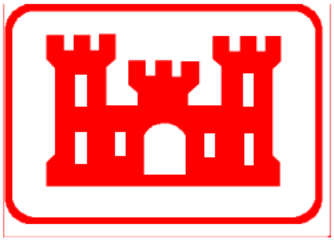
ATMOS PIPELINE ASSESSMENT
DALLAS, TEXAS

GOVERNMENT GEOTECHNICAL REPORT

FOR NATIONAL TRANSPORTATION SAFETY BOARD



PREPARED BY

U.S. ARMY CORPS OF ENGINEERS

FORT WORTH DISTRICT

ENGINEERING AND CONSTRUCTION DIVISION

GEOTECHNICAL BRANCH

CESWF-EC-G

APRIL 2019

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DALLAS, TEXAS

GOVERNMENT GEOTECHNICAL REPORT

1. General.

The purpose of this report is to outline the results of a geotechnical study performed to help the National Transportation Safety Board (NTSB) evaluate the technical accuracy of the preliminary geotechnical assessment report provided by Bryant Consultants, Incorporated (BCI) regarding the possible cause of the gas pipeline explosion in Dallas, TX.

The NTSB has requested the services of U.S. Army Corps of Engineers (USACE) for this study. This work is being performed as per the Inter/Intra-Agency Agreement Number 9531BM19H0019 dated October 10, 2018 between NTSB and USACE. This agreement was modified on February 20, 2019 to change the technical point of contact and extend the period of performance to April 30, 2019. The scope of our work included reviewing the preliminary assessment report prepared by Bryant Consultants, Incorporated, performing borings to determine subsurface stratigraphy and collecting soil samples within the accident area, determining the characteristics of the soil samples and performing analyses to determine the shrink/swell potential of the soils. Figure 1 shows the accident block and the location of natural gas leaks.

Figure 1 Map of the block bounded by Durango Drive, Larga Drive, Espanola Drive, and El Centro Drive showing the location of natural gas leaks and affected houses.

2. Subsurface Investigation.

In line with the Scope of Work developed by the U.S. Army Corps of Engineers (USACE), Fort Worth District, three (3) borings were drilled for this assessment. One of the originally proposed borings (Boring B-3) could not be drilled due to the presence of existing utilities. The borings were drilled to depths of 20 feet below ground surface. The field investigation was performed using a Gus Pech 1300C truck-mounted drill rig and conventional drilling attachments. Test hole advancement and sample recovery was performed using 6-inch diameter short flight hollow stem augers, a nominal 3-inch diameter Shelby tube sampler, and a 6-inch diameter drag bit. Samples recovered from the borings were sealed in airtight containers and taken to the laboratory of TEAM Consultants, Incorporated (Arlington, Texas) for testing. Boring locations are shown in Figure B-101. Results of the field investigation are shown in Logs of Borings (Appendix A).

a. Groundwater Conditions. Groundwater conditions were monitored during and upon completion of drilling operations. The borings were dry during the observation period. However, it should be noted that groundwater conditions are relative to the time of drilling, annual precipitation, and drainage conditions at the site.

3. Subsurface Conditions.

General Geology. Based on the Geological Atlas of Texas, Dallas Sheet, primary material underlying the accident block consists of Eagle Ford Shale Formation (K_{ef}). Figure 2 shows the location of the accident block. To the West of the block is the Fluviatile Terrace Deposits (Q_t) and to the East of the block is the Austin Chalk Formation (K_{au}). Eagle Ford Shale Formation and the Austin Chalk Formation are of the Upper Cretaceous age whereas the Fluviatile Terrace Deposits are of the Pleistocene age.

Figure 2 Geology at the accident block (Geological Atlas of Texas, Dallas Sheet)

The Eagle Ford Shale Formation typically consists of shale, sandstone, and limestone interbedded with clay seams. Soils derived from the Eagle Ford Shale Formation are typically plastic clays exhibiting high shrink/swell potential with variations in moisture content. The Austin Chalk Formation consists of gray chalky limestone with some shale and partings. This

unit weathers to a light tan; it is typically overlain by a layer of residual, dark colored clay. The residual clays on top of the chalky limestone are highly expansive. Fluviatile Terrace deposits consist of gravel, sand, silt and clay.

Subsurface conditions representative of the project site are shown on the logs of borings in Appendix A. The legend on the individual boring logs show materials as classified in the laboratory using procedures presented in ASTM D 2488. It should be noted that the actual interface between material types may be far more gradual or abrupt than presented; therefore, actual subsurface conditions in areas not sampled may differ from those predicted.

4. Testing.

Laboratory Testing. Representative soil samples recovered from test holes were subjected to laboratory testing for identification, moisture content, grain-size distribution, Atterberg limits, density, and controlled expansion-consolidation. The accumulative test results are tabulated and presented in Appendix B. Results of identification and moisture content testing are shown on the boring logs, Appendix A.

Results of laboratory testing performed on samples obtained from the site are presented graphically in Appendix B as follows: Plasticity characteristics are shown on Plate 1, Plasticity Chart. Moisture content values of representative samples are shown with respect to depth on Plate 2. Atterberg limits test results are shown with respect to depth on Plate 3. Dry density values of representative undisturbed samples and their corresponding moisture contents are shown with respect to depth on Plate 4.

(1) Controlled Expansion-Consolidation Testing and Swell Pressure Testing. Controlled expansion-consolidation (CEC) testing was performed on eight specimens of high plasticity (CH) clay and one specimen of low plasticity (CL) clay collected at the site. The high plasticity (CH) clay overburden specimens were collected at depths ranging between

2 to 15 feet. Liquid limits (LL) measured from representative samples of the high plasticity clays vary between 51 and 64, plastic limits (PL) vary between 18 and 25 with plasticity indices (PI) between 32 and 41. The moisture content is equal to and up to 3 percent higher than the plastic limit. An expansion pressure (P_{exp}) of approximately 0.75 tons per square foot (tsf) to 1.5 tsf was recorded during CEC testing of the high plasticity clay specimens. Based on CEC test results, and the considerations discussed above, the high plasticity clay specimens have a moderate to high expansion potential (C_s = 0.04 to 0.06) and a moderate to high consolidation potential (C_c = 0.15 to 0.22) at present moisture contents.

Controlled expansion-consolidation testing was performed on one specimen of the low plasticity clay at depth of 18 to 20 feet. LL measured from representative samples of the low plasticity clays were 45 and 46, PL was 18, with PI of 27 and 28. The moisture content is 2 percent higher than the plastic limit. An expansion pressure (P_{exp}) of approximately 1.0 tsf was recorded during CEC testing of the low plasticity clay specimen. Based on CEC test results, the low plasticity clay specimen has moderate expansion potential (C_s = 0.04) and a moderate consolidation potential (C_c = 0.15) at present moisture content. Controlled expansion-consolidation test results are presented in Appendix C at the end of this report.

Controlled expansion-consolidation test results are summarized below.

Boring Number	Depth (feet)	Liquid Limit	Plasticity Index	P_{exp} (tsf)	P_{exp}/P_o	C_s	C_c	Soil Type
B-1	2.0	63	39	0.75	4.0	0.06	0.19	CH
B-1	8.0	55	33	1.0	1.8	0.05	0.18	CH
B-2	2.0	61	36	1.0	5.4	0.06	0.22	CH
B-2	4.0	57	36	1.0	3.2	0.05	0.19	CH
B-2	13.0	60	40	1.5	1.7	0.05	0.15	CH
B-4	1.0	64	40	1.5	12.0	0.06	0.22	CH
B-4	5.0	61	39	1.0	2.7	0.06	0.19	CH
B-4	8.0	52	32	1.0	1.8	0.04	0.16	CH
B-4	18.0	45	27	1.0	0.8	0.04	0.15	CL

P_{exp}= Swell Pressure in tons per square foot; P_o= Overburden Pressure in tons per square foot
C_s= Swell Index; C_c= Compression Index

5. Discussions.

The surficial soils encountered in the borings are high plasticity clays. Swell potential significantly increases as subgrade moisture content increases. Based on TxDOT test method TEX-124-E which uses Atterberg limits values and in situ moisture content, we estimate a potential vertical rise (PVR) in the range of 1-¾ to 2-½ inches. Our estimate assumes a zone of influence of 15.0 feet below ground surface. PVR in the range of 2-½ to 3.0 inches is estimated assuming a dry soil moisture condition.

As mentioned previously in the general geology section of this report, the accident block is located in an area underlain by the Eagle Ford Shale Formation. Fluviatile Terrace deposits are located to the west and Austin Chalk Formation is located to the east of the Eagle Ford Formation. Soils derived from the Eagle Ford Shale Formation and the residual soils on top of the Austin Chalk Formation are high plasticity clays. These clays shrink on drying and swell when provided access to water. This shrink/swell movement causes a lot of distress to the structures constructed on top or within these formations.

The borings were drilled in March during the colder months. So, the soils encountered at the site were moist and the moisture content was equal to and up to 3 percent higher than the plastic limit of the soil. The swell pressure recorded in the soil samples tested ranged between 0.75 tons per square foot (tsf) to 1.5 tsf. Drier high plasticity soils exert very high swell pressures (5 to 6 tsf) when provided access to water and prevented from swelling. The ratio of the swell pressure to overburden pressure (P_{exp}/P_o) of high plasticity clays at this site ranged from 1.7 to 12 indicating a moderate to very high swell potential.

Structures and pipes founded within highly expansive soils as well as in different geological formations experience differential movements when variable moisture conditions are present in the soils supporting the structures or pipes. Clays are impermeable and water cannot easily flow through them whereas sands and gravels are permeable and provide easy access for water to permeate. Granular backfill around the pipes also provide a medium through which

water flows easily. There may be localized areas where water may stagnate within these granular backfill and cause heave. This localized heave will cause differential movement between this area and the area not provided access to water. There may also be low areas where water is ponding causing localized heave. During summer, the highly plastic clays shrink. This cyclic shrink /swell movement exerts a lot of forces on the joints and pipe connections. The magnitude of the force is directly proportional to the plasticity of the soil and the variability of the moisture content within the soil. Construction in the vicinity of the buried pipes may also provide access to water in the soils supporting the pipes.

6. Conclusions.

BCI's report asserts there are two different geologic formations, the Eagle Ford and Austin Chalk, underlying the accident site. USACE, Fort Worth District disagrees that there are two different geologic formations underlying the accident site. Based on the site-specific borings, drilled as part of the USACE subsurface investigation, there is only one geologic formation, the Eagle Ford Shale, underlying the accident site. Furthermore, based on the lab test results, the plasticity characteristics and swell potential of the subsurface materials within the accident block are highly uniform.

References:

- TEAM Consultants, Incorporated Report No. 192031
- TM 5-818-1 – Soils and Geology Procedures for Foundation Design of Buildings and Other Structures (Except Hydraulic Structures)
- TM 5-818-7 – Foundations in Expansive Soils
- UFGS Guide Specifications for Construction

APPENDIX A

BORING LOCATIONS & LOGS OF BORINGS

BORING COORDINATES		
HOLE	N	E
B-1	[redacted]	[redacted]
B-2	[redacted]	[redacted]
B-3	NOT DRILLED DUE TO UTILITY CONFLICT	
B-4	[redacted]	[redacted]

US ARMY CORPS OF ENGINEERS ®
FORT WORTH DISTRICT

Rev	Description	Tracking No.	Action	Date

Designed by AHMED FAISAL, P.E.	Date APR 2019
Drawn by DAVID CHOUNG	Solicitation No.
Reviewed by	Contract No.
Submitted by LORIE BALDI, P.E. CHIEF, GEOTECHNICAL BRANCH	File Name PLOT DATE PLOT SCALE

U.S. ARMY ENGINEER DISTRICT, CORPS OF ENGINEERS FORT WORTH, TEXAS

ENGINEERING/ CONSTRUCTION DIVISION GEOTECHNICAL BRANCH

DALLAS, TX PIPELINE INCIDENT
PLD18FR002

BORING LAYOUT PLAN

SHEET SEQUENCE NUMBER
B-101

Hole No. B-1

DRILLING LOG

DIVISION: SWD	INSTALLATION: SWF	SHEET 1 OF 1 SHEETS	
1. PROJECT: ATMOS Pipeline - Dallas	10. SIZE AND TYPE OF BIT: 4-1/4"x8" HSA + IBS		
2. LOCATION (Coordinates or Station): [redacted]	11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*:		
3. DRILLING AGENCY: USACE	12. MANUFACTURER'S DESIGNATION OF DRILL: GP-1300C		
4. HOLE NO. *(As shown on drawing title and file number)*: B-1	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED 6	UNDISTURBED 2	
5. NAME OF DRILLER: D. Spencer	14. TOTAL NUMBER CORE BOXES: N/A		
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.	15. ELEVATION GROUND WATER: DRY at completeion		
7. THICKNESS OF OVERBURDEN: 20.0'	16. DATE HOLE: STARTED 3/13/2019	COMPLETED 3/13/2019	
8. DEPTH DRILLED INTO ROCK: 0.0'	17. ELEVATION TOP OF HOLE:		
9. TOTAL DEPTH OF HOLE: 20.0'	18. TOTAL CORE RECOVERY FOR BORING: N/A %		
	19. GEOLOGIST: Joel Webster		

% MOISTURE CONTENT a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc , if significant) g
			ASPHALT - 0.0' to 0.3'			Shelby Tube Samples ST-1: 2' to 4' 500 psi for 20 sec PP=2.25 ST-X: 4' to 6' 500 psi for 17 sec no recovery ST-2: 8' to 10' 500 psi for 16 sec PP=2.5 ST-Y: 13' to 15' 500 psi for 16 sec no recovery Jar Samples A: 2' to 4' B: 4' to 7.2' C: 8' to 13' D: 13' to 17.1' E: 17.1' to 17.9' F: 18' to 20'
			BASE MATERIAL - SANDY GRAVEL - 0.3' to 1.6' coarse to fine grained, subangular, medium dense, moist to wet, pale brown, chalky, trace to few fines.			
25.3			FAT CLAY (CH) - 1.6' to 7.2' high plasticity, stiff, moist, gray, silty, few to little fine grained sand, moderate HCl reaction, trace to few lime granules to 1/16", trace iron oxide staining; becoming gray and light gray with little lime granules to 1/4" below 6'.	IBS 85%	A ST-1	
25.0				IBS 100%	B	
22.1			FAT CLAY (CH) - 7.2' to 17.1' high plasticity, stiff, moist, light gray with yellowish brown staining, moderate HCl reaction, trace black staining/iron oxide granules to 1/4", trace lime granules to 1/4".	IBS 100%	ST-2	
	10				C	
23.9				SPT-N 6-8-9-9 95%	D	
26.6						
17.5			LEAN CLAY WITH SAND (CL) - 17.1' to 17.9' tan and gray, moist, very silty with some fine grained, slickensided in fractures.		E	
19.0			SILTY SAND (SM) - 17.9' to 20.0' fine grained, poorly graded quartz, medium dense, light gray to 19', yellowish brown below 19', trace fines.		F	
	20		- end of boring at 20'.			
	21					

Hole No. B-2

DRILLING LOG

DIVISION: SWD	INSTALLATION: SWF	SHEET 1 OF 1 SHEETS	
1. PROJECT: ATMOS Pipeline - Dallas	10. SIZE AND TYPE OF BIT: 4-1/4"x8" HSA + IBS		
2. LOCATION (Coordinates or Station): [redacted]	11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*		
3. DRILLING AGENCY: USACE	12. MANUFACTURER'S DESIGNATION OF DRILL: GP-1300C		
4. HOLE NO. *(As shown on drawing title and file number)*: B-2	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED 6 / UNDISTURBED 4		
5. NAME OF DRILLER: D. Spencer	14. TOTAL NUMBER CORE BOXES: N/A		
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.	15. ELEVATION GROUND WATER: DRY at completeion		
7. THICKNESS OF OVERBURDEN: 20.0'	16. DATE HOLE: STARTED 3/13/2019 / COMPLETED 3/13/2019		
8. DEPTH DRILLED INTO ROCK: 0.0'	17. ELEVATION TOP OF HOLE		
9. TOTAL DEPTH OF HOLE: 20.0'	18. TOTAL CORE RECOVERY FOR BORING: N/A %		
	19. GEOLOGIST: Joel Webster		

% MOISTURE CONTENT a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc , if significant) g
			ASPHALT - 0.0' to 0.3'			Shelby Tube Samples ST-1: 2' to 4' 500 psi for 15 sec PP=2.75 ST-2: 4' to 6' 500 psi for 15 sec PP=2.5 ST-3: 8' to 10' 500 psi for 19 sec PP=2.5 ST-4: 13' to 15' 500 psi for 20 sec PP=2.75 ST-5: 18' to 20' (no recovery - SPT on 2nd attempt) 500 psi for 19 sec PP=2.75 Jar Samples A: 2' to 5.7' B: 5.7' to 8' C: 8' to 11.3' D: 11.3' to 12.1' E: 13' to 18' F: 18' to 20'
			BASE MATERIAL - SANDY GRAVEL - 0.3' to 1.0' coarse to fine grained, subangular, medium dense, moist, pale brown, chalky, trace to few fines.			
26.6			FAT CLAY (CH) - 1.0' to 5.7' high plasticity, stiff, moist, dark gray, slightly silty, trace fine grained sand, trace lime granules to 1/16", trace rootlets; becoming light gray with little lime granules to 1/8" below 4.5', strong HCl reaction.	85%	A ST-1	
21.7				100%	A ST-2	
19.4			FAT CLAY (CH) - 5.7' to 8.0' 'same as CH below'	IBS 100%	B	
17.8			LEAN CLAY (CL) - 8.0' to 11.3' tan and gray, moist.	IBS 100%	C ST-3	
	10				C	
20.8						
14.7			LEAN CLAY WITH SAND (CL) - 11.3' to 12.1' tan, moist, some lime nodules to 1'.		D	
			FAT CLAY (CH) - 12.1' to 20.0' high plasticity, stiff, moist, light gray with little yellowish brown staining, moderate HCl reaction, trace to few silt, few lime nodules to 1/4", trace black staining/granules to 1/8", few to little slickensides at 30° to 60°; yellowish brown with some light gray below 12.1'.			
21.2				IBS 95%	E ST-4	
23.3					E	
21.4				SPT-N 2-5-7-9 100%	F	
	20		- end of boring at 20'.			
	21					

Hole No. B-4

DRILLING LOG

DIVISION: SWD	INSTALLATION: SWF	SHEET 1 OF 1 SHEETS	
1. PROJECT: ATMOS Pipeline - Dallas	10. SIZE AND TYPE OF BIT: 4-1/4"x8" HSA + IBS		
2. LOCATION (Coordinates or Station): [redacted]	11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*:		
3. DRILLING AGENCY: USACE	12. MANUFACTURER'S DESIGNATION OF DRILL: GP-1300C		
4. HOLE NO. *(As shown on drawing title and file number)*: B-4	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED 4	UNDISTURBED 6	
5. NAME OF DRILLER: D. Spencer	14. TOTAL NUMBER CORE BOXES: N/A		
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.	15. ELEVATION GROUND WATER: DRY at completeion		
7. THICKNESS OF OVERBURDEN: 20.0'	16. DATE HOLE: STARTED 3/12/2019	COMPLETED 3/12/2019	
8. DEPTH DRILLED INTO ROCK: 0.0'	17. ELEVATION TOP OF HOLE:		
9. TOTAL DEPTH OF HOLE: 20.0'	18. TOTAL CORE RECOVERY FOR BORING: N/A %		
	19. GEOLOGIST: Joel Webster		

% MOISTURE CONTENT a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc , if significant) g
			ASPHALT - 0.0' to 0.2'			Shelby Tube Samples ST-1: 1' to 3' 500 psi for 21 sec PP=2.5-2.75 ST-2: 3' to 5' 500 psi for 19 sec PP=2-2.5 ST-3: 5' to 7' 500 psi for 21 sec PP=2-2.25 ST-4: 8' to 10' 500 psi for 18 sec PP=2.5-2.75 ST-5: 13' to 15' 500 psi for 16 sec PP>4.5 ST-6: 18' to 20' Jar Samples A: 1' to 5' B: 5' to 7' C: 8' to 13' D: 13' to 18'
			CONCRETE - 0.2' to 0.6'			
25.8			FAT CLAY (CH) - 0.6' to 7.0' high plasticity, stiff, moist, very dark grayish brown, slightly silty, moderate HCl reaction, trace to few iron oxide staining/deposits and lime granules to 1/16".	50%	A ST-1	
26.0				80%	A ST-2	
24.5				100%	B ST-3	
20.7			FAT CLAY (CH) - 7.0' to 18.0' high plasticity, stiff, moist, pale brown to light olive brown, slight silty to 8', strong HCl reaction, few to little lime nodules to 1/4" to 11', iron oxide staining/black granules, yellowish brown after 11.3', slicken sided in fractures.			
	10			80%	C ST-4	
22.7					C	
19.1				100%	D ST-5	
22.0					D	
19.8			LEAN CLAY (CL) - 18.0' to 20.0' tan and gray, moist.	100%	ST-6	
	20		- end of boring at 20'.			
	21					

APPENDIX B

LABORATORY TESTING DATA PLOTS

ATMOS PIPELINE - DALLAS
PLASTICITY CHART

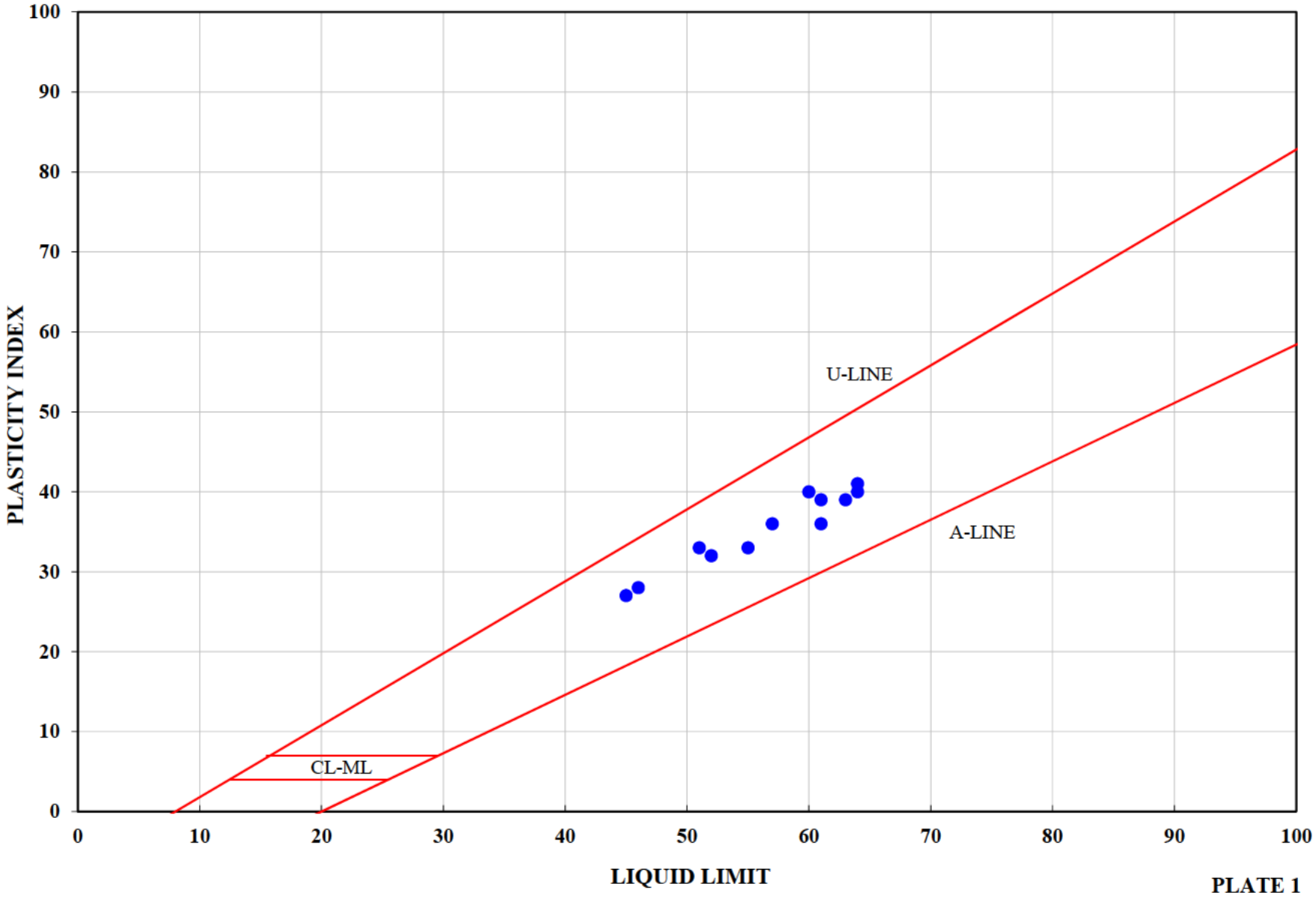


PLATE 1

ATMOS PIPELINE - DALLAS
MOISTURE CONTENT VS DEPTH

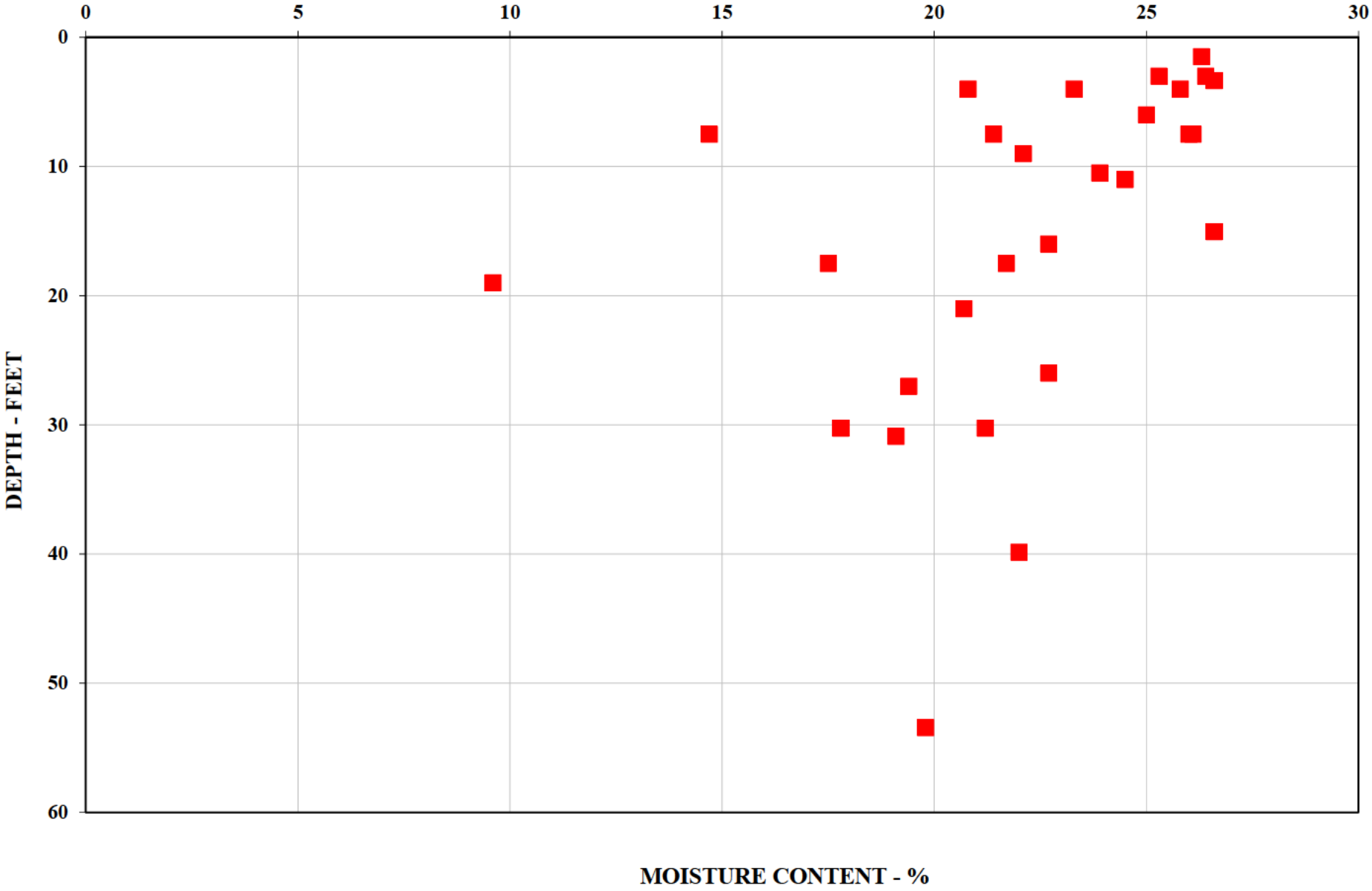


PLATE 2

ATMOS PIPELINE - DALLAS
ATTERBERG LIMITS VS DEPTH

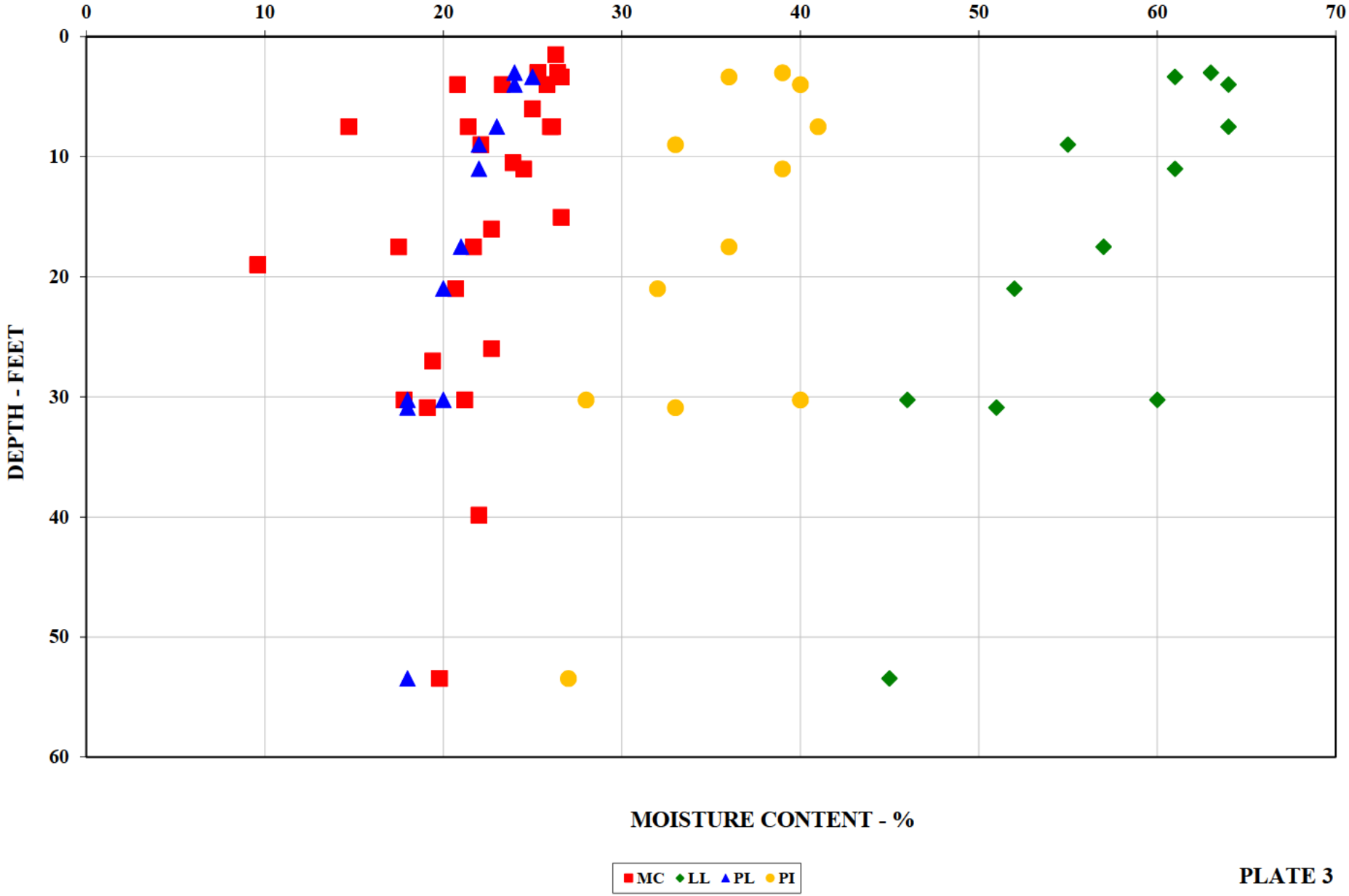


PLATE 3

ATMOS PIPELINE - DALLAS
MOISTURE CONTENT - DRY DENSITY VS DEPTH

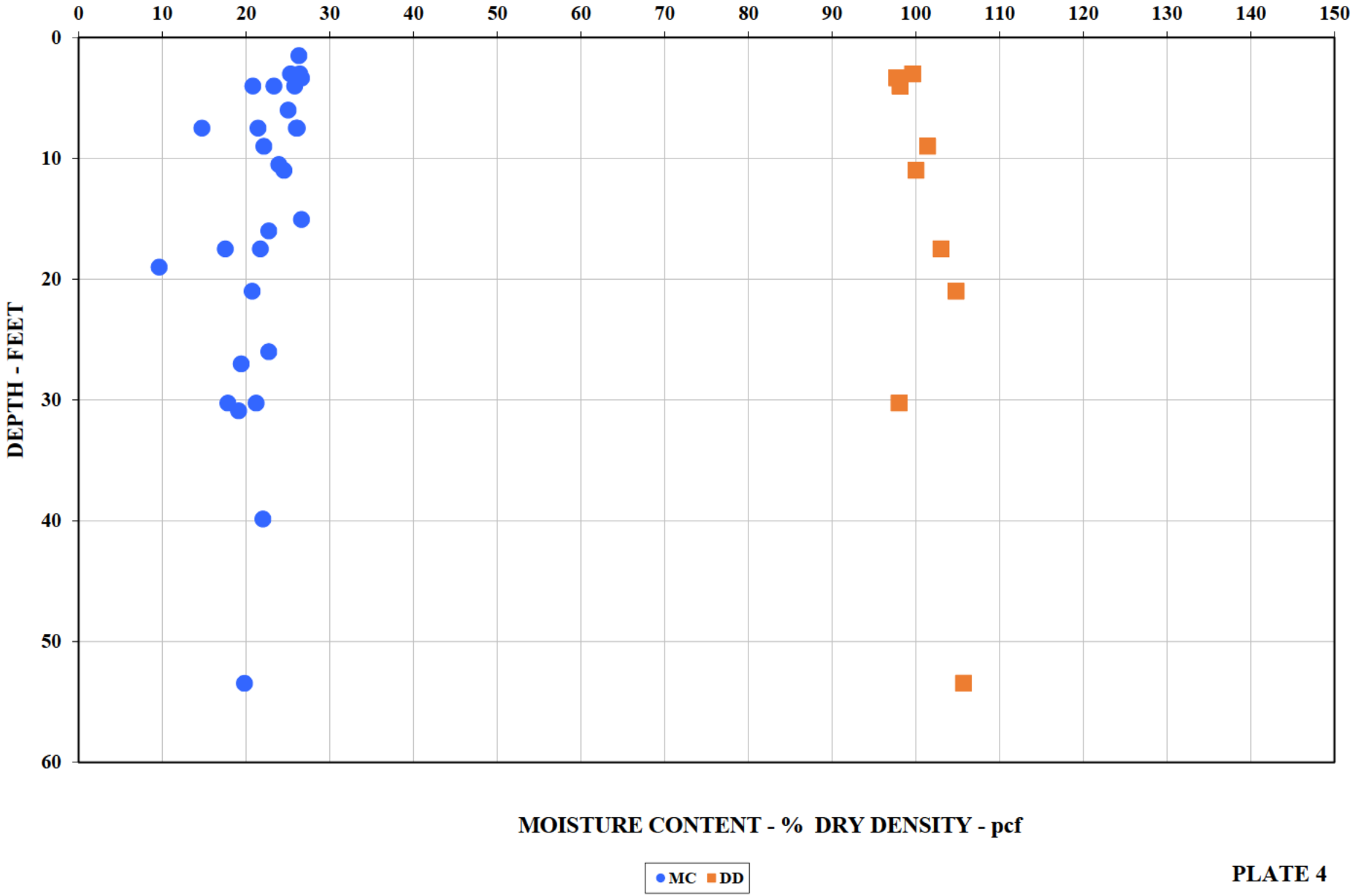


PLATE 4

APPENDIX C

LABORATORY TESTING DATA

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

April 15, 2019
TEAM Project No. 192031
Report No. 1

U.S. Army Corps of Engineers
CESWF-EC-DG
[redacted]

Attn: Mr. Faisal Ahmed

Re: Laboratory Testing Services
[redacted]

Dear Mr. Ahmed:

Submitted here is our report of laboratory testing services completed on soil samples received at our materials testing laboratory in Arlington, Texas, on March 13, 2019 for the above referenced project. The laboratory test program authorized March 15, 2019 was finished utilizing the following test methodologies:

Moisture Content	ASTM D-2216
Atterberg Limits	ASTM D-4318
Grain Size Analysis	ASTM D-422
Classification of Soils	ASTM D-2487/D-2488
Controlled Expansion Consolidation	USACE EM 1110-2-1906, App. VIII

We appreciate the opportunity to be of assistance to you with this project. Should you have any questions, or if we may be of further assistance, please call the undersigned at [redacted].

