHALK LIMESTONE



GFILE: MR451680 DATE: 08-12-90

SEE STRESS–STRAIN PLOTS
FOR INDIVIDUAL SAMPLE DATA

(1) DEPTH (FT): 168.0
(2) DEPTH (FT): 168.4
(3) DEPTH (FT): 169.6

INCLINATION (DEG): VERTICAL
TEST TYPE: UNCONFINED COMPRESSION (ASTM D2938)
TRIAXIAL COMPRESSION (ASTM D2664)

TEXAS SSC SITE

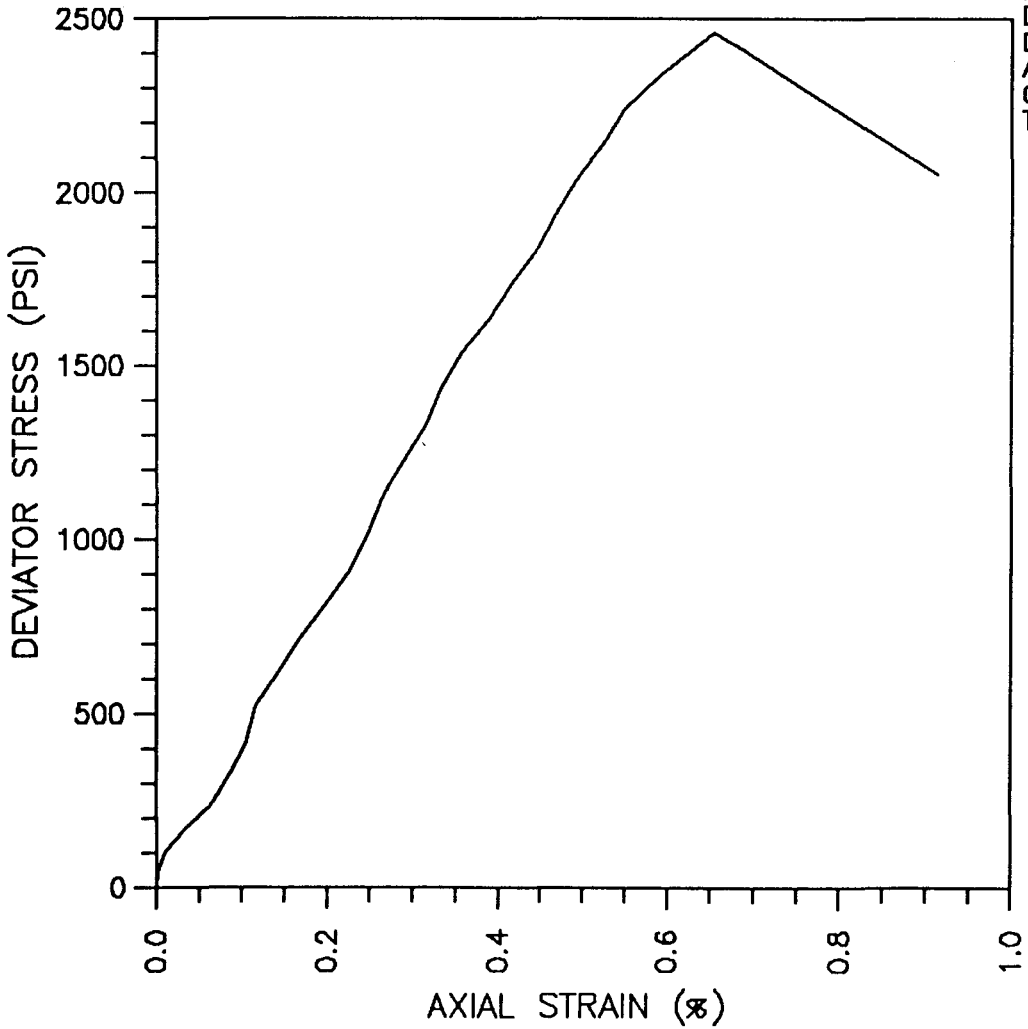
MOHR CIRCLE PLOT

MASON–JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS–ENGINEERS

JOB NO.: 5530.15

FIGURE

BORING NO.: BIR45
DEPTH (FT): 168.0
AUSTIN CHALK LIMESTONE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 12.8
DRY UNIT WEIGHT (PCF): 123.8
DEG. OF SATURATION (%): 95.5
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 100
TEST TYPE: TRIAXIAL COMPRESSION
(ASTM D 2664)

GFILE: IR451880 DATE: 04-30-90 CAL: MCTS

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
4.082 x10E5 PSI

FAILURE MODE:
AXIAL SPLITTING

TEXAS SSC SITE

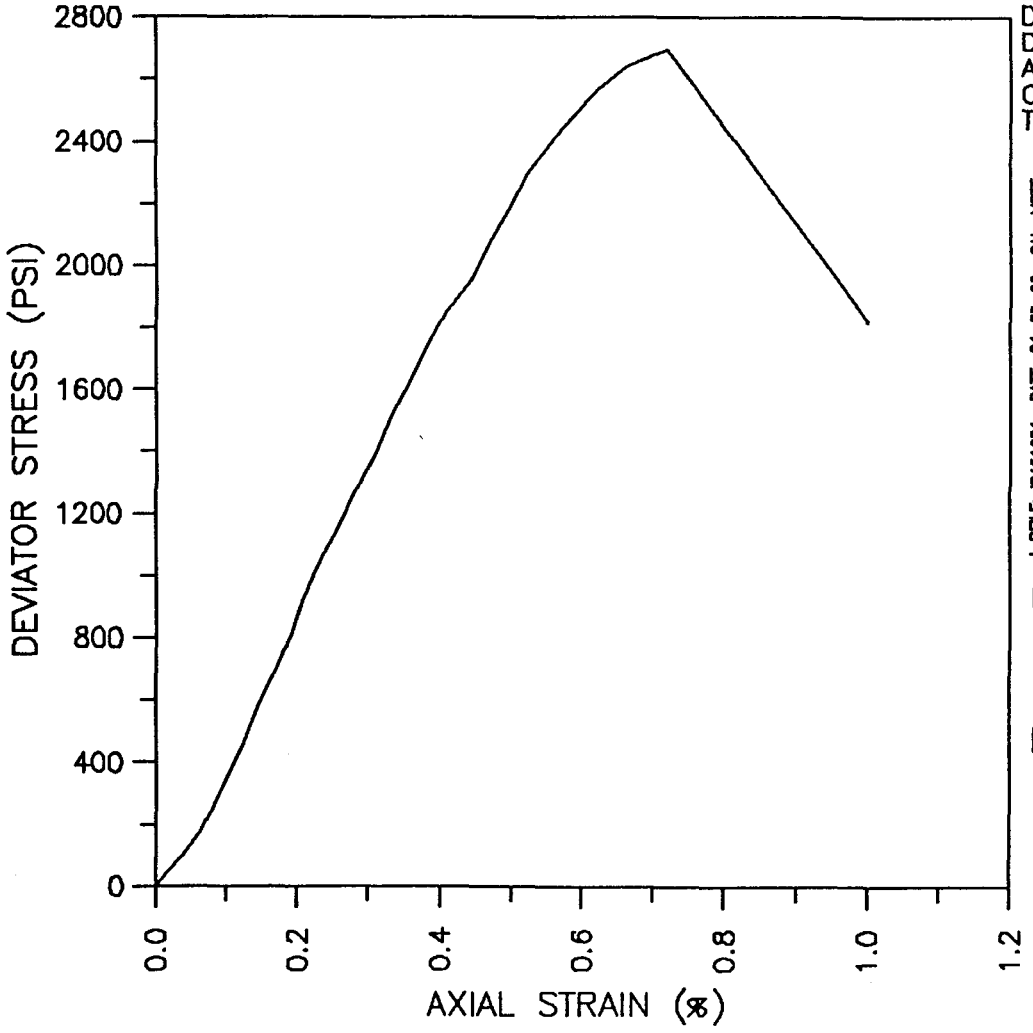
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

FIGURE

BORING NO.: BIR45
DEPTH (FT): 168.4
AUSTIN CHALK LIMESTONE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 13.0
DRY UNIT WEIGHT (PCF): 123.7
DEG. OF SATURATION (%): 96.9
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 200
TEST TYPE: TRIAXIAL COMPRESSION
(ASTM D 2664)

BFILE: IR451684 DATE: 04-28-90 CAL: MCT5

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
4.615 x10E5 PSI

FAILURE MODE:
SHEAR PLANES W/
CONICAL AT BOTTOM

TEXAS SSC SITE

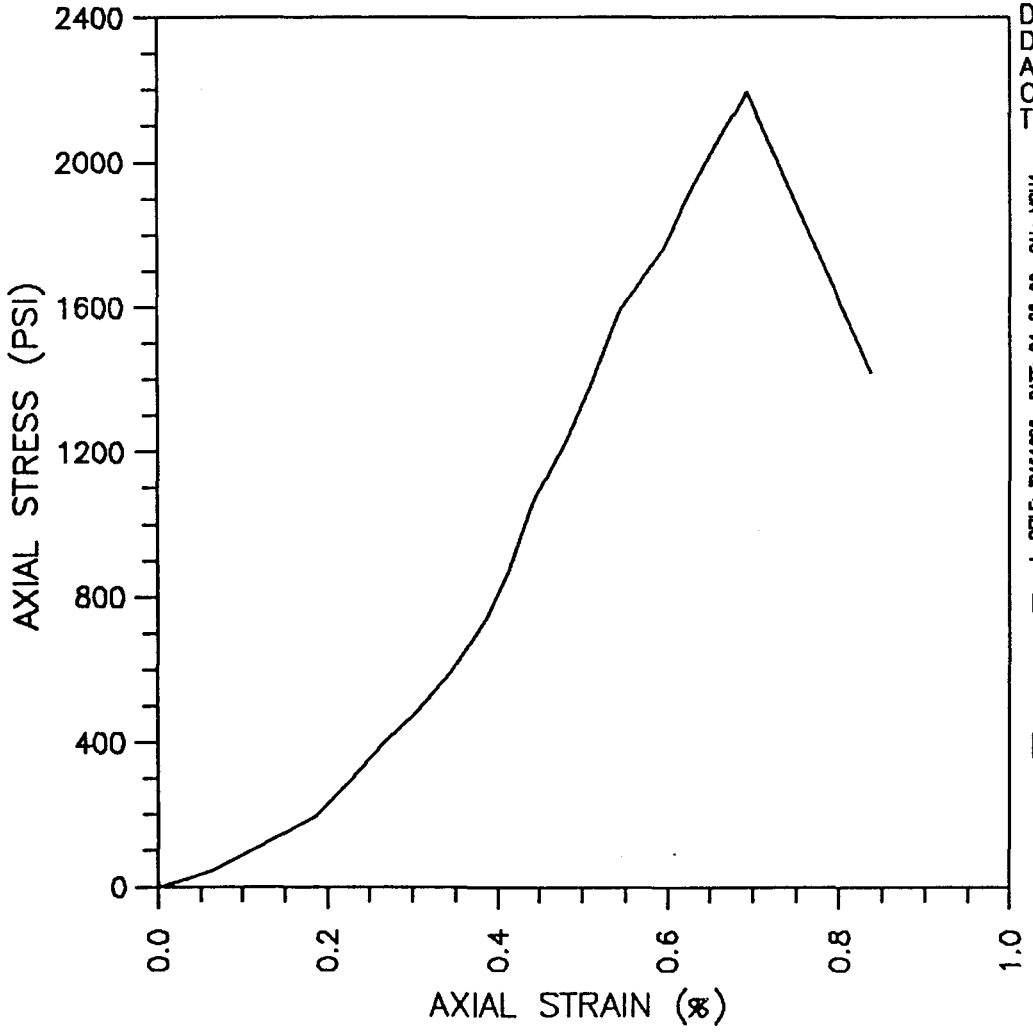
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