Very truly yours,

[redacted]

Jason Young, GIT
Staff Geologist

[redacted]

James Hutt
Vice President

[redacted]

SUMMARY OF LABORATORY TEST RESULTS

LABORATORY TESTING SERVICES
NTSB Dallas Pipeline
Dallas, Texas

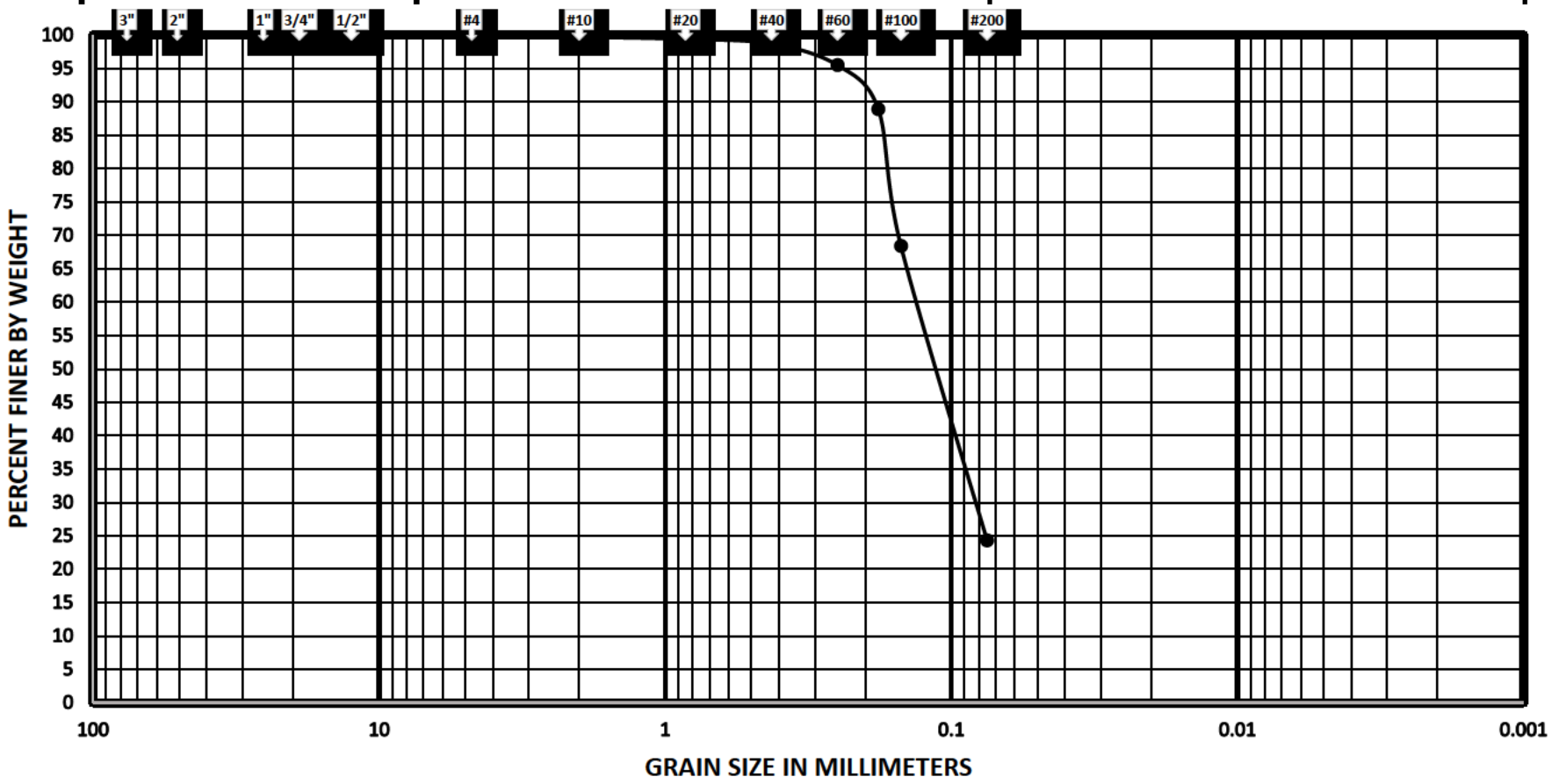
Boring No.	Sample No.	Sample Depth (ft.)	Visual Description & Unified Soil Classification (ASTM D-2487/2488)		Percent Passing Sieve #4	#10	#20	#40	#60	#80	#100	#200
B-1	ST-1	2-4	Gray fat clay	CH	99.6	97.4	96.0	95.2	94.4	93.3	92.1	88.2
	A	2-4	Gray fat clay	CH	---	---	---	---	---	---	---	---
	B	4-8	Light brown fat clay	CH	---	---	---	---	---	---	---	---
	ST-2	8-10	Tan and gray fat clay	CH	99.4	98.0	97.0	96.5	95.9	95.2	94.4	92.0
	C	8-13	Tan and gray fat clay	CH	---	---	---	---	---	---	---	---
	D	13-17.1	Tan and gray fat clay	CH	---	---	---	---	---	---	---	---
	E	17.1-17.9	Tan and gray lean clay with sand	CL	---	---	---	---	---	---	---	---
	F	18-20	Tan silty sand	SM	99.8	99.7	99.4	98.7	95.5	88.9	68.4	24.3
B-2	ST-1	2-4	Gray and dark brown fat clay	CH	100	99.6	99.2	98.9	98.4	97.6	96.7	94.3
	A	2-5.7	Dark gray fat clay	CH	---	---	---	---	---	---	---	---
	ST-2	4-6	Gray and dark gray fat clay	CH	99.0	97.8	97.0	96.6	96.2	95.5	94.8	92.6
	B	5.7-8	Light gray fat clay	CH	---	---	---	---	---	---	---	---
	ST-3	8-10	Tan and gray lean clay	CL	99.9	99.6	98.7	97.9	97.1	96.4	95.6	93.6
	C	8-11.3	Tan and gray fat clay	CH	---	---	---	---	---	---	---	---
	D	11.3-12.1	Tan lean clay with sand	CL	---	---	---	---	---	---	---	---
	ST-4	13-15	Tan and gray fat clay	CH	100	100	99.8	99.6	99.2	98.7	98.2	96.5
	E	13-18	Brown and gray fat clay	CH	---	---	---	---	---	---	---	---
	F	18-20	Brown and gray fat clay	CH	---	---	---	---	---	---	---	---
B-4	A	1-5	Gray fat clay	CH	---	---	---	---	---	---	---	---
	ST-1	1-3	Gray and dark brown fat clay	CH	98.9	98.0	96.8	96.1	95.2	94.0	92.6	88.9
	ST-2	3-5	Gray and brown fat clay	CH	100	99.1	98.1	97.3	96.4	95.1	93.8	90.3
	ST-3	5-7	Brown and gray fat clay	CH	98.3	95.7	94.5	93.5	92.6	91.5	90.7	87.6
	B	5-7	Tan and gray fat clay	CH	---	---	---	---	---	---	---	---
	ST-4	8-10	Tan and gray fat clay	CH	99.9	98.6	97.4	96.5	95.7	95.1	94.7	93.0
	C	8-13	Tan and gray fat clay	CH	---	---	---	---	---	---	---	---
	ST-5	13-15	Brown and gray fat clay	CH	100	100	100	99.9	99.7	99.4	99.1	97.4
	D	13-18	Brown and tan fat clay	CH	---	---	---	---	---	---	---	---
	ST-6	18-20	Tan and gray lean clay	CL	100	99.4	99.2	99.1	98.9	98.7	98.5	97.7

SUMMARY OF LABORATORY TEST RESULTS

LABORATORY TESTING SERVICES
NTSB Dallas Pipeline
Dallas, Texas

Boring No.	Sample No.	Sample Depth (ft.)	Visual Description & Unified Soil Classification (ASTM D-2487/2488)		Moisture Content (%)	Unit Dry Weight (pcf)	Atterberg Limits LL	PL	PI	Remarks
B-1	ST-1	2-4	Gray fat clay	CH	25.3	99.6	63	24	39	(1)
	A	2-4	Gray fat clay	CH	26.4	---	---	---	---	
	B	4-8	Light brown fat clay	CH	25.0	---	---	---	---	
	ST-2	8-10	Tan and gray fat clay	CH	22.1	101.4	55	22	33	(1)
	C	8-13	Tan and gray fat clay	CH	23.9	---	---	---	---	
	D	13-17.1	Tan and gray fat clay	CH	26.6	---	---	---	---	
	E	17.1-17.9	Tan and gray lean clay with sand	CL	17.5	---	---	---	---	
	F	18-20	Tan silty sand	SM	9.6	---	Non-Plastic			
B-2	ST-1	2-4	Gray and dark brown fat clay	CH	26.6	97.7	61	25	36	(1)
	A	2-5.7	Dark gray fat clay	CH	26.1	---	---	---	---	
	ST-2	4-6	Gray and dark gray fat clay	CH	21.7	103.0	57	21	36	(1)
	B	5.7-8	Light gray fat clay	CH	19.4	---	---	---	---	
	ST-3	8-10	Tan and gray lean clay	CL	17.8	---	46	18	28	
	C	8-11.3	Tan and gray fat clay	CH	20.8	---	---	---	---	
	D	11.3-12.1	Tan lean clay with sand	CL	14.7	---	---	---	---	
	ST-4	13-15	Tan and gray fat clay	CH	21.2	98.0	60	20	40	(1)
	E	13-18	Brown and gray fat clay	CH	23.3	---	---	---	---	
	F	18-20	Brown and gray fat clay	CH	21.4	---	---	---	---	
B-4	A	1-5	Gray fat clay	CH	26.3	---	---	---	---	
	ST-1	1-3	Gray and dark brown fat clay	CH	25.8	98.1	64	24	40	(1)
	ST-2	3-5	Gray and brown fat clay	CH	26.0	---	64	23	41	
	ST-3	5-7	Brown and gray fat clay	CH	24.5	100.0	61	22	39	(1)
	B	5-7	Tan and gray fat clay	CH	22.7	---	---	---	---	
	ST-4	8-10	Tan and gray fat clay	CH	20.7	104.8	52	20	32	(1)
	C	8-13	Tan and gray fat clay	CH	22.7	---	---	---	---	
	ST-5	13-15	Brown and gray fat clay	CH	19.1	---	51	18	33	
	D	13-18	Brown and tan fat clay	CH	22.0	---	---	---	---	
	ST-6	18-20	Tan and gray lean clay	CL	19.8	105.7	45	18	27	(1)

(1) See attached "Laboratory Data Sheets" for Consolidation Test results.



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Data	D90	D60	D50	D30	D10	% Gravel	% Sand	% Silt & Clay	C_C	C_U
B-1 F 18-20'	0.18	0.13	0.12	0.081	N/A	0.2	75.5	24.3	N/A	N/A

SOIL CLASSIFICATION (ASTM D-2487): Tan silty sand **(SM)**

PROJECT: ATMOS Pipeline Date: 3/28/2019

LOCATION: Dallas, Texas Performed By: Y. Hu

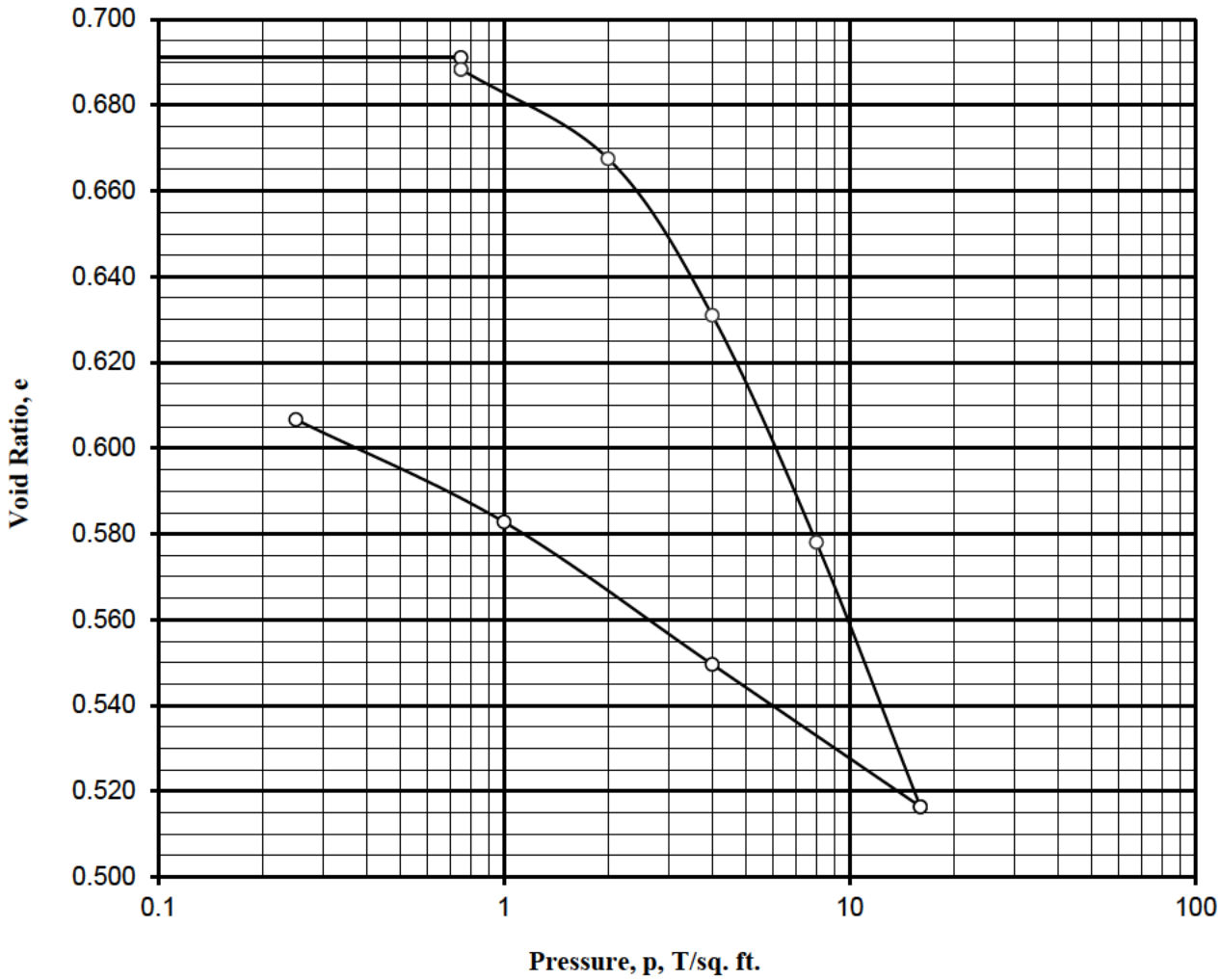
TEAM Project Number: 192031

TEAM Consultants, Inc.

PARTICLE SIZE ANALYSIS (ASTM D-422)

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing



Type of specimen:	Undisturbed			Before Test		After Test	
Diam. 2.50 in.	Ht. 0.501 in.			Water Content, w_o	25.31%	W_f	22.49%
Overburden Pressure, P_o	T/sq. ft.			Void Ratio, e_o	0.6911	e_f	0.6067
Preconsol. Pressure, P_c	T/sq. ft.			Saturation, S_o	98.8%	S_f	100.0%
Compression Index, C_c				Dry Density, γd	99.6 lb/ft^3		
Classification	Gray fat clay						
LL 63	G_s 2.698			Project	USACE, ATMOS Pipeline		
PL 24					TEAM Project No.: 192031		
Remarks				Boring No:	B-1	Sample No.:	ST-1
				Depth:	2-4'	Date:	3/15/19
				CONSOLIDATION TEST REPORT			

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST
(Specimen Data)

Project: USACE, ATMOS Pipeline — TEAM Job No.: 192031

Boring No.: B-1 — Sample No.: ST-1 — Depth: 2-4' — Date: 3/15/19

Classification: Gray fat clay

			Before Test		After Test	
			Specimen	Trimmings	Specimen	
Tare No.			Ring and Plates	625	451	
Weight in grams	Tare plus wet soil		191.03	582.91	113.03	
	Tare plus dry soil		174.76	507.24	98.57	
	Water	W_W	W_{WO} 16.27	75.67	W_{wf}	14.46
	Tare		110.46	208.30	34.27	
	Dry soil	W_S	64.30	298.94	64.30	
Water Content		w	W_O 25.31%	25.31%	W_f	22.49%

Consolidometer No.:	5	Area of specimen, A, (sq. cm.)	31.67
Weight of ring, g	N/A	Height of specimen, H, (in.)	0.501
Weight of plates, g	N/A	Specific Gravity of solids, (Gs)	2.698

Height of solids, $H_s = \frac{W_S}{A \times G_s \times \gamma_W} = \frac{64.30}{31.67 \times 2.70 \times 1 \times 2.54} = 0.2963$ in.

Original height of water, $H_{WO} = \frac{W_{WO}}{A \times \gamma_W} = \frac{16.27}{31.67 \times 1 \times 2.54} = 0.2023$ in.

Final height of water, $H_{Wf} = \frac{W_{Wf}}{A \times \gamma_W} = \frac{14.46}{31.67 \times 1 \times 2.54} = 0.1798$ in.

Net change in height of specimen at end of test, ΔH = -0.02500 in.

Height of specimen at end of test, $H_f = H - \Delta H$ = 0.4760 in.

Void ratio before test, $e_O = \frac{H - H_S}{H_S} = \frac{0.501 - 0.2963}{0.2963} = 0.6911$

Void ratio after test, $e_f = \frac{H_f - H_S}{H_S} = \frac{0.476 - 0.2963}{0.2963} = 0.6067$

Degree of saturation before test, $S_O = \frac{H_{WO}}{H - H_S} = \frac{0.2023}{0.5010 - 0.2963} = 98.8\%$

Degree of saturation after test, $S_f = \frac{H_{wf}}{H_f - H_S} = \frac{0.1798}{0.4760 - 0.2963} = 100.0\%$

Dry density before test, $\gamma_d = \frac{W_S}{H \times A} = \frac{64.30 \times 62.4}{0.501 \times 31.67 \times 2.54} = 99.6$ lb./cu.ft.

Remarks

Technician: Jason Young — Computed by: Jason Young — Checked by: James Hutt

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Time - Consolidation Data)

Project: USACE, ATMOS Pipeline TEAM Job No.: 192031

Boring No.: B-1 Sample No.: ST-1 Depth: 2-4' Consol.No.: 5

Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C	Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C
3/15	0.25	11:00	0	2003	20	3/19	4	8:50	0	2098.8	20
3/15	0.5	11:05	5	2002		3/19	4	8:50	0.05	2119	
3/15	0.75	11:40	40	2010		3/19	4	8:50	0.1	2121.5	
3/18	0.75	8:00	4140	2020	19	3/19	4	8:50	0.2	2124	
						3/19	4	8:50	0.33	2126	
						3/19	4	8:50	0.5	2128	
						3/19	4	8:50	0.75	2130	
						3/19	4	8:51	1	2132	
3/18	2	8:45	0	2020	19	3/19	4	8:52	2	2136.5	
3/18	2	8:45	0.05	2043.5		3/19	4	8:54	4	2143.2	
3/18	2	8:45	0.1	2045		3/19	4	8:58	8	2151	
3/18	2	8:45	0.2	2046.2		3/19	4	9:05	15	2162.5	
3/18	2	8:45	0.33	2047.2		3/19	4	9:20	30	2174.2	
3/18	2	8:45	0.5	2049		3/19	4	9:50	60	2188	
3/18	2	8:45	0.75	2050.5		3/19	4	10:30	100	2197	
3/18	2	8:46	1	2052		3/19	4	12:10	200	2207.2	
3/18	2	8:47	2	2055		3/19	4	13:50	300	2212	
3/18	2	8:49	4	2059.5		3/19	4	17:15	505	2216	
3/18	2	8:53	8	2065		3/20	4	9:05	1455	2219	20
3/18	2	9:00	15	2070.5							
3/18	2	9:15	30	2077.8							
3/18	2	9:50	65	2084.8							
3/18	2	10:35	110	2088.2							
3/18	2	12:05	200	2092							
3/18	2	13:45	300	2094.2							
3/18	2	18:15	570	2096.5							
3/19	2	8:50	1445	2098.8	20						

Technician Jason Young

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Time - Consolidation Data)

Project: USACE, ATMOS Pipeline TEAM Job No.: 192031

Boring No.: B-1 Sample No.: ST-1 Depth: 2-4' Consol.No.: 5

Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C	Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C
3/20	8	9:05	0	2219	20	3/21	16	8:50	0	2388.8	20
3/20	8	9:05	0.05	2240		3/21	16	8:50	0.05	2408	
3/20	8	9:05	0.1	2242.5		3/21	16	8:50	0.1	2410	
3/20	8	9:05	0.2	2244.5		3/21	16	8:50	0.2	2412	
3/20	8	9:05	0.33	2246.8		3/21	16	8:50	0.33	2414	
3/20	8	9:05	0.5	2249		3/21	16	8:50	0.5	2416.5	
3/20	8	9:05	0.75	2251.2		3/21	16	8:50	0.75	2418.8	
3/20	8	9:06	1	2253		3/21	16	8:51	1	2420.8	
3/20	8	9:07	2	2259		3/21	16	8:52	2	2426.5	
3/20	8	9:09	4	2266.8		3/21	16	8:54	4	2434	
3/20	8	9:13	8	2277.5		3/21	16	8:58	8	2445	
3/20	8	9:20	15	2292.8		3/21	16	9:05	15	2458.8	
3/20	8	9:35	30	2312		3/21	16	9:20	30	2481	
3/20	8	10:05	60	2336		3/21	16	9:50	60	2510	
3/20	8	10:45	100	2353		3/21	16	10:30	100	2530	
3/20	8	12:25	200	2369.8		3/21	16	12:10	200	2557.5	
3/20	8	14:05	300	2376.2		3/21	16	13:50	300	2568	
3/20	8	17:45	520	2383.5		3/21	16	19:00	610	2578.8	
3/21	8	8:50	1425	2388.8	20	3/22	16	9:25	1475	2584.5	20

Technician Jason Young

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Time - Consolidation Data)

Project: USACE, ATMOS Pipeline TEAM Job No.: 192031

Boring No.: B-1 Sample No.: ST-1 Depth: 2-4' Consol.No.: 5

Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. °C	Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. °C
						REBOUND LOADS					
						3/22	4	9:25	Rebound	2584.5	20
						3/24	4	14:15	3170	2469.2	20
						3/24	1	14:15	Rebound	2469.2	20
						3/25	1	17:30	1635	2348.8	21
						3/25	0.25	17:30	Rebound	2348.8	21
						3/26	0.25	15:30	1320	2260	20
						Machine Deflection Readings					
							0.25			2003	
							0.75			2012	
							2			2029	
							4			2041	
							8			2054	
							16			2067	
							4			2050	
							1			2028	
							0.25			2010	

Technician Jason Young

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Computation of Void Ratio)

PROJECT: USACE, ATMOS Pipeline | TEAM Job No.: 192031 | DATE: 3/15/19

BORING NO.: B-1 | SAMPLE NO.: ST-1 | DEPTH: 2-4' | CONSOLIDOMETER NO.: 5

Pressure, P T./sq.ft.	Date Increment Applied	Time in Min. Increment Effective	Dial Reading 10^{-4} in.	Correction 10^{-4} in.	Change in Height, ΔH 10^{-4} in.	Height of Voids, H_V 10^{-4} in.	Void Ratio, e
0.1	3/15	Zero Point	2000	2000	0	2047	0.6911
0.75	3/15	Initial Load	2012	2012	0	2047	0.6911
0.75	3/15	4140	2020	2012	-8	2039	0.6884
2	3/18	1445	2098.8	2029	-69.8	1978	0.6675
4	3/19	1455	2219	2041	-178	1869	0.6310
8	3/20	1425	2388.8	2054	-334.8	1713	0.5781
16	3/21	1475	2584.5	2067	-517.5	1530	0.5164
4	3/22	3170	2469.2	2050	-419.2	1628	0.5496
1	3/24	1635	2348.8	2028	-320.8	1727	0.5828
0.25	3/25	1320	2260	2010	-250	1797	0.6067

Note:

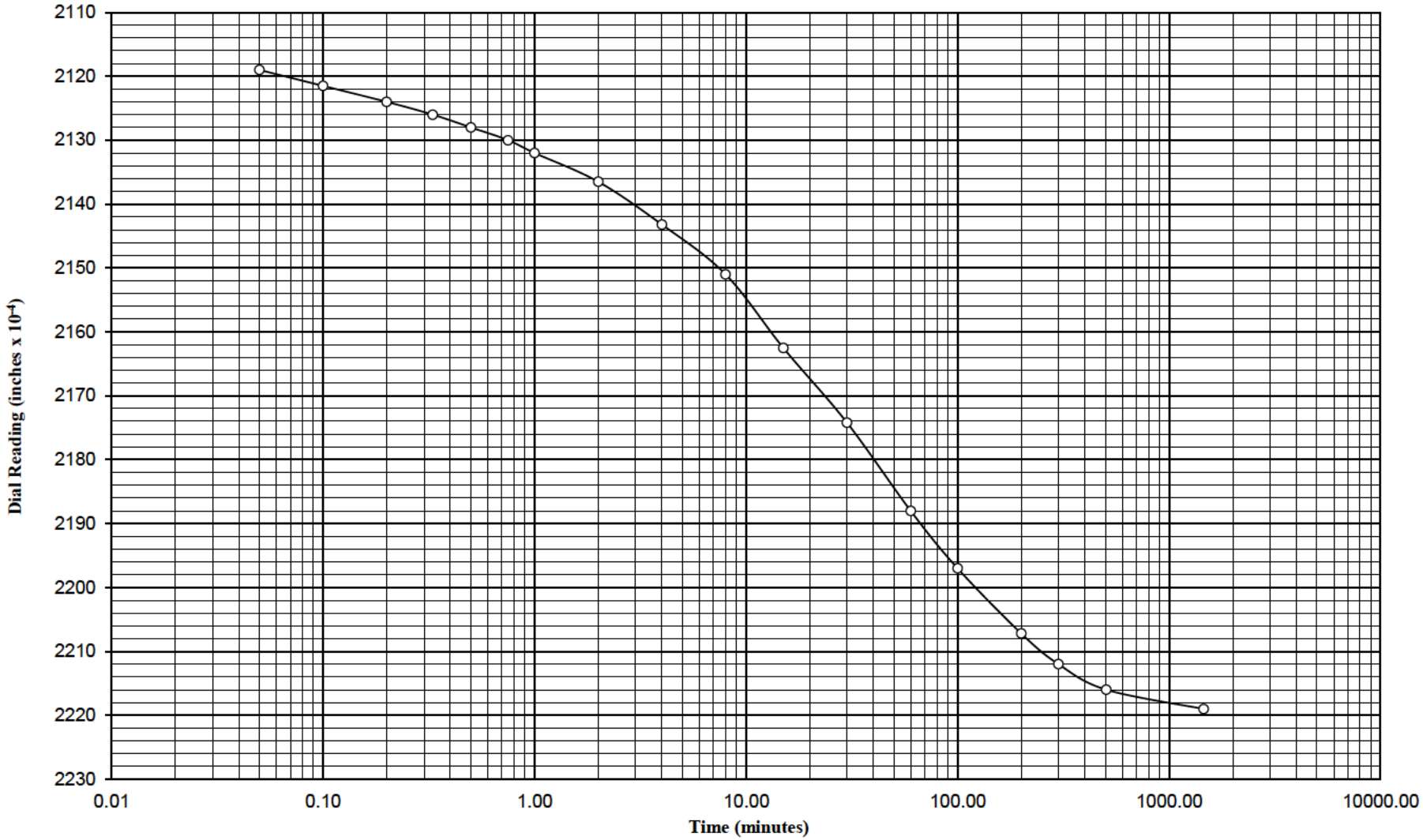
Height of voids, $H_V = (H - H_S) - \Delta H$ $H_S =$ 0.2963

Void Ratio, $e = \frac{H_V}{H_S}$

Technician: Jason Young | Computed by: Jason Young | Checked by: James Hutt

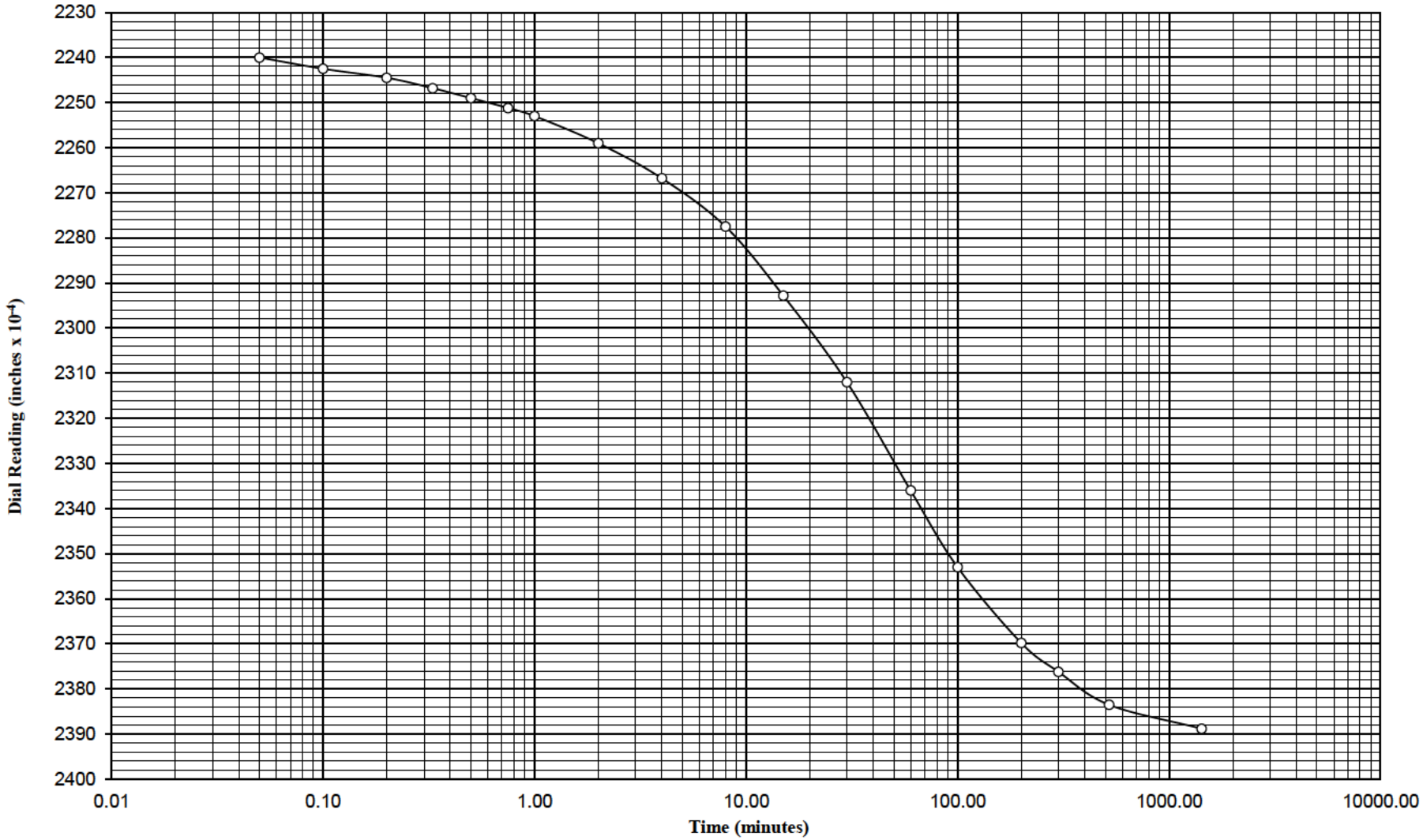
CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	1.32×10^{-4} (cm²/sec)		
		d_{50} (inches):	0.20667	TEAM Project No.:	192031
BORING NO.:	B-1	t_{50} (min):	9.9	Date:	3/15/2019
DEPTH:	2-4'	Load (tsf):	2	Remarks	
SAMPLE:	ST-1	Thickness (inches)	0.501		



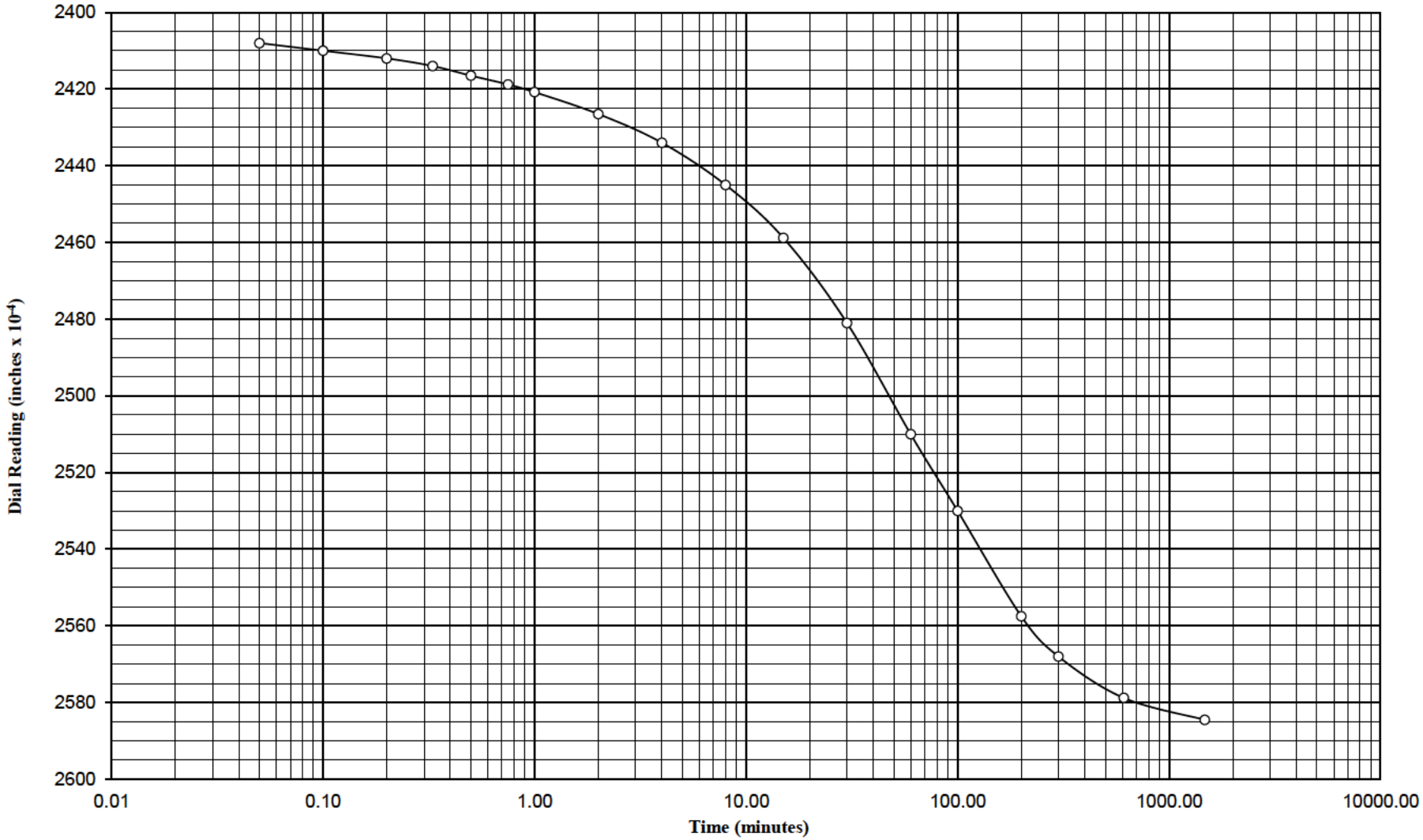
CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	0.79×10^{-4} (cm²/sec)		
		d_{50} (inches):	0.21635	TEAM Project No.:	192031
BORING NO.:	B-1	t_{50} (min):	16	Date:	3/15/2019
DEPTH:	2-4'	Load (tsf):	4	Remarks	
SAMPLE:	ST-1	Thickness (inches)	0.501		



CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	0.48×10^{-4} (cm²/sec)		
		d_{50} (inches):	0.23065	TEAM Project No.:	192031
BORING NO.:	B-1	t_{50} (min):	25	Date:	3/15/2019
DEPTH:	2-4'	Load (tsf):	8	Remarks	
SAMPLE:	ST-1	Thickness (inches)	0.501		

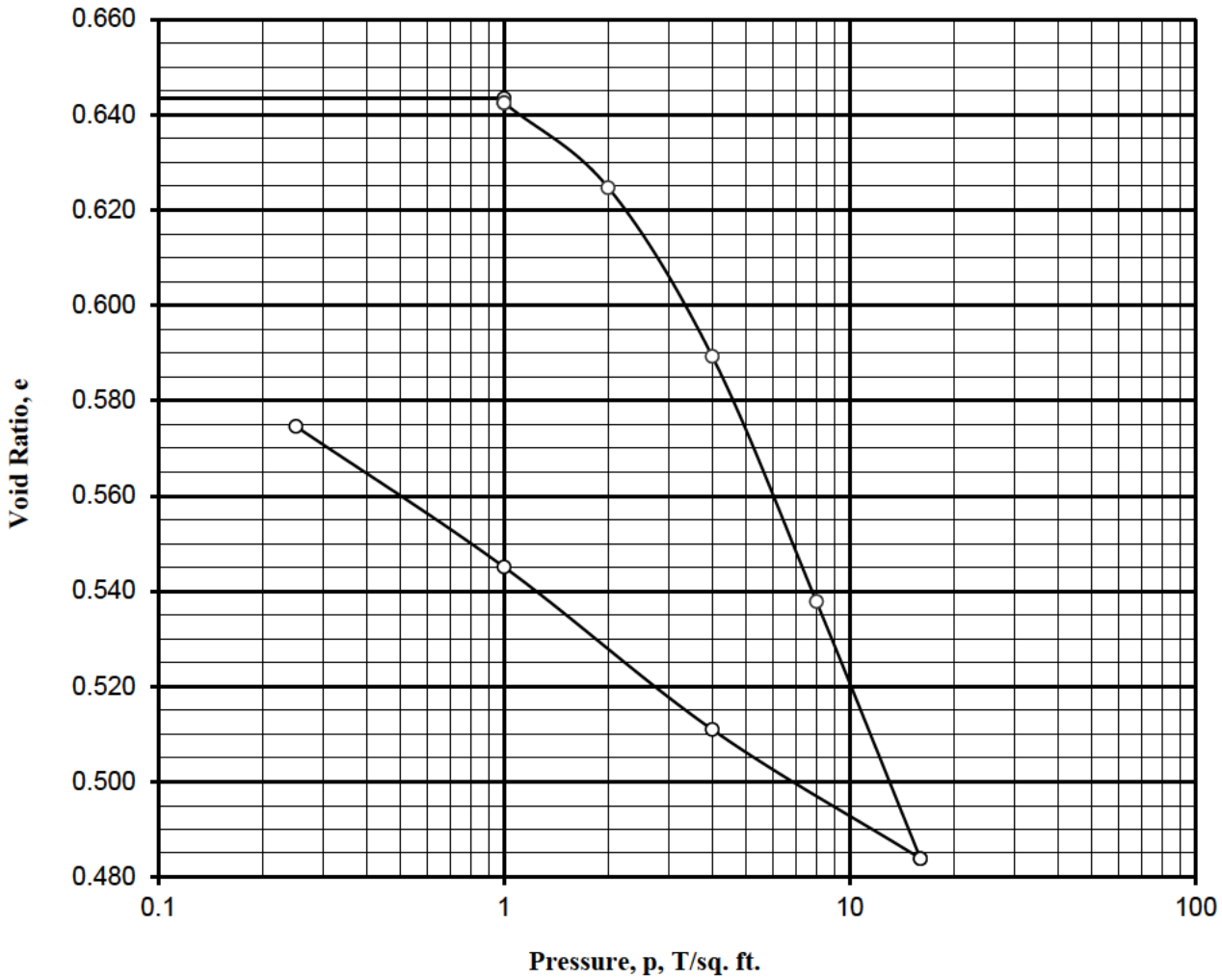


CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	0.31×10^{-4} (cm²/sec)		
		d_{50} (inches):	0.24885	TEAM Project No.:	192031
BORING NO.:	B-1	t_{50} (min):	36	Date:	3/15/2019
DEPTH:	2-4'	Load (tsf):	16	Remarks	
SAMPLE:	ST-1	Thickness (inches)	0.501		

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing



Type of specimen:	Undisturbed			Before Test		After Test	
Diam. 2.50 in.	Ht. 0.501 in.			Water Content, w_o	22.07%	W_f	21.51%
Overburden Pressure, P_o	T/sq. ft.			Void Ratio, e_o	0.6435	e_f	0.5746
Preconsol. Pressure, P_c	T/sq. ft.			Saturation, S_o	91.6%	S_f	100.0%
Compression Index, C_c				Dry Density, γd	101.4 lb/ft^3		
Classification	Tan and gray fat clay						
LL 55	G_s 2.671			Project	USACE, ATMOS Pipeline		
PL 22					TEAM Project No.: 192031		
Remarks				Boring No:	B-1	Sample No.:	ST-2
				Depth:	8-10'	Date:	3/19/19
				CONSOLIDATION TEST REPORT			

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST
(Specimen Data)

Project: USACE, ATMOS Pipeline — TEAM Job No.: 192031

Boring No.: B-1 — Sample No.: ST-2 — Depth: 8-10' — Date: 3/19/19

Classification: Tan and gray fat clay

			Before Test		After Test	
			Specimen	Trimmings	Specimen	
Tare No.			Ring and Plates	626	430	
Weight in grams	Tare plus wet soil		189.96	532.47	114.99	
	Tare plus dry soil		175.50	472.29	100.90	
	Water	W_W	W_{WO} 14.46	60.18	W_{wf}	14.09
	Tare		110.00	199.63	35.40	
	Dry soil	W_S	65.50	272.66	65.50	
Water Content		w	W_O 22.07%	22.07%	W_f	21.51%

Consolidometer No.:	3	Area of specimen, A, (sq. cm.)	31.67
Weight of ring, g	N/A	Height of specimen, H, (in.)	0.501
Weight of plates, g	N/A	Specific Gravity of solids, (Gs)	2.671

Height of solids, $H_s = \frac{W_S}{A \times G_s \times \gamma_W} = \frac{65.50}{31.67 \times 2.67 \times 1 \times 2.54} = 0.3048$ in.

Original height of water, $H_{WO} = \frac{W_{WO}}{A \times \gamma_W} = \frac{14.46}{31.67 \times 1 \times 2.54} = 0.1797$ in.

Final height of water, $H_{Wf} = \frac{W_{Wf}}{A \times \gamma_W} = \frac{14.09}{31.67 \times 1 \times 2.54} = 0.1752$ in.

Net change in height of specimen at end of test, ΔH = -0.02100 in.

Height of specimen at end of test, $H_f = H - \Delta H$ = 0.4800 in.

Void ratio before test, $e_O = \frac{H - H_S}{H_S} = \frac{0.501 - 0.3048}{0.3048} = 0.6435$

Void ratio after test, $e_f = \frac{H_f - H_S}{H_S} = \frac{0.48 - 0.3048}{0.3048} = 0.5746$

Degree of saturation before test, $S_O = \frac{H_{WO}}{H - H_S} = \frac{0.1797}{0.5010 - 0.3048} = 91.6\%$

Degree of saturation after test, $S_f = \frac{H_{wf}}{H_f - H_S} = \frac{0.1752}{0.4800 - 0.3048} = 100.0\%$

Dry density before test, $\gamma_d = \frac{W_S}{H \times A} = \frac{65.50 \times 62.4}{0.501 \times 31.67 \times 2.54} = 101.4$ lb./cu.ft.

Remarks

Technician: Jason Young — Computed by: Jason Young — Checked by: James Hutt

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Time - Consolidation Data)

Project: USACE, ATMOS Pipeline TEAM Job No.: 192031

Boring No.: B-1 Sample No.: ST-2 Depth: 8-10' Consol.No.: 3

Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C	Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C
3/19	0.125	10:30	0	2003	20	3/21	4	8:40	0	2099.2	
3/19	0.25	10:31	1	1998		3/21	4	8:40	0.05	2140.5	
3/19	0.5	10:32	2	2006		3/21	4	8:40	0.1	2144.8	
3/19	0.75	12:00	90	2008		3/21	4	8:40	0.2	2149.8	
3/19	1	12:30	120	2019		3/21	4	8:40	0.33	2153.5	
3/20	1	8:55	1345	2031	20	3/21	4	8:40	0.5	2157	
						3/21	4	8:40	0.75	2160.2	
						3/21	4	8:41	1	2162.5	
3/20	2	8:55	0	2031	20	3/21	4	8:42	2	2168.8	
3/20	2	8:55	0.05	2053.5		3/21	4	8:44	4	2175.5	
3/20	2	8:55	0.1	2057		3/21	4	8:48	8	2183.2	
3/20	2	8:55	0.2	2059		3/21	4	8:55	15	2191.2	
3/20	2	8:55	0.33	2061.5		3/21	4	9:10	30	2199.2	
3/20	2	8:55	0.5	2063		3/21	4	9:40	60	2206	
3/20	2	8:55	0.75	2065		3/21	4	10:20	100	2210.8	
3/20	2	8:56	1	2066.5		3/21	4	12:00	200	2215	
3/20	2	8:57	2	2070		3/21	4	13:40	300	2217.5	
3/20	2	8:59	4	2074		3/21	4	19:00	620	2221	
3/20	2	9:03	8	2078		3/22	4	9:35	1495	2224.2	20
3/20	2	9:10	15	2081.8							
3/20	2	9:25	30	2085.5							
3/20	2	9:55	60	2089							
3/20	2	10:35	100	2091.5							
3/20	2	12:15	200	2094							
3/20	2	13:55	300	2095.5							
3/20	2	17:45	530	2097.5							
3/21	2	8:40	1425	2099.2	20						

Technician Jason Young

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Time - Consolidation Data)

Project: USACE, ATMOS Pipeline TEAM Job No.: 192031

Boring No.: B-1 Sample No.: ST-2 Depth: 8-10' Consol.No.: 3

Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C	Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C
3/22	8	9:35	0	2224.2	20	3/25	16	8:45	0	2402	21
3/22	8	9:35	0.05	2281		3/25	16	8:45	0.05	2445.5	
3/22	8	9:35	0.1	2285.5		3/25	16	8:45	0.1	2448.8	
3/22	8	9:35	0.2	2290		3/25	16	8:45	0.2	2452.5	
3/22	8	9:35	0.33	2293.8		3/25	16	8:45	0.33	2455.8	
3/22	8	9:35	0.5	2298		3/25	16	8:45	0.5	2458.8	
3/22	8	9:35	0.75	2300.8		3/25	16	8:45	0.75	2462	
3/22	8	9:36	1	2303		3/25	16	8:46	1	2464.5	
3/22	8	9:37	2	2309.8		3/25	16	8:47	2	2472	
3/22	8	9:40	5	2321.8		3/25	16	8:49	4	2482.5	
3/22	8	9:45	10	2332.5		3/25	16	8:53	8	2496.2	
3/22	8	9:50	15	2340		3/25	16	9:00	15	2512.8	
3/22	8	10:05	30	2355		3/25	16	9:15	30	2534	
3/22	8	10:35	60	2368.5		3/25	16	9:45	60	2552	
3/22	8	11:15	100	2376		3/25	16	10:25	100	2564.5	
3/22	8	12:55	200	2383		3/25	16	12:05	200	2576	
3/22	8	14:55	320	2387		3/25	16	13:45	300	2580.2	
3/22	8	19:00	565	2391		3/25	16	17:30	525	2585.2	
3/25	8	8:45	4270	2402	21	3/26	16	8:30	1425	2592.5	20

Technician Jason Young

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Time - Consolidation Data)

Project: USACE, ATMOS Pipeline TEAM Job No.: 192031

Boring No.: B-1 Sample No.: ST-2 Depth: 8-10' Consol.No.: 3

Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. °C	Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. °C
						REBOUND LOADS					
						3/26	4	8:30	Rebound	2592.5	20
						3/27	4	7:30	1380	2475	20
						3/27	1	7:30	Rebound	2475	20
						3/28	1	8:45	1515	2343	20
						3/28	0.25	8:45	Rebound	2343	20
						3/29	0.25	12:30	1665	2232	20
						Machine Deflection Readings					
							0.125			2003	
							1			2028	
							2			2042	
							4			2059	
							8			2080	
							16			2106	
							4			2071	
							1			2043	
							0.25			2022	

Technician Jason Young

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Computation of Void Ratio)

PROJECT: USACE, ATMOS Pipeline | TEAM Job No.: 192031 | DATE: 3/19/19

BORING NO.: B-1 | SAMPLE NO.: ST-2 | DEPTH: 8-10' | CONSOLIDOMETER NO.: 3

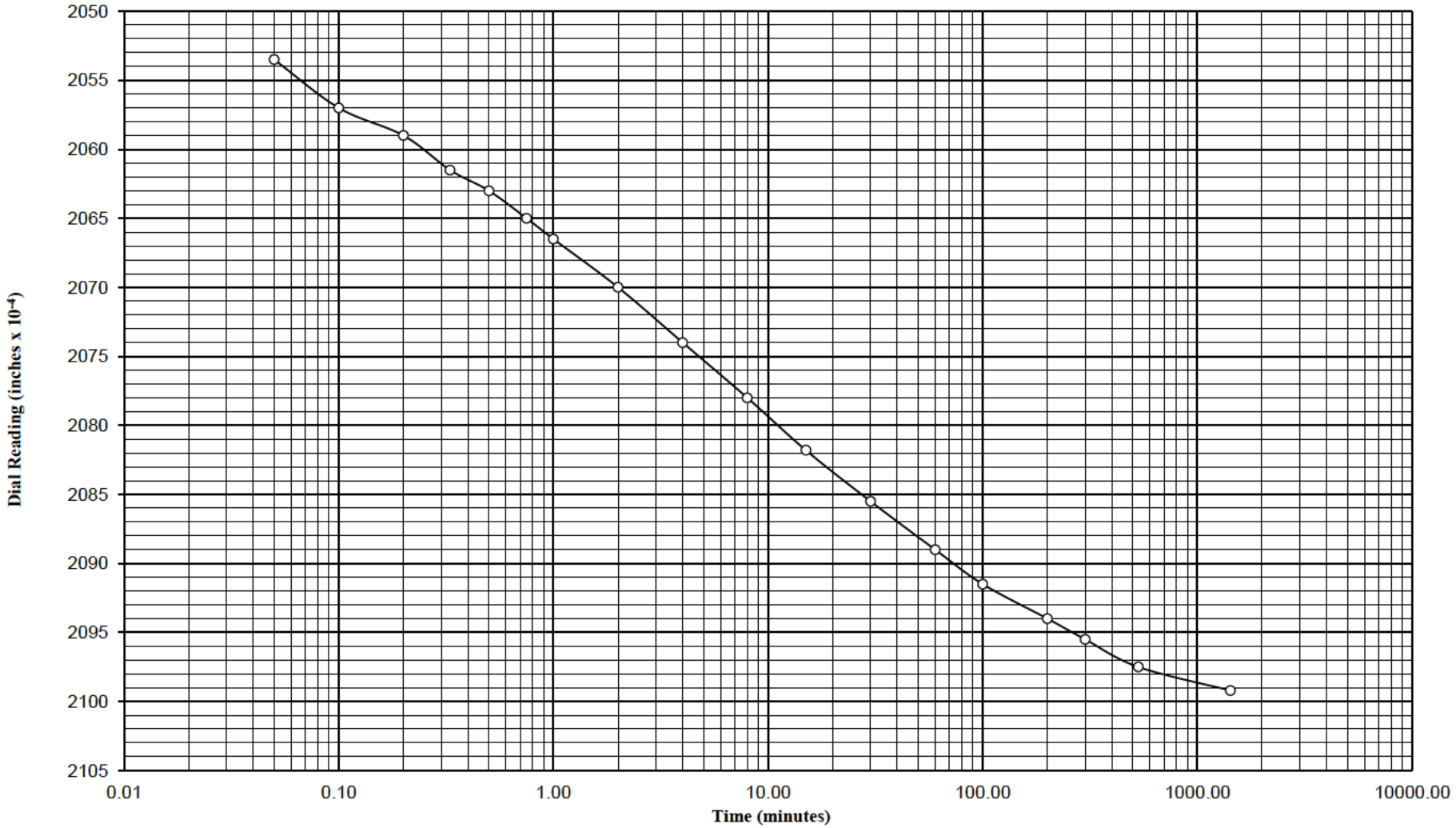
Pressure, P T./sq.ft.	Date Increment Applied	Time in Min. Increment Effective	Dial Reading 10^{-4} in.	Correction 10^{-4} in.	Change in Height, ΔH 10^{-4} in.	Height of Voids, H_V 10^{-4} in.	Void Ratio, e
0.1	3/19	Zero Point	2000	2000	0	1962	0.6435
1	3/19	Initial Load	2028	2028	0	1962	0.6435
1	3/19	1345	2031	2028	-3	1959	0.6425
2	3/20	1425	2099.2	2042	-57.2	1904	0.6247
4	3/21	1495	2224.2	2059	-165.2	1796	0.5893
8	3/22	4270	2402	2080	-322	1640	0.5379
16	3/25	1425	2592.5	2106	-486.5	1475	0.4839
4	3/26	1380	2475	2071	-404	1558	0.5110
1	3/27	1515	2343	2043	-300	1662	0.5451
0.25	3/28	1665	2232	2022	-210	1752	0.5746

Note:

Height of voids, $H_V = (H - H_S) - \Delta H$ $H_S =$ 0.3048

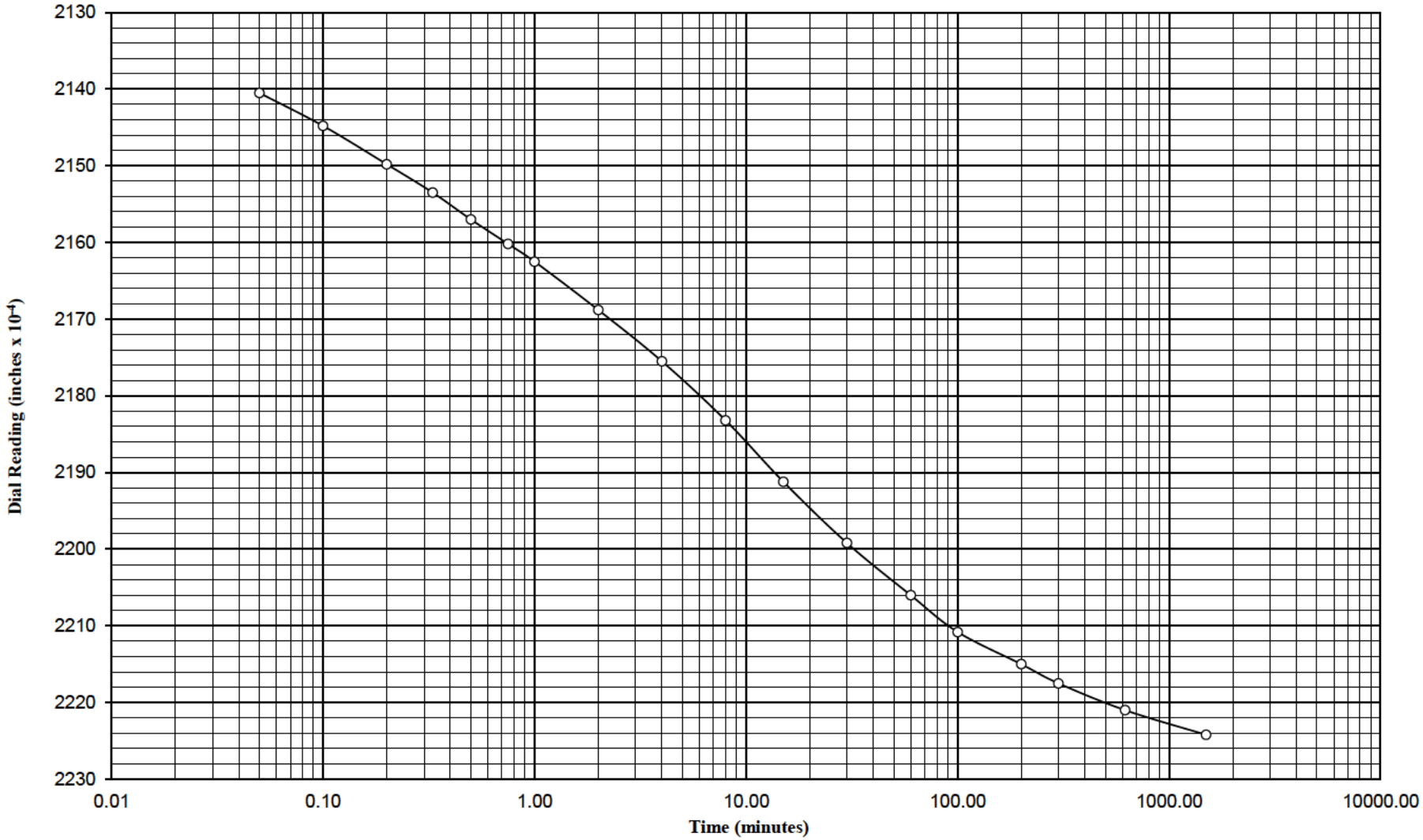
Void Ratio, $e = \frac{H_V}{H_S}$

Technician: Jason Young | Computed by: Jason Young | Checked by: James Hutt



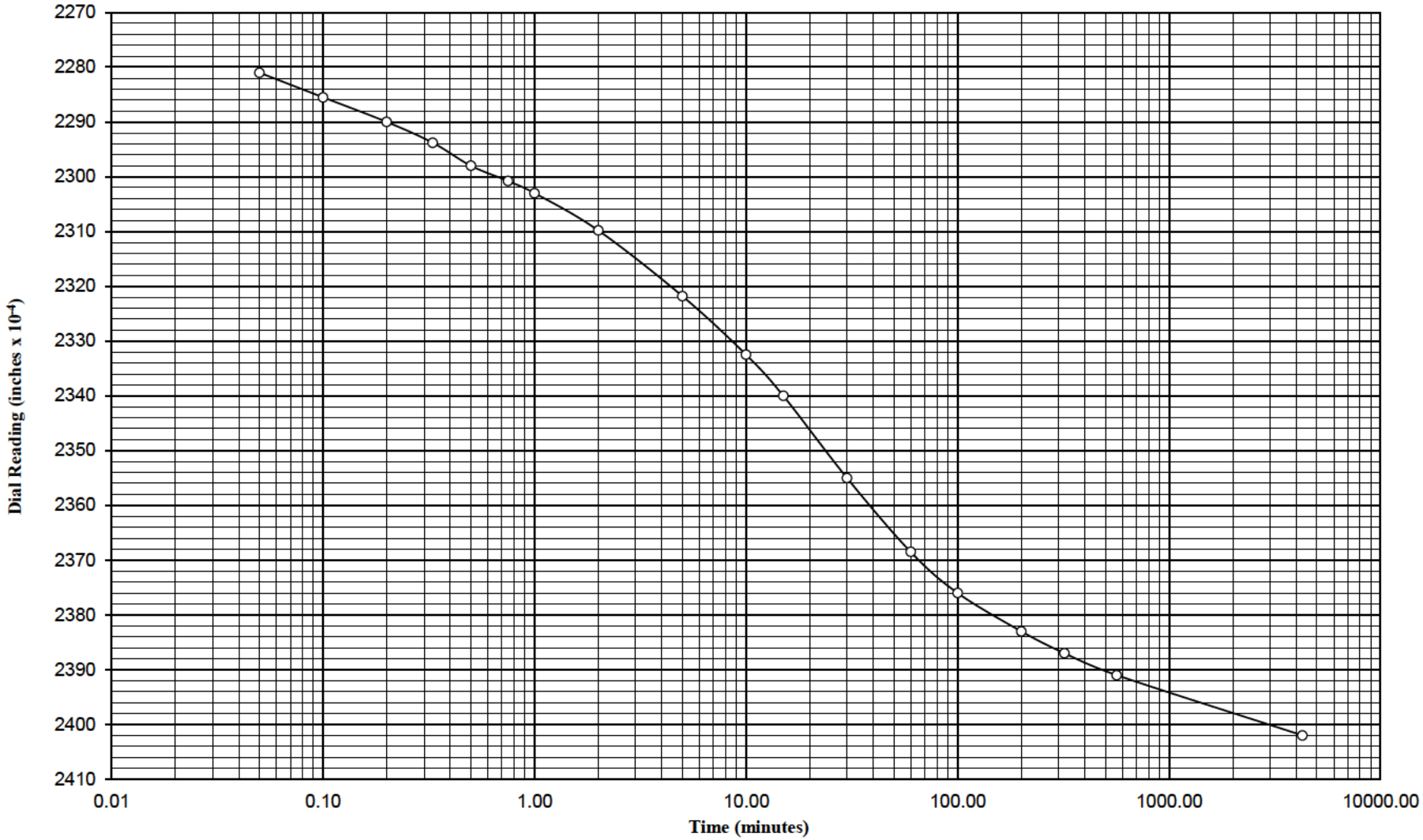
CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	5.05×10^{-4} (cm²/sec)		
		d_{50} (inches):	0.20715	TEAM Project No.:	192031
BORING NO.:	B-1	t_{50} (min):	2.6	Date:	3/19/2019
DEPTH:	8-10'	Load (tsf):	2	Remarks	
SAMPLE:	ST-2	Thickness (inches)	0.501		



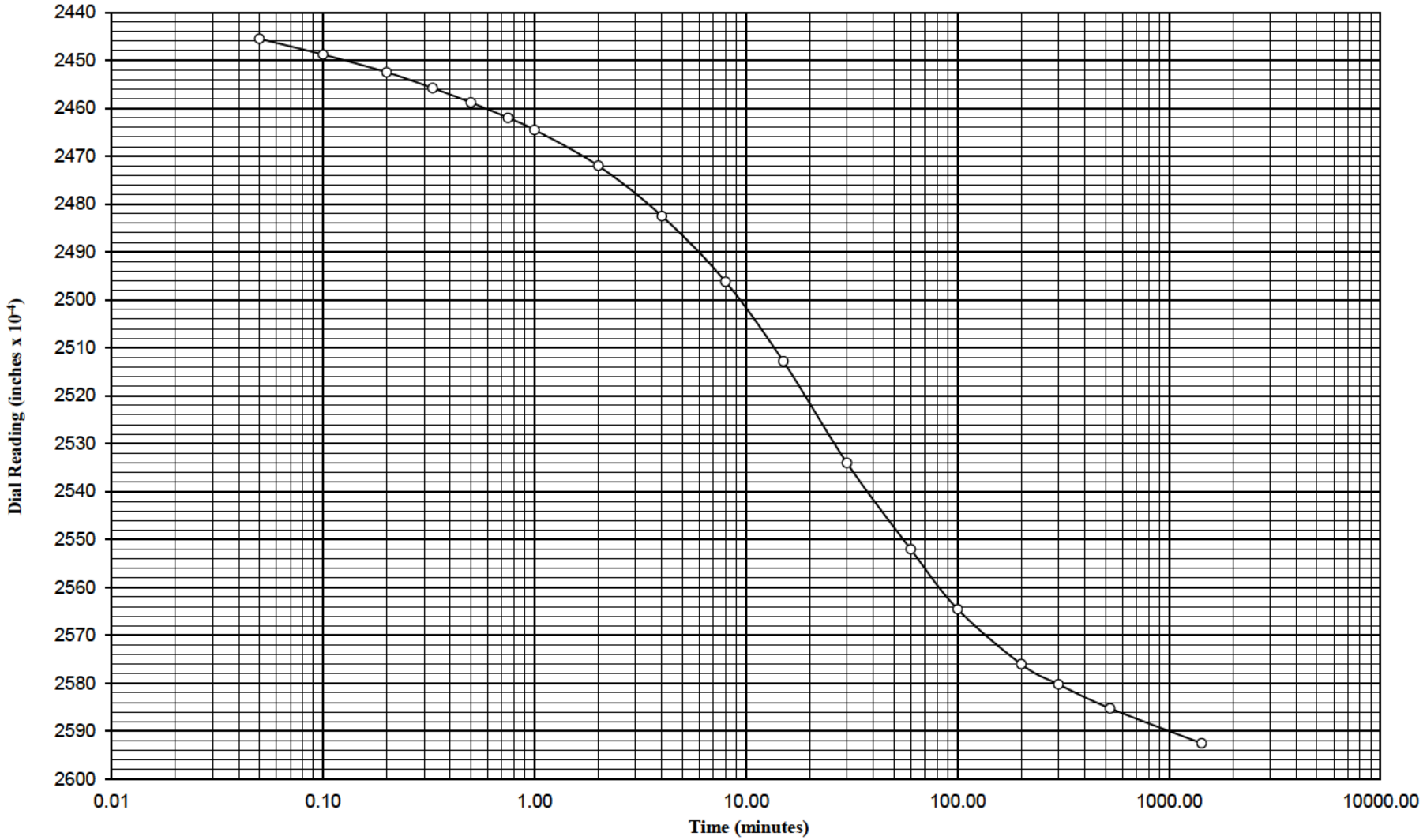
CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	4.54×10^{-4} (cm²/sec)		
		d_{50} (inches):	0.21721	TEAM Project No.:	192031
BORING NO.:	B-1	t_{50} (min):	2.8	Date:	3/19/2019
DEPTH:	8-10'	Load (tsf):	4	Remarks	
SAMPLE:	ST-2	Thickness (inches)	0.501		



CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	1.74×10^{-4} (cm²/sec)		
		d_{50} (inches):	0.23265	TEAM Project No.:	192031
BORING NO.:	B-1	t_{50} (min):	6.9	Date:	3/19/2019
DEPTH:	8-10'	Load (tsf):	8	Remarks	
SAMPLE:	ST-2	Thickness (inches)	0.501		

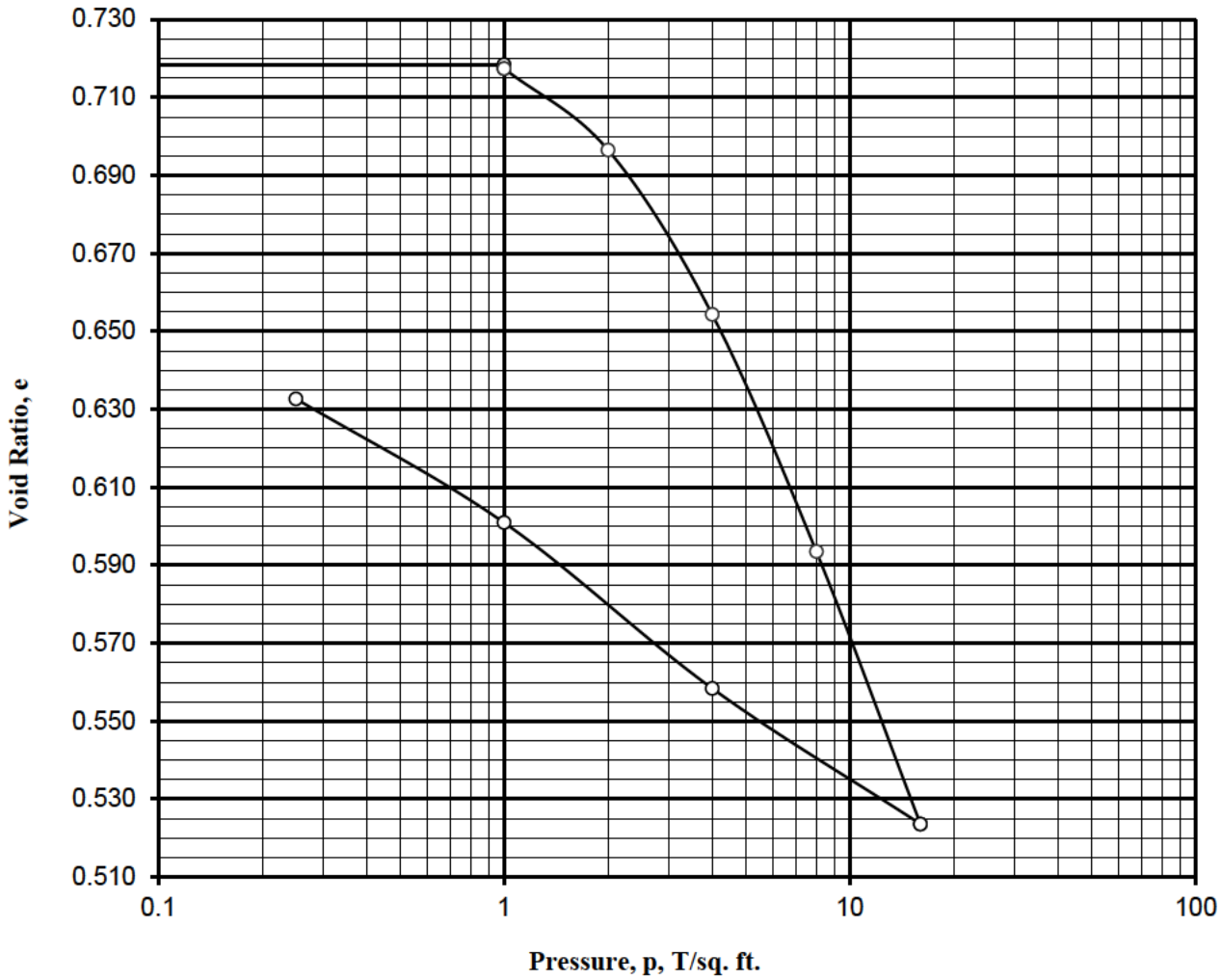


CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	0.94×10^{-4} (cm²/sec)		
		d_{50} (inches):	0.25048	TEAM Project No.:	192031
BORING NO.:	B-1	t_{50} (min):	12	Date:	3/19/2019
DEPTH:	8-10'	Load (tsf):	16	Remarks	
SAMPLE:	ST-2	Thickness (inches)	0.501		

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing



Type of specimen:	Undisturbed			Before Test		After Test	
Diam. 2.50 in.	Ht. 0.493 in.			Water Content, w_o	26.62%	W_f	23.52%
Overburden Pressure, P_o	T/sq. ft.			Void Ratio, e_o	0.7185	e_f	0.6327
Preconsol. Pressure, P_c	T/sq. ft.			Saturation, S_o	99.7%	S_f	100.0%
Compression Index, C_c				Dry Density, γd	97.7 lb/ft^3		
Classification	Gray and dark brown fat clay						
LL 61	G_s 2.690			Project	USACE, ATMOS Pipeline		
PL 25					TEAM Project No.: 192031		
Remarks				Boring No:	B-2	Sample No.:	ST-1
				Depth:	2-4'	Date:	3/15/19
				CONSOLIDATION TEST REPORT			

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST
(Specimen Data)

Project: USACE, ATMOS Pipeline — TEAM Job No.: 192031

Boring No.: B-2 — Sample No.: ST-1 — Depth: 2-4' — Date: 3/15/19

Classification: Gray and dark brown fat clay

			Before Test			After Test	
			Specimen		Trimmings	Specimen	
Tare No.			Ring and Plates		632	409	
Weight in grams	Tare plus wet soil		183.08		566.37	111.10	
	Tare plus dry soil		166.56		491.19	96.50	
	Water	W_W	W_{WO}	16.52	75.18	W_{wf}	14.60
	Tare		104.49		208.78	34.43	
	Dry soil	W_S	62.07		282.41	62.07	
Water Content		w	W_O	26.62%	26.62%	W_f	23.52%

Consolidometer No.:	4	Area of specimen, A, (sq. cm.)	31.67
Weight of ring, g	N/A	Height of specimen, H, (in.)	0.493
Weight of plates, g	N/A	Specific Gravity of solids, (Gs)	2.690

Height of solids, $H_s = \frac{W_S}{A \times G_s \times \gamma_W} = \frac{62.07}{31.67 \times 2.69 \times 1 \times 2.54} = 0.2869$ in.