FIGURE

BORING NO.: BIR45
DEPTH (FT): 169.6
AUSTIN CHALK LIMESTONE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 13.2
DRY UNIT WEIGHT (PCF): 119.1
DEG. OF SATURATION (%): 86.1
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE: UNCONFINED COMPRESSION
(ASTM D 2938)

CFILE: IR451698 DATE: 04-28-90 CAL: MCU4

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
4.324 x10E5 PSI

FAILURE MODE:
AXIAL SPLITTING

TEXAS SSC SITE

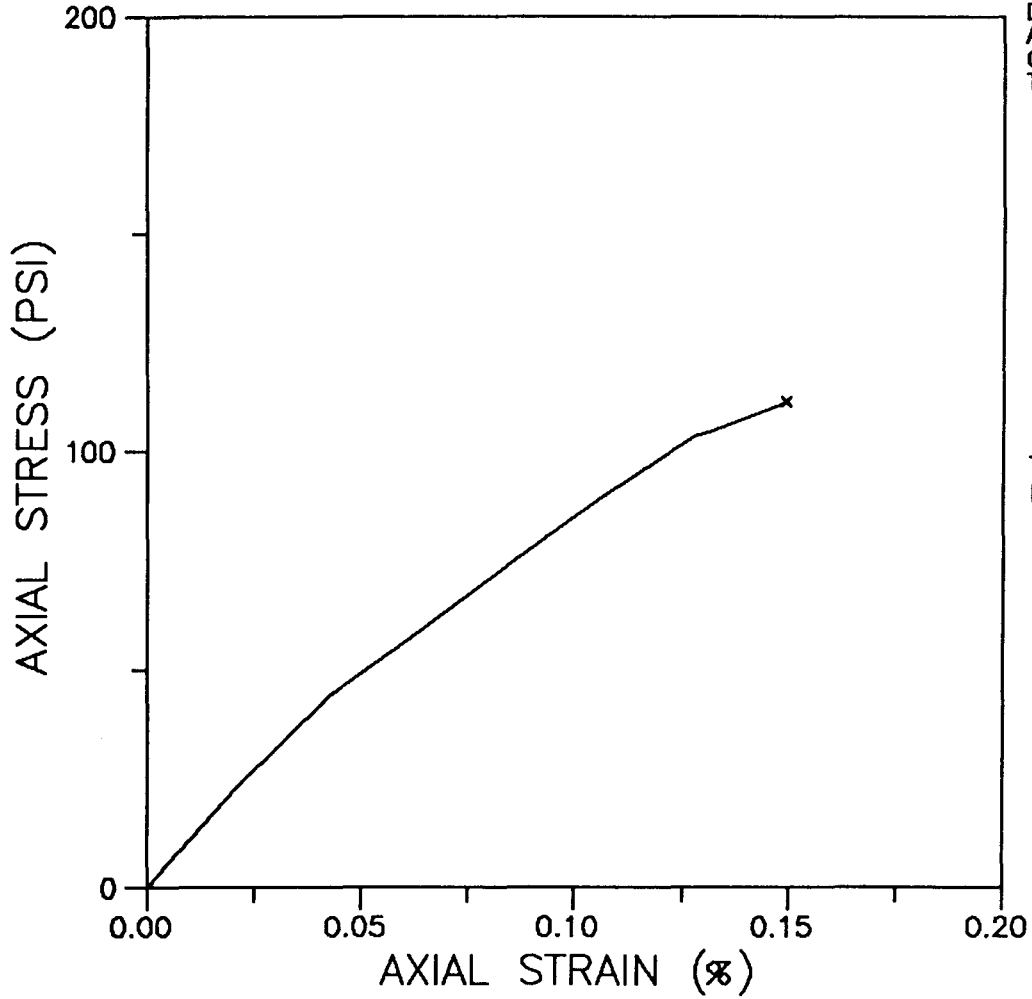
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

FIGURE

BORING NO: BIR45
DEPTH (FT): 197.7
EAGLE FORD SHALE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 16.4
DRY UNIT WEIGHT (PCF): 118.8
DEG. OF SATURATION (%): 105.9
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
7.2 x 10E4 PSI

FAILURE MODE:
PRE-EXISTING SHEAR
PLANE AT 45 DEG

TEXAS SSC SITE

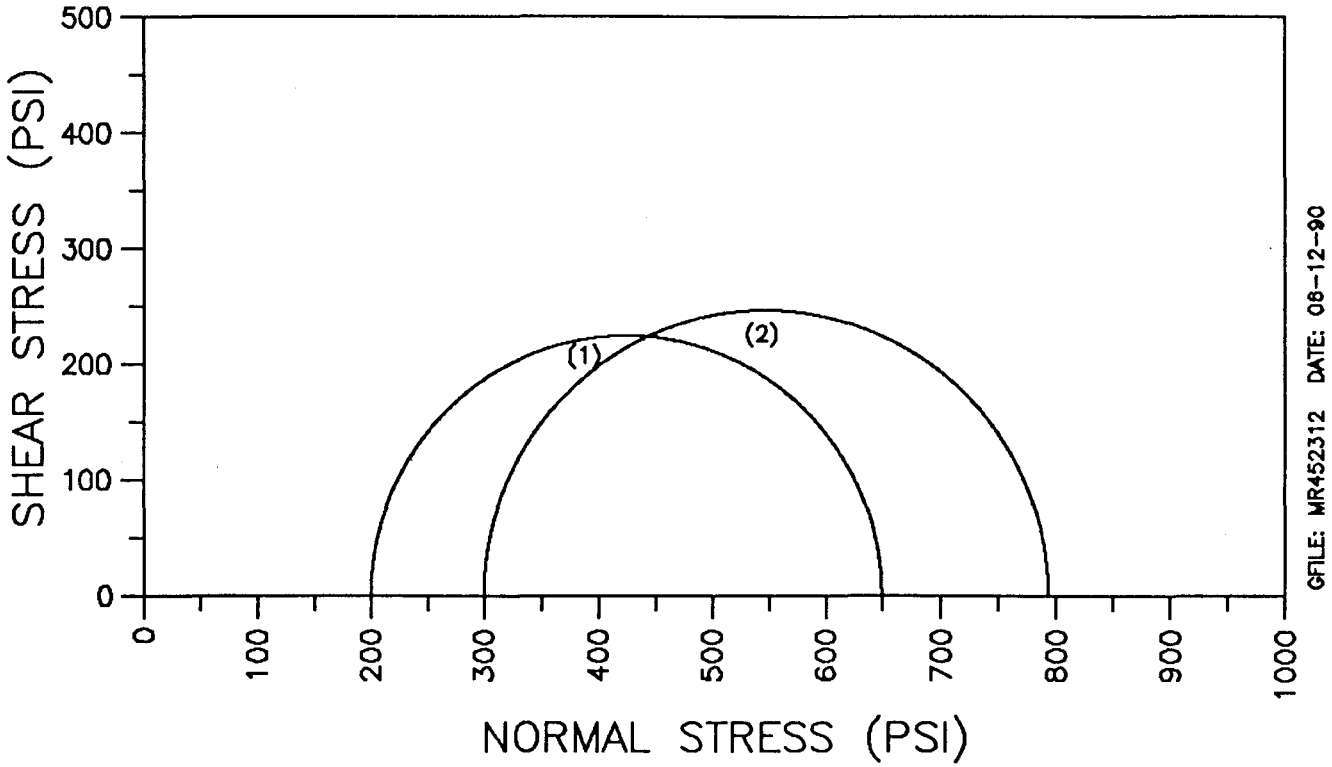
STRESS-STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89-192

FIGURE

BORING NO.: BIR45
DEPTH RANGE (FT): 231.2–232.0
EAGLE FORD SHALE



GFILE: MR452312 DATE: 08-12-90

SEE STRESS–STRAIN PLOTS
FOR INDIVIDUAL SAMPLE DATA

(1) DEPTH (FT): 231.2
(2) DEPTH (FT): 231.6

INCLINATION (DEG): VERTICAL
TEST TYPE: TRIAXIAL COMPRESSION (ASTM D2664)