Original height of water, $H_{WO} = \frac{W_{WO}}{A \times \gamma_W} = \frac{16.52}{31.67 \times 1 \times 2.54} = 0.2054$ in.

Final height of water, $H_{Wf} = \frac{W_{Wf}}{A \times \gamma_W} = \frac{14.60}{31.67 \times 1 \times 2.54} = 0.1815$ in.

Net change in height of specimen at end of test, ΔH = -0.02460 in.

Height of specimen at end of test, $H_f = H - \Delta H$ = 0.4684 in.

Void ratio before test, $e_O = \frac{H - H_S}{H_S} = \frac{0.493 - 0.2869}{0.2869} = 0.7185$

Void ratio after test, $e_f = \frac{H_f - H_S}{H_S} = \frac{0.4684 - 0.2869}{0.2869} = 0.6327$

Degree of saturation before test, $S_O = \frac{H_{WO}}{H - H_S} = \frac{0.2054}{0.4930 - 0.2869} = 99.7\%$

Degree of saturation after test, $S_f = \frac{H_{wf}}{H_f - H_S} = \frac{0.1815}{0.4684 - 0.2869} = 100.0\%$

Dry density before test, $\gamma_d = \frac{W_S}{H \times A} = \frac{62.07 \times 62.4}{0.493 \times 31.67 \times 2.54} = 97.7$ lb./cu.ft.

Remarks

Technician: Jason Young — Computed by: Jason Young — Checked by: James Hutt

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Time - Consolidation Data)

Project: USACE, ATMOS Pipeline TEAM Job No.: 192031

Boring No.: B-2 Sample No.: ST-1 Depth: 2-4' Consol.No.: 4

Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C	Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C
3/15	0.25	10:15	0	2003.0	20	3/19	4	8:45	0	2095	
3/15	0.5	10:20	5	2005.0		3/19	4	8:45	0.05	2113	
3/15	1	11:15	60	2017.0		3/19	4	8:45	0.1	2115	
3/18	1	8:00	4185	2021.0	19	3/19	4	8:45	0.2	2117.5	
						3/19	4	8:45	0.33	2119.2	
						3/19	4	8:45	0.5	2121.2	
						3/19	4	8:45	0.75	2123.2	
						3/19	4	8:46	1	2125	
3/18	2	8:40	0	2021	19	3/19	4	8:47	2	2129.5	
3/18	2	8:40	0.05	2034		3/19	4	8:49	4	2136	
3/18	2	8:40	0.1	2035.5		3/19	4	8:53	8	2144.8	
3/18	2	8:40	0.2	2037		3/19	4	9:00	15	2154.5	
3/18	2	8:40	0.33	2038		3/19	4	9:15	30	2172.5	
3/18	2	8:40	0.5	2039.2		3/19	4	9:45	60	2189	
3/18	2	8:40	0.75	2040.5		3/19	4	10:25	100	2200	
3/18	2	8:41	1	2042		3/19	4	12:05	200	2214.5	
3/18	2	8:42	2	2044.5		3/19	4	13:45	300	2220	
3/18	2	8:44	4	2048.2		3/19	4	17:15	510	2225.8	
3/18	2	8:48	8	2053		3/20	4	9:00	1455	2230	20
3/18	2	8:55	15	2058.5							
3/18	2	9:10	30	2066.5							
3/18	2	9:45	65	2075.2							
3/18	2	10:20	100	2080							
3/18	2	12:00	200	2085.8							
3/18	2	13:40	300	2089							
3/18	2	18:15	575	2092.2							
3/19	2	8:45	1445	2095	20						

Technician Jason Young

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Time - Consolidation Data)

Project: USACE, ATMOS Pipeline TEAM Job No.: 192031

Boring No.: B-2 Sample No.: ST-1 Depth: 2-4' Consol.No.: 4

Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C	Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C
3/20	8	9:00	0	2230	20	3/21	16	8:45	0	2420.5	20
3/20	8	9:00	0.05	2250		3/21	16	8:45	0.05	2439.8	
3/20	8	9:00	0.1	2251.5		3/21	16	8:45	0.1	2441.8	
3/20	8	9:00	0.2	2253		3/21	16	8:45	0.2	2443.8	
3/20	8	9:00	0.33	2255.2		3/21	16	8:45	0.33	2445.8	
3/20	8	9:00	0.5	2257		3/21	16	8:45	0.5	2447.8	
3/20	8	9:00	0.75	2259.5		3/21	16	8:45	0.75	2450	
3/20	8	9:01	1	2261.5		3/21	16	8:46	1	2452	
3/20	8	9:02	2	2266.5		3/21	16	8:47	2	2458	
3/20	8	9:04	4	2274.5		3/21	16	8:49	4	2466	
3/20	8	9:08	8	2285.5		3/21	16	8:53	8	2477	
3/20	8	9:15	15	2300		3/21	16	9:00	15	2493.5	
3/20	8	9:30	30	2320.8		3/21	16	9:15	30	2514.8	
3/20	8	10:00	60	2347.5		3/21	16	9:45	60	2546	
3/20	8	10:40	100	2368.8		3/21	16	10:25	100	2570.2	
3/20	8	12:20	200	2394		3/21	16	12:05	200	2602.5	
3/20	8	14:00	300	2403		3/21	16	13:45	300	2615.5	
3/20	8	17:45	525	2413		3/21	16	19:00	615	2629.5	
3/21	8	8:45	1425	2420.5	20	3/22	16	9:25	1480	2637	20

Technician Jason Young

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Time - Consolidation Data)

Project: USACE, ATMOS Pipeline TEAM Job No.: 192031

Boring No.: B-2 Sample No.: ST-1 Depth: 2-4' Consol.No.: 4

Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. °C	Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. °C
						REBOUND LOADS					
						3/22	4	9:25	Rebound	2637	20
						3/24	4	14:15	3170	2514.2	20
						3/24	1	14:15	Rebound	2514.2	20
						3/25	1	17:30	1635	2369.2	21
						3/25	0.25	17:30	Rebound	2369.2	21
						3/26	0.25	15:30	1320	2257	20
						Machine Deflection Readings					
							0.25			2003	
							1			2018	
							2			2032	
							4			2046	
							8			2062	
							16			2078	
							4			2055	
							1			2032	
							0.25			2011	

Technician Jason Young

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Computation of Void Ratio)

PROJECT: USACE, ATMOS Pipeline | TEAM Job No.: 192031 | DATE: 3/15/19

BORING NO.: B-2 | SAMPLE NO.: ST-1 | DEPTH: 2-4' | CONSOLIDOMETER NO.: 4

Pressure, P T./sq.ft.	Date Increment Applied	Time in Min. Increment Effective	Dial Reading 10^{-4} in.	Correction 10^{-4} in.	Change in Height, ΔH 10^{-4} in.	Height of Voids, H_V 10^{-4} in.	Void Ratio, e
0.1	3/15	Zero Point	2000	2000	0	2061	0.7185
1	3/15	Initial Load	2018	2018	0	2061	0.7185
1	3/15	4185	2021	2018	-3	2058	0.7174
2	3/18	1445	2095	2032	-63	1998	0.6965
4	3/19	1455	2230	2046	-184	1877	0.6543
8	3/20	1425	2420.5	2062	-358.5	1703	0.5935
16	3/21	1480	2637	2078	-559	1502	0.5236
4	3/22	3170	2514.2	2055	-459.2	1602	0.5584
1	3/24	1635	2369.2	2032	-337.2	1724	0.6009
0.25	3/25	1320	2257	2011	-246	1815	0.6327

Note:

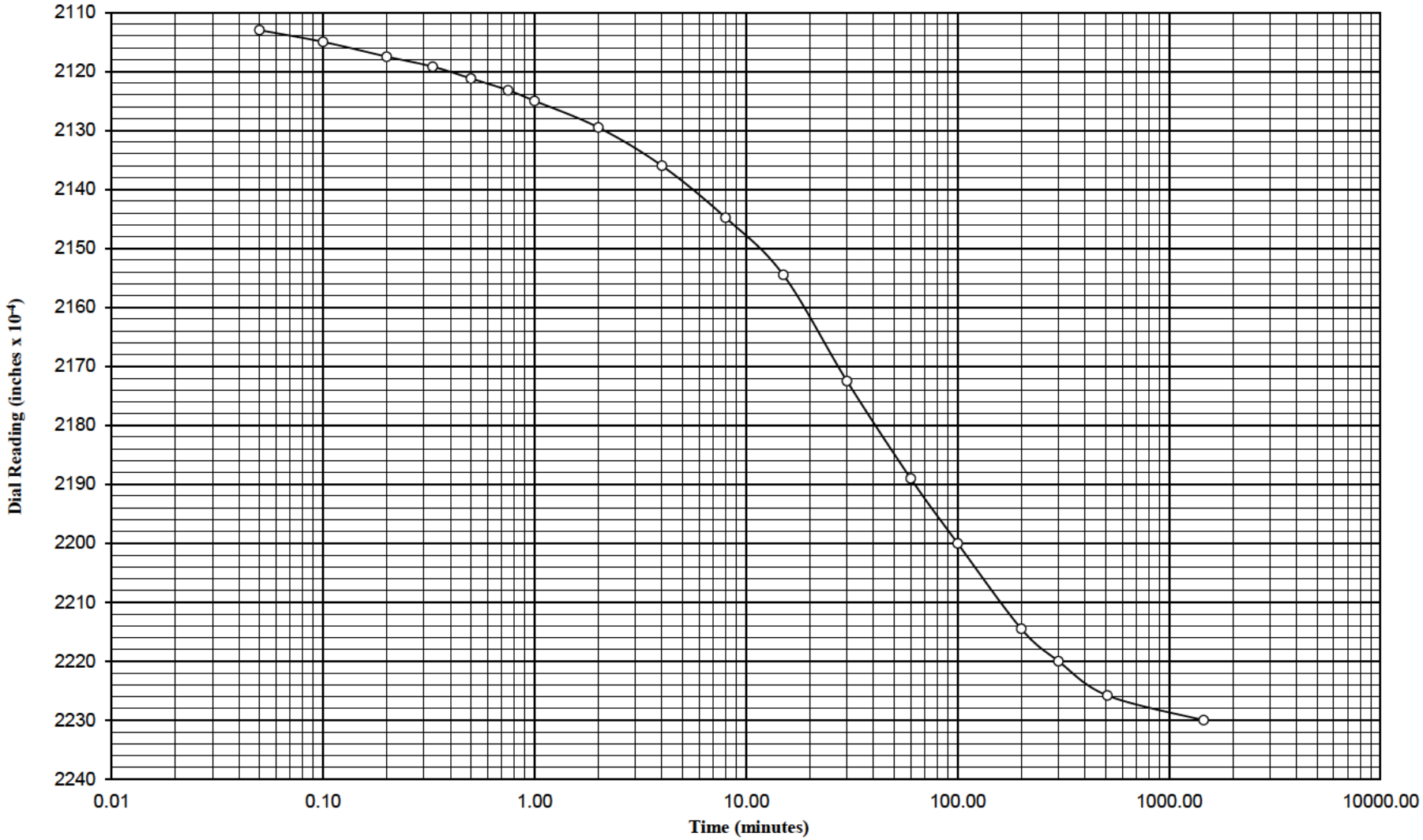
Height of voids, $H_V = (H - H_S) - \Delta H$ $H_S =$ 0.2869

Void Ratio, $e = \frac{H_V}{H_S}$

Technician: Jason Young | Computed by: Jason Young | Checked by: James Hutt

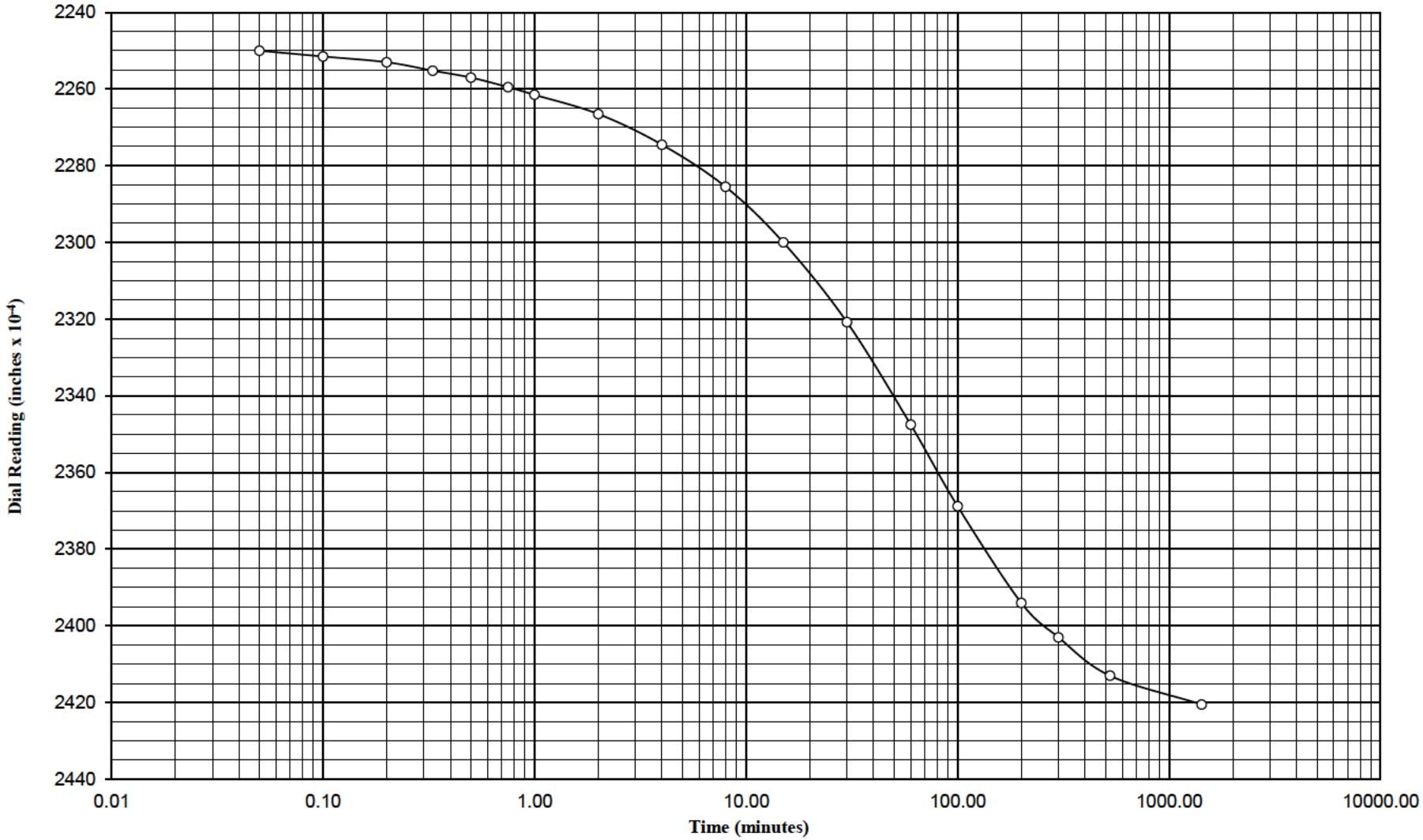
CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	0.75×10^{-4} (cm²/sec)		
		d_{50} (inches):	0.20599	TEAM Project No.:	192031
BORING NO.:	B-2	t_{50} (min):	17	Date:	3/15/2019
DEPTH:	2-4'	Load (tsf):	2	Remarks	
SAMPLE:	ST-1	Thickness (inches)	0.493		



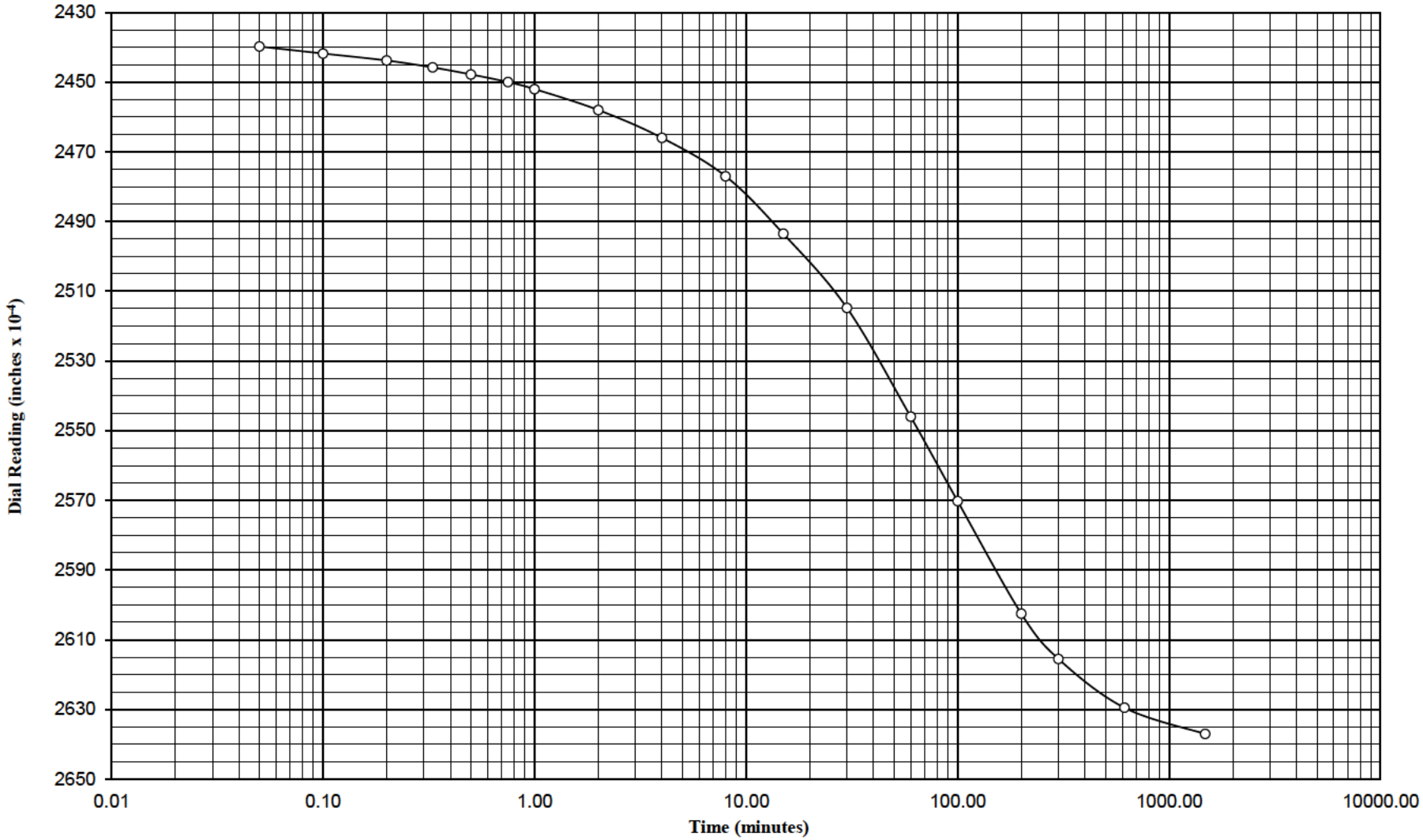
CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	0.53×10^{-4} (cm²/sec)		
		d_{50} (inches):	0.21648	TEAM Project No.:	192031
BORING NO.:	B-2	t_{50} (min):	23	Date:	3/15/2019
DEPTH:	2-4'	Load (tsf):	4	Remarks	
SAMPLE:	ST-1	Thickness (inches)	0.493		



CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	0.33×10^{-4} (cm²/sec)		
		d_{50} (inches):	0.23265	TEAM Project No.:	192031
BORING NO.:	B-2	t_{50} (min):	35	Date:	3/15/2019
DEPTH:	2-4'	Load (tsf):	8	Remarks	
SAMPLE:	ST-1	Thickness (inches)	0.493		



CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	0.27×10^{-4} (cm²/sec)		
		d_{50} (inches):	0.25289	TEAM Project No.:	192031
BORING NO.:	B-2	t_{50} (min):	40	Date:	3/15/2019
DEPTH:	2-4'	Load (tsf):	16	Remarks	
SAMPLE:	ST-1	Thickness (inches)	0.493		

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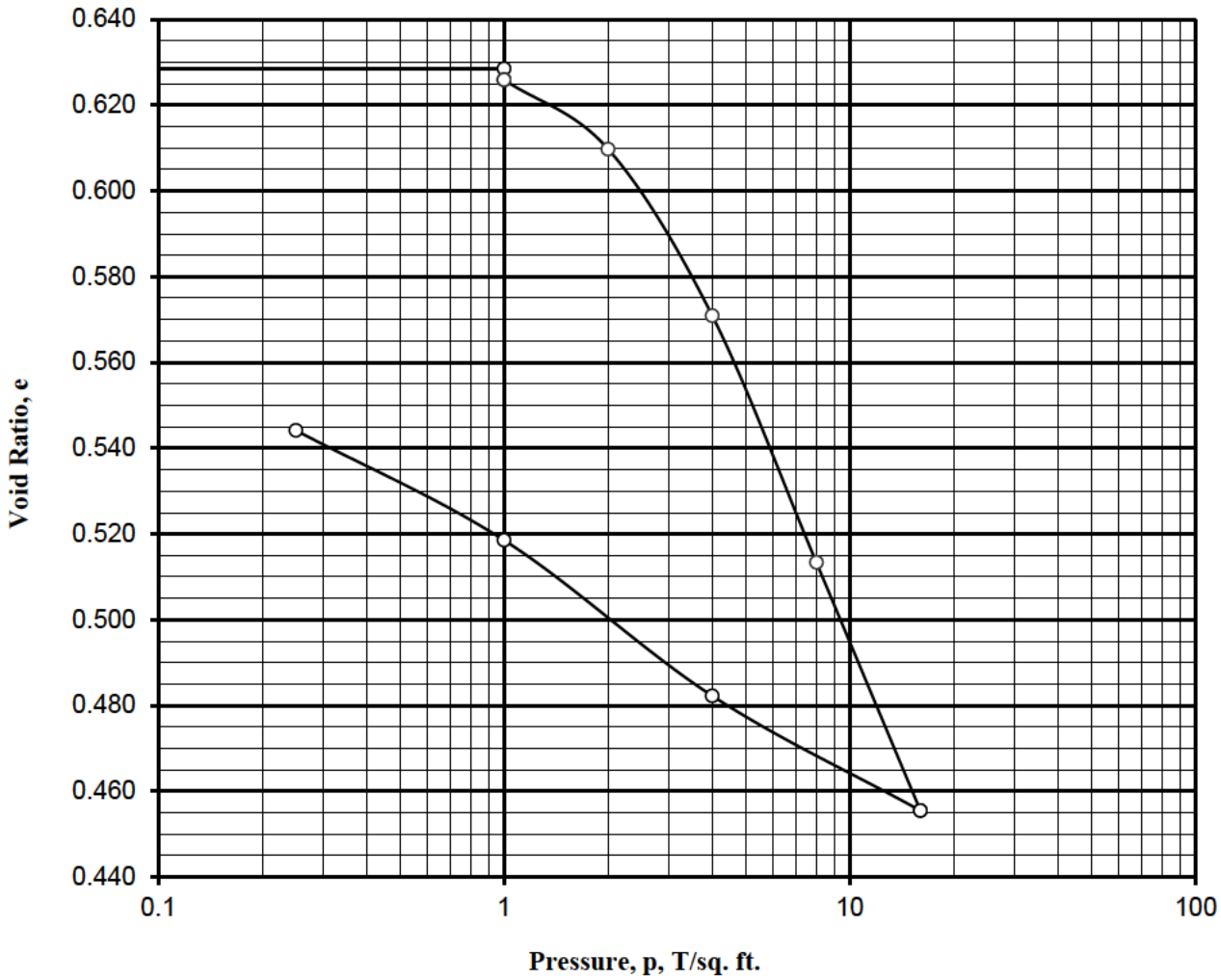

Type of specimen:	Undisturbed			Before Test		After Test	
Diam. 2.50 in.	Ht. 0.499 in.			Water Content, w_o	21.71%	W_f	20.23%
Overburden Pressure, P_o	T/sq. ft.			Void Ratio, e_o	0.6285	e_f	0.5442
Preconsol. Pressure, P_c	T/sq. ft.			Saturation, S_o	92.9%	S_f	100.0%
Compression Index, C_c				Dry Density, γd	103.0 lb/ft^3		
Classification	Gray and dark gray fat clay						
LL 57	G_s 2.689			Project	USACE, ATMOS Pipeline		
PL 21					TEAM Project No.: 192031		
Remarks				Boring No:	B-2	Sample No.:	ST-2
				Depth:	4-6'	Date:	3/19/19
				CONSOLIDATION TEST REPORT			

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST
(Specimen Data)

Project: USACE, ATMOS Pipeline — TEAM Job No.: 192031

Boring No.: B-2 — Sample No.: ST-2 — Depth: 4-6' — Date: 3/19/19

Classification: Gray and dark gray fat clay

			Before Test			After Test	
			Specimen		Trimmings	Specimen	
Tare No.			Ring and Plates		663	417	
Weight in grams	Tare plus wet soil		190.67		569.55	114.75	
	Tare plus dry soil		176.28		505.23	101.34	
	Water	W_W	W_{WO}	14.39	64.32	W_{wf}	13.41
	Tare		110.00		209.00	35.06	
	Dry soil	W_S	66.28		296.23	66.28	
Water Content		w	W_O	21.71%	21.71%	W_f	20.23%

Consolidometer No.:	2	Area of specimen, A, (sq. cm.)	31.67
Weight of ring, g	N/A	Height of specimen, H, (in.)	0.499
Weight of plates, g	N/A	Specific Gravity of solids, (Gs)	2.689

Height of solids, $H_s = \frac{W_S}{A \times G_s \times \gamma_W} = \frac{66.28}{31.67 \times 2.69 \times 1 \times 2.54} = 0.3064$ in.

Original height of water, $H_{WO} = \frac{W_{WO}}{A \times \gamma_W} = \frac{14.39}{31.67 \times 1 \times 2.54} = 0.1789$ in.

Final height of water, $H_{Wf} = \frac{W_{Wf}}{A \times \gamma_W} = \frac{13.41}{31.67 \times 1 \times 2.54} = 0.1667$ in.

Net change in height of specimen at end of test, ΔH = -0.02585 in.

Height of specimen at end of test, $H_f = H - \Delta H$ = 0.4732 in.

Void ratio before test, $e_O = \frac{H - H_S}{H_S} = \frac{0.499 - 0.3064}{0.3064} = 0.6285$

Void ratio after test, $e_f = \frac{H_f - H_S}{H_S} = \frac{0.47315 - 0.3064}{0.3064} = 0.5442$

Degree of saturation before test, $S_O = \frac{H_{WO}}{H - H_S} = \frac{0.1789}{0.4990 - 0.3064} = 92.9\%$

Degree of saturation after test, $S_f = \frac{H_{wf}}{H_f - H_S} = \frac{0.1667}{0.4732 - 0.3064} = 100.0\%$

Dry density before test, $\gamma_d = \frac{W_S}{H \times A} = \frac{66.28 \times 62.4}{0.499 \times 31.67 \times 2.54} = 103.0$ lb./cu.ft.

Remarks

Technician: Jason Young — Computed by: Jason Young — Checked by: James Hutt

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Time - Consolidation Data)

Project: USACE, ATMOS Pipeline TEAM Job No.: 192031

Boring No.: B-2 Sample No.: ST-2 Depth: 4-6' Consol.No.: 2

Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C	Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C
3/19	0.125	10:10	0	2003	20	3/21	4	8:35	0	2104.5	20
3/19	0.25	10:11	1	1996		3/21	4	8:35	0.05	2143.5	
3/19	0.5	10:12	2	2007		3/21	4	8:35	0.1	2147.8	
3/19	0.75	11:20	70	2015		3/21	4	8:35	0.2	2153	
3/19	1	13:00	170	2028		3/21	4	8:35	0.33	2156	
3/20	1	8:50	1360	2039	20	3/21	4	8:35	0.5	2160	
						3/21	4	8:35	0.75	2162.8	
						3/21	4	8:36	1	2166.2	
3/20	2	8:50	0	2039	20	3/21	4	8:37	2	2173	
3/20	2	8:50	0.05	2063.5		3/21	4	8:39	4	2179.8	
3/20	2	8:50	0.1	2065		3/21	4	8:43	8	2187.5	
3/20	2	8:50	0.2	2067.2		3/21	4	8:50	15	2196	
3/20	2	8:50	0.33	2069		3/21	4	9:05	30	2204.2	
3/20	2	8:50	0.5	2070.5		3/21	4	9:35	60	2214	
3/20	2	8:50	0.75	2072.2		3/21	4	10:25	110	2222	
3/20	2	8:51	1	2073.2		3/21	4	11:55	200	2229.5	
3/20	2	8:52	2	2076.2		3/21	4	13:35	300	2232.8	
3/20	2	8:54	4	2079.2		3/21	4	19:00	625	2237.5	
3/20	2	8:58	8	2082.5		3/22	4	9:30	1495	2241.5	20
3/20	2	9:05	15	2085.5							
3/20	2	9:20	30	2088.8							
3/20	2	9:50	60	2092							
3/20	2	10:30	100	2094							
3/20	2	12:10	200	2097							
3/20	2	13:50	300	2098.8							
3/20	2	17:45	535	2101.8							
3/21	2	8:35	1425	2104.5	20						

Technician Jason Young

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Time - Consolidation Data)

Project: USACE, ATMOS Pipeline TEAM Job No.: 192031

Boring No.: B-2 Sample No.: ST-2 Depth: 4-6' Consol.No.: 2

Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C	Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C
3/22	8	9:30	0	2241.5	20	3/25	16	8:40	0	2437.5	21
3/22	8	9:30	0.05	2298		3/25	16	8:40	0.05	2480.5	
3/22	8	9:30	0.1	2302.5		3/25	16	8:40	0.1	2484.5	
3/22	8	9:30	0.2	2306.8		3/25	16	8:40	0.2	2488	
3/22	8	9:30	0.33	2311		3/25	16	8:40	0.33	2491.5	
3/22	8	9:30	0.5	2314.5		3/25	16	8:40	0.5	2494.2	
3/22	8	9:30	0.75	2318		3/25	16	8:40	0.75	2497.5	
3/22	8	9:31	1	2320.8		3/25	16	8:41	1	2499.8	
3/22	8	9:32	2	2328.5		3/25	16	8:42	2	2507.5	
3/22	8	9:34	4	2336.8		3/25	16	8:44	4	2516.8	
3/22	8	9:38	8	2348		3/25	16	8:48	8	2529.2	
3/22	8	9:45	15	2357		3/25	16	8:55	15	2542.2	
3/22	8	10:00	30	2371.8		3/25	16	9:10	30	2564	
3/22	8	10:30	60	2388		3/25	16	9:40	60	2586.8	
3/22	8	11:10	100	2400.2		3/25	16	10:25	105	2604.2	
3/22	8	12:50	200	2413		3/25	16	12:00	200	2619.5	
3/22	8	14:55	325	2421		3/25	16	13:40	300	2625.2	
3/22	8	19:00	570	2426		3/25	16	17:30	530	2631.5	
3/25	8	8:40	4270	2435.8	21	3/26	16	8:30	1430	2638.2	20

Technician Jason Young

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Time - Consolidation Data)

Project: USACE, ATMOS Pipeline TEAM Job No.: 192031

Boring No.: B-2 Sample No.: ST-2 Depth: 4-6' Consol.No.: 2

Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C	Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C
						REBOUND LOADS					
						3/26	4	8:30	Rebound	2638.2	20
						3/27	4	7:30	1380	2522.2	20
						3/27	1	7:30	Rebound	2522.2	20
						3/28	1	8:45	1515	2382	20
						3/28	0.25	8:45	Rebound	2382	20
						3/29	0.25	12:30	1665	2278.5	20
						Machine Deflection Readings					
							0.125			2003	
							1			2031	
							2			2047	
							4			2065	
							8			2083	
							16			2108	
							4			2074	
							1			2045	
							0.25			2020	

Technician Jason Young

TEAM Consultants, Inc.

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CONSOLIDATION TEST

(Computation of Void Ratio)

PROJECT: USACE, ATMOS Pipeline | TEAM Job No.: 192031 | DATE: 3/19/19

BORING NO.: B-2 | SAMPLE NO.: ST-2 | DEPTH: 4-6' | CONSOLIDOMETER NO.: 2

Pressure, P T./sq.ft.	Date Increment Applied	Time in Min. Increment Effective	Dial Reading 10^{-4} in.	Correction 10^{-4} in.	Change in Height, ΔH 10^{-4} in.	Height of Voids, H_V 10^{-4} in.	Void Ratio, e
0.1	3/19	Zero Point	2000	2000	0	1926	0.6285
1	3/19	Initial Load	2031	2031	0	1926	0.6285
1	3/19	1360	2039	2031	-8	1918	0.6259
2	3/20	1425	2104.5	2047	-57.5	1868	0.6098
4	3/21	1495	2241.5	2065	-176.5	1749	0.5709
8	3/22	4270	2435.8	2083	-352.8	1573	0.5134
16	3/25	1430	2638.2	2108	-530.2	1396	0.4555
4	3/26	1380	2522.2	2074	-448.2	1478	0.4823
1	3/27	1515	2382	2045	-337	1589	0.5186
0.25	3/28	1665	2278.5	2020	-258.5	1667	0.5442

Note:

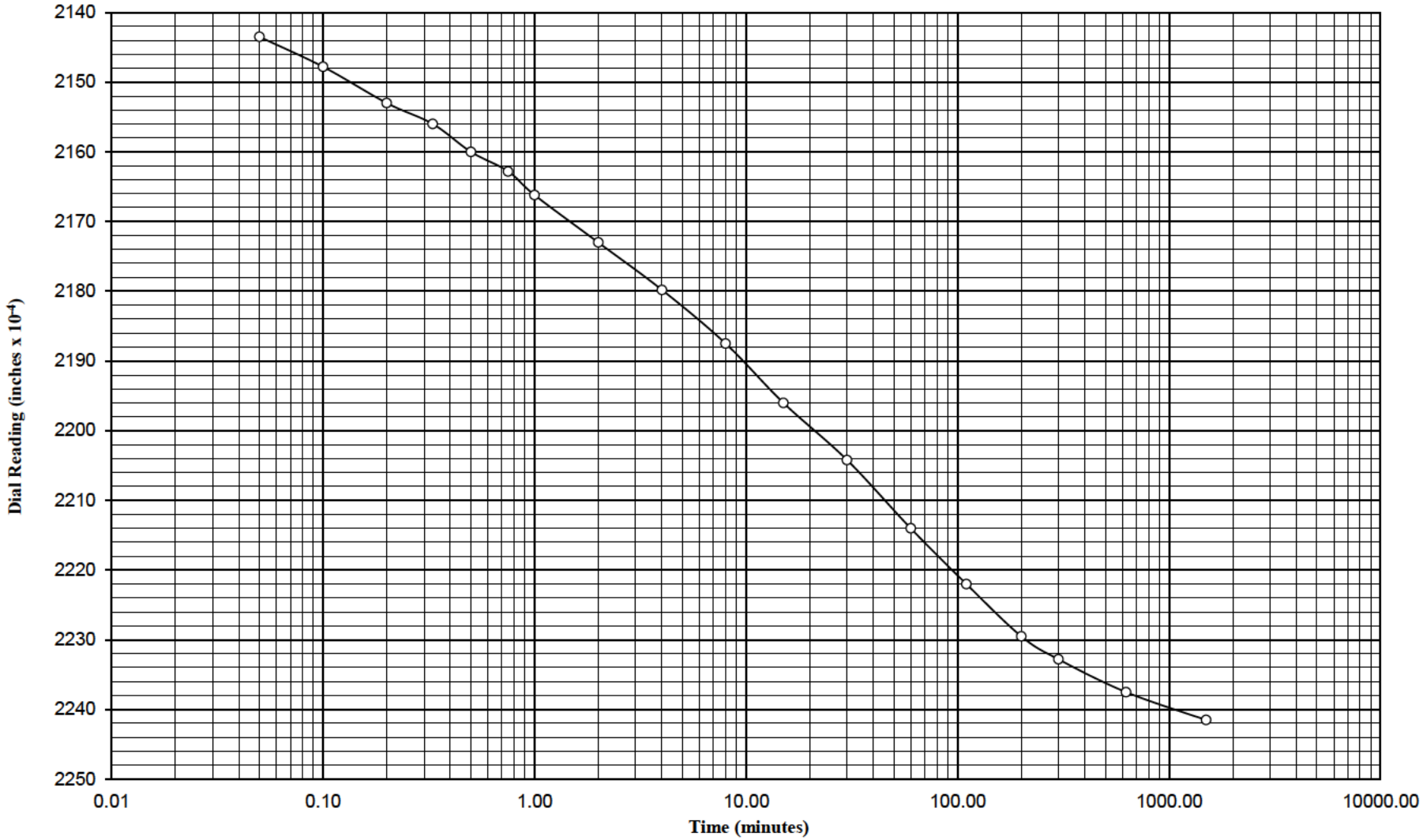
Height of voids, $H_V = (H - H_S) - \Delta H$ $H_S =$ 0.3064

Void Ratio, $e = \frac{H_V}{H_S}$

Technician: Jason Young | Computed by: Jason Young | Checked by: James Hutt

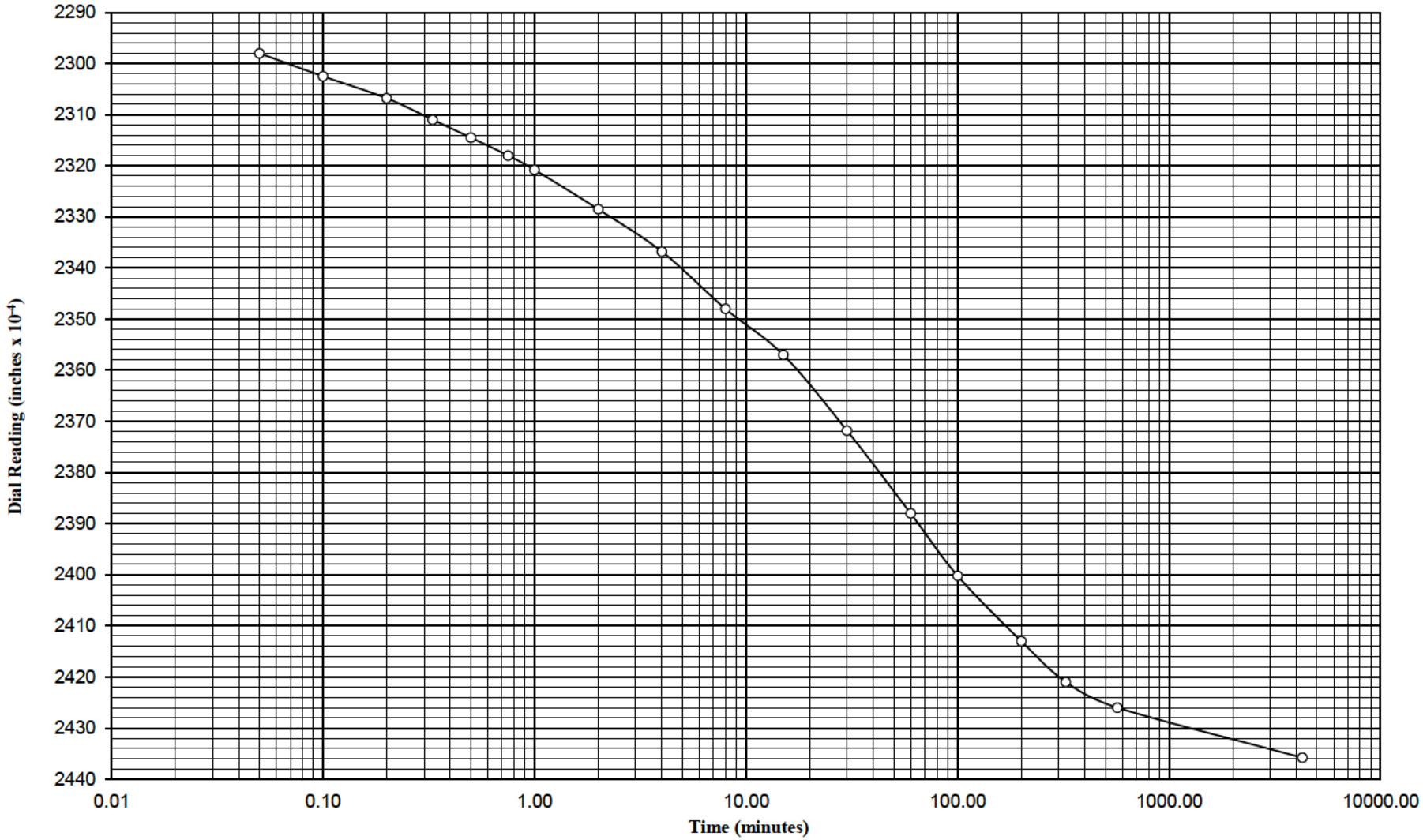
CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	2.89×10^{-4} (cm^2/sec)		
		d_{50} (inches):	0.20799	TEAM Project No.:	192031
BORING NO.:	B-2	t_{50} (min):	4.5	Date:	3/19/2019
DEPTH:	4-6'	Load (tsf):	2	Remarks	
SAMPLE:	ST-2	Thickness (inches)	0.499		



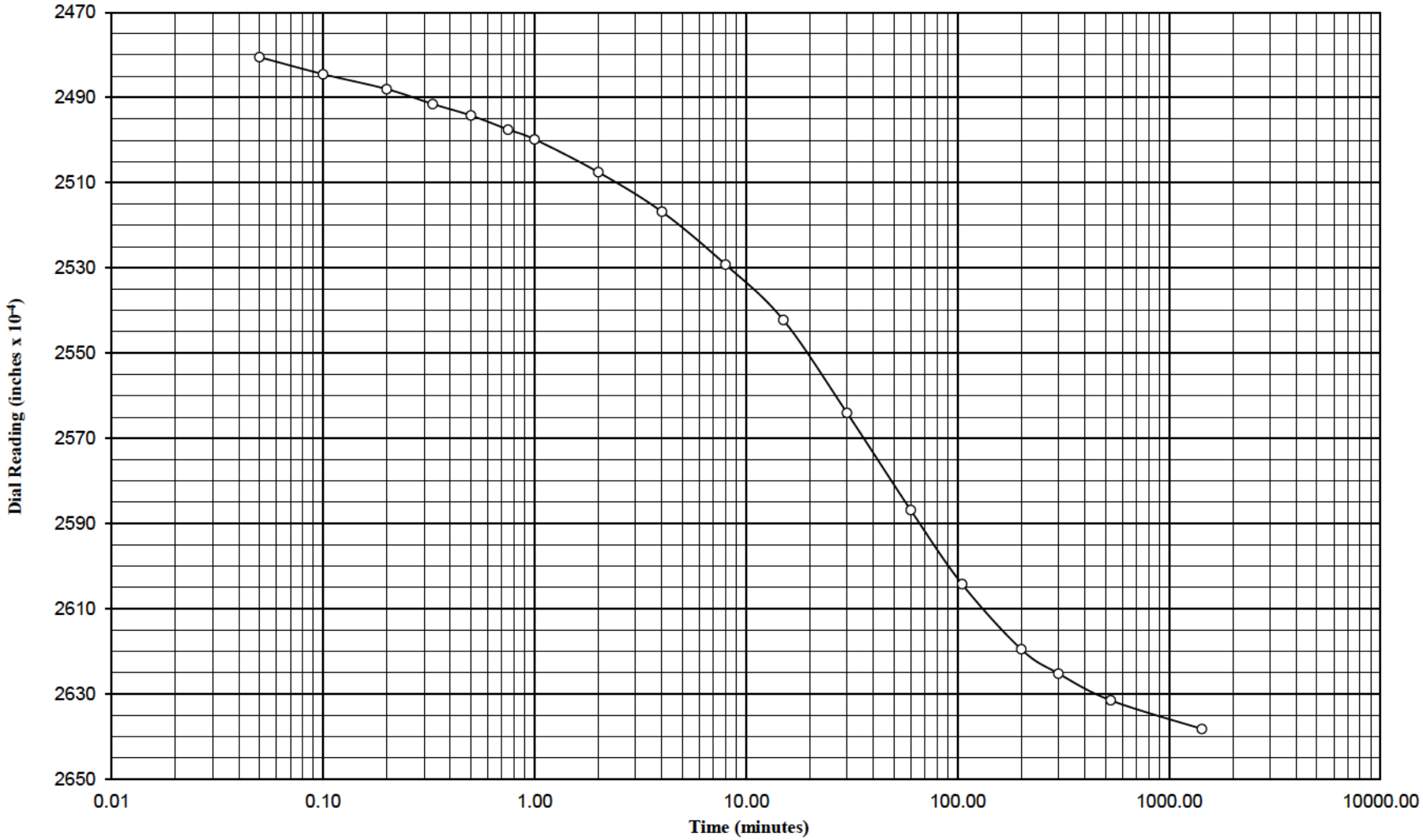
CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	2.24×10^{-4} (cm²/sec)		
		d_{50} (inches):	0.21833	TEAM Project No.:	192031
BORING NO.:	B-2	t_{50} (min):	5.6	Date:	3/19/2019
DEPTH:	4-6'	Load (tsf):	4	Remarks	
SAMPLE:	ST-2	Thickness (inches)	0.499		



CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	0.84×10^{-4} (cm²/sec)		
		d_{50} (inches):	0.23551	TEAM Project No.:	192031
BORING NO.:	B-2	t_{50} (min):	14	Date:	3/19/2019
DEPTH:	4-6'	Load (tsf):	8	Remarks	
SAMPLE:	ST-2	Thickness (inches)	0.499		



CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	0.61×10^{-4} (cm²/sec)		
		d_{50} (inches):	0.25475	TEAM Project No.:	192031
BORING NO.:	B-2	t_{50} (min):	18	Date:	3/19/2019
DEPTH:	4-6'	Load (tsf):	16	Remarks	
SAMPLE:	ST-2	Thickness (inches)	0.499		

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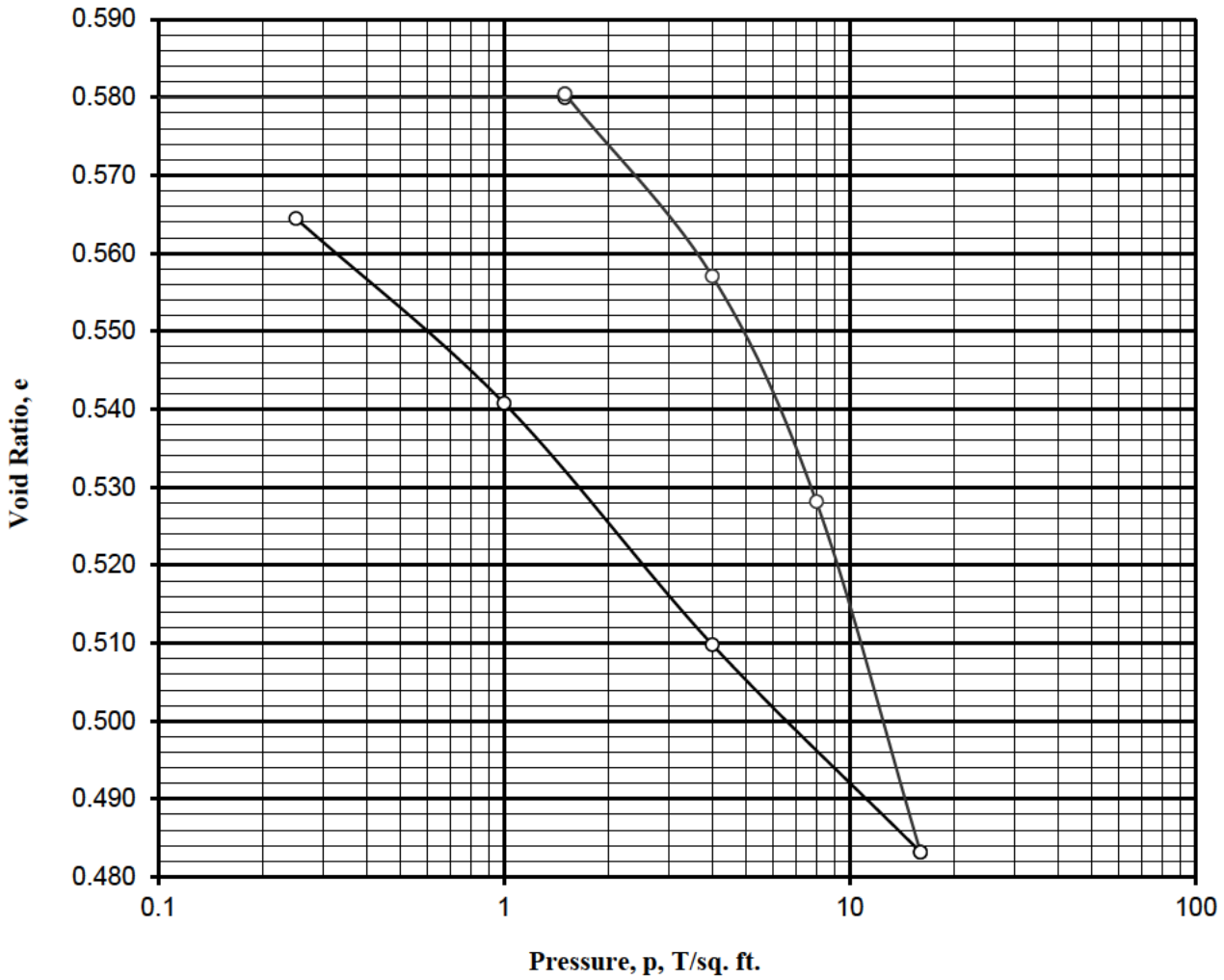


Type of specimen:	Undisturbed			Before Test		After Test	
Diam. 2.50 in.	Ht. 0.500 in.			Water Content, w_o	21.17%	W_f	21.02%
Overburden Pressure, P_o	T/sq. ft.			Void Ratio, e_o	0.5800	e_f	0.5645
Preconsol. Pressure, P_c	T/sq. ft.			Saturation, S_o	98.0%	S_f	100.0%
Compression Index, C_c				Dry Density, γd	106.0 lb/ft^3		
Classification	Tan and gray fat clay						
LL 60	G_s 2.685			Project	USACE, ATMOS Pipeline		
PL 20					TEAM Project No.: 192031		
Remarks				Boring No:	B-2	Sample No.:	ST-4
				Depth:	13-15'	Date:	3/25/19
				CONSOLIDATION TEST REPORT			

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST
(Specimen Data)

Project: USACE, ATMOS Pipeline — TEAM Job No.: 192031
Boring No.: B-2 — Sample No.: ST-4 — Depth: 13-15' — Date: 3/25/19

Classification: Tan and gray fat clay

			Before Test			After Test	
			Specimen		Trimmings	Specimen	
Tare No.			Ring and Plates		662	404	
Weight in grams	Tare plus wet soil		192.81		504.45	116.39	
	Tare plus dry soil		178.34		453.49	102.02	
	Water	W_W	W_{WO}	14.47	50.96	W_{wf}	14.37
	Tare		109.99		212.80	33.67	
	Dry soil	W_S	68.35		240.69	68.35	
Water Content		w	W_O	21.17%	21.17%	W_f	21.02%

Consolidometer No.:	1	Area of specimen, A, (sq. cm.)	31.67
Weight of ring, g	N/A	Height of specimen, H, (in.)	0.500
Weight of plates, g	N/A	Specific Gravity of solids, (Gs)	2.685

Height of solids, $H_s = \frac{W_S}{A \times G_s \times \gamma_W} = \frac{68.35}{31.67 \times 2.68 \times 1 \times 2.54} = 0.3165$ in.

Original height of water, $H_{WO} = \frac{W_{WO}}{A \times \gamma_W} = \frac{14.47}{31.67 \times 1 \times 2.54} = 0.1799$ in.

Final height of water, $H_{Wf} = \frac{W_{Wf}}{A \times \gamma_W} = \frac{14.37}{31.67 \times 1 \times 2.54} = 0.1786$ in.

Net change in height of specimen at end of test, ΔH = -0.00490 in.

Height of specimen at end of test, $H_f = H - \Delta H$ = 0.4951 in.

Void ratio before test, $e_O = \frac{H - H_S}{H_S} = \frac{0.5 - 0.3165}{0.3165} = 0.5800$

Void ratio after test, $e_f = \frac{H_f - H_S}{H_S} = \frac{0.4951 - 0.3165}{0.3165} = 0.5645$

Degree of saturation before test, $S_O = \frac{H_{WO}}{H - H_S} = \frac{0.1799}{0.5000 - 0.3165} = 98.0\%$

Degree of saturation after test, $S_f = \frac{H_{wf}}{H_f - H_S} = \frac{0.1786}{0.4951 - 0.3165} = 100.0\%$

Dry density before test, $\gamma_d = \frac{W_S}{H \times A} = \frac{68.35 \times 62.4}{0.5 \times 31.67 \times 2.54} = 106.0$ lb./cu.ft.

Remarks

Technician: Jason Young — Computed by: Jason Young — Checked by: James Hutt

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Time - Consolidation Data)

Project: USACE, ATMOS Pipeline TEAM Job No.: 192031

Boring No.: B-2 Sample No.: ST-4 Depth: 13-15' Consol.No.: 1

Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C	Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C
3/25	0.25	11:30	0	2009	21	3/27	8	7:15	0	2135.5	20
3/25	0.5	11:35	5	2003		3/27	8	7:15	0.05	2166	
3/25	1	11:38	8	2018		3/27	8	7:15	0.1	2168.5	
3/25	1.5	12:00	30	2029		3/27	8	7:15	0.2	2171	
3/26	1.5	8:20	1250	2038.5	20	3/27	8	7:15	0.33	2174	
						3/27	8	7:15	0.5	2176	
						3/27	8	7:15	0.75	2178.5	
						3/27	8	7:16	1	2180	
3/26	4	8:20	0	2038.5	20	3/27	8	7:17	2	2188	
3/26	4	8:20	0.05	2078		3/27	8	7:19	4	2195	
3/26	4	8:20	0.1	2080.5		3/27	8	7:23	8	2203.2	
3/26	4	8:20	0.2	2083.2		3/27	8	7:30	15	2212.5	
3/26	4	8:20	0.33	2086		3/27	8	7:45	30	2222.5	
3/26	4	8:20	0.5	2088.2		3/27	8	8:15	60	2230	
3/26	4	8:20	0.75	2090.8		3/27	8	8:55	100	2234.5	
3/26	4	8:21	1	2092.2		3/27	8	10:35	200	2238.5	
3/26	4	8:22	2	2096.8		3/27	8	12:15	300	2240.2	
3/26	4	8:24	4	2102		3/27	8	19:45	750	2245	
3/26	4	8:28	8	2108		3/28	8	8:45	1530	2248	20
3/26	4	8:35	15	2114							
3/26	4	8:50	30	2119.8							
3/26	4	9:20	60	2124.5							
3/26	4	10:00	100	2127							
3/26	4	11:40	200	2129.2							
3/26	4	13:20	300	2130.8							
3/26	4	17:00	520	2132.2							
3/27	4	7:15	1375	2135.5	20						

Technician Jason Young

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Time - Consolidation Data)

Project: USACE, ATMOS Pipeline TEAM Job No.: 192031

Boring No.: B-2 Sample No.: ST-4 Depth: 13-15' Consol.No.: 1

Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C
3/28	16	8:45	0	2248	20
3/28	16	8:45	0.05	2287.5	
3/28	16	8:45	0.1	2290.5	
3/28	16	8:45	0.2	2293.2	
3/28	16	8:45	0.33	2296	
3/28	16	8:45	0.5	2298.5	
3/28	16	8:45	0.75	2301.2	
3/28	16	8:46	1	2303.5	
3/28	16	8:47	2	2310.2	
3/28	16	8:49	4	2319.8	
3/28	16	8:53	8	2330.8	
3/28	16	9:00	15	2345.2	
3/28	16	9:15	30	2363.2	
3/28	16	9:45	60	2379.5	
3/28	16	10:25	100	2389	
3/28	16	12:05	200	2399	
3/28	16	13:45	300	2403.2	
3/28	16	17:15	510	2408	
3/29	16	7:45	1380	2415.2	20

Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C
REBOUND LOADS					
3/29	4	7:45	Rebound	2415.2	20
3/30	4	21:30	2265	2295	20
3/30	1	21:30	Rebound	2295	20
4/1	1	8:15	2085	2170	19
4/1	0.25	8:15	Rebound	2170	19
4/2	0.25	8:00	1425	2075	20
Machine Deflection Readings					
	0.25			2009	
	1.5			2040	
	4			2063	
	8			2084	
	16			2109	
	4			2073	
	1			2046	
	0.25			2026	

Technician Jason Young

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Computation of Void Ratio)

PROJECT: USACE, ATMOS Pipeline | TEAM Job No.: 192031 | DATE: 3/25/19

BORING NO.: B-2 | SAMPLE NO.: ST-4 | DEPTH: 13-15' | CONSOLIDOMETER NO.: 1

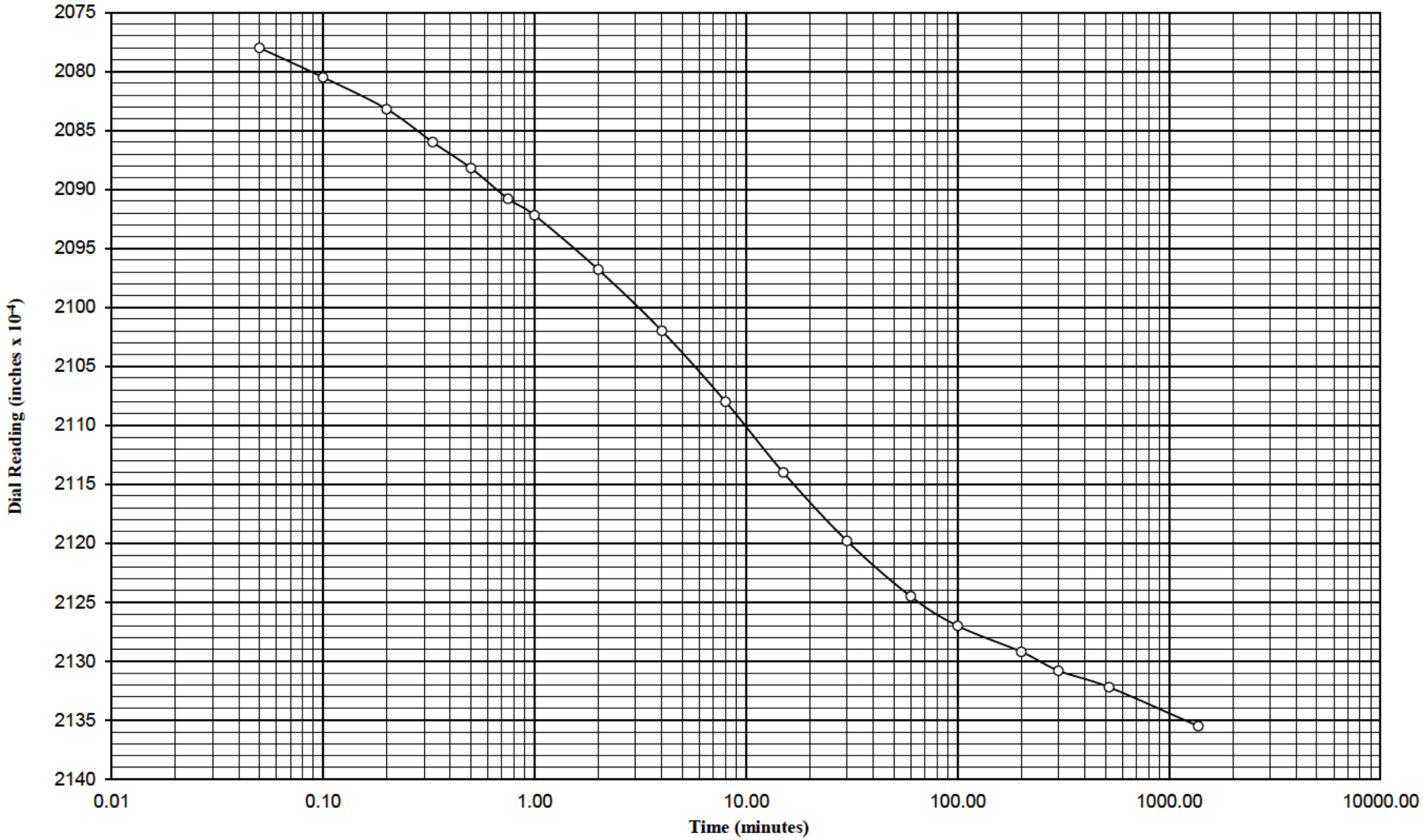
Pressure, P T./sq.ft.	Date Increment Applied	Time in Min. Increment Effective	Dial Reading 10^{-4} in.	Correction 10^{-4} in.	Change in Height, ΔH 10^{-4} in.	Height of Voids, H_V 10^{-4} in.	Void Ratio, e
0.1	3/25	Zero Point	2000	2000	0	1835	0.5800
1.5	3/25	Initial Load	2040	2040	0	1835	0.5800
1.5	3/25	1250	2038.5	2040	1.5	1837	0.5804
4	3/26	1375	2135.5	2063	-72.5	1763	0.5571
8	3/27	1530	2248	2084	-164	1671	0.5281
16	3/28	1380	2415.2	2109	-306.2	1529	0.4832
4	3/29	2265	2295	2073	-222	1613	0.5098
1	3/30	2085	2170	2046	-124	1711	0.5408
0.25	4/1	1425	2075	2026	-49	1786	0.5645

Note:

Height of voids, $H_V = (H - H_S) - \Delta H$ $H_S =$ 0.3165

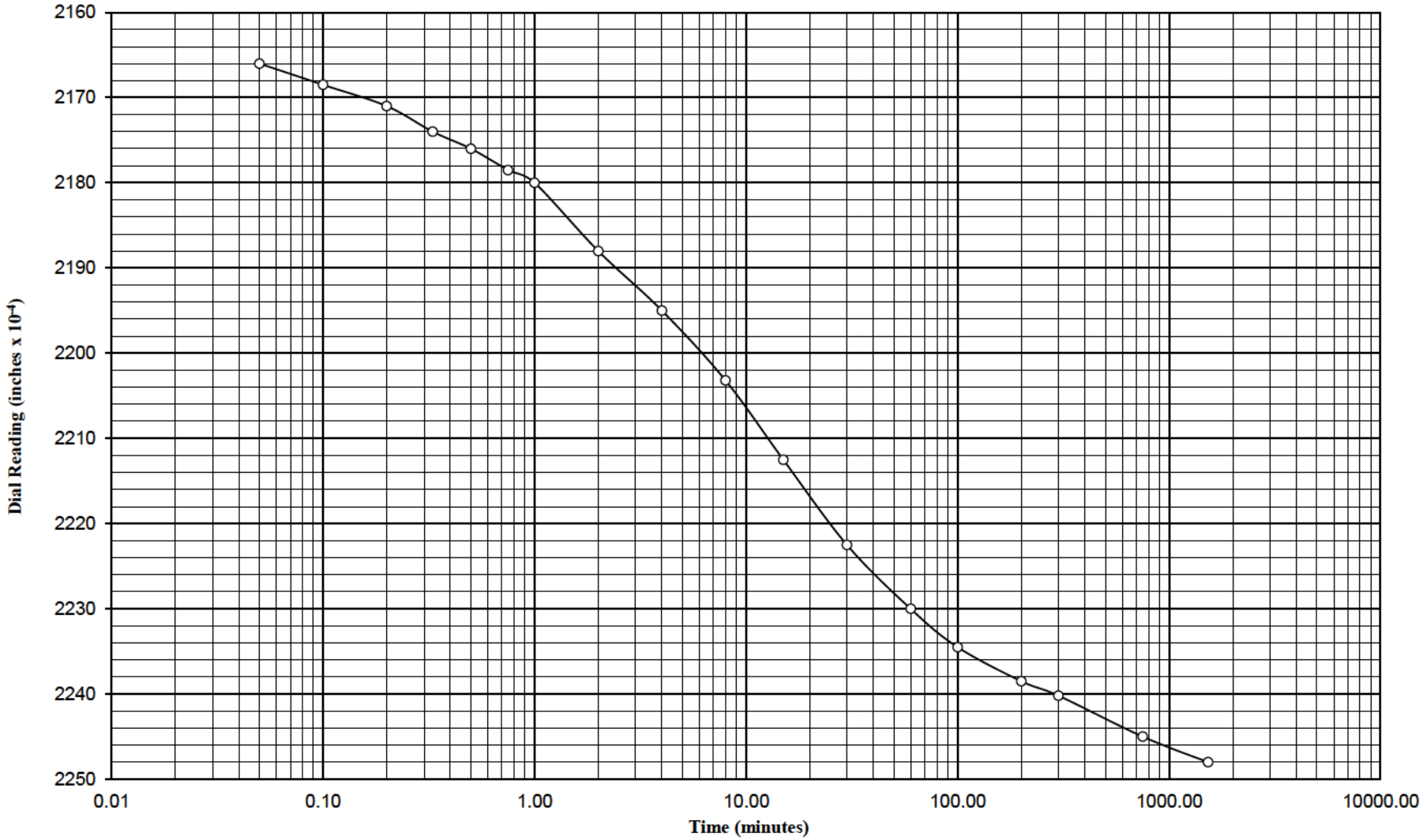
Void Ratio, $e = \frac{H_V}{H_S}$

Technician: Jason Young | Computed by: Jason Young | Checked by: James Hutt



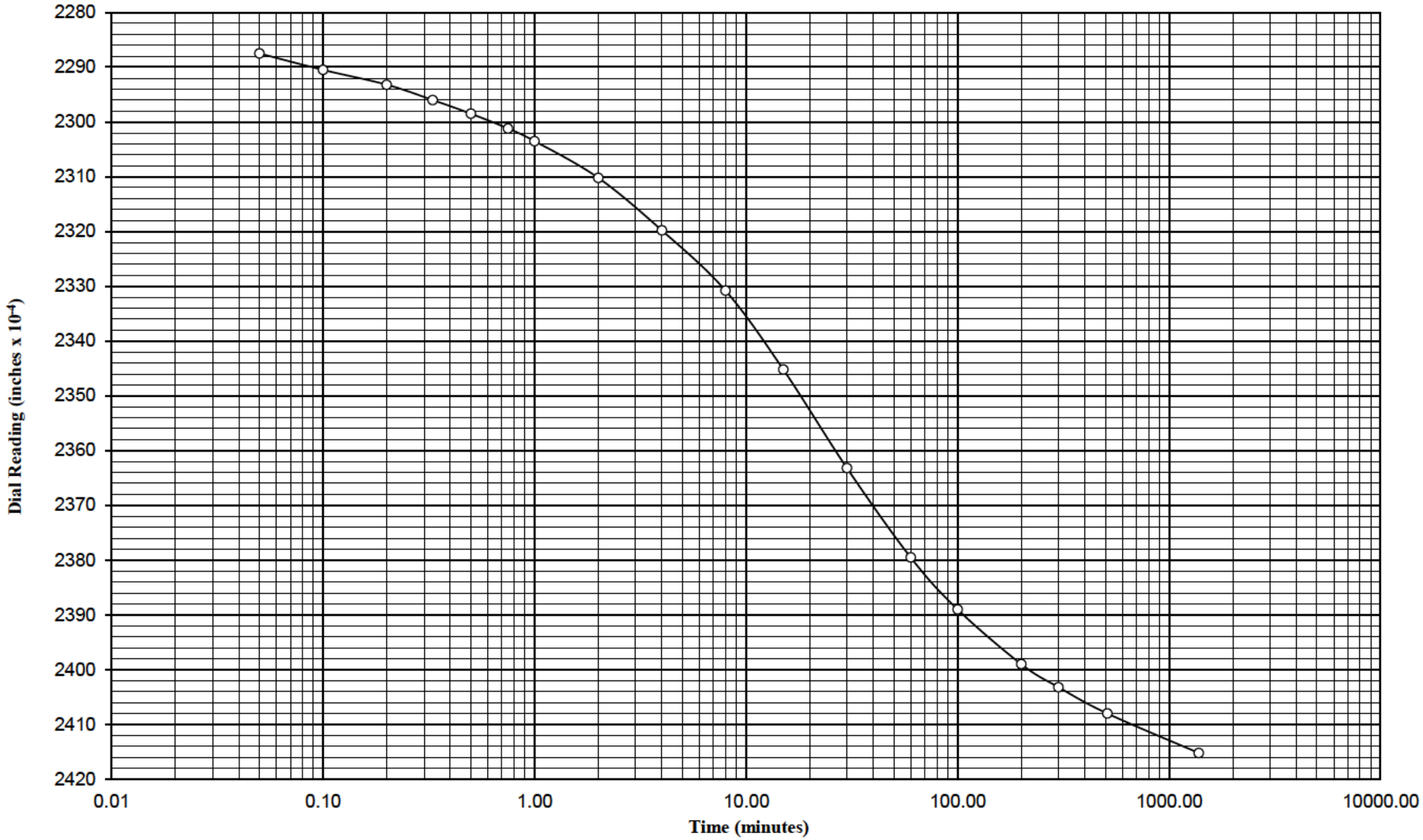
CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	5.22×10^{-4} (cm²/sec)		
		d_{50} (inches):	0.20984	TEAM Project No.:	192031
BORING NO.:	B-2	t_{50} (min):	2.5	Date:	3/25/2019
DEPTH:	13-15'	Load (tsf):	4	Remarks	
SAMPLE:	ST-4	Thickness (inches)	0.500		



CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	2.75×10^{-4} (cm^2/sec)		
		d_{50} (inches):	0.21965	TEAM Project No.:	192031
BORING NO.:	B-2	t_{50} (min):	4.6	Date:	3/25/2019
DEPTH:	13-15'	Load (tsf):	8	Remarks	
SAMPLE:	ST-4	Thickness (inches)	0.500		

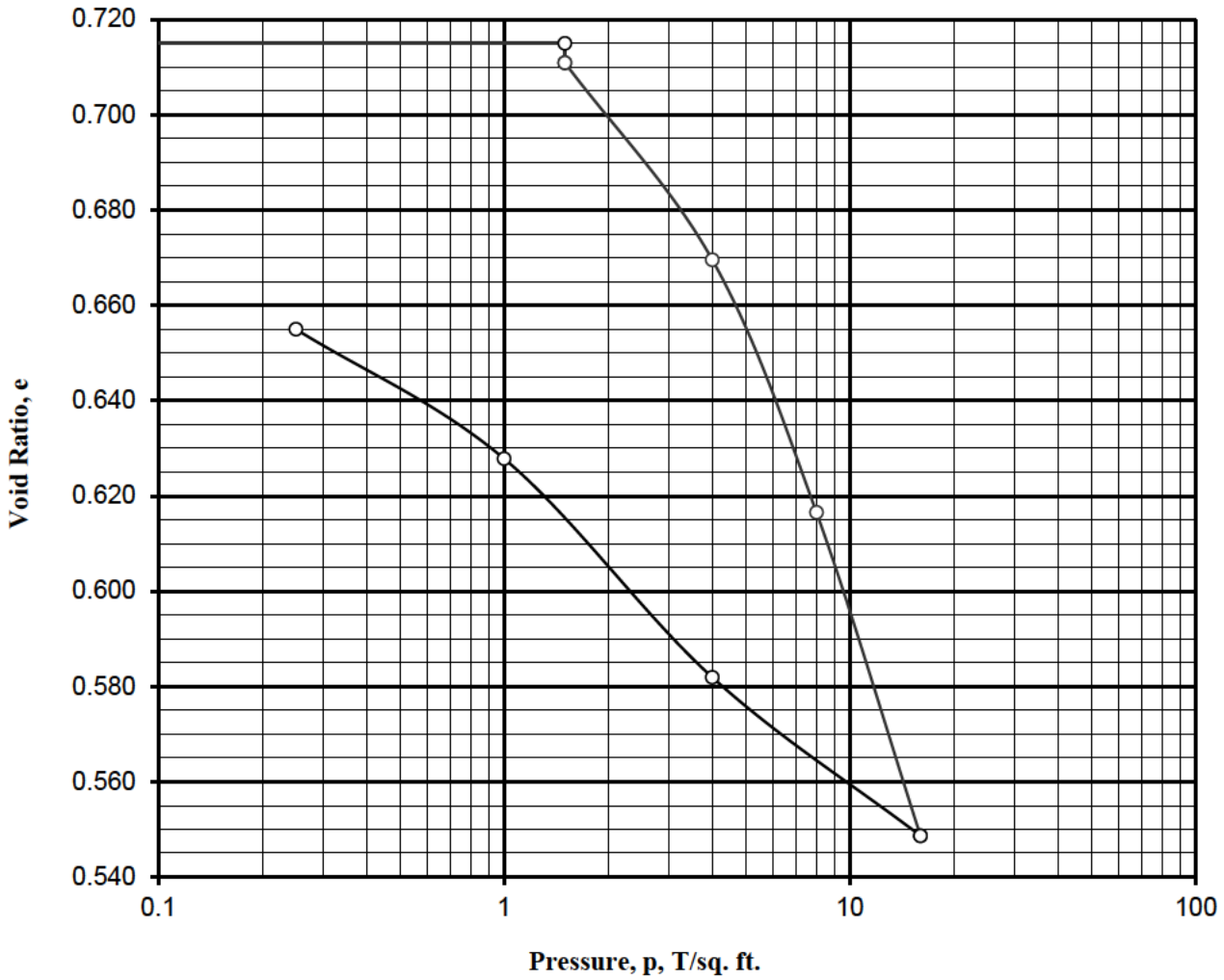


CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	1.10×10^{-4} (cm²/sec)		
		d_{50} (inches):	0.23384	TEAM Project No.:	192031
BORING NO.:	B-2	t_{50} (min):	11	Date:	3/25/2019
DEPTH:	13-15'	Load (tsf):	16	Remarks	
SAMPLE:	ST-4	Thickness (inches)	0.500		

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing



Type of specimen:	Undisturbed			Before Test		After Test	
Diam. 2.50 in.	Ht. 0.500 in.			Water Content, w_o	25.79%	W_f	24.28%
Overburden Pressure, P_o	T/sq. ft.			Void Ratio, e_o	0.7150	e_f	0.6550
Preconsol. Pressure, P_c	T/sq. ft.			Saturation, S_o	97.3%	S_f	100.0%
Compression Index, C_c				Dry Density, γd	98.1 lb/ft^3		
Classification	Gray and dark brown fat clay						
LL 64	G_s 2.697			Project	USACE, ATMOS Pipeline		
PL 24					TEAM Project No.: 192031		
Remarks				Boring No:	B-4	Sample No.:	ST-1
				Depth:	1-3'	Date:	3/15/19
				CONSOLIDATION TEST REPORT			

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST
(Specimen Data)

Project: USACE, ATMOS Pipeline TEAM Job No.: 192031
Boring No.: B-4 Sample No.: ST-1 Depth: 1-3' Date: 3/15/19

Classification: Gray and dark brown fat clay

			Before Test			After Test	
			Specimen		Trimmings	Specimen	
Tare No.			Ring and Plates		630	440	
Weight in grams	Tare plus wet soil		189.56		522.45	114.13	
	Tare plus dry soil		173.25		457.91	98.77	
	Water	W_W	W_{WO}	16.31	64.54	W_{wf}	15.36
	Tare		110.00		207.61	35.52	
	Dry soil	W_S	63.25		250.30	63.25	
Water Content		w	W_O	25.79%	25.79%	W_f	24.28%

Consolidometer No.:	1	Area of specimen, A, (sq. cm.)	31.67
Weight of ring, g	N/A	Height of specimen, H, (in.)	0.500
Weight of plates, g	N/A	Specific Gravity of solids, (Gs)	2.697

Height of solids, $H_s = \frac{W_S}{A \times G_s \times \gamma_W} = \frac{63.25}{31.67 \times 2.70 \times 1 \times 2.54} = 0.2915$ in.

Original height of water, $H_{WO} = \frac{W_{WO}}{A \times \gamma_W} = \frac{16.31}{31.67 \times 1 \times 2.54} = 0.2027$ in.

Final height of water, $H_{Wf} = \frac{W_{Wf}}{A \times \gamma_W} = \frac{15.36}{31.67 \times 1 \times 2.54} = 0.1909$ in.

Net change in height of specimen at end of test, ΔH = -0.01750 in.

Height of specimen at end of test, $H_f = H - \Delta H$ = 0.4825 in.

Void ratio before test, $e_O = \frac{H - H_S}{H_S} = \frac{0.5 - 0.2915}{0.2915} = 0.7150$

Void ratio after test, $e_f = \frac{H_f - H_S}{H_S} = \frac{0.4825 - 0.2915}{0.2915} = 0.6550$

Degree of saturation before test, $S_O = \frac{H_{WO}}{H - H_S} = \frac{0.2027}{0.5000 - 0.2915} = 97.3\%$

Degree of saturation after test, $S_f = \frac{H_{wf}}{H_f - H_S} = \frac{0.1909}{0.4825 - 0.2915} = 100.0\%$

Dry density before test, $\gamma_d = \frac{W_S}{H \times A} = \frac{63.25 \times 62.4}{0.5 \times 31.67 \times 2.54} = 98.1$ lb./cu.ft.

Remarks

Technician: Jason Young Computed by: Jason Young Checked by: James Hutt

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Time - Consolidation Data)

Project: USACE, ATMOS Pipeline TEAM Job No.: 192031

Boring No.: B-4 Sample No.: ST-1 Depth: 1-3' Consol.No.: 1

Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C	Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C
3/15	0.125	9:55	0	2004	20	3/19	8	8:40	0	2195.5	20
3/15	0.25	9:56	1	1992		3/19	8	8:40	0.05	2220	
3/15	0.5	9:57	2	2003		3/19	8	8:40	0.1	2222.5	
3/15	1	9:59	4	2021		3/19	8	8:40	0.2	2224.2	
3/15	1.5	11:40	105	2035		3/19	8	8:40	0.33	2226.8	
3/18	1.5	8:00	4205	2052	19	3/19	8	8:40	0.5	2228.5	
						3/19	8	8:40	0.75	2230.5	
						3/19	8	8:41	1	2232.2	
3/18	4	8:35	0	2052	19	3/19	8	8:42	2	2237.8	
3/18	4	8:35	0.05	2088.5		3/19	8	8:44	4	2245	
3/18	4	8:35	0.1	2090.5		3/19	8	8:48	8	2255.5	
3/18	4	8:35	0.2	2093.5		3/19	8	9:00	20	2274	
3/18	4	8:35	0.33	2096		3/19	8	9:10	30	2286.5	
3/18	4	8:35	0.5	2098.2		3/19	8	9:40	60	2310	
3/18	4	8:35	0.75	2100.5		3/19	8	10:20	100	2328.5	
3/18	4	8:36	1	2102.8		3/19	8	12:00	200	2348	
3/18	4	8:37	2	2108		3/19	8	13:40	300	2356	
3/18	4	8:39	4	2115		3/19	8	17:15	515	2365.2	
3/18	4	8:43	8	2124		3/20	8	8:45	1445	2371	20
3/18	4	8:50	15	2135							
3/18	4	9:05	30	2149							
3/18	4	9:40	65	2166.8							
3/18	4	10:15	100	2174.5							
3/18	4	11:55	200	2184.2							
3/18	4	13:35	300	2188.5							
3/18	4	18:15	580	2192							
3/19	4	8:35	1440	2195.5	20						

Technician Jason Young

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Time - Consolidation Data)

Project: USACE, ATMOS Pipeline TEAM Job No.: 192031

Boring No.: B-4 Sample No.: ST-1 Depth: 1-3' Consol.No.: 1

Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C
3/20	16	8:45	0	2371	20
3/20	16	8:45	0.05	2402	
3/20	16	8:45	0.1	2404	
3/20	16	8:45	0.2	2406	
3/20	16	8:45	0.33	2408.5	
3/20	16	8:45	0.5	2410	
3/20	16	8:45	0.75	2413.2	
3/20	16	8:46	1	2415	
3/20	16	8:47	2	2420.5	
3/20	16	8:49	4	2429.8	
3/20	16	8:53	8	2440.8	
3/20	16	9:00	15	2454.5	
3/20	16	9:15	30	2479	
3/20	16	9:45	60	2507	
3/20	16	10:25	100	2529.5	
3/20	16	12:05	200	2560.8	
3/20	16	13:45	300	2574	
3/20	16	17:45	540	2586.5	
3/21	16	8:30	1425	2594	20

Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C
REBOUND LOADS					
3/21	4	8:30	Rebound	2594	20
3/22	4	9:20	1490	2461	20
3/22	1	9:20	Rebound	2461	20
3/24	1	14:15	3175	2300.2	20
3/24	0.25	14:15	Rebound	2300.2	20
3/25	0.25	17:30	1635	2201	21
Machine Deflection Readings					
	0.125			2004	
	1.5			2040	
	4			2063	
	8			2084	
	16			2109	
	4			2073	
	1			2046	
	0.25			2026	

Technician Jason Young

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Computation of Void Ratio)

PROJECT: USACE, ATMOS Pipeline | TEAM Job No.: 192031 | DATE: 3/15/19

BORING NO.: B-4 | SAMPLE NO.: ST-1 | DEPTH: 1-3' | CONSOLIDOMETER NO.: 1

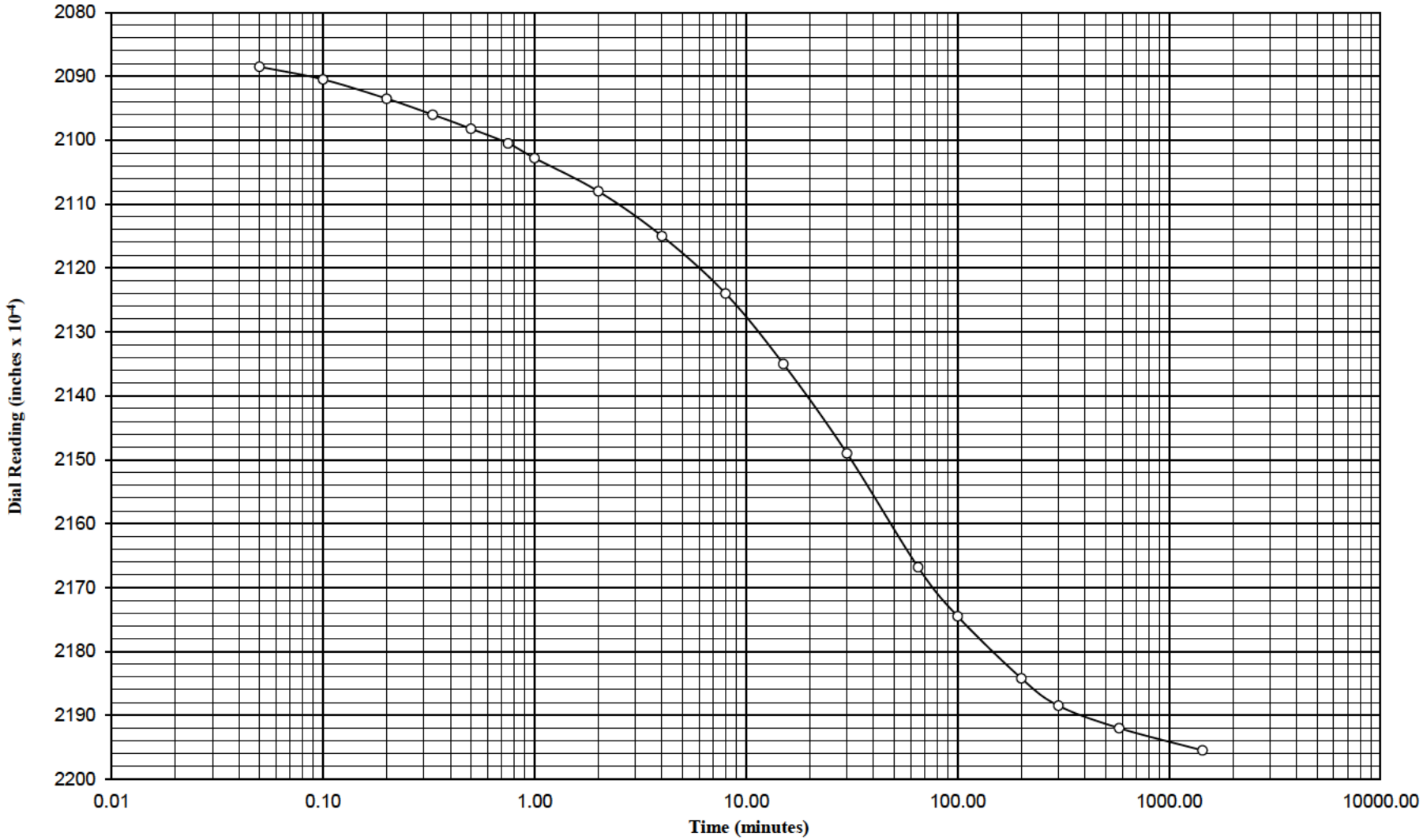
Pressure, P T./sq.ft.	Date Increment Applied	Time in Min. Increment Effective	Dial Reading 10^{-4} in.	Correction 10^{-4} in.	Change in Height, ΔH 10^{-4} in.	Height of Voids, H_V 10^{-4} in.	Void Ratio, e
0.1	3/15	Zero Point	2000	2000	0	2085	0.7150
1.5	3/15	Initial Load	2040	2040	0	2085	0.7150
1.5	3/15	4205	2052	2040	-12	2073	0.7109
4	3/18	1440	2195.5	2063	-132.5	1952	0.6696
8	3/19	1445	2371	2084	-287	1798	0.6166
16	3/20	1425	2594	2109	-485	1600	0.5487
4	3/21	1490	2461	2073	-388	1697	0.5819
1	3/22	3175	2300.2	2046	-254.2	1830	0.6278
0.25	3/24	1635	2201	2026	-175	1910	0.6550

Note:

Height of voids, $H_V = (H - H_S) - \Delta H$ $H_S =$ 0.2915

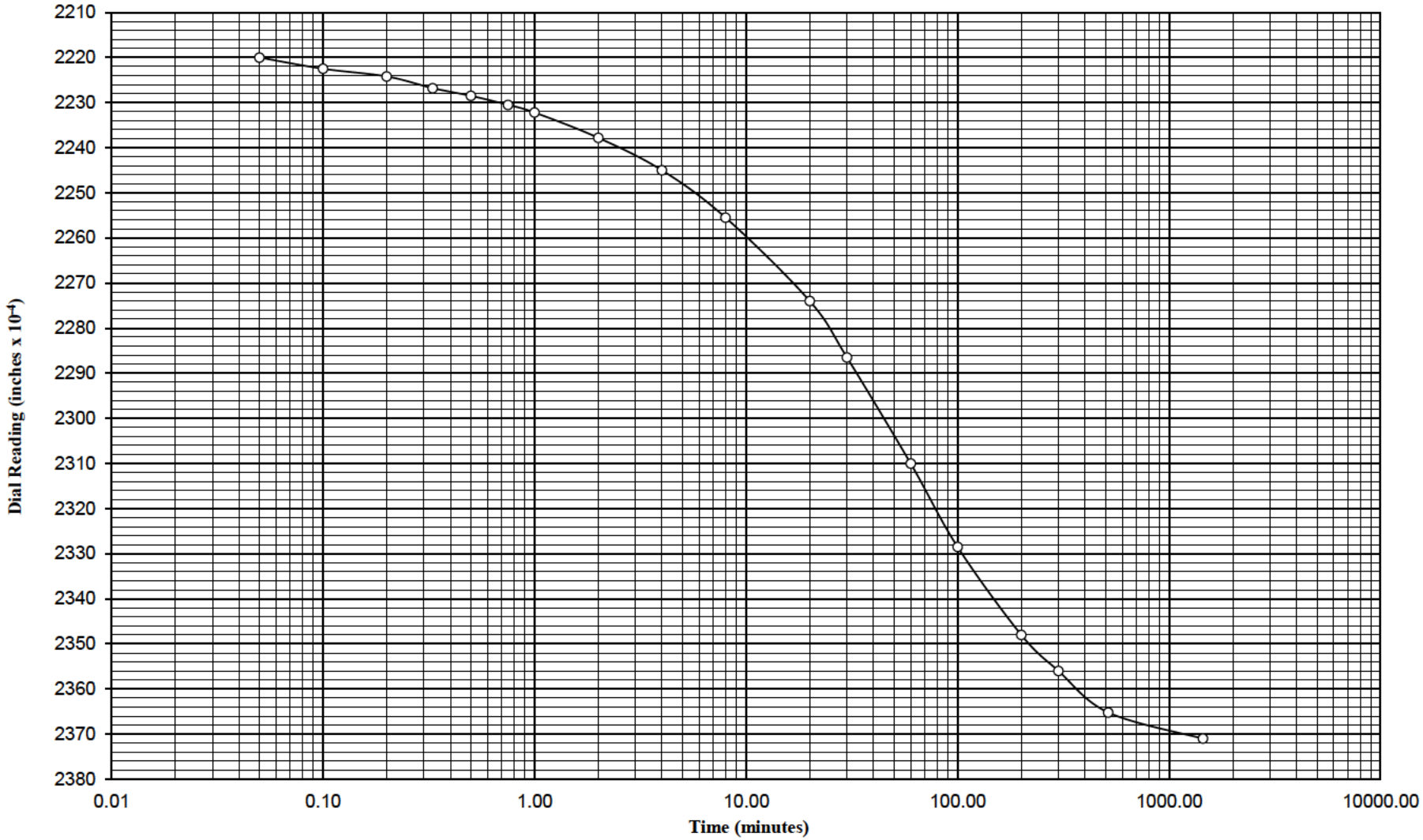
Void Ratio, $e = \frac{H_V}{H_S}$

Technician: Jason Young | Computed by: Jason Young | Checked by: James Hutt



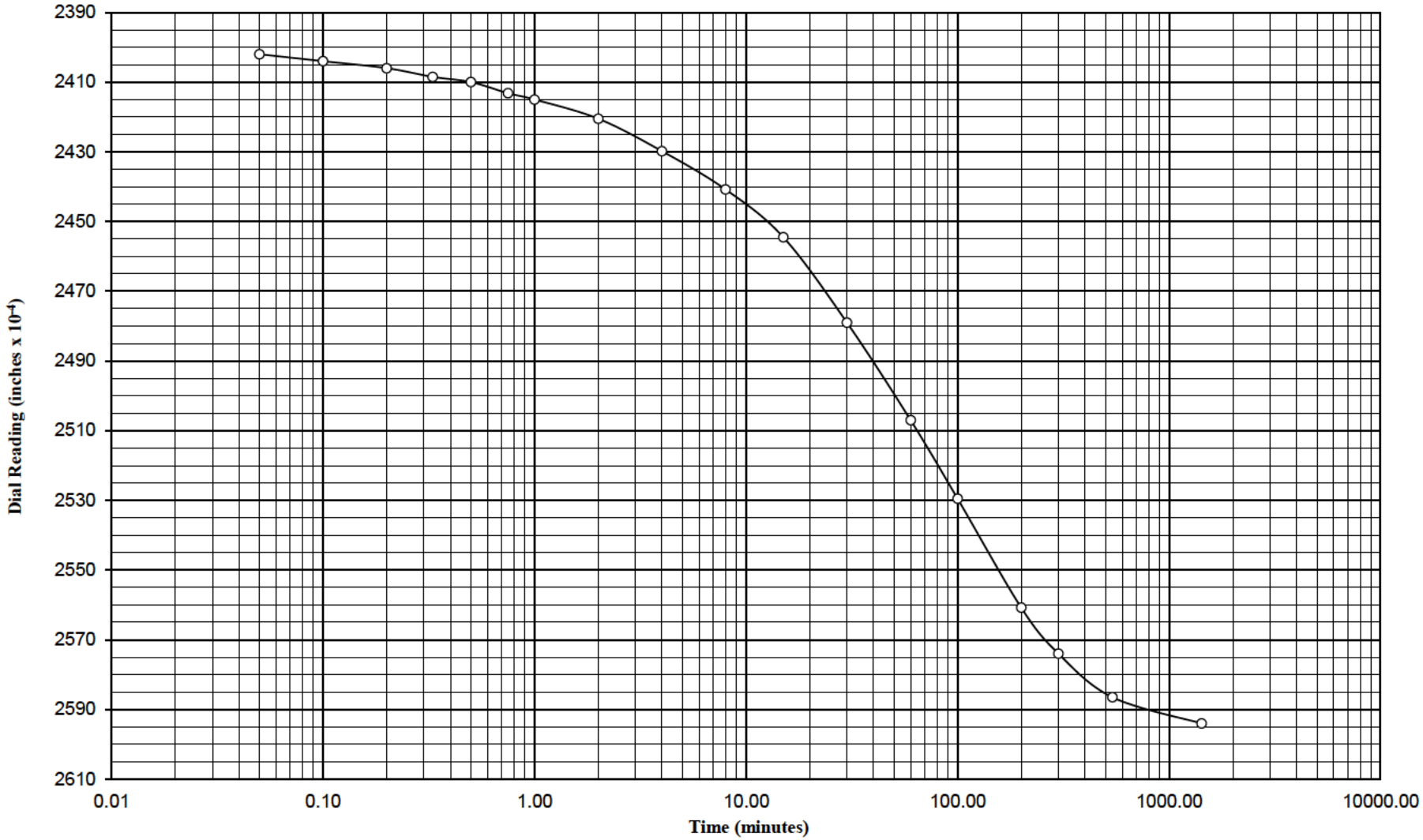
CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	0.92×10^{-4} (cm²/sec)		
		d_{50} (inches):	0.21345	TEAM Project No.:	192031
BORING NO.:	B-4	t_{50} (min):	14	Date:	3/15/2019
DEPTH:	1-3'	Load (tsf):	4	Remarks	
SAMPLE:	ST-1	Thickness (inches)	0.500		



CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	0.51×10^{-4} (cm²/sec)		
		d_{50} (inches):	0.22784	TEAM Project No.:	192031
BORING NO.:	B-4	t_{50} (min):	24	Date:	3/15/2019
DEPTH:	1-3'	Load (tsf):	8	Remarks	
SAMPLE:	ST-1	Thickness (inches)	0.500		

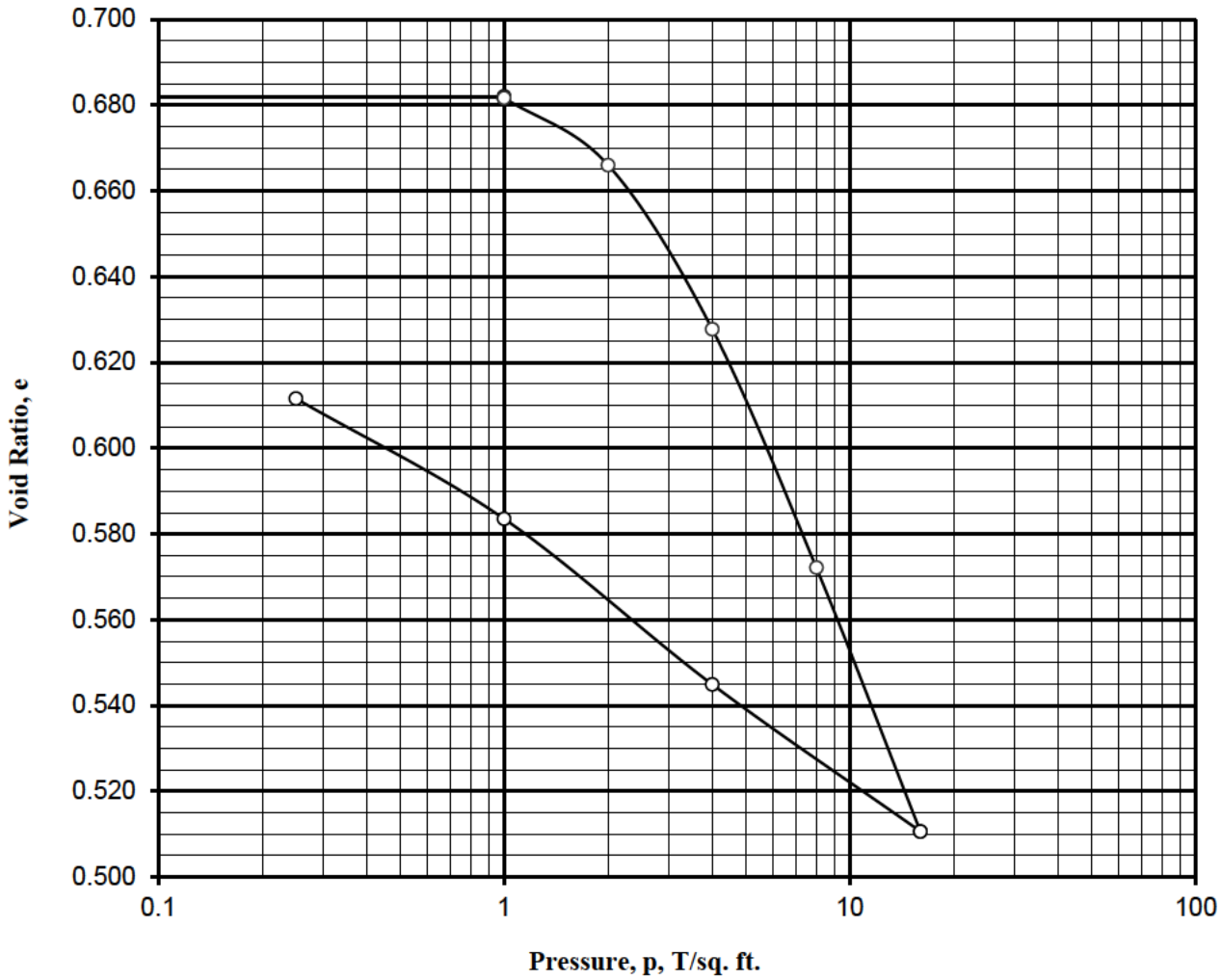


CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	0.29×10^{-4} (cm²/sec)		
		d_{50} (inches):	0.24895	TEAM Project No.:	192031
BORING NO.:	B-4	t_{50} (min):	39	Date:	3/15/2019
DEPTH:	1-3'	Load (tsf):	16	Remarks	
SAMPLE:	ST-1	Thickness (inches)	0.500		

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing



Type of specimen:	Undisturbed			Before Test		After Test	
Diam. 2.50 in.	Ht. 0.499 in.			Water Content, w_o	24.50%	W_f	22.69%
Overburden Pressure, P_o	T/sq. ft.			Void Ratio, e_o	0.6820	e_f	0.6116
Preconsol. Pressure, P_c	T/sq. ft.			Saturation, S_o	96.8%	S_f	100.0%
Compression Index, C_c				Dry Density, γd	100.0 lb/ft^3		
Classification	Brown and gray fat clay						
LL 61	G_s 2.695			Project	USACE, ATMOS Pipeline		
PL 22					TEAM Project No.: 192031		
Remarks				Boring No:	B-4	Sample No.:	ST-3
				Depth:	5-7'	Date:	3/29/19
				CONSOLIDATION TEST REPORT			

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST
(Specimen Data)

Project: USACE, ATMOS Pipeline — TEAM Job No.: 192031

Boring No.: B-4 — Sample No.: ST-3 — Depth: 5-7' — Date: 3/29/19

Classification: Brown and gray fat clay

			Before Test			After Test	
			Specimen		Trimmings	Specimen	
Tare No.			Ring and Plates		662	440	
Weight in grams	Tare plus wet soil		190.06		602.15	114.42	
	Tare plus dry soil		174.30		524.51	99.83	
	Water	W_W	W_{WO}	15.76	77.64	W_{wf}	14.59
	Tare		110.00		207.64	35.53	
	Dry soil	W_S	64.30		316.87	64.30	
Water Content		w	W_O	24.50%	24.50%	W_f	22.69%

Consolidometer No.:	2	Area of specimen, A, (sq. cm.)	31.67
Weight of ring, g	N/A	Height of specimen, H, (in.)	0.499
Weight of plates, g	N/A	Specific Gravity of solids, (Gs)	2.695

Height of solids, $H_s = \frac{W_S}{A \times G_s \times \gamma_W} = \frac{64.30}{31.67 \times 2.69 \times 1 \times 2.54} = 0.2967$ in.

Original height of water, $H_{WO} = \frac{W_{WO}}{A \times \gamma_W} = \frac{15.76}{31.67 \times 1 \times 2.54} = 0.1959$ in.

Final height of water, $H_{Wf} = \frac{W_{Wf}}{A \times \gamma_W} = \frac{14.59}{31.67 \times 1 \times 2.54} = 0.1814$ in.

Net change in height of specimen at end of test, ΔH = -0.02090 in.

Height of specimen at end of test, $H_f = H - \Delta H$ = 0.4781 in.

Void ratio before test, $e_O = \frac{H - H_S}{H_S} = \frac{0.499 - 0.2967}{0.2967} = 0.6820$

Void ratio after test, $e_f = \frac{H_f - H_S}{H_S} = \frac{0.4781 - 0.2967}{0.2967} = 0.6116$

Degree of saturation before test, $S_O = \frac{H_{WO}}{H - H_S} = \frac{0.1959}{0.4990 - 0.2967} = 96.8\%$

Degree of saturation after test, $S_f = \frac{H_{wf}}{H_f - H_S} = \frac{0.1814}{0.4781 - 0.2967} = 100.0\%$

Dry density before test, $\gamma_d = \frac{W_S}{H \times A} = \frac{64.30}{0.499 \times 31.67 \times 2.54 \times 62.4} = 100.0$ lb./cu.ft.