TEXAS SSC SITE

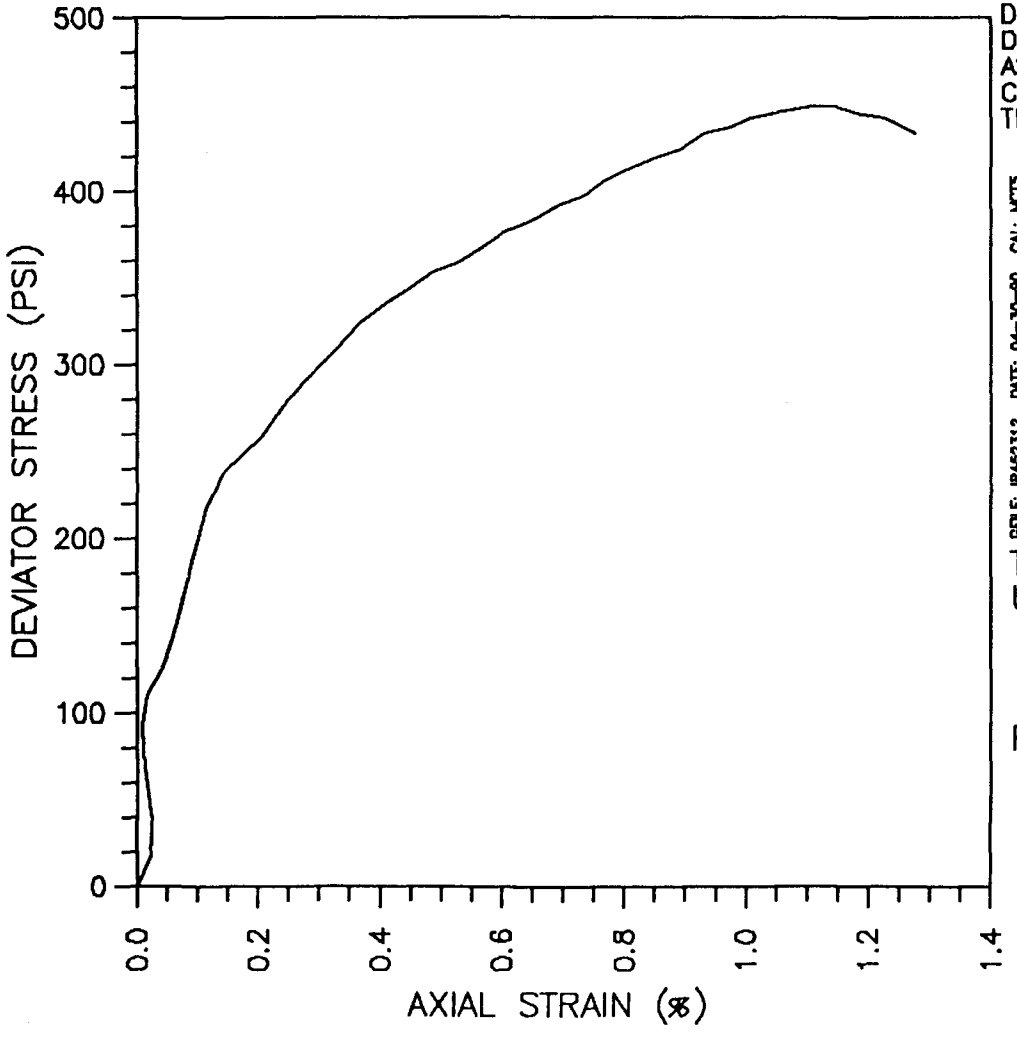
MOHR CIRCLE PLOT

MASON–JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS–ENGINEERS

JOB NO.: 5530.15

FIGURE

BORING NO.: BIR45
DEPTH (FT): 231.2
EAGLE FORD SHALE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 12.9
DRY UNIT WEIGHT (PCF): 123.0
DEG. OF SATURATION (%): 94.3
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 200
TEST TYPE: TRIAXIAL COMPRESSION
(ASTM D 2664)

FILE: IR462312 DATE: 04-30-90 CAL: MCTS

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
0.762 x10E5 PSI

FAILURE MODE:
CONICAL FAILURE

TEXAS SSC SITE

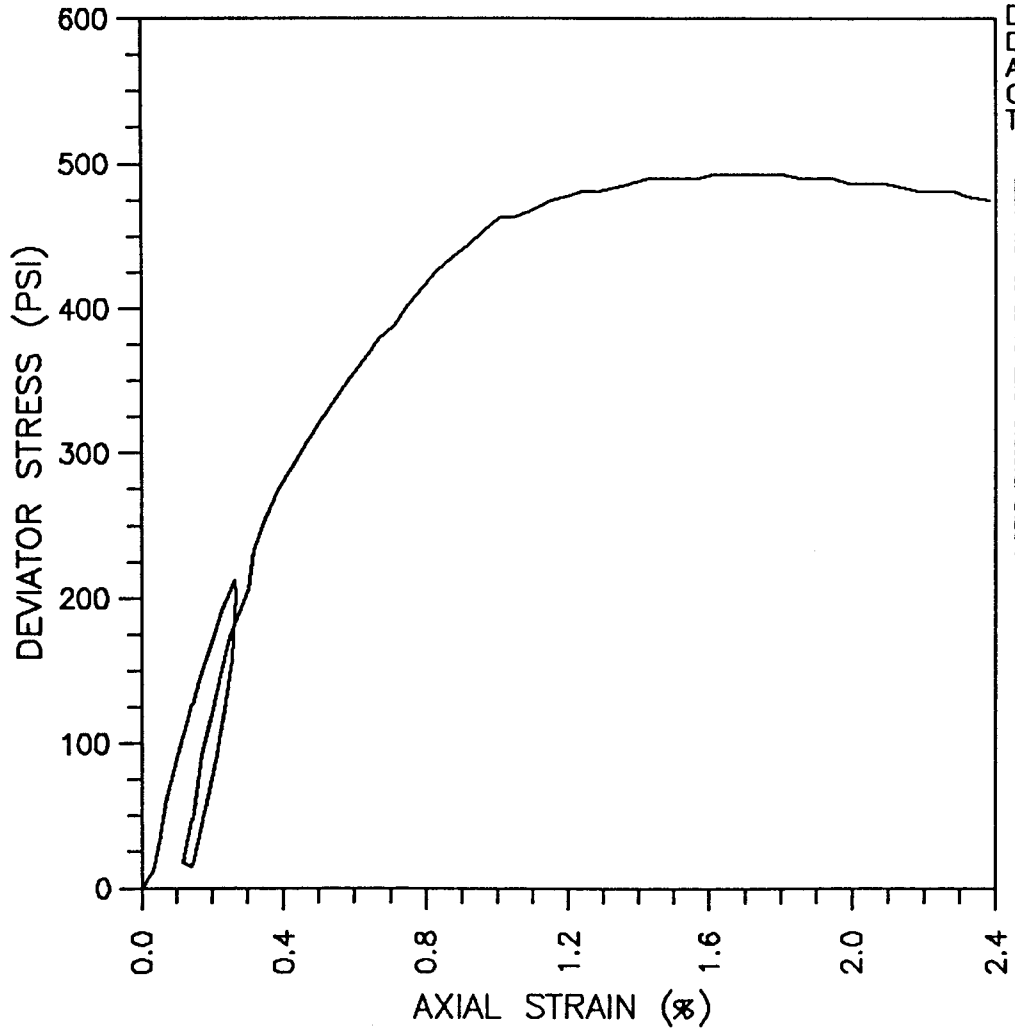
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

FIGURE

BORING NO.: BIR45
DEPTH (FT): 231.6
EAGLE FORD SHALE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 11.0
DRY UNIT WEIGHT (PCF): 127.0
DEG. OF SATURATION (%): 90.9
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 300
TEST TYPE: TRIAXIAL COMPRESSION
(ASTM D 2664)

BFILE: IR45231B DATE: 04-28-90 CAL: MCT5

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
0.494 x10E5 PSI

FAILURE MODE:
SHEAR PLANE
AT 40 DEG.

TEXAS SSC SITE

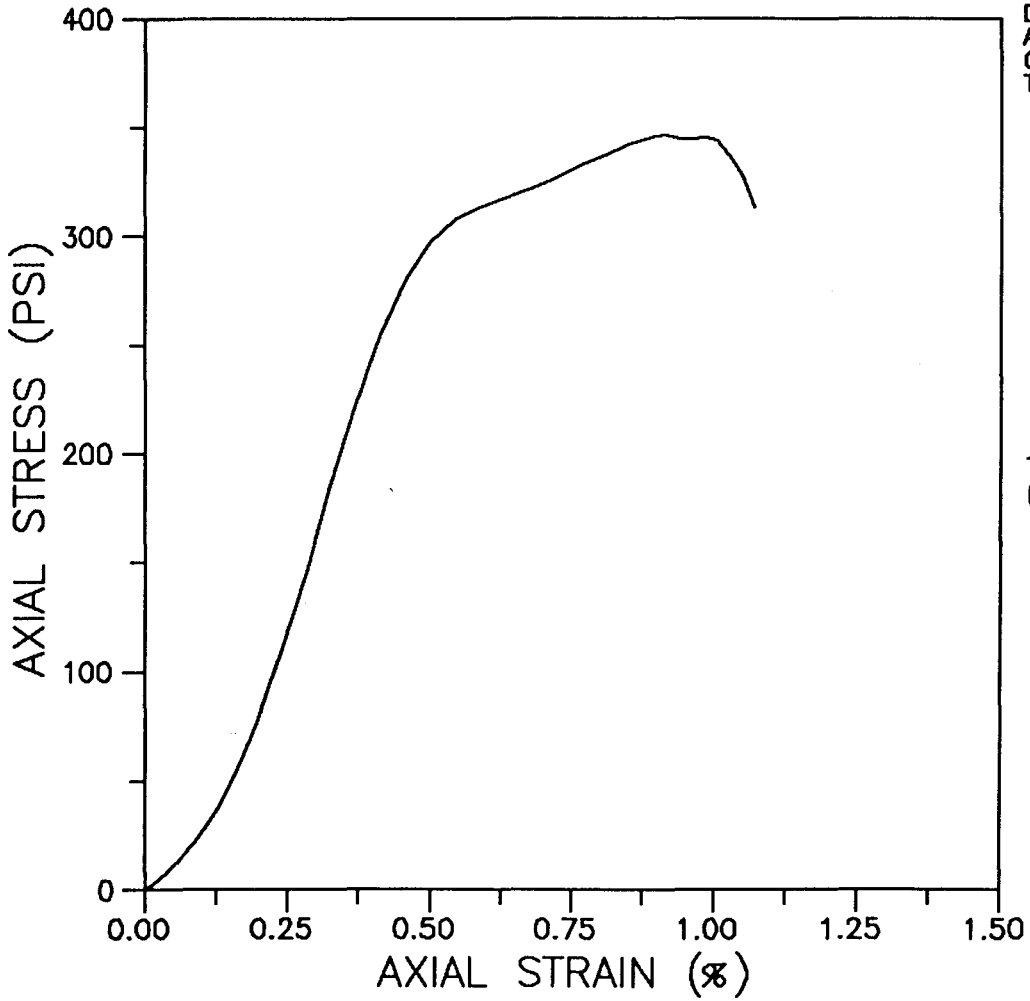
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

FIGURE

BORING NO: BIR45
DEPTH (FT): 233.0
EAGLE FORD SHALE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 15.5
DRY UNIT WEIGHT (PCF): 118.4
DEG. OF SATURATION (%): 98.9
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
8.95 x 10E4 PSI

FAILURE MODE:
LONGITUDINAL (AXIAL)
SPLITTING

TEXAS SSC SITE

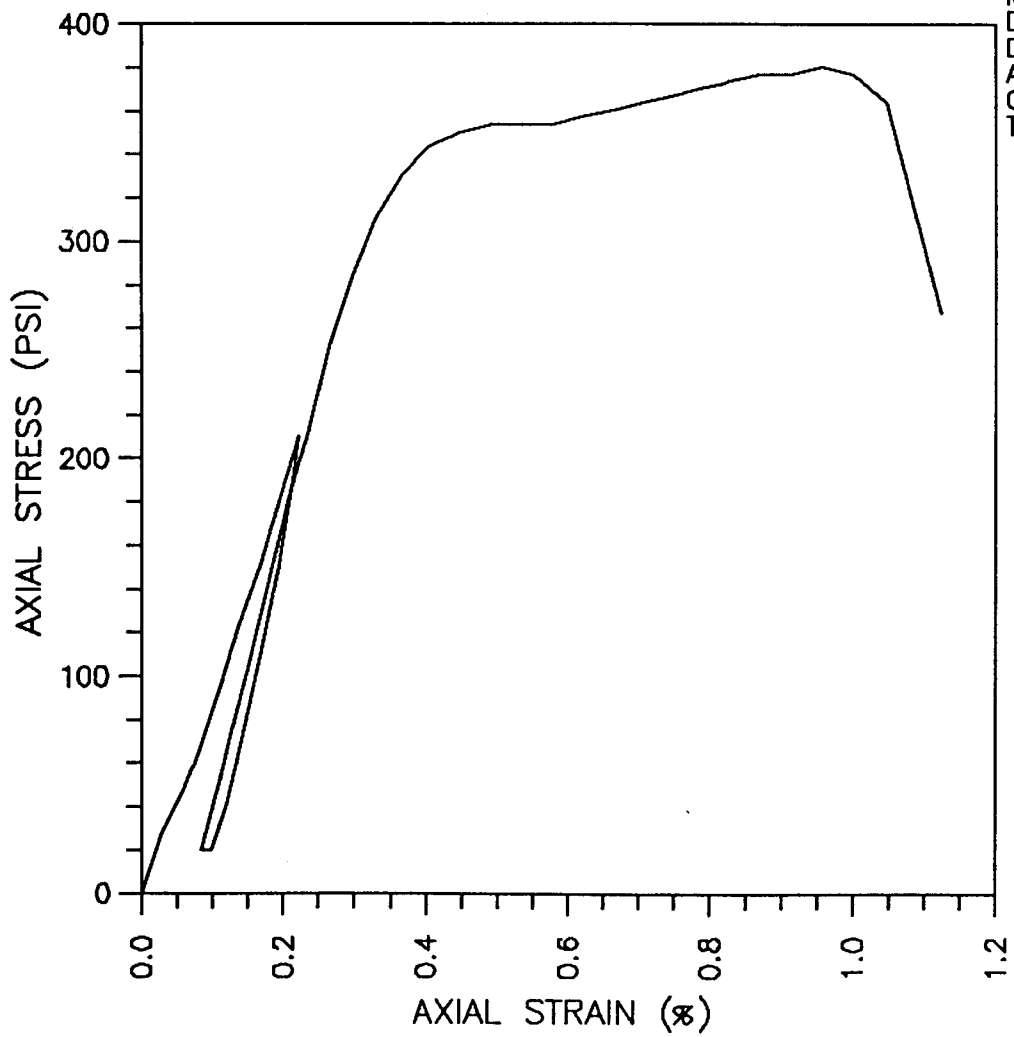
STRESS-STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89-192

FIGURE

BORING NO.: BIR45
DEPTH (FT): 260.6
EAGLE FORD SHALE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 15.1
DRY UNIT WEIGHT (PCF): 120.1
DEG. OF SATURATION (%): 101.2
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE: UNCONFINED COMPRESSION
(ASTM D 2938)

GFILE: IR482808 DATE: 04-28-90 CAL: MCTS

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
1.046 x10E5 PSI

FAILURE MODE:
AXIAL SPLITTING

TEXAS SSC SITE

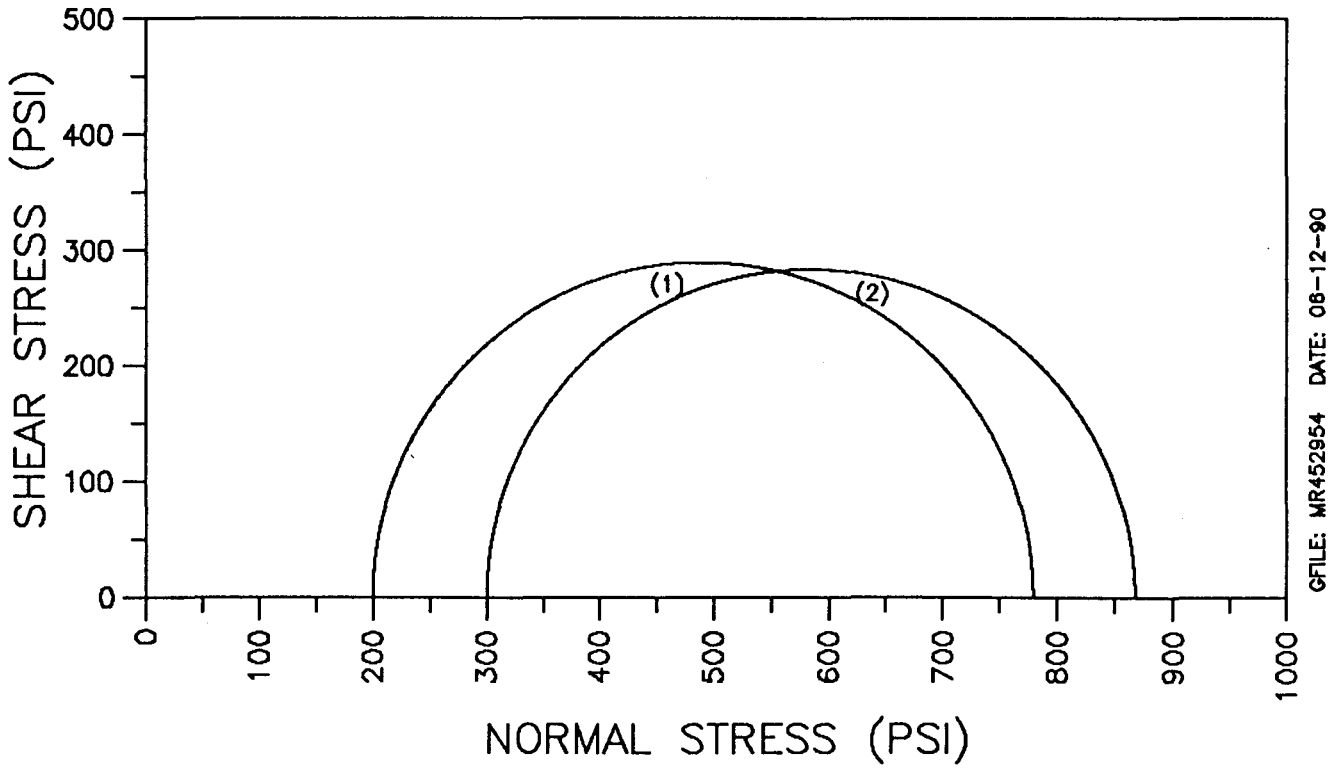
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

FIGURE

BORING NO.: BIR45
DEPTH RANGE (FT): 295.4–296.2
EAGLE FORD SHALE



GFILE: MR452954 DATE: 06-12-90

SEE STRESS–STRAIN PLOTS
FOR INDIVIDUAL SAMPLE DATA

(1) DEPTH (FT): 295.4
(2) DEPTH (FT): 295.8

INCLINATION (DEG): VERTICAL
TEST TYPE: TRIAXIAL COMPRESSION (ASTM D2664)

TEXAS SSC SITE

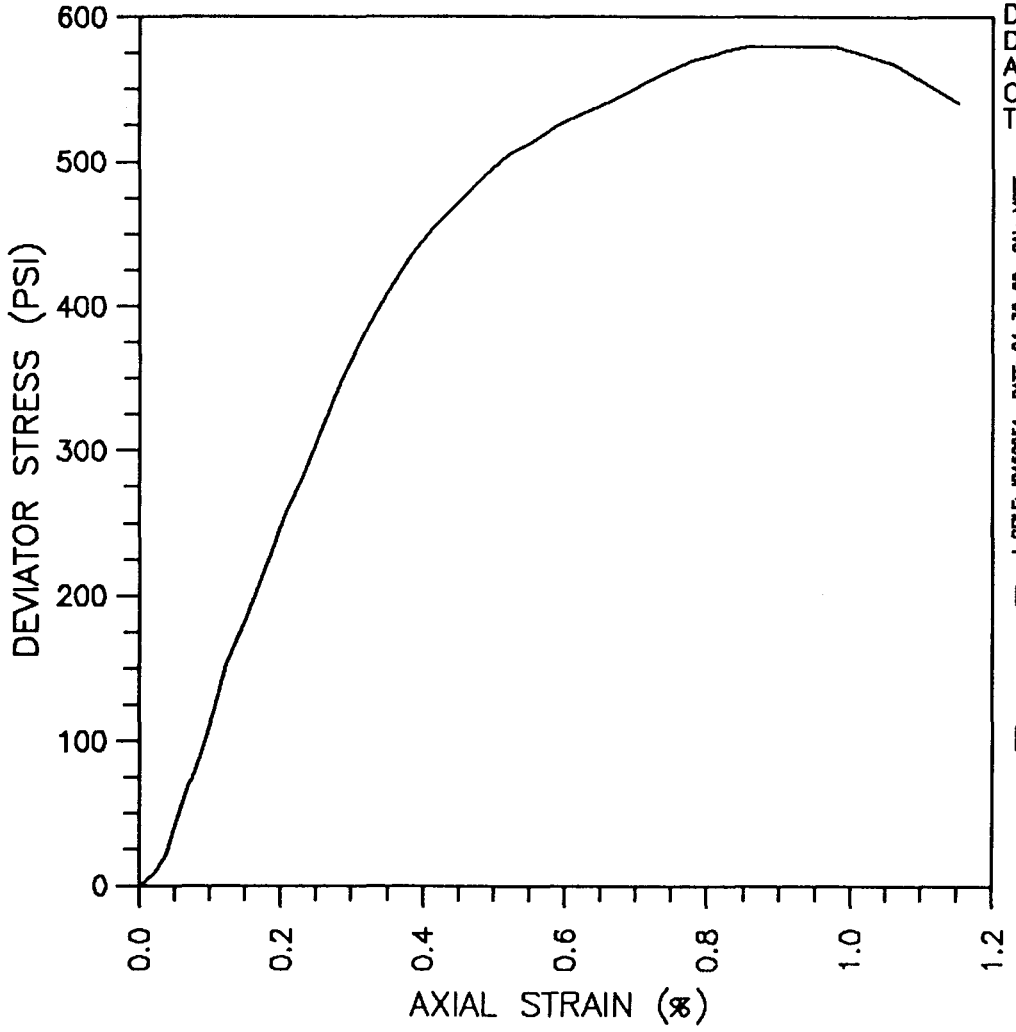
MOHR CIRCLE PLOT

MASON–JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS–ENGINEERS

JOB NO.: 5530.15

FIGURE

BORING NO.: BIR45
DEPTH (FT): 295.4
EAGLE FORD SHALE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 12.9
DRY UNIT WEIGHT (PCF): 123.6
DEG. OF SATURATION (%): 96.0
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 200
TEST TYPE: TRIAXIAL COMPRESSION
(ASTM D 2664)