Remarks

Technician: Jason Young — Computed by: Jason Young — Checked by: James Hutt

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Time - Consolidation Data)

Project: USACE, ATMOS Pipeline TEAM Job No.: 192031

Boring No.: B-4 Sample No.: ST-3 Depth: 5-7' Consol.No.: 2

Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C	Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C
3/29	0.25	13:10	0	2008	20	4/2	4	9:05	0	2094.5	20
3/29	0.5	13:15	5	2005		4/2	4	9:05	0.05	2128	
3/29	0.75	14:00	50	2010		4/2	4	9:05	0.1	2131	
3/29	1	16:00	170	2023		4/2	4	9:05	0.2	2134	
4/1	1	8:20	4030	2032	19	4/2	4	9:05	0.33	2137.8	
						4/2	4	9:05	0.5	2140	
						4/2	4	9:05	0.75	2143	
						4/2	4	9:06	1	2145.2	
4/1	2	8:20	0	2032	19	4/2	4	9:07	2	2151.2	
4/1	2	8:20	0.05	2051		4/2	4	9:09	4	2158	
4/1	2	8:20	0.1	2052.5		4/2	4	9:13	8	2166.8	
4/1	2	8:20	0.2	2054		4/2	4	9:20	15	2175.5	
4/1	2	8:20	0.33	2055.5		4/2	4	9:35	30	2186	
4/1	2	8:20	0.5	2056.8		4/2	4	10:05	60	2198.8	
4/1	2	8:20	0.75	2058		4/2	4	10:45	100	2207	
4/1	2	8:21	1	2059		4/2	4	12:25	200	2215	
4/1	2	8:22	2	2061.8		4/2	4	14:05	300	2219.5	
4/1	2	8:24	4	2064.8		4/2	4	17:00	475	2222.2	
4/1	2	8:28	8	2068.2		4/3	4	7:55	1370	2226	20
4/1	2	8:35	15	2072							
4/1	2	8:50	30	2076.2							
4/1	2	9:20	60	2080.8							
4/1	2	10:00	100	2084							
4/1	2	11:40	200	2088							
4/1	2	13:20	300	2090.2							
4/1	2	17:00	520	2092.5							
4/2	2	9:05	1485	2094.5	20						

Technician Jason Young

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Time - Consolidation Data)

Project: USACE, ATMOS Pipeline TEAM Job No.: 192031

Boring No.: B-4 Sample No.: ST-3 Depth: 5-7' Consol.No.: 2

Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C	Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C
4/3	8	7:55	0	2226	20	4/4	16	8:25	0	2409	21
4/3	8	7:55	0.05	2272		4/4	16	8:25	0.05	2449	
4/3	8	7:55	0.1	2276		4/4	16	8:25	0.1	2452	
4/3	8	7:55	0.2	2280		4/4	16	8:25	0.2	2454.8	
4/3	8	7:55	0.33	2283.2		4/4	16	8:25	0.33	2457.8	
4/3	8	7:55	0.5	2286		4/4	16	8:25	0.5	2460.2	
4/3	8	7:55	0.75	2288.8		4/4	16	8:25	0.75	2463.2	
4/3	8	7:56	1	2291		4/4	16	8:26	1	2465.5	
4/3	8	7:57	2	2297.2		4/4	16	8:27	2	2472.2	
4/3	8	7:59	4	2305.2		4/4	16	8:29	4	2481	
4/3	8	8:03	8	2315		4/4	16	8:33	8	2492.5	
4/3	8	8:10	15	2327		4/4	16	8:40	15	2507	
4/3	8	8:25	30	2342.2		4/4	16	8:55	30	2526.8	
4/3	8	8:55	60	2361.5		4/4	16	9:25	60	2552	
4/3	8	9:35	100	2375.5		4/4	16	10:05	100	2572.8	
4/3	8	11:15	200	2391.8		4/4	16	11:45	200	2595.5	
4/3	8	12:55	300	2397		4/4	16	13:25	300	2603.2	
4/3	8	17:00	545	2403.5		4/4	16	17:00	515	2609.5	
4/4	8	8:25	1470	2409	21	4/5	16	8:00	1415	2616.5	21

Technician Jason Young

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Time - Consolidation Data)

Project: USACE, ATMOS Pipeline TEAM Job No.: 192031

Boring No.: B-4 Sample No.: ST-3 Depth: 5-7' Consol.No.: 2

Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. °C	Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. °C
						REBOUND LOADS					
						4/5	4	8:00	Rebound	2616.5	21
						4/6	4	11:10	1630	2480.8	21
						4/6	1	11:10	Rebound	2480.8	21
						4/7	1	13:30	1580	2337.2	21
						4/7	0.25	13:30	Rebound	2337.2	21
						4/8	0.25	13:30	1440	2229	21
						Machine Deflection Readings					
							0.25			2008	
							1			2031	
							2			2047	
							4			2065	
							8			2083	
							16			2108	
							4			2074	
							1			2045	
							0.25			2020	

Technician Jason Young

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Computation of Void Ratio)

PROJECT: USACE, ATMOS Pipeline | TEAM Job No.: 192031 | DATE: 3/29/19

BORING NO.: B-4 | SAMPLE NO.: ST-3 | DEPTH: 5-7' | CONSOLIDOMETER NO.: 2

Pressure, P T./sq.ft.	Date Increment Applied	Time in Min. Increment Effective	Dial Reading 10^{-4} in.	Correction 10^{-4} in.	Change in Height, ΔH 10^{-4} in.	Height of Voids, H_V 10^{-4} in.	Void Ratio, e
0.1	3/29	Zero Point	2000	2000	0	2023	0.6820
1	3/29	Initial Load	2031	2031	0	2023	0.6820
1	3/29	4030	2032	2031	-1	2022	0.6817
2	4/1	1485	2094.5	2047	-47.5	1976	0.6660
4	4/2	1370	2226	2065	-161	1862	0.6278
8	4/3	1470	2409	2083	-326	1697	0.5722
16	4/4	1415	2616.5	2108	-508.5	1515	0.5106
4	4/5	1630	2480.8	2074	-406.8	1617	0.5449
1	4/6	1580	2337.2	2045	-292.2	1731	0.5836
0.25	4/7	1440	2229	2020	-209	1814	0.6116

Note:

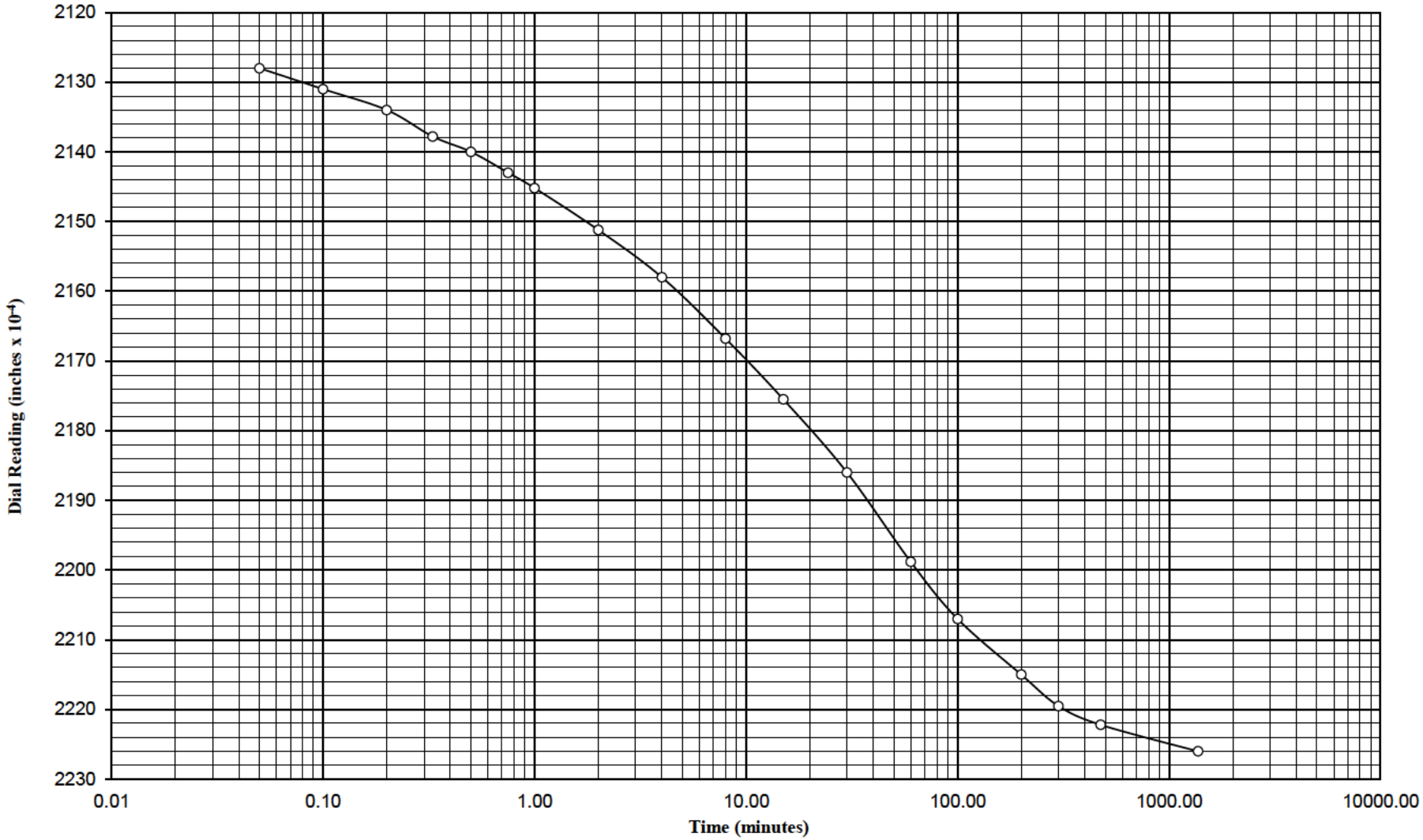
Height of voids, $H_V = (H - H_S) - \Delta H$ $H_S =$ 0.2967

Void Ratio, $e = \frac{H_V}{H_S}$

Technician: Jason Young | Computed by: Jason Young | Checked by: James Hutt

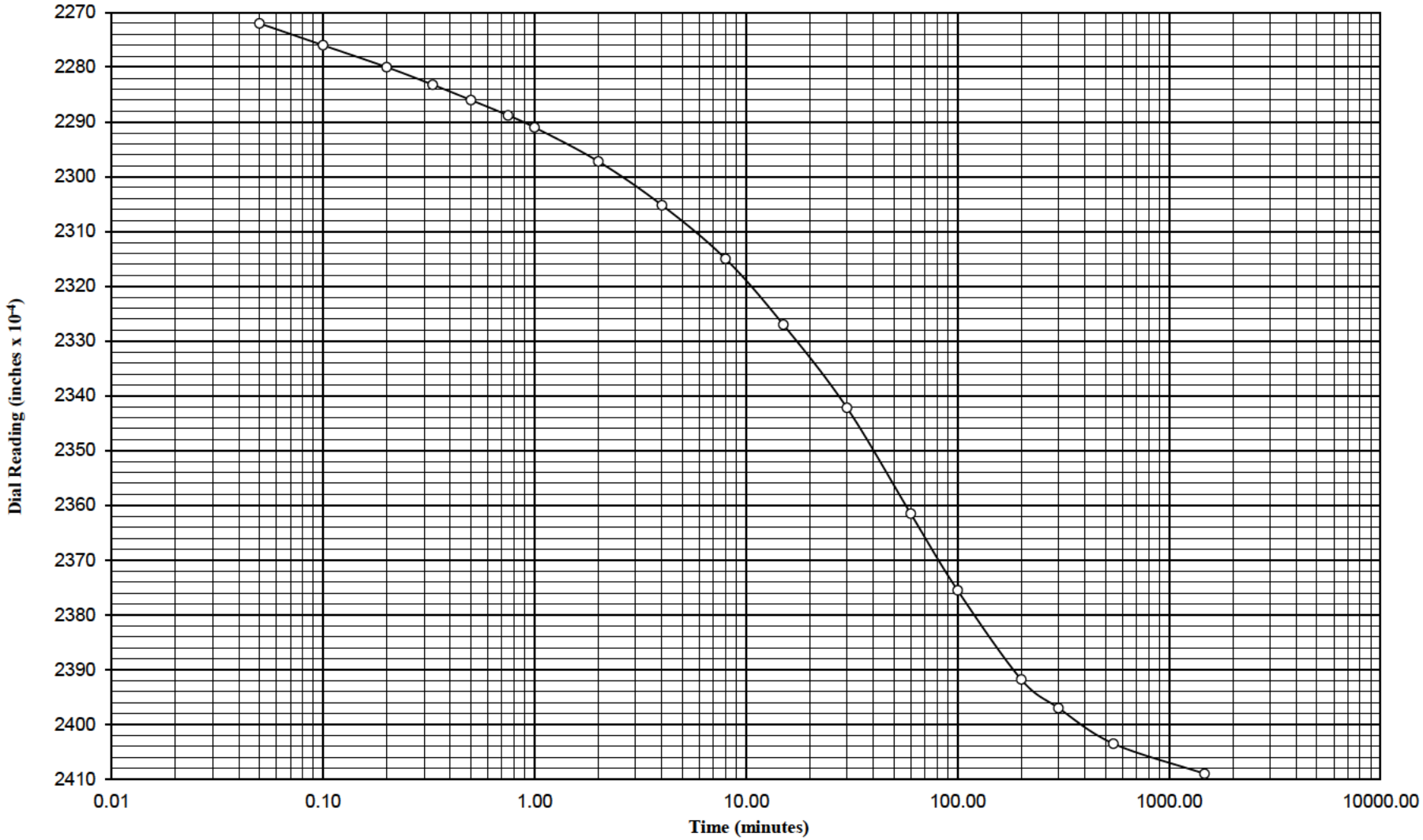
CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	1.31×10^{-4} (cm²/sec)		
		d_{50} (inches):	0.20695	TEAM Project No.:	192031
BORING NO.:	B-4	t_{50} (min):	10	Date:	3/29/2019
DEPTH:	5-7'	Load (tsf):	2	Remarks	
SAMPLE:	ST-3	Thickness (inches)	0.499		



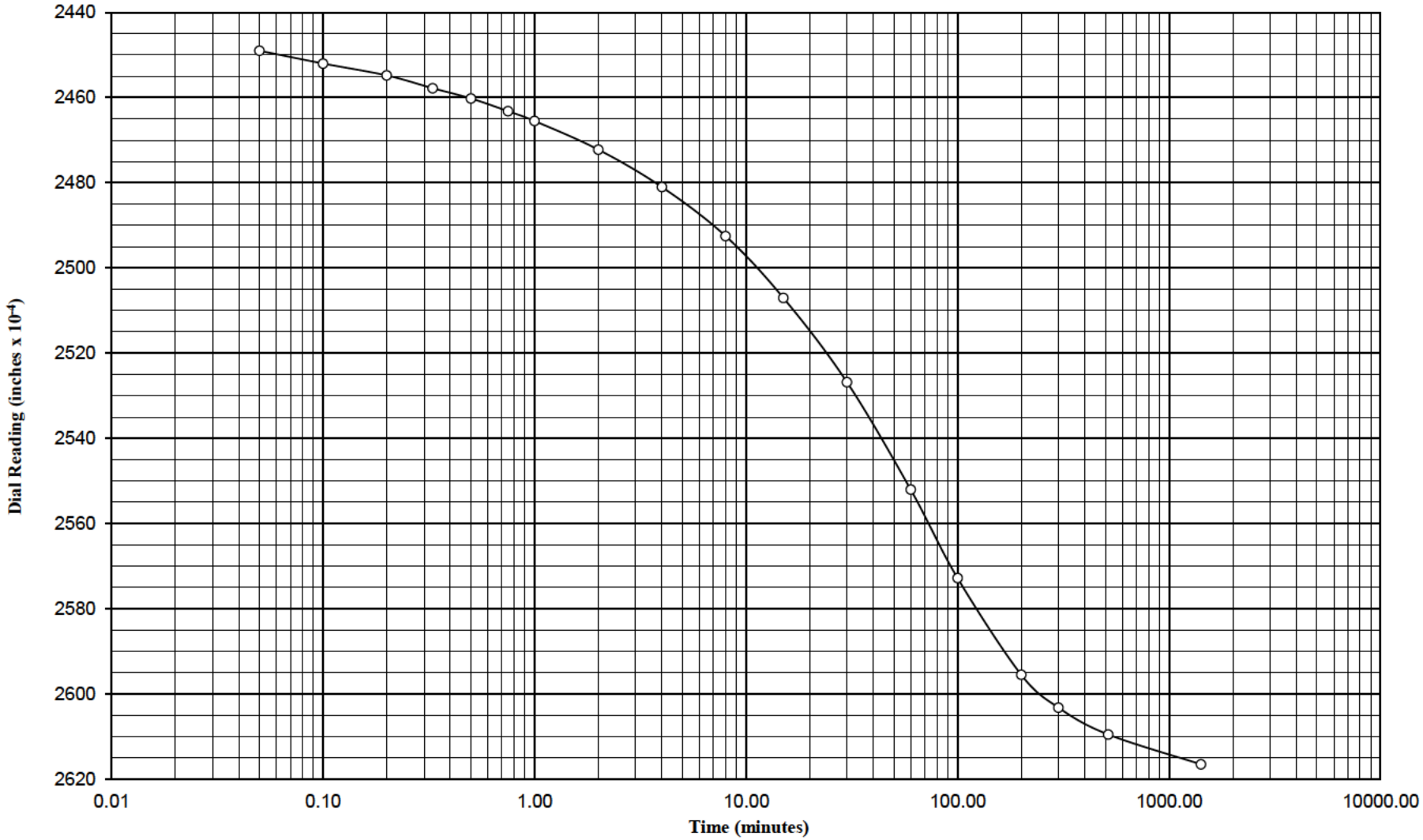
CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	1.26×10^{-4} (cm²/sec)		
		d_{50} (inches):	0.21700	TEAM Project No.:	192031
BORING NO.:	B-4	t_{50} (min):	10	Date:	3/29/2019
DEPTH:	5-7'	Load (tsf):	4	Remarks	
SAMPLE:	ST-3	Thickness (inches)	0.499		



CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	0.70×10^{-4} (cm²/sec)		
		d_{50} (inches):	0.23305	TEAM Project No.:	192031
BORING NO.:	B-4	t_{50} (min):	17	Date:	3/29/2019
DEPTH:	5-7'	Load (tsf):	8	Remarks	
SAMPLE:	ST-3	Thickness (inches)	0.499		

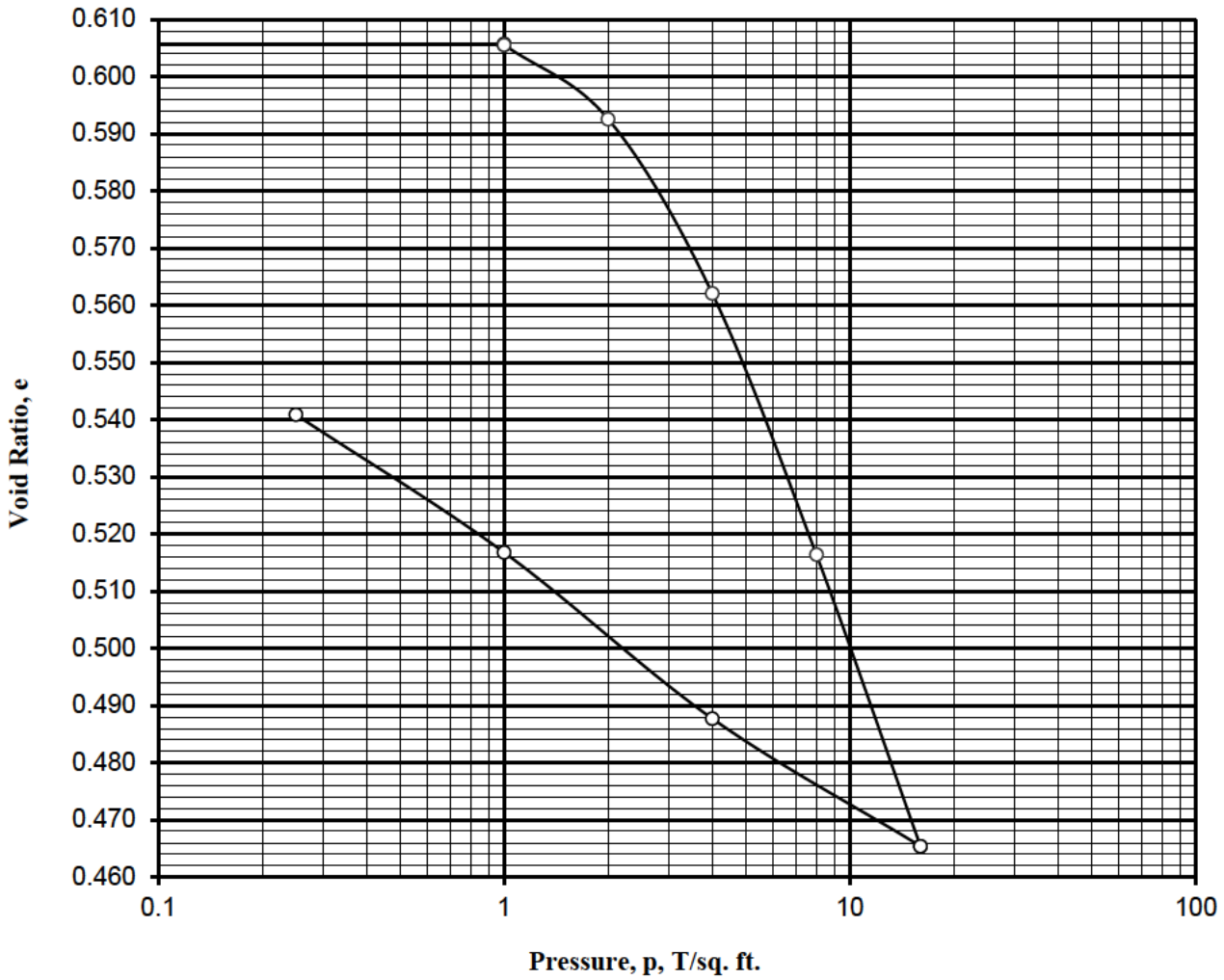


CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	0.41×10^{-4} (cm²/sec)		
		d_{50} (inches):	0.25236	TEAM Project No.:	192031
BORING NO.:	B-4	t_{50} (min):	27	Date:	3/29/2019
DEPTH:	5-7'	Load (tsf):	16	Remarks	
SAMPLE:	ST-3	Thickness (inches)	0.499		

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing



Type of specimen:	Undisturbed			Before Test		After Test	
Diam. 2.50 in.	Ht. 0.500 in.			Water Content, w_o	20.72%	W_f	20.05%
Overburden Pressure, P_o	T/sq. ft.			Void Ratio, e_o	0.6057	e_f	0.5409
Preconsol. Pressure, P_c	T/sq. ft.			Saturation, S_o	92.3%	S_f	100.0%
Compression Index, C_c				Dry Density, γd	104.8 lb/ft^3		
Classification	Tan and gray fat clay						
LL 52	G_s 2.698			Project	USACE, ATMOS Pipeline		
PL 20					TEAM Project No.: 192031		
Remarks				Boring No:	B-4	Sample No.:	ST-4
				Depth:	8-10'	Date:	3/29/19
				CONSOLIDATION TEST REPORT			

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST
(Specimen Data)

Project: USACE, ATMOS Pipeline — TEAM Job No.: 192031

Boring No.: B-4 — Sample No.: ST-4 — Depth: 8-10' — Date: 3/29/19

Classification: Tan and gray fat clay

			Before Test		After Test	
			Specimen	Trimmings	Specimen	
Tare No.			Ring and Plates	623	411	
Weight in grams	Tare plus wet soil		191.58	620.28	116.55	
	Tare plus dry soil		177.58	551.10	103.00	
	Water	W_W	W_{WO} 14.00	69.18	W_{wf}	13.55
	Tare		110.00	217.16	35.42	
	Dry soil	W_S	67.58	333.94	67.58	
Water Content		w	W_O 20.72%	20.72%	W_f	20.05%

Consolidometer No.:	3	Area of specimen, A, (sq. cm.)	31.67
Weight of ring, g	N/A	Height of specimen, H, (in.)	0.500
Weight of plates, g	N/A	Specific Gravity of solids, (Gs)	2.698

Height of solids, $H_s = \frac{W_S}{A \times G_s \times \gamma_W} = \frac{67.58}{31.67 \times 2.70 \times 1 \times 2.54} = 0.3114$ in.

Original height of water, $H_{WO} = \frac{W_{WO}}{A \times \gamma_W} = \frac{14.00}{31.67 \times 1 \times 2.54} = 0.1740$ in.

Final height of water, $H_{Wf} = \frac{W_{Wf}}{A \times \gamma_W} = \frac{13.55}{31.67 \times 1 \times 2.54} = 0.1684$ in.

Net change in height of specimen at end of test, ΔH = -0.02020 in.

Height of specimen at end of test, $H_f = H - \Delta H$ = 0.4798 in.

Void ratio before test, $e_O = \frac{H - H_S}{H_S} = \frac{0.5 - 0.3114}{0.3114} = 0.6057$

Void ratio after test, $e_f = \frac{H_f - H_S}{H_S} = \frac{0.4798 - 0.3114}{0.3114} = 0.5409$

Degree of saturation before test, $S_O = \frac{H_{WO}}{H - H_S} = \frac{0.1740}{0.5000 - 0.3114} = 92.3\%$

Degree of saturation after test, $S_f = \frac{H_{wf}}{H_f - H_S} = \frac{0.1684}{0.4798 - 0.3114} = 100.0\%$

Dry density before test, $\gamma_d = \frac{W_S}{H \times A} = \frac{67.58 \times 62.4}{0.5 \times 31.67 \times 2.54} = 104.8$ lb./cu.ft.

Remarks

Technician: Jason Young — Computed by: Jason Young — Checked by: James Hutt

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Time - Consolidation Data)

Project: USACE, ATMOS Pipeline TEAM Job No.: 192031

Boring No.: B-4 Sample No.: ST-4 Depth: 8-10' Consol.No.: 3

Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C	Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C
3/29	0.25	13:50	0	2008	20	4/2	4	9:10	0	2083	20
3/29	0.5	14:00	10	2005		4/2	4	9:10	0.05	2122	
3/29	1	14:05	15	2020		4/2	4	9:10	0.1	2125	
4/1	1	8:25	3995	2028.5	19	4/2	4	9:10	0.2	2129	
						4/2	4	9:10	0.33	2133	
						4/2	4	9:10	0.5	2136.2	
						4/2	4	9:10	0.75	2139.5	
						4/2	4	9:11	1	2141.5	
4/1	2	8:25	0	2028.5	19	4/2	4	9:12	2	2146.8	
4/1	2	8:25	0.05	2046.2		4/2	4	9:14	4	2153	
4/1	2	8:25	0.1	2048		4/2	4	9:18	8	2159.5	
4/1	2	8:25	0.2	2050		4/2	4	9:25	15	2165.5	
4/1	2	8:25	0.33	2051.8		4/2	4	9:40	30	2173	
4/1	2	8:25	0.5	2053		4/2	4	10:10	60	2178.8	
4/1	2	8:25	0.75	2054.5		4/2	4	10:50	100	2182.2	
4/1	2	8:26	1	2055.2		4/2	4	12:30	200	2186.5	
4/1	2	8:27	2	2058		4/2	4	14:10	300	2188.8	
4/1	2	8:29	4	2060.8		4/2	4	17:00	470	2191.8	
4/1	2	8:33	8	2063.8		4/3	4	8:00	1370	2195	20
4/1	2	8:40	15	2066.2							
4/1	2	8:55	30	2069.2							
4/1	2	9:25	60	2072.2							
4/1	2	10:05	100	2074.5							
4/1	2	11:45	200	2077							
4/1	2	13:25	300	2078.5							
4/1	2	17:00	515	2080.8							
4/2	2	9:10	1485	2083	20						

Technician Jason Young

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Time - Consolidation Data)

Project: USACE, ATMOS Pipeline TEAM Job No.: 192031

Boring No.: B-4 Sample No.: ST-4 Depth: 8-10' Consol.No.: 3

Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C	Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C
4/3	8	8:00	0	2195	20	4/4	16	8:30	0	2358.2	21
4/3	8	8:00	0.05	2249		4/4	16	8:30	0.05	2406	
4/3	8	8:00	0.1	2253		4/4	16	8:30	0.1	2409	
4/3	8	8:00	0.2	2257.5		4/4	16	8:30	0.2	2412.2	
4/3	8	8:00	0.33	2262.2		4/4	16	8:30	0.33	2416.5	
4/3	8	8:00	0.5	2265.5		4/4	16	8:30	0.5	2419.8	
4/3	8	8:00	0.75	2269		4/4	16	8:30	0.75	2423	
4/3	8	8:01	1	2271.2		4/4	16	8:31	1	2425.5	
4/3	8	8:02	2	2278.5		4/4	16	8:32	2	2433.8	
4/3	8	8:04	4	2287		4/4	16	8:34	4	2444	
4/3	8	8:08	8	2297.2		4/4	16	8:38	8	2457.5	
4/3	8	8:15	15	2308.2		4/4	16	8:45	15	2472.5	
4/3	8	8:30	30	2320.8		4/4	16	9:00	30	2491.8	
4/3	8	9:00	60	2332.5		4/4	16	9:30	60	2510.2	
4/3	8	9:40	100	2339.2		4/4	16	10:10	100	2520.2	
4/3	8	11:20	200	2345.5		4/4	16	11:50	200	2529.2	
4/3	8	13:00	300	2349.2		4/4	16	13:30	300	2533	
4/3	8	17:00	540	2353.5		4/4	16	17:00	510	2537	
4/4	8	8:30	1470	2358.2	21	4/5	16	8:00	1410	2543	21

Technician Jason Young

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Time - Consolidation Data)

Project: USACE, ATMOS Pipeline TEAM Job No.: 192031

Boring No.: B-4 Sample No.: ST-4 Depth: 8-10' Consol.No.: 3

Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. °C
REBOUND LOADS					
4/5	4	8:00	Rebound	2543	21
4/6	4	11:10	1630	2438.5	21
4/6	1	11:10	Rebound	2438.5	21
4/7	1	13:30	1580	2320	21
4/7	0.25	13:30	Rebound	2320	21
4/8	0.25	13:30	1440	2224	21
Machine Deflection Readings					
	0.25			2008	
	1			2028	
	2			2042	
	4			2059	
	8			2080	
	16			2106	
	4			2071	
	1			2043	
	0.25			2022	

Technician Jason Young

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Computation of Void Ratio)

PROJECT: USACE, ATMOS Pipeline | TEAM Job No.: 192031 | DATE: 3/29/19

BORING NO.: B-4 | SAMPLE NO.: ST-4 | DEPTH: 8-10' | CONSOLIDOMETER NO.: 3

Pressure, P T./sq.ft.	Date Increment Applied	Time in Min. Increment Effective	Dial Reading 10^{-4} in.	Correction 10^{-4} in.	Change in Height, ΔH 10^{-4} in.	Height of Voids, H_V 10^{-4} in.	Void Ratio, e
0.1	3/29	Zero Point	2000	2000	0	1886	0.6057
1	3/29	Initial Load	2028	2028	0	1886	0.6057
1	3/29	3995	2028.5	2028	-0.5	1886	0.6056
2	4/1	1485	2083	2042	-41	1845	0.5926
4	4/2	1370	2195	2059	-136	1750	0.5621
8	4/3	1470	2358.2	2080	-278.2	1608	0.5164
16	4/4	1410	2543	2106	-437	1449	0.4654
4	4/5	1630	2438.5	2071	-367.5	1519	0.4877
1	4/6	1580	2320	2043	-277	1609	0.5168
0.25	4/7	1440	2224	2022	-202	1684	0.5409

Note:

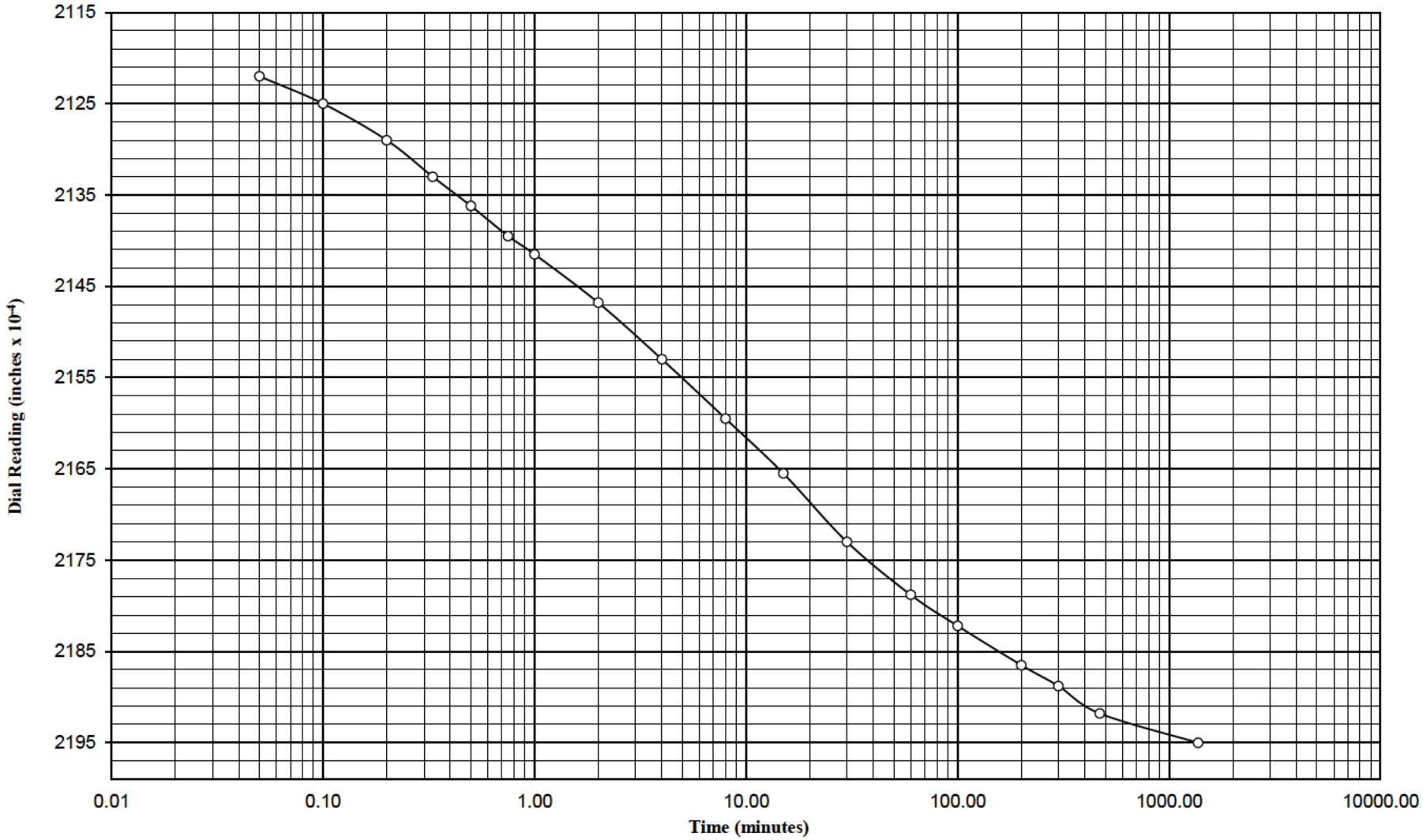
Height of voids, $H_V = (H - H_S) - \Delta H$ $\quad H_S =$ 0.3114

Void Ratio, $e = \frac{H_V}{H_S}$

Technician: Jason Young | Computed by: Jason Young | Checked by: James Hutt

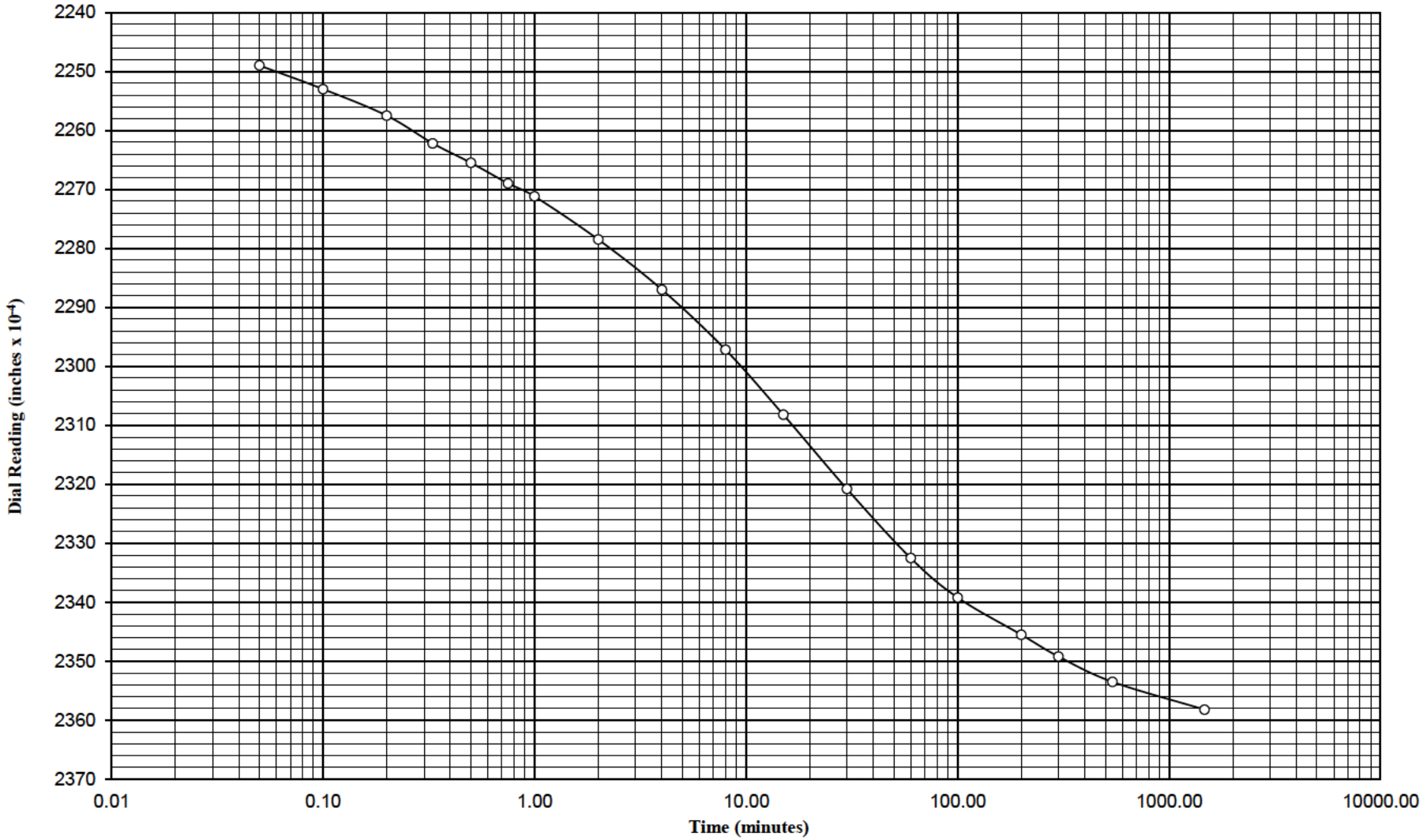
CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	3.28×10^{-4} (cm^2/sec)		
		d_{50} (inches):	0.20610	TEAM Project No.:	192031
BORING NO.:	B-4	t_{50} (min):	4.0	Date:	3/29/2019
DEPTH:	8-10'	Load (tsf):	2	Remarks	
SAMPLE:	ST-4	Thickness (inches)	0.500		