BFILE: IR452854 DATE: 04-30-90 CAL: MCTS

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
1.205 x10E5 PSI

FAILURE MODE:
SHEAR PLANE
AT 40 DEG.

TEXAS SSC SITE

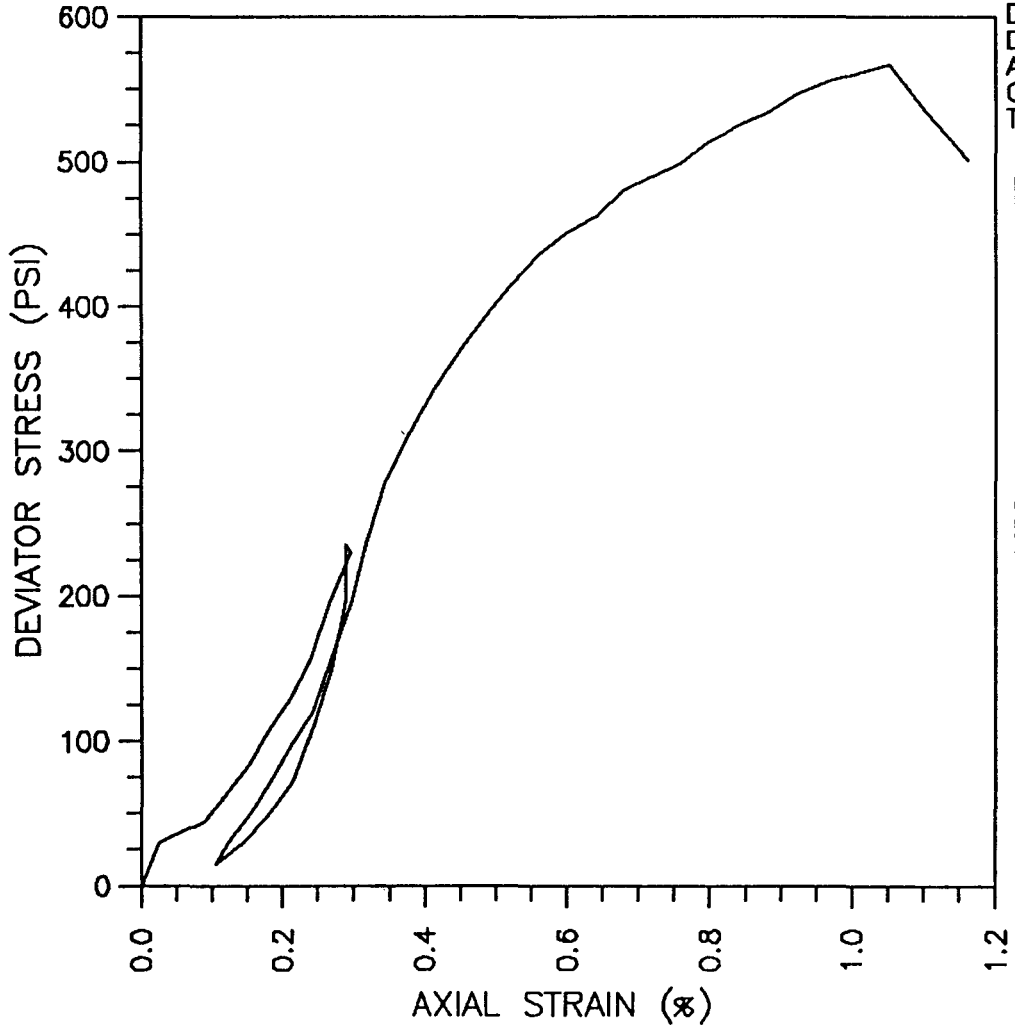
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

FIGURE

BORING NO.: BIR45
DEPTH (FT): 295.8
EAGLE FORD SHALE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 13.7
DRY UNIT WEIGHT (PCF): 121.3
DEG. OF SATURATION (%): 95.0
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 300
TEST TYPE: TRIAXIAL COMPRESSION
(ASTM D 2664)

CFILE: IR452858 DATE: 04-28-90 CAL: MCTS

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
1.053 x10E5 PSI

FAILURE MODE:
SHEAR PLANE
AT 50 DEG.

TEXAS SSC SITE

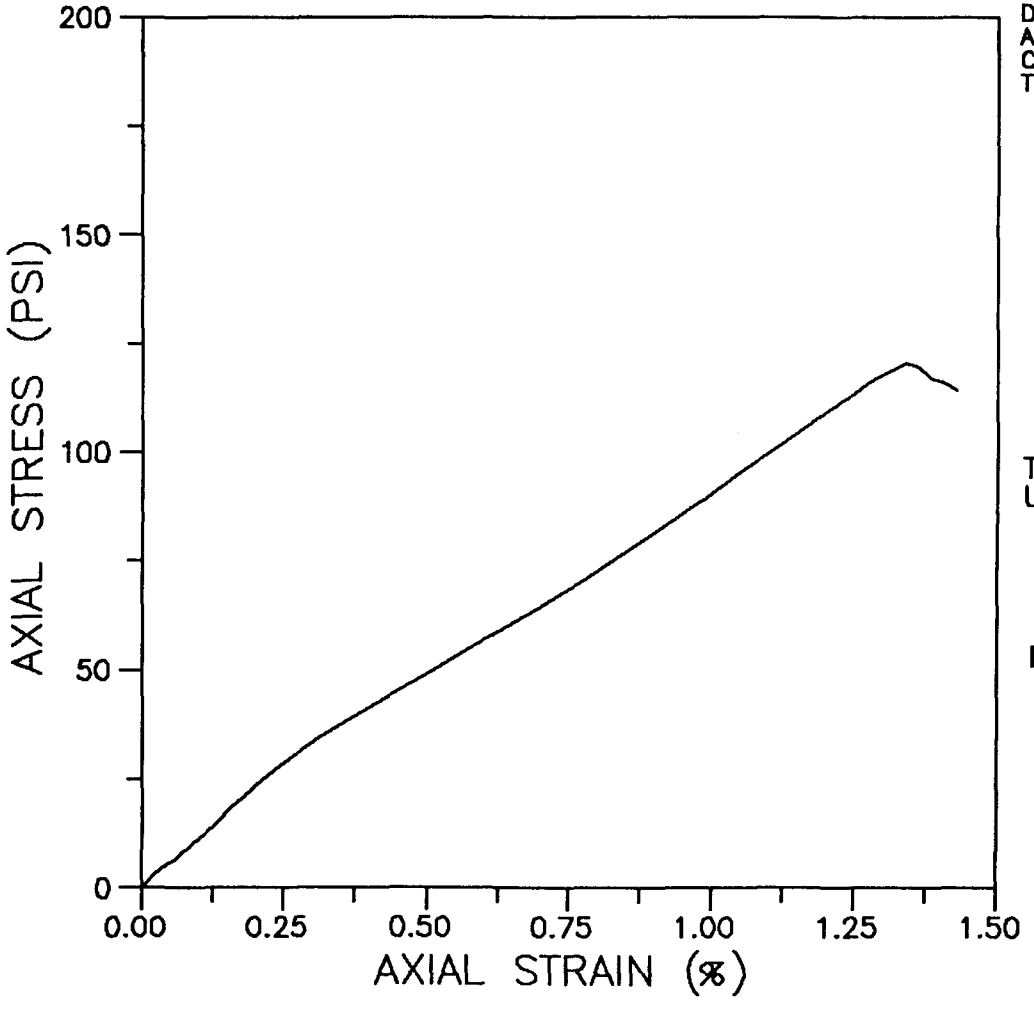
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES,INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

FIGURE

BORING NO: BIR45
DEPTH (FT): 307.3
EAGLE FORD SHALE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 10.5
DRY UNIT WEIGHT (PCF): 131.3
DEG. OF SATURATION (%): 100.1
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
8.00 x 10E3 PSI

FAILURE MODE:
PRE-EXISTING FRACTURE
AT 60 DEG

TEXAS SSC SITE

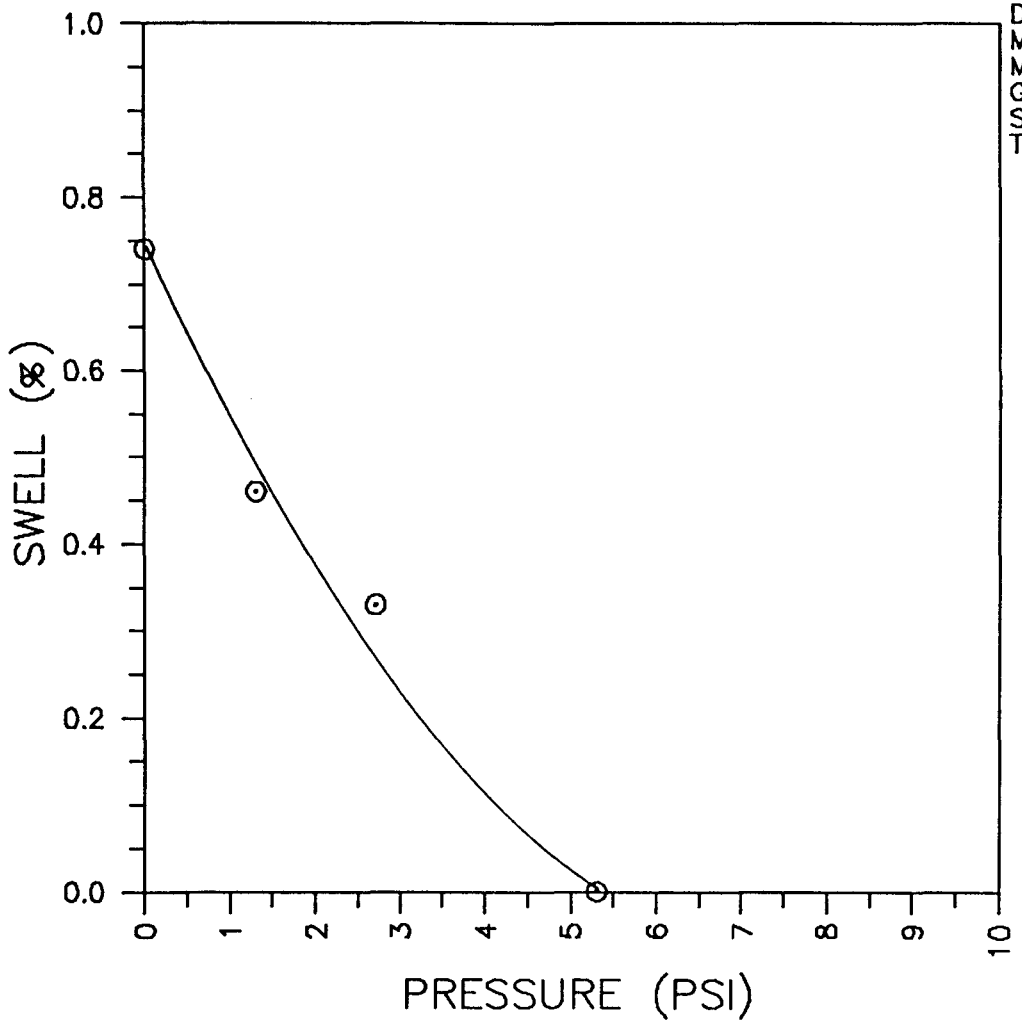
STRESS-STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89-192

FIGURE

BORING NO.: BIR45
DEPTH (FT): 105.0
BENTONITIC CLAY



INCLINATION (DEG): VERTICAL
DRY UNIT WEIGHT (PCF): 81.8
M.C. BEFORE TEST (%): 41.1
M.C.AFTER TEST (%): 45.0
GAIN IN MOISTURE (%): 3.9
SWELLING PRESSURE INDEX (PSI): 5
TEST TYPE: SWELLING PRESSURE INDEX (ISRM)

TEXAS SSC SITE

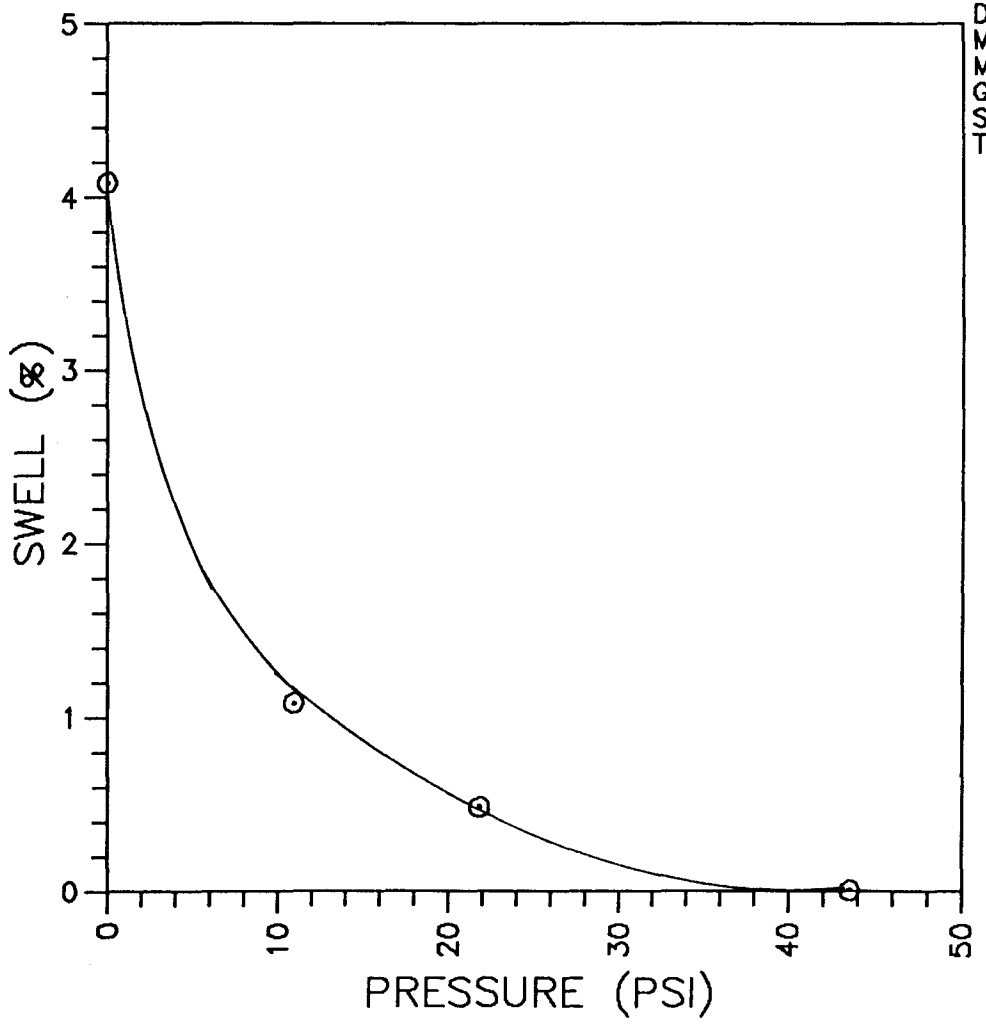
SWELLING PRESSURE INDEX

MASON-JOHNSTON & ASSOCIATES,INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

FIGURE

BORING NO.: BIR45
DEPTH (FT): 200.8
EAGLE FORD SHALE



INCLINATION (DEG): VERTICAL
DRY UNIT WEIGHT (PCF): 114.0
M.C. BEFORE TEST (%): 16.7
M.C.AFTER TEST (%): 22.5
GAIN IN MOISTURE (%): 5.8
SWELLING PRESSURE INDEX (PSI): 44
TEST TYPE: SWELLING PRESSURE INDEX (ISRM)

TEXAS SSC SITE

SWELLING PRESSURE INDEX

MASON-JOHNSTON & ASSOCIATES,INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.15

FIGURE

APPENDIX F

DOWNHOLE VELOCITY SURVEYS

APPENDIX F

DOWNHOLE VELOCITY SURVEYS

MEASUREMENT

Downhole seismic velocity surveys at boring BIR41 were completed on November 29, 1989. The survey objectives were to determine the in-situ compressional (P) and shear (S) wave velocity profiles of subsurface materials. Dynamic elastic moduli were estimated from interpreted velocities and densities obtained from laboratory analysis of boring samples.

Seismic waves were generated at the surface and recorded at a number of depths in the boring. Seismic waves were detected with a downhole package of three mutually perpendicular geophones (Mark Products model L-10-3WD, 28 Hz resonant frequency) with one geophone vertically oriented. Spring-loaded steel wedges were used to press the geophone package against the casing. The package diameter was increased with duct tape until a tight fit was obtained. The tape also minimized mechanical resonance of the spring.

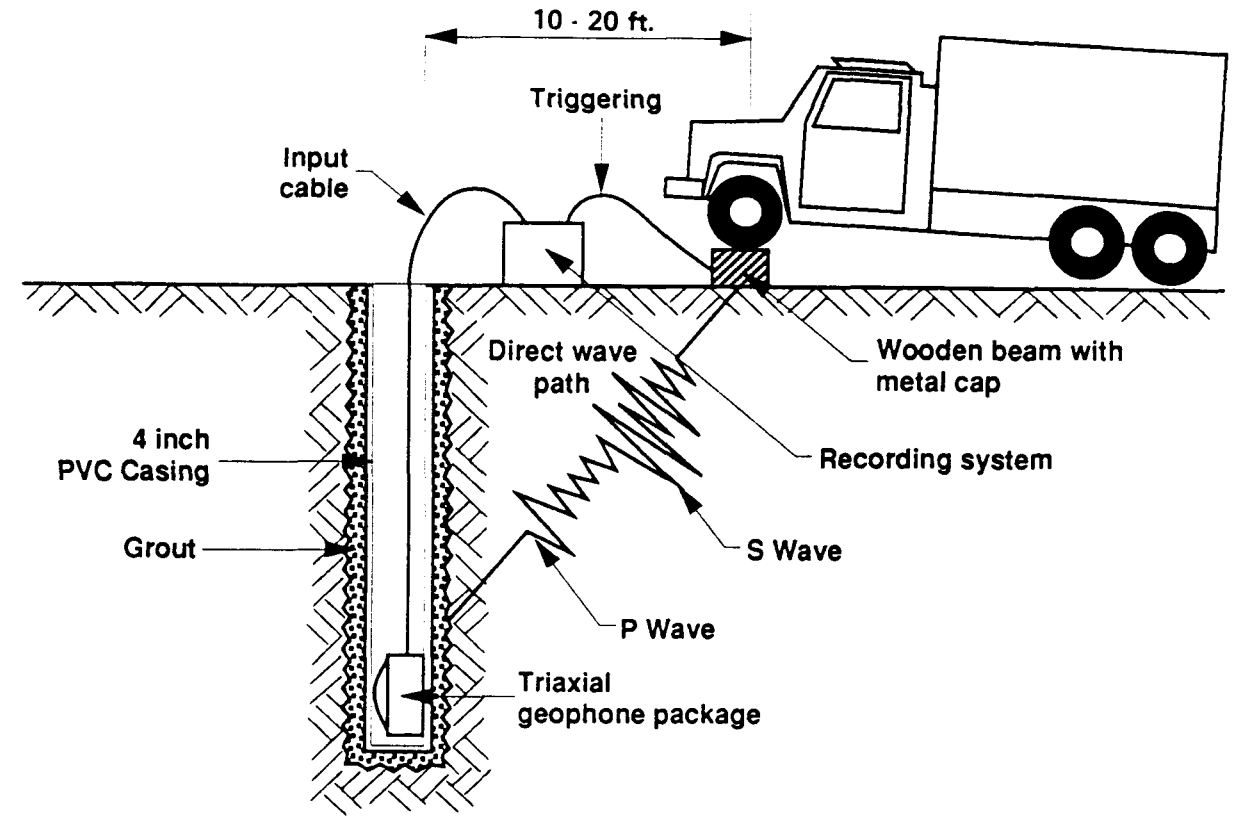
Geophone output signals were recorded with a twelve-channel, signal enhancement seismograph (EG&G Geometrics model ES-1210F, S/N 19186). The seismograph was triggered at the instant of energy generation by a transistor switch attached to the source. For a given measurement depth, waveforms from several impacts were stacked (added together) and the sum stored in memory. Often, stacking permits building a weak seismic waveform to a recognizable level even in 'noisy' environments. No filtering was used in recording the data. During acquisition, seismic waves were displayed on an oscilloscope. When the proper sequence of data traces was developed, a hard copy record was made with full-width timing lines (0.5 millisecond intervals). Travel times have an uncertainty of $\pm$ 0.25 milliseconds.