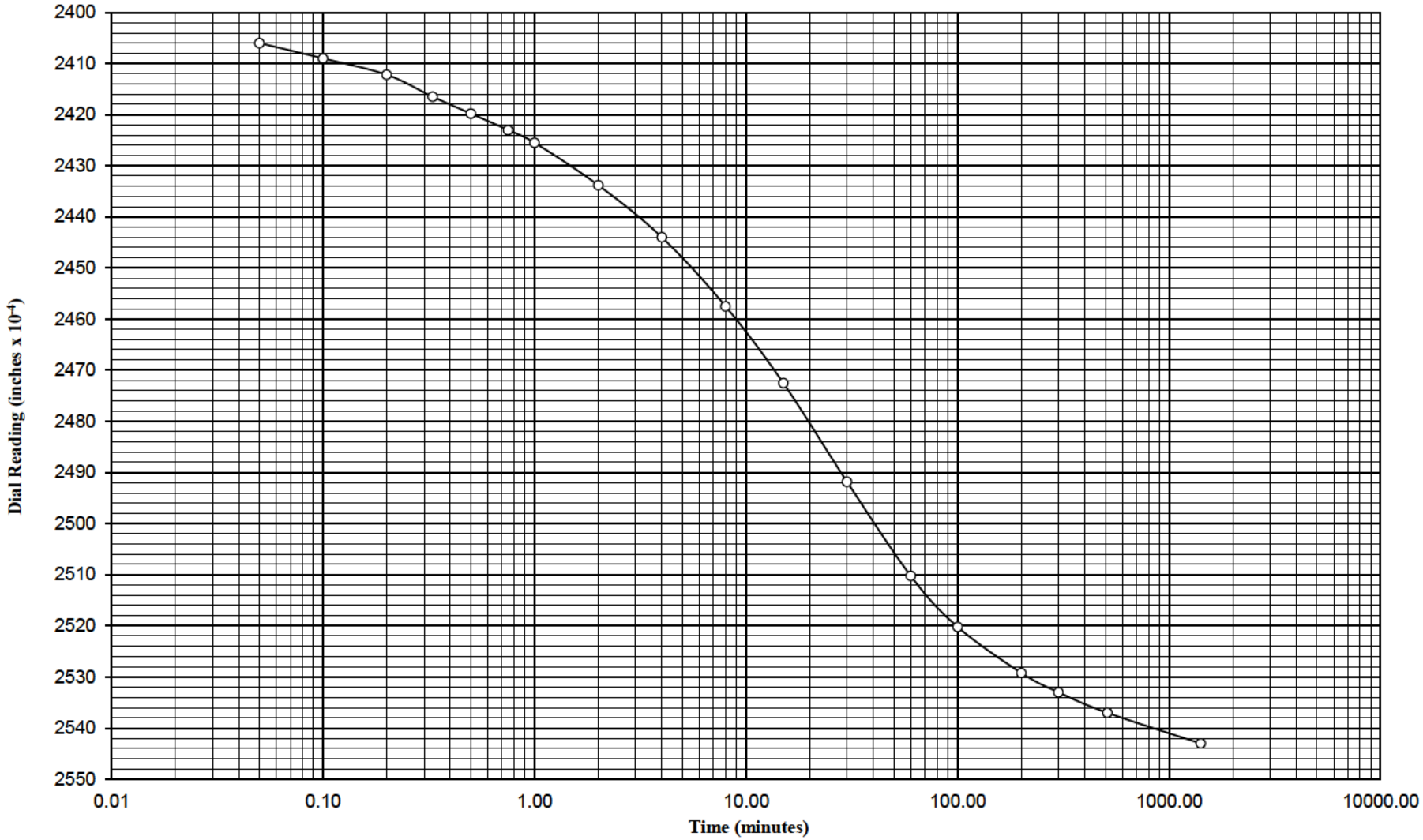
CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	4.11×10^{-4} (cm²/sec)		
		d_{50} (inches):	0.21515	TEAM Project No.:	192031
BORING NO.:	B-4	t_{50} (min):	3.1	Date:	3/29/2019
DEPTH:	8-10'	Load (tsf):	4	Remarks	
SAMPLE:	ST-4	Thickness (inches)	0.500		



CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	1.99×10^{-4} (cm²/sec)		
		d_{50} (inches):	0.22930	TEAM Project No.:	192031
BORING NO.:	B-4	t_{50} (min):	6.1	Date:	3/29/2019
DEPTH:	8-10'	Load (tsf):	8	Remarks	
SAMPLE:	ST-4	Thickness (inches)	0.500		

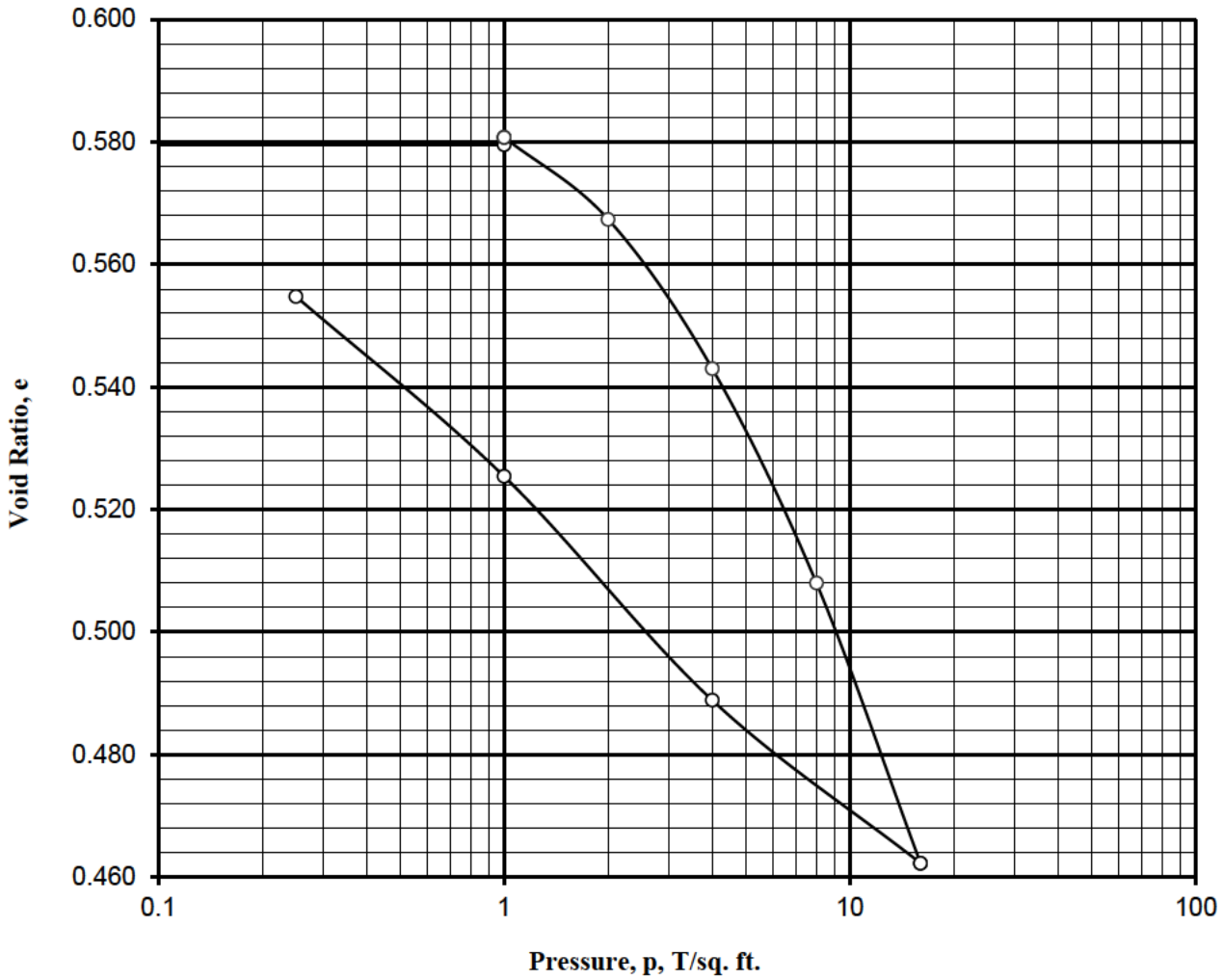


CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	1.04×10^{-4} (cm²/sec)		
		d_{50} (inches):	0.24634	TEAM Project No.:	192031
BORING NO.:	B-4	t_{50} (min):	11	Date:	3/29/2019
DEPTH:	8-10'	Load (tsf):	16	Remarks	
SAMPLE:	ST-4	Thickness (inches)	0.500		

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing



Type of specimen:	Undisturbed			Before Test		After Test	
Diam. 2.50 in.	Ht. 0.499 in.			Water Content, w_o	19.76%	W_f	20.74%
Overburden Pressure, P_o	T/sq. ft.			Void Ratio, e_o	0.5796	e_f	0.5548
Preconsol. Pressure, P_c	T/sq. ft.			Saturation, S_o	91.2%	S_f	100.0%
Compression Index, C_c				Dry Density, γd	105.7 lb/ft^3		
Classification	Tan and gray lean clay						
LL 45	G_s 2.676			Project	USACE, ATMOS Pipeline		
PL 18					TEAM Project No.: 192031		
Remarks				Boring No:	B-4	Sample No.:	ST-6
				Depth:	18-20'	Date:	4/2/19
				CONSOLIDATION TEST REPORT			

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST
(Specimen Data)

Project: USACE, ATMOS Pipeline — TEAM Job No.: 192031

Boring No.: B-4 — Sample No.: ST-6 — Depth: 18-20' — Date: 4/2/19

Classification: Tan and gray lean clay

			Before Test			After Test	
			Specimen		Trimmings	Specimen	
Tare No.			Ring and Plates		625	412	
Weight in grams	Tare plus wet soil		191.44		634.10	117.52	
	Tare plus dry soil		178.00		562.60	103.42	
	Water	W_W	W_{WO}	13.44	71.50	W_{wf}	14.10
	Tare		110.00		200.80	35.42	
	Dry soil	W_S	68.00		361.8	68.00	
Water Content		w	W_O	19.76%	19.76%	W_f	20.74%

Consolidometer No.:	1	Area of specimen, A, (sq. cm.)	31.67
Weight of ring, g	N/A	Height of specimen, H, (in.)	0.499
Weight of plates, g	N/A	Specific Gravity of solids, (Gs)	2.676

Height of solids, $H_s = \frac{W_S}{A \times G_s \times \gamma_W} = \frac{68.00}{31.67 \times 2.68 \times 1 \times 2.54} = 0.3159$ in.

Original height of water, $H_{WO} = \frac{W_{WO}}{A \times \gamma_W} = \frac{13.44}{31.67 \times 1 \times 2.54} = 0.1671$ in.

Final height of water, $H_{Wf} = \frac{W_{Wf}}{A \times \gamma_W} = \frac{14.10}{31.67 \times 1 \times 2.54} = 0.1753$ in.

Net change in height of specimen at end of test, ΔH = -0.00782 in.

Height of specimen at end of test, $H_f = H - \Delta H$ = 0.4912 in.

Void ratio before test, $e_O = \frac{H - H_S}{H_S} = \frac{0.499 - 0.3159}{0.3159} = 0.5796$

Void ratio after test, $e_f = \frac{H_f - H_S}{H_S} = \frac{0.49118 - 0.3159}{0.3159} = 0.5548$

Degree of saturation before test, $S_O = \frac{H_{WO}}{H - H_S} = \frac{0.1671}{0.4990 - 0.3159} = 91.2\%$

Degree of saturation after test, $S_f = \frac{H_{wf}}{H_f - H_S} = \frac{0.1753}{0.4912 - 0.3159} = 100.0\%$

Dry density before test, $\gamma_d = \frac{W_S}{H \times A} = \frac{68.00 \times 62.4}{0.499 \times 31.67 \times 2.54} = 105.7$ lb./cu.ft.

Remarks

Technician: Jason Young — Computed by: Jason Young — Checked by: James Hutt

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Time - Consolidation Data)

Project: USACE, ATMOS Pipeline TEAM Job No.: 192031

Boring No.: B-4 Sample No.: ST-6 Depth: 18-20' Consol.No.: 1

Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C	Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C
4/2	0.25	10:30	0	2009	20	4/4	4	8:20	0	2084.5	21
4/2	0.50	10:35	5	2008		4/4	4	8:20	0.05	2118	
4/2	1.00	11:30	60	2017		4/4	4	8:20	0.1	2121.5	
4/3	1.00	7:50	1280	2028.2	20	4/4	4	8:20	0.2	2124.8	
						4/4	4	8:20	0.33	2128.5	
						4/4	4	8:20	0.5	2130	
						4/4	4	8:20	0.75	2132.2	
						4/4	4	8:21	1	2134.8	
4/3	2	7:50	0	2028.2	20	4/4	4	8:22	2	2138.8	
4/3	2	7:50	0.05	2047.2		4/4	4	8:24	4	2143.5	
4/3	2	7:50	0.1	2049.2		4/4	4	8:28	8	2149.8	
4/3	2	7:50	0.2	2051		4/4	4	8:35	15	2153.2	
4/3	2	7:50	0.33	2053.2		4/4	4	8:50	30	2159	
4/3	2	7:50	0.5	2054.8		4/4	4	9:20	60	2163.2	
4/3	2	7:50	0.75	2056.5		4/4	4	10:00	100	2165	
4/3	2	7:51	1	2057.8		4/4	4	11:40	200	2168.5	
4/3	2	7:52	2	2060.8		4/4	4	13:20	300	2170	
4/3	2	7:54	4	2063.8		4/4	4	17:00	520	2176.5	
4/3	2	7:58	8	2066.8		4/5	4	8:00	1420	2178.5	21
4/3	2	8:05	15	2069.2							
4/3	2	8:20	30	2071.8							
4/3	2	8:50	60	2074							
4/3	2	9:30	100	2075.5							
4/3	2	11:10	200	2077.8							
4/3	2	12:50	300	2078.8							
4/3	2	17:00	550	2083							
4/4	2	8:20	1470	2084.5	21						

Technician Jason Young

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Time - Consolidation Data)

Project: USACE, ATMOS Pipeline TEAM Job No.: 192031

Boring No.: B-4 Sample No.: ST-6 Depth: 18-20' Consol.No.: 1

Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C	Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. ^{o}C
4/5	8	8:00	0	2178.5	21	4/8	16	8:00	0	2310	21
4/5	8	8:00	0.05	2220		4/8	16	8:00	0.05	2355.5	
4/5	8	8:00	0.1	2224		4/8	16	8:00	0.1	2358.5	
4/5	8	8:00	0.2	2228		4/8	16	8:00	0.2	2362	
4/5	8	8:00	0.33	2231.8		4/8	16	8:00	0.33	2366.2	
4/5	8	8:00	0.5	2234.8		4/8	16	8:00	0.5	2370.5	
4/5	8	8:00	0.75	2237.8		4/8	16	8:00	0.75	2374.5	
4/5	8	8:01	1	2240		4/8	16	8:01	1	2380	
4/5	8	8:02	2	2246.8		4/8	16	8:02	2	2389.8	
4/5	8	8:04	4	2254.5		4/8	16	8:04	4	2400.5	
4/5	8	8:08	8	2262.8		4/8	16	8:08	8	2413.8	
4/5	8	8:15	15	2270.2		4/8	16	8:15	15	2427	
4/5	8	8:30	30	2278.2		4/8	16	8:30	30	2441.2	
4/5	8	9:00	60	2284.2		4/8	16	9:00	60	2451.8	
4/5	8	9:40	100	2288.2		4/8	16	9:40	100	2458	
4/5	8	11:20	200	2292.8		4/8	16	11:20	200	2464.5	
4/5	8	13:00	300	2295		4/8	16	13:00	300	2468	
4/5	8	17:15	555	2298.5		4/8	16	18:00	600	2473.2	
4/8	8	8:00	4320	2310	21	4/9	16	8:00	1440	2479.5	21

Technician Jason Young

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Time - Consolidation Data)

Project: USACE, ATMOS Pipeline TEAM Job No.: 192031

Boring No.: B-4 Sample No.: ST-6 Depth: 18-20' Consol.No.: 1

Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. °C	Date	Press. (tsf)	Time	Elapsed Time, (min)	Dial Reading (10^{-4} in.)	Temp. °C
						REBOUND LOADS					
						4/9	4	8:00	Rebound	2479.5	21
						4/10	4	8:00	1440	2359.5	21
						4/10	1	8:00	Rebound	2359.5	21
						4/11	1	8:00	1440	2217	21
						4/11	0.25	8:00	Rebound	2217	21
						4/12	0.25	7:30	1410	2104.2	21
						Machine Deflection Readings					
							0.25			2009	
							1			2032	
							2			2046	
							4			2063	
							8			2084	
							16			2109	
							4			2073	
							1			2046	
							0.25			2026	

Technician Jason Young

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

CONSOLIDATION TEST

(Computation of Void Ratio)

PROJECT: USACE, ATMOS Pipeline | TEAM Job No.: 192031 | DATE: 4/2/19

BORING NO.: B-4 | SAMPLE NO.: ST-6 | DEPTH: 18-20' | CONSOLIDOMETER NO.: 1

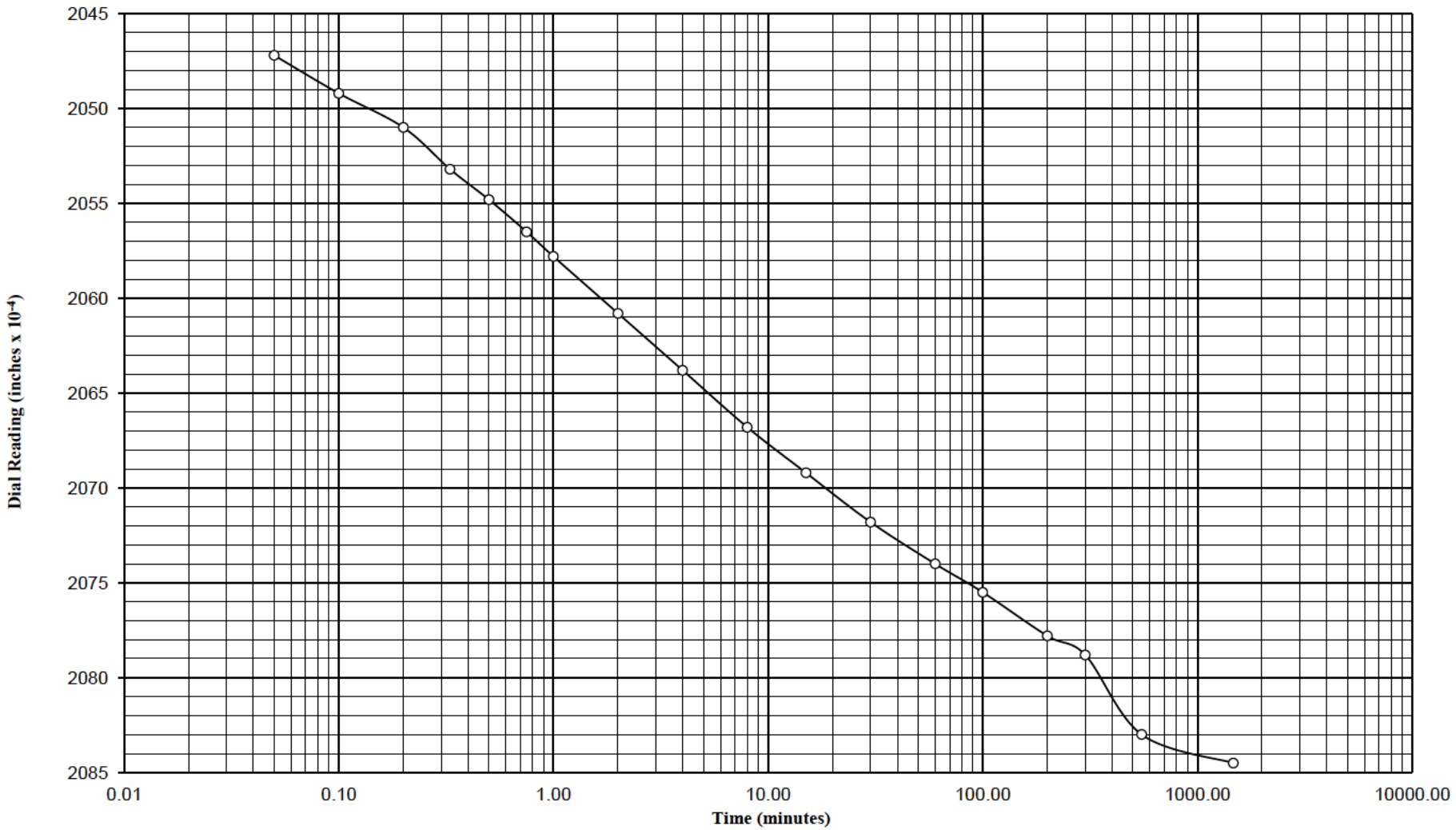
Pressure, P T./sq.ft.	Date Increment Applied	Time in Min. Increment Effective	Dial Reading 10^{-4} in.	Correction 10^{-4} in.	Change in Height, ΔH 10^{-4} in.	Height of Voids, H_V 10^{-4} in.	Void Ratio, e
0.1	4/2	Zero Point	2000	2000	0	1831	0.5796
1	4/2	Initial Load	2032	2032	0	1831	0.5796
1	4/2	1280	2028.2	2032	3.8	1835	0.5808
2	4/3	1470	2084.5	2046	-38.5	1792	0.5674
4	4/4	1420	2178.5	2063	-115.5	1715	0.5430
8	4/5	4320	2310	2084	-226	1605	0.5080
16	4/8	1440	2479.5	2109	-370.5	1460	0.4623
4	4/9	1440	2359.5	2073	-286.5	1544	0.4889
1	4/10	1440	2217	2046	-171	1660	0.5254
0.25	4/11	1410	2104.2	2026	-78.2	1753	0.5548

Note:

Height of voids, $H_V = (H - H_S) - \Delta H$ $H_S =$ 0.3159

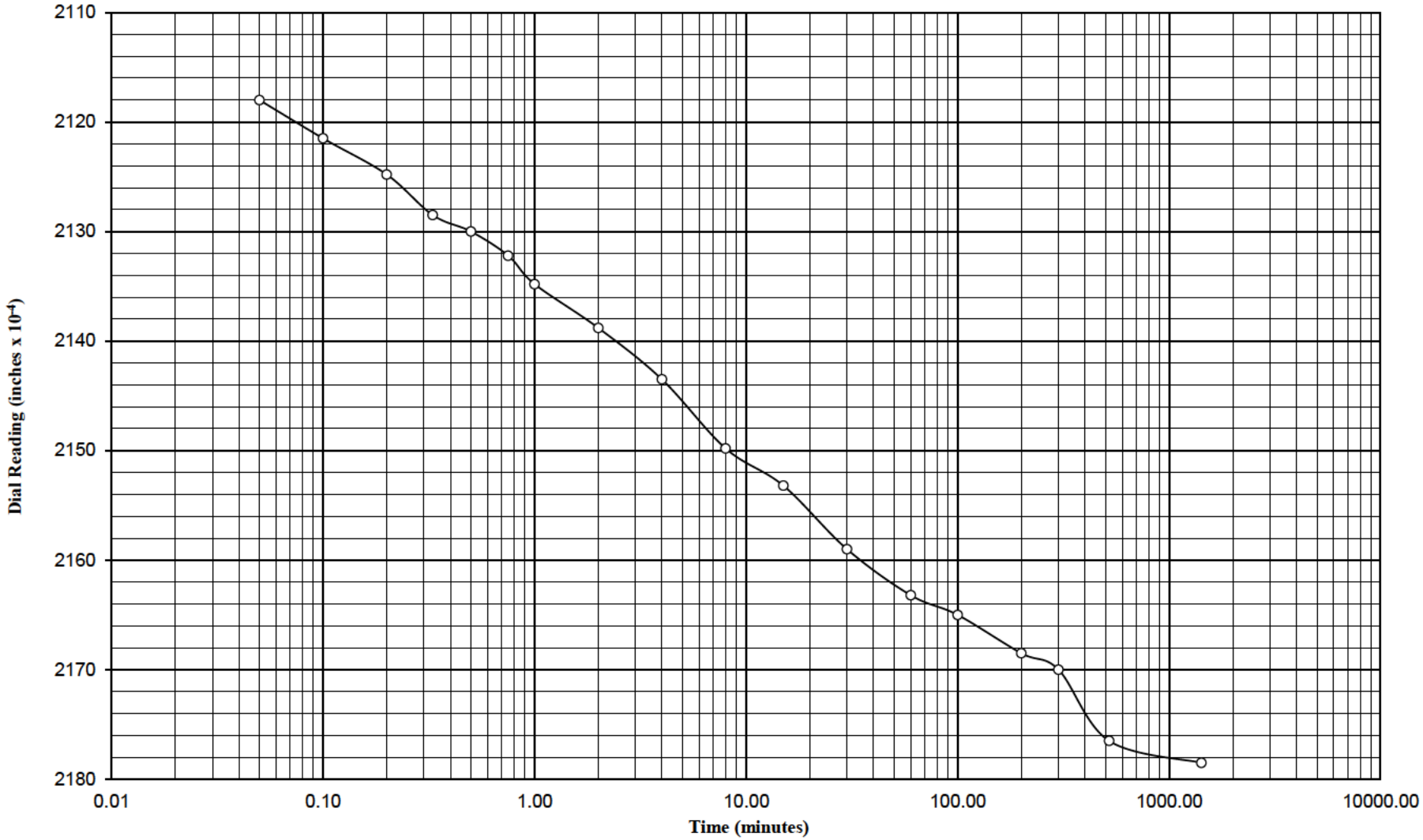
Void Ratio, $e = \frac{H_V}{H_S}$

Technician: Jason Young | Computed by: Jason Young | Checked by: James Hutt



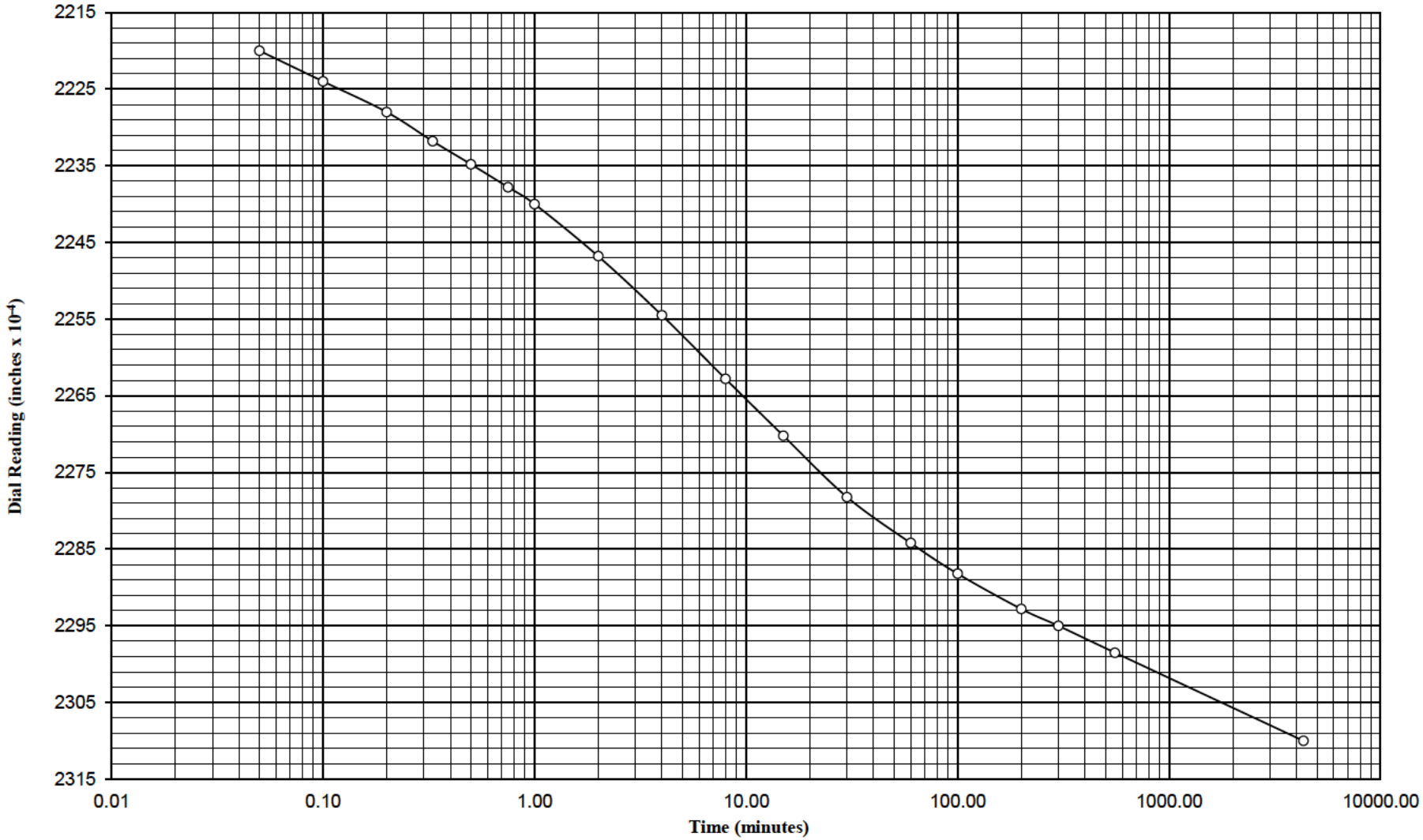
CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	14.6×10^{-4} (cm^2/sec)		
		d_{50} (inches):	0.20572	TEAM Project No.:	192031
BORING NO.:	B-4	t_{50} (min):	0.9	Date:	4/2/2019
DEPTH:	18-20'	Load (tsf):	2	Remarks	
SAMPLE:	ST-6	Thickness (inches)	0.499		



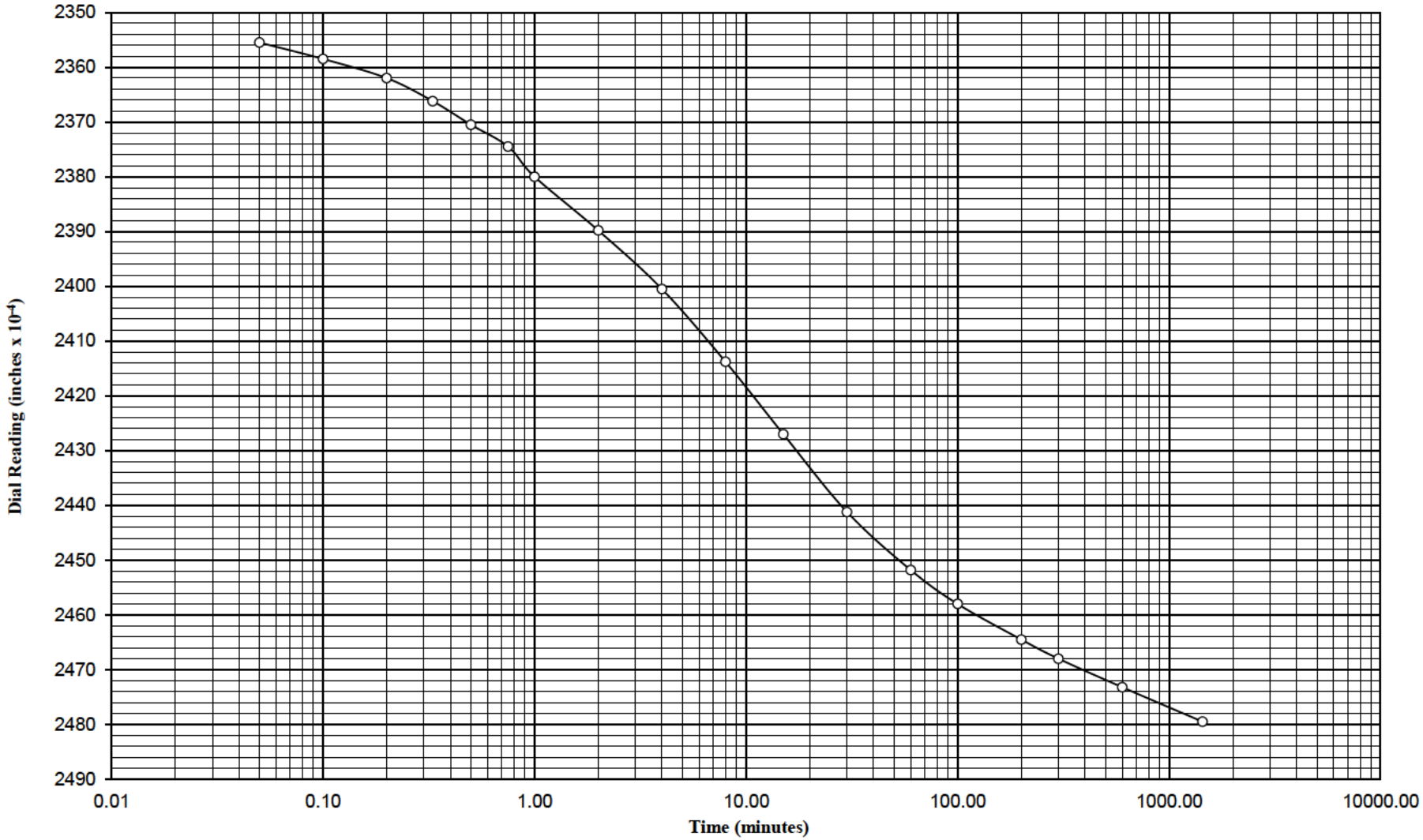
CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	7.11×10^{-4} (cm²/sec)		
		d_{50} (inches):	0.21381	TEAM Project No.:	192031
BORING NO.:	B-4	t_{50} (min):	1.8	Date:	4/2/2019
DEPTH:	18-20'	Load (tsf):	4	Remarks	
SAMPLE:	ST-6	Thickness (inches)	0.499		



CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	5.87×10^{-4} (cm²/sec)		
		d_{50} (inches):	0.22480	TEAM Project No.:	192031
BORING NO.:	B-4	t_{50} (min):	2.1	Date:	4/2/2019
DEPTH:	18-20'	Load (tsf):	8	Remarks	
SAMPLE:	ST-6	Thickness (inches)	0.499		



CONSOLIDATION TEST - DIAL READING TIME CURVE

PROJECT:	USACE, ATMOS Pipeline	Coefficient of Consolidation C_v	2.65×10^{-4}	(cm^2/sec)	
		d_{50} (inches):	0.24025	TEAM Project No.:	192031
BORING NO.:	B-4	t_{50} (min):	4.4	Date:	4/2/2019
DEPTH:	18-20'	Load (tsf):	16	Remarks	
SAMPLE:	ST-6	Thickness (inches)	0.499		