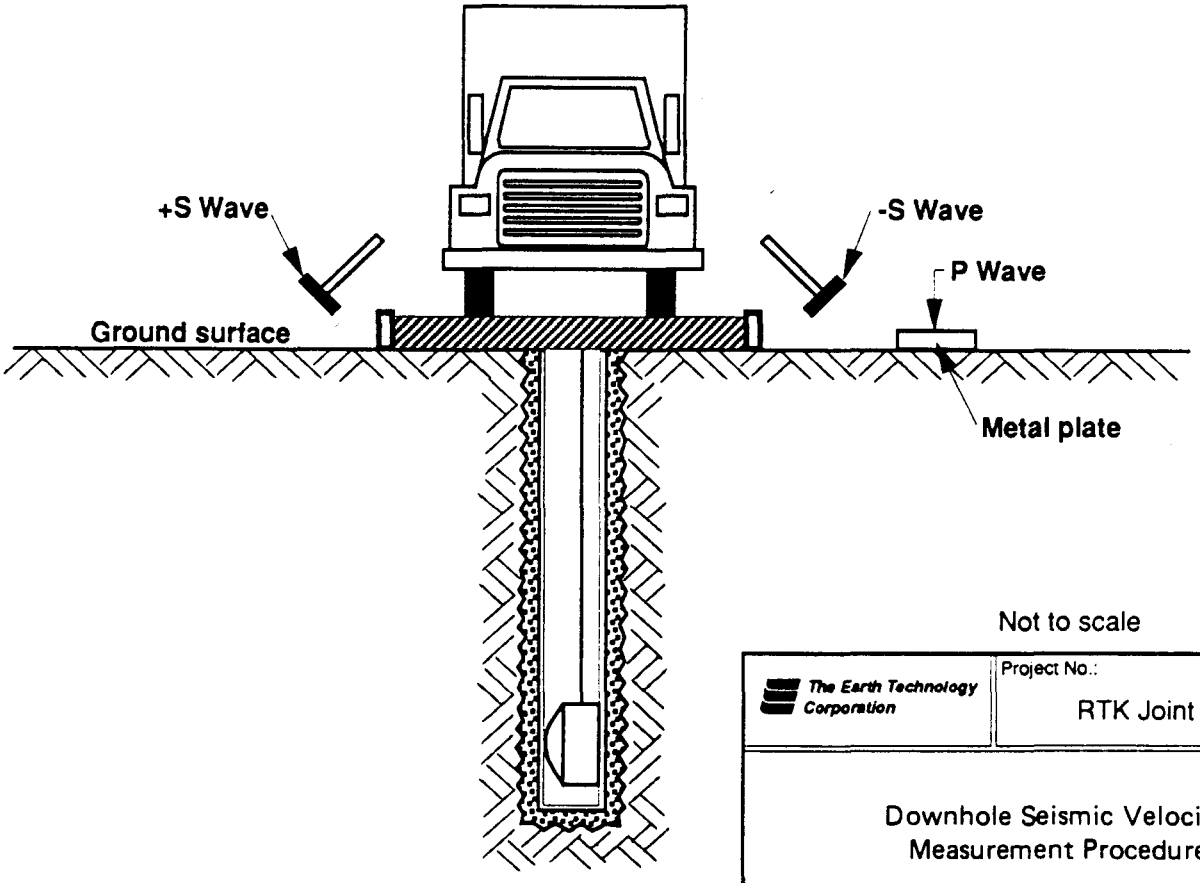
The layout for measuring seismic velocity is shown in Figure F-1. Measurement depths have an uncertainty of $\pm$ 0.1 foot. The quality of P and S wave arrivals was judged to be generally good to fair.

RESULTS

Downhole velocity survey results at boring BIR 41 (Figure F-2) agree well with conditions described by boring and wireline logs. Interpreted subsurface velocity zones are similar to those determined by the velocity survey at boring BIR 31 (718 feet to the north). Dynamic elastic moduli and Poisson's ratio were calculated using the intergrated subsurface velocities and measured densities of samples from borings. All P and S wave arrivals to a depth of 130 feet were judged to have good to very good clarity. Both wave arrivals below 130 feet are of only fair quality and produce scatter on the data graph. No data were recorded within the screened interval, at depths of 165 to 185 feet. The interpreted velocities and moduli are thought to have an uncertainty of $\pm$ 10 percent.

The boring log describes surficial clayey overburden (4 feet thick) underlain by weathered Austin Chalk (12 feet thick). The downhole velocity survey determined a P velocity of 3,000 fps (feet/second) and an S velocity of 1,000 fps for the weathered chalk. The interpreted weathered/fresh chalk interface is at a





Not to scale

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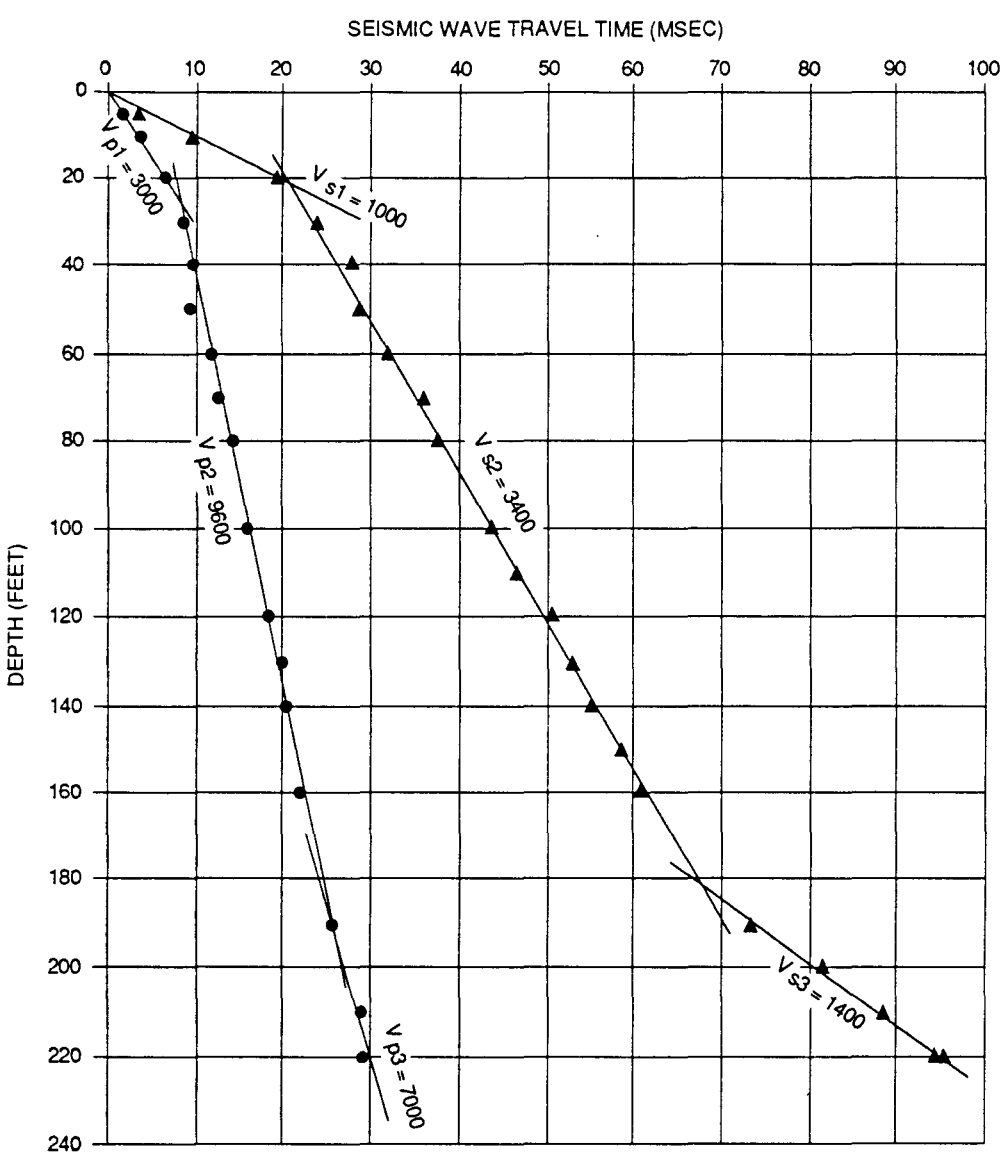
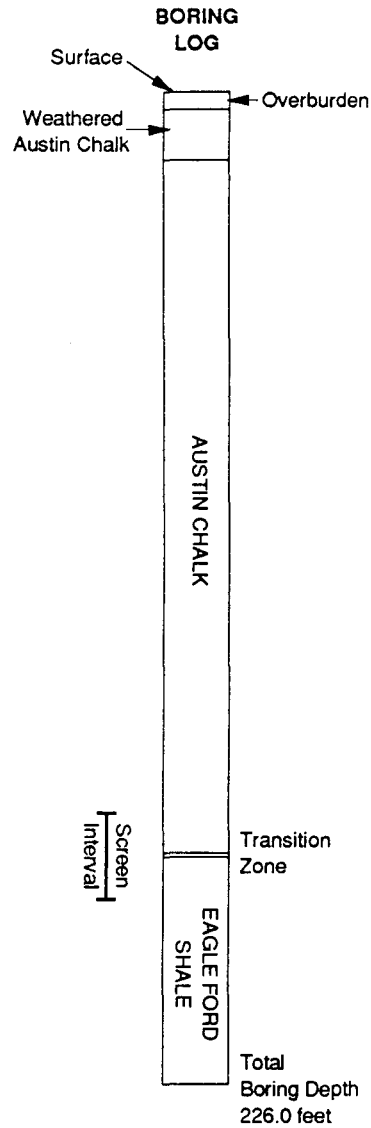
Downhole Seismic Velocity Measurement Procedure

12-89

Figure F-1





EXPLANATION

- ● P WAVE ARRIVAL TIMES
- ▲ S WAVE ARRIVAL TIMES

NOTES

1. Vp-COMPRESSIONAL WAVE VELOCITY (fps)
2. VS-SHEAR WAVE VELOCITY (fps)
3. ENERGY SOURCE TO BORING DISTANCE WAS 20 FEET.

The Earth Technology Corporation

Project No. 87-888-0015

RTK Joint Venture

Boring BIR 41
Downhole Velocity Survey
Data and Interpreted Results

1-90

Figure F-2

depth of 22 feet (38 percent deeper than described by the boring log). The sonic log did not measure a velocity within the weathered chalk.

Fresh Austin Chalk was identified in the boring log between depths of 16 and 174.5 feet. The average P velocity of the fresh chalk as interpreted from full-wave sonic logging is 9,500 fps. The downhole velocity survey identified a P velocity of 9,600 fps (1 percent greater than the sonic logging value) and an S velocity of 3,400 fps.

The boring log describes Eagle Ford Shale from depths of 175 to 226 feet (boring termination). The measured sonic logging P velocity for the shale is 6,500 fps. The downhole velocity survey identified a large P and S wave velocity inversion below an average interpreted depth of 184 feet (5 percent deeper than described in the boring log). The shale P velocity is 7,000 fps (8 percent greater than the sonic logging value) and the S velocity is 1,400 fps. Both shale velocities are about 30 percent lower than velocities in the overlying chalk. All shale moduli are about half the corresponding chalk values.

SUMMARY OF SEISMIC VELOCITIES AND ELASTIC MODULI FOR BORING BIR41

Depth (ft)	Vp (fps)	Vs (fps)	Average Bulk Density (pcf)	Poisson's Ratio*	Shear Modulus* ($x10^5$ psi)	Constrained Modulus* ($x10^5$ psi)	Young's Modulus* ($x10^5$ psi)	Bulk Modulus* ($x10^5$ psi)
0-23	3,000	1,000	140.0	0.44	0.30	2.72	0.87	2.32
23-184	9,600	3,400	139.9	0.43	3.49	27.80	9.98	23.19
184-220	7,000	1,400	136.9	0.48	0.58	14.46	1.71	13.72

* Equations used to calculate Poisson's ratio and dynamic elastic moduli are listed below.

Poisson's Ratio, u (dimensionless) $$u = \frac{Vp^2 - 2Vs^2}{2(Vp^2 - Vs^2)}$$

Shear Modulus, G (psi) $$G = CDVs^2$$

Constrained Modulus, M (psi) $$M = CDVp^2$$

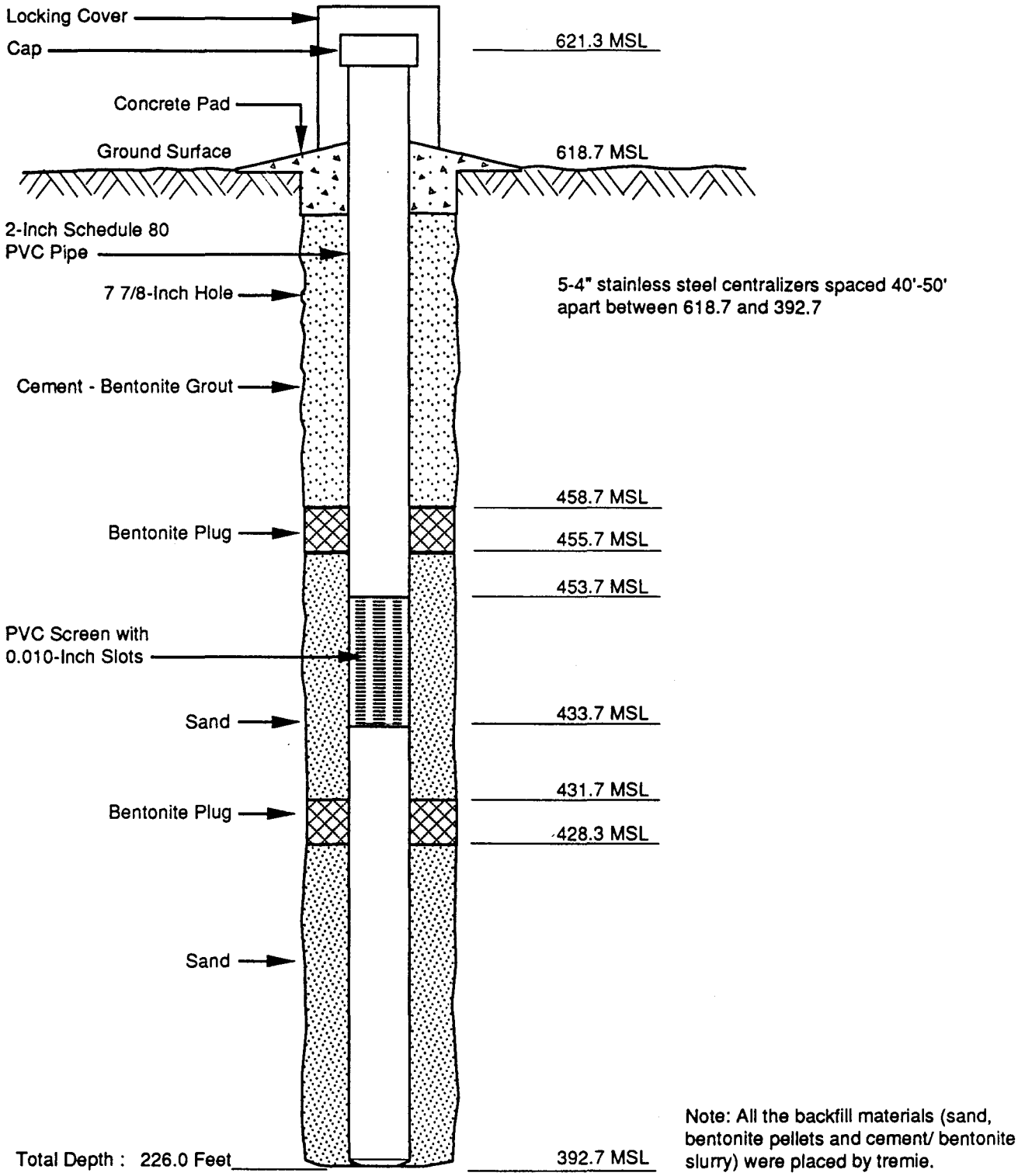
Young's Modulus, E (psi) $$E = 2G(1 + u)$$

Bulk Modulus, K (psi) $$K = CD(Vp^2 - 4/3Vs^2)$$

where:
- Vp = P wave velocity (fps)
- Vs = S wave velocity (fps)
- D = Bulk (wet) density (pcf)
- C = 2.156×10^{-4} (units conversion)

APPENDIX G

WELL CONSTRUCTION AND PLUGGING REPORTS



NOT TO SCALE

Boring: BIR 41
Location: N 231,388
E 2,178,618
Date(s) Installed: 9/28-9/29/89
Well Construction
Supervising Geologist: Shawn Wood
Approved By: Shawn Wood **Date: 5/18/90**

"As Built"
Well Construction Diagram
Observation Well
No. BIR 41

5/90 Figure

SSC BOREHOLE PLUGGING REPORT

TETC Project No. 87-888-0015

Task No. 15

Boring No. BIR-42

Texas Coordinate Location: N 231,357 feet E 2,176,714 feet

Surface Elevation: 620.0 feet

Total Boring Depth: 282.5 feet

Plugging Remarks:

Surface casing was removed and boring was grouted with a cement/bentonite/water mixture with a ratio of 1 sack cement: 5 pounds bentonite: 16 gallons water. Grout mixture was placed with PVC tremie pipe. Supplies used included 12 sacks cement, 1 sack bentonite.

Date Plugged: 9-25-89

Time Completed: 3:00 pm

Drilling Geologist: Scott E. Lesikar

MJA Coordinator: W. D. Flanigan

MJA No.: 5530.15

SSC BOREHOLE PLUGGING REPORT

Project No. 87-888

Task No. 15

Boring No. BIR 43

Texas Coordination Location: N 231,237
E 2,178,839

Surface Elevation: 623.3 feet

Total Boring Depth: 320.0 feet

Date Drilled: 3/5/90-3/12/90

Date Plugged: 3/17/90

Time Completed: 11:00 a.m.

Remarks:

294 gallons of grout (tremie placed) was used to completely cement boring from bottom to top. Water/cement ratio was approximately 7 gallons per sack.

Drilling geologist: Mike Granger
Coordinator: Shawn Wood
SwL Report No. 89-192

SSC BOREHOLE PLUGGING REPORT

Project No. 87-888

Task No. 15

Boring No. BIR 44

Texas Coordination Location: N 231,160
E 2,178,664

Surface Elevation: 617.9 feet

Total Boring Depth: 315.0 feet

Date Drilled: 3/5-3/15/90

Date Plugged: 3/15/90

Time Completed: 5:30 p.m.

Remarks:

280 gallons of grout was used to completely cement boring from bottom to top. Water/cement ratio was approximately 7 gallons per sack.

Drilling geologist: Dale Brown
Coordinator: Shawn Wood
SwL Report No. 89-192

SSC BOREHOLE PLUGGING REPORT

Project No. 87-888

Task No. 15

Boring No. BIR 45

Texas Coordination Location: N 231,515
E 2,178,508

Surface Elevation: 616.3 feet

Total Boring Depth: 312.0 feet

Date Drilled: 4/4-4/11/90

Date Plugged: 4/11/90

Time Completed: 5:00 p.m.

Remarks:

323 gallons of grout was used to completely cement boring from bottom to top. Water/cement ratio was approximately 7 gallons per sack.

Drilling geologist: Dale Brown
Coordinator: Shawn Wood
SwL Report No. 89-